KEMENTERIAN PENDIDIKAN
JABATAN PENDIDIKAN NEGERI SELANGOR

SELANGOR

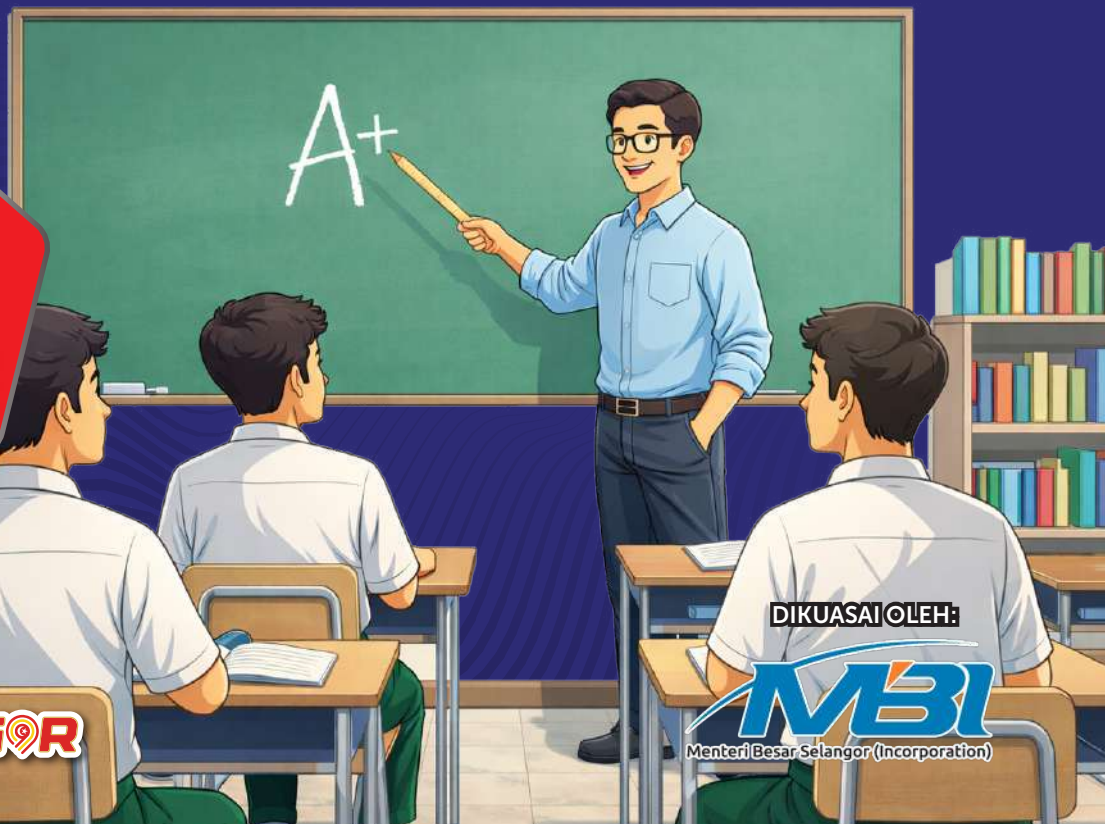
TUISYEN RAKYAT PT RS SELANGOR

PROGRAM TUISYEN RAKYAT SELANGOR 2026

FIZIK

DWIBAHASA

TINGKATAN 4



MALAYSIA MADANI

KITASELANGOR

DIKUASAI OLEH:

MBI
Menteri Besar Selangor (Incorporation)

PROGRAM TUISYEN RAKYAT SELANGOR 2026

FIZIK

DWIBAHASA

TINGKATAN 4

Program Tuisyen Rakyat Selangor
Fizik Tingkatan 4

CIRI-CIRI EKSKLUSIF

- Modul ini dibina mengikut silibus Fizik KSSM dan disusun mengikut bab Tingkatan 4.
- Modul ini dilengkapi dengan analisis soalan SPM Fizik kertas 2 bagi tahun 2022 hingga 2024 yang terperinci mengikut topik atau subtopik Tingkatan 4.
- Setiap bab mengandungi soalan bagi Kertas 1 (objektif) dan Kertas 2 (bahagian A, B dan C).
- Soalan dibina berdasarkan Format SPM terkini.
- Latihan diberikan merangkumi pelbagai aras yang membolehkan guru mencakupi keperluan murid.
- Guru boleh mempraktikkan kaedah latih tubi berperingkat mahupun latih tubi kendiri kepada murid.
- Bilangan soalan KBAT telah dipertingkatkan bagi meningkatkan kebolehan murid menjawab soalan Fizik Tingkatan 4 2026.
- 1 set Penilaian Akhir Tahun dibekalkan di akhir modul.
- Skema jawapan dibekalkan bagi memberi panduan kepada guru dan murid untuk menjawab mengikut kehendak soalan.

Program Tuisyen Rakyat Selangor
Fizik Tingkatan 4

PANEL PENULIS

Famizah binti Girun
SMK Taman Jasmin 2

Anwaruddin bin Mohd Kasim
SMK Kuala Kubu Bharu

Ishak bin Borhan
SMK Rantau Panjang

Liza Fahrani binti Safri
SMK Sungai Rawang

Norhaiza binti Zakaria
SMK Taman Melawati

Mohd. Faiszie bin Jamil
SMK Seksyen 9, Shah Alam

KANDUNGAN

JAWAPAN

FORMAT INSTRUMEN PEPERIKSAAN SPM FIZIK

Perkara	KERTAS 1 (4531/1)	KERTAS 2 (4531/2)	KERTAS 3 (4531/3)
Jenis instrumen	Ujian Bertulis		Ujian Amali Sains Bersepadu
Jenis item	Soalan objektif • Aneka pilihan • Aneka gabungan	Soalan subjektif • Subjektif berstruktur • Subjektif respond terhad • Subjektif respond terbuka	Soalan subjektif • Subjektif berstruktur
Bilangan soalan	40 soalan (40 markah) (Jawab semua soalan)	Bahagian A: (60 markah) • 8 soalan (Jawab semua soalan) Bahagian B: (20 markah) • 2 soalan (Jawab satu soalan) Bahagian C: (20 markah) • 1 soalan (Jawab semua soalan)	• 3 item (Jawab mengikut subjek yang didaftar)
Jumlah markah	40 markah	100 markah	15 markah (bagi setiap item)
Konstruk	• Mengingat • Memahami • Mengaplikasi • Menganalisis	• Mengingat • Memahami • Mengaplikasi • Menganalisis • Menilai • Mencipta	• Kemahiran Proses Sains
Tempoh ujian	1 jam 15 minit	2 jam 30 minit	• Sesi merancang 5 minit setiap item •Masa menjawab 40 minit setiap item
Cakupan konteks	Standard kandungan dan standard pembelajaran dalam Dokumen Standard Kurikulum dan Pentaksiran (DSKP) KSSM Tingkatan 4 dan 5		
Aras kesukaran	Rendah : Sederhana : Tinggi 5 : 3 : 2		
Kaedah penskoran	Dikotomus	Analitik	
Alat tambahan	Kalkulator saintifik		

ANALISIS SOALAN SPM 2022-2024
FIZIK KERTAS 2 (4531/2)

BAB	Subtopik	Tahun		
		SPM 2022	SPM 2023	SPM 2024
Bab 1: Pengukuran	1.1 Kuantiti fizik			S1: Kuantiti fizik & penyiasatan saintifik
	1.2 Penyiasatan saintifik			
Bab 2: Daya dan Gerakan I	2.1 Gerakan linear			
	2.2 Graf gerakan linear			
	2.3 Gerakan jatuh bebas			
	2.4 Inersia			
	2.5 Momentum			
	2.6 Daya			
	2.7 Impuls dan daya impuls		S9: Daya impuls (pemandu cerucuk, topi keledar keselamatan)	
	2.8 Berat			
Bab 3: Kegravitian	3.1 Hukum Kegravitian Semesta Newton			
	3.2 Hukum Kepler			
	3.3 Saletit buatan manusia	S4: Satelit bukan geopegun	S7: Satelit geopegun (telekomunikasi-siaran langsung)	S8: Satelit bukan geopegun
Bab 4: Haba	4.1 Keseimbangan terma	S11: Suhu & haba		
	4.2 Muatan haba tentu	S11: Darat & laut	S1: Bayu laut	
	4.3 Haba pendam tentu			
	4.4 Hukum gas			S6: Hukum Charles (rendam bola pingpong)
Bab 5: Gelombang	5.1 Asas gelombang			
	5.2 Pelembapan dan resonans			
	5.3 Pantulan gelombang			
	5.4 Pembiasan gelombang			
	5.5 Pembelauan gelombang		S5: Siren banjir	
	5.6 Interferens gelombang	S5: Interferens gelombang air		S9: Interferens gelombang air
	5.7 Gelombang elektromagnet			

Bab 6: Cahaya dan Optik	6.1 Pembiasan cahaya			S11: Sinar merambat dari udara ke blok, memerhati syiling dalam gelas & gentian optik
	6.2 Pantulan dalam penuh	S7: Sudut genting prisma		
	6.3 Pembentukan imej oleh kanta		S3: Kanta cembung & pembesaran linear	
	6.4 Formula kanta nipis			
	6.5 Peralatan optik	S7: Maksrokop (panjang fokus & diameter kanta)		
	6.6 Pembentukan imej oleh cermin sfera			

SENARAI RUMUS FIZIK

Rumus-rumus berikut boleh membantu anda menjawab soalan. Simbol-simbol yang diberi adalah yang biasa digunakan.

DAYA DAN GERAKAN I
FORCE AND MOTION I

1 $v = u + at$

2 $s = \frac{1}{2}(u + v)\,t$

3 $s = ut + \frac{1}{2}at^2$

4 $v^2 = u^2 + 2as$

5 Momentum = mv

6 $F = ma$

KEGRAVITIAN
GRAVITATION

1 $F = \frac{Gm_1m_2}{r^2}$

2 $g = \frac{GM}{R^2}$

3 $F = \frac{mv^2}{r}$

4 $a = \frac{v^2}{r}$

5 $v = \frac{2\pi r}{T}$

6 $\frac{T_1^2}{r_1^3} = \frac{T_2^2}{r_2^3}$

7 $v = \sqrt{\frac{GM}{r}}$

8 $u = -\frac{GMm}{r}$

9 $v = \sqrt{\frac{2GM}{r}}$

10 $g = 9.81 \text{ m s}^{-2}$ @ 9.81 N kg^{-1}

11 $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$

12 Jisim Bumi, $M = 5.97 \times 10^{24}$ kg
Mass of Earth

13 Jejari Bumi, $R = 6.37 \times 10^{6}$ m
Radius of Earth

HABA
HEAT

1 $Q = mc\theta$

2 $Q = ml$

3 $Q = Pt$

4 $P_1V_1 = P_2V_2$

5 $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

6 $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

GELOMBANG
WAVES

1 $v = f\lambda$

2 $\lambda = \frac{ax}{D}$

CAHAYA DAN OPTIK
LIGHT AND OPTICS

1 $n = \frac{c}{v}$

2 $n = \frac{\sin i}{\sin r}$

3 $n = \frac{1}{\sin c}$

4 $n = \frac{H}{h}$

5 $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

6 $n_1 \sin \theta_1 = n_2 \sin \theta_2$

7 $m = \frac{v}{u}$

BAB 1

Pengukuran
Measurement

NOTA EFEKTIF

1 Kuantiti fizik terdiri daripada kuantiti asas dan kuantiti terbitan.
Physical quantities consists of base quantity and derived quantity.

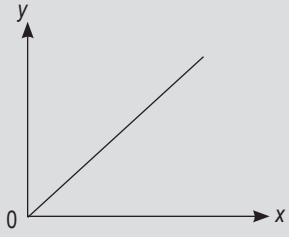
(a) Kuantiti asas: Kuantiti yang tidak boleh ditakrifkan dalam kuantiti fizik yang lain.
Base quantity: A quantity that cannot be expressed in terms of other physical quantities.

(b) Kuantiti terbitan: Gabungan kuantiti asas secara pendaraban, pembahagian, atau kedua-dua operasi ini.
Derived quantity: Combination of base quantities by operation of multiplication, division or both.

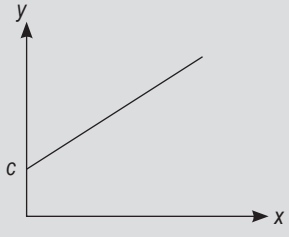
2 (a) Kuantiti skalar: Kuantiti fizik yang mempunyai magnitud sahaja.
Scalar quantity: Physical quantity which has magnitude only.

(b) Kuantiti vektor: Kuantiti fizik yang mempunyai kedua-dua magnitud dan arah.
Vector quantity: Physical quantity which has both magnitude and direction.

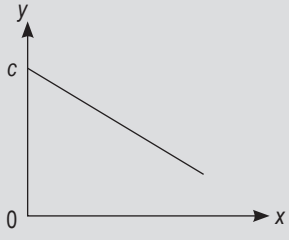
3 Mentafsir bentuk graf/ *Interpret graphs*



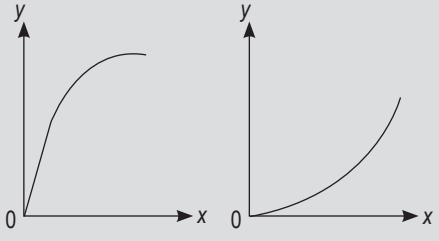
y berkadar terus dengan *x*
y directly proportional to x



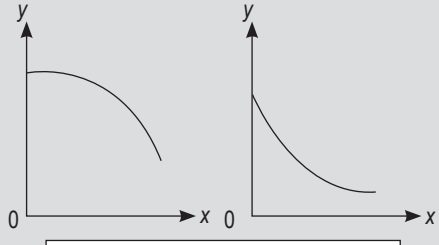
y bertambah secara linear dengan *x*
y increases linearly with x



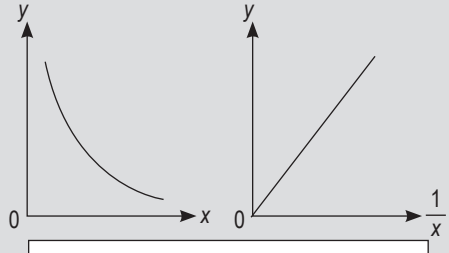
y berkurang secara linear dengan *x*
y decreases linearly with x



y bertambah dengan *x*
y increases with x



y berkurang dengan *x*
y decreases with x



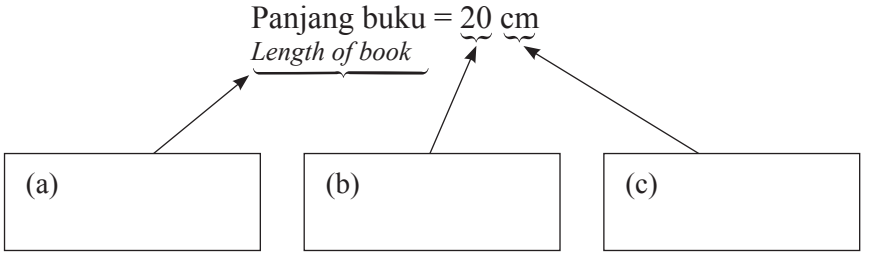
y berkadar songsang dengan *x*
y inversely proportional to x

4 Laporan lengkap bagi suatu eksperimen terdiri daripada inferens, hipotesis, tujuan, pemboleh ubah, bahan dan radas, keputusan, perbincangan dan kesimpulan.
The complete report of an experiment consists of inference, hypothesis, variables, apparatus and materials, result, discussion and conclusion.

1.1 KUANTITI FIZIK

1 Apakah maksud kuantiti fizik?
What is the meaning of physical quantity?

2 Labelkan kuantiti fizik, magnitud dan unit S.I bagi hasil pengukuran di bawah.
Label the physical quantity, magnitude and S.I unit for the measurement below.



3 Apakah maksud kuantiti asas?
What is the meaning of base quantity?

4 Lengkapkan jadual di bawah dengan simbol dan unit S.I bagi kuantiti asas diberi.
Complete the table below with their symbols and S.I units for the given base quantities.

Kuantiti asas *Base quantity*	**Simbol** *Symbol*	**Unit S.I dan simbol** *S.I unit and its symbol*	
Jisim *Mass*	*m*	kilogram	kg
(a) Masa *Time*			
(b) Panjang *Length*			
(c) Suhu *Temperature*			

5 Apakah maksud kuantiti terbitan?
What is the meaning of derived quantity?

6 Tentukan unit bagi kuantiti terbitan berikut.
Determine the unit for the following derived quantities.

(a) Luas = panjang × lebar *Area = length × width*	(f) Pecutan = $\frac{\text{perubahan halaju}}{\text{masa}}$ *Acceleration* = $\frac{\textit{change in velocity}}{\textit{time}}$
(b) Isi padu = panjang × lebar × tinggi *Volume = length × width × height*	(g) Daya = jisim × pecutan *Force = mass × acceleration*
(c) Ketumpatan = $\frac{\text{jisim}}{\text{isi padu}}$ *Density* = $\frac{\textit{mass}}{\textit{volume}}$	(h) Tekanan = $\frac{\text{daya}}{\text{luas}}$ *Pressure* = $\frac{\textit{force}}{\textit{area}}$
(d) Halaju = $\frac{\text{panjang}}{\text{masa}}$ *Velocity* = $\frac{\textit{length}}{\textit{time}}$	(i) Kerja = daya × sesaran *Work done = force × displacement*
(e) Momentum = jisim × halaju *Momentum = mass × velocity*	(j) Cas = arus × masa *Charge = current × time*

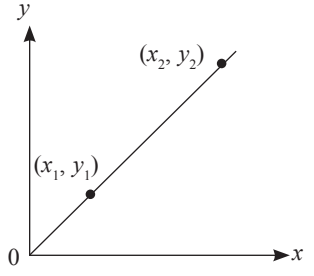
7 Lengkapkan jadual di bawah mengenai perbandingan antara kuantiti skalar dan kuantiti vektor.
Complete the table below of the comparison between scalar quantities and vector quantities.

Jenis ***Type***	Kuantiti skalar *Scalar quantities*	(b)
Definisi ***Definition***	(a)	Kuantiti fizik yang mempunyai kedua-dua magnitud dan arah. *Physical quantity which has both magnitude and direction.*
Contoh ***Example***	Jarak, laju, jisim, kuasa, tenaga, masa, suhu *Distance, speed, mass, power, energy, time, temperature*	(c)

1.2 PENYIASATAN SAINTIFIK

1 Mentafsir bentuk-bentuk graf berikut untuk menentukan hubungan antara dua kuantiti fizik.
Interpret the following graphs to determine the relationship between two physical quantities.

(a)



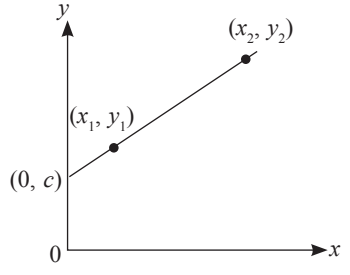
Jenis graf: Garis _____ yang _____ asalan dan mempunyai kecerunan _____.

Type of graph: *A* _____ *line that* _____ *through origin with a* _____ *gradient.*

Tafsiran graf: *y* _____ dengan *x*.

Interpret graph: *y* _____ *to x.*

(b)



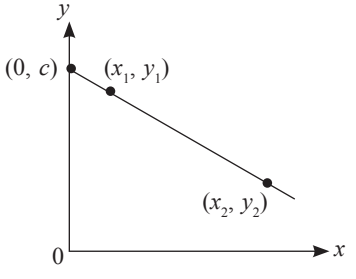
Jenis graf: Garis _____ yang _____ asalan dan mempunyai kecerunan _____.

Type of graph: *A* _____ *line that* _____ *through origin with a* _____ *gradient.*

Tafsiran graf: *y* _____ dengan *x*.

Interpret graph: *y* _____ *with x.*

(c)



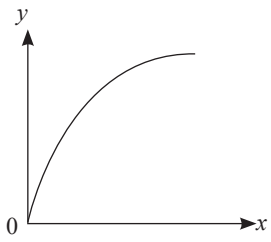
Jenis graf: Garis _____ yang _____ asalan dan mempunyai kecerunan _____.

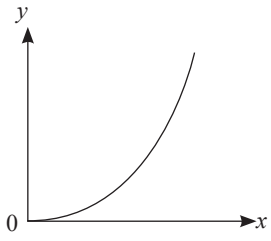
Type of graph: *A* _____ *line that* _____ *through origin with a* _____ *gradient.*

Tafsiran graf: *y* _____ dengan *x*.

Interpret graph: *y* _____ *with x.*

(d)





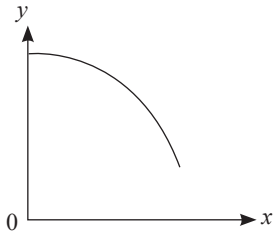
Jenis graf: Garis _____ yang _____ asalan dan mempunyai kecerunan _____.

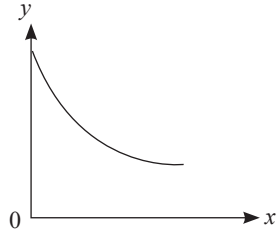
Type of graph: *A _____ that _____ through origin with a _____ gradient.*

Tafsiran graf: *y* _____ dengan *x*.

Interpret graph: *y _____ with x.*

(e)





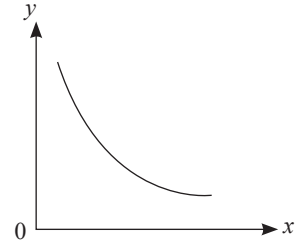
Jenis graf: Garis _____ yang _____ asalan dan mempunyai kecerunan _____.

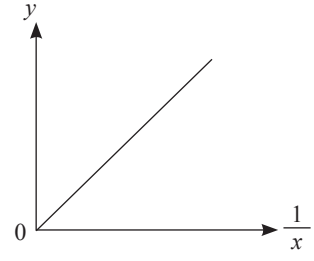
Type of graph: *A _____ that _____ through origin with a _____ gradient.*

Tafsiran graf: *y* _____ dengan *x*.

Interpret graph: *y _____ with x.*

(f)





Jenis graf:

Garis _____ yang _____ paksi dan mempunyai kecerunan _____.

Garis _____ yang _____ asalan dan mempunyai kecerunan _____.

Type of graph: *A _____ that _____ both axes with a _____ gradient.*

A _____ line that _____ through the origin with a _____ gradient.

Tafsiran graf: *y* _____ dengan *x*.

Interpret graph: *y _____ to x.*

Kertas 1

1 Maklumat berikut menunjukkan satu kumpulan kuantiti fizik.
The following information show a group of physical quantities.

- Jisim/ *Mass*
- Laju/ *Speed*
- Suhu/ *Temperature*
- Masa/ *Time*

Kumpulan ini boleh dikategorikan sebagai
The group can be categorised as

A kuantiti asas
base quantity
B kuantiti skalar
scalar quantity
C kuantiti vektor
vector quantity
D kuantiti terbitan
derived quantity

2 Antara berikut, pasangan yang manakah betul?
Which of the following pairs is correct?

	Kuantiti fizik ***Physical quantity***	**Unit S.I** ***S.I. unit***
A	Arus elektrik *Electric current*	candela
B	Berat *Weight*	kilogram
C	Suhu *Temperature*	kelvin
D	Cas *Charge*	ampere

3 Antara berikut, rumus manakah merupakan terbitan bagi momentum?
Which of the following formulas is derived for momentum?

A $m \times a$ **B** $m \times v$

C $\frac{m}{v}$ **D** $\frac{F}{A}$

4 Kuantiti vektor merupakan kuantiti fizik yang mempunyai magnitud dan arah.
Apakah contoh kuantiti vektor?
Vector quantity is the physical quantity that has magnitude and direction.
What is the example of the vector quantity?

A Daya *Force*
B Tenaga *Energy*
C Laju *Speed*
D Ketumpatan *Density*

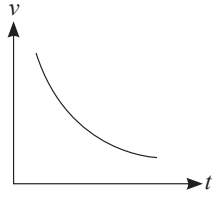
5 Satu kuantiti fizik, k, boleh didapati dengan menggunakan rumus seperti yang berikut:
A physics quantity, k, can be obtained from the following formula:

$$k = \frac{\text{jisim} \times \text{halaju}}{\text{masa}} \; / \; \frac{mass \times speed}{time}$$

Terbitkan unit bagi k.
Derive the unit for k.

A kg m s^{-1} **B** N s^{-1}
C N s **D** N

6 Rajah 1 menunjukkan graf halaju, v melawan masa, t.
Diagram 1 *shows a graph of velocity, v against time, t.*

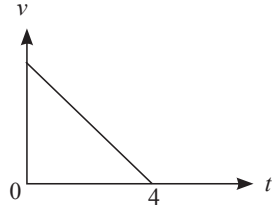


Rajah 1/ *Diagram* 1

Apakah hubungan antara v dengan t?
What is the relationship between v and t?

A v berkurang secara linear dengan t
v decreases linearly with t
B v berkurang dengan t
v decreases with t
C v berkadar terus dengan t
v directly proportional to t
D v berkadar songsang dengan t
v inversely proportional to t

7 Rajah 2 menunjukkan graf hubungan antara v dan t.
Diagram 2 *shows the relationship of graph between v and t.*



Rajah 2/ *Diagram* 2

Apakah persamaan yang diwakili oleh graf di atas?
What is the formula that represented by the graph in above?

A $v = t + 4$ **B** $v = t + 1$
C $v = -t + 4$ **D** $v = -t + 1$

Menguasai Tidak Menguasai

Kertas 2
Bahagian A

1 Persamaan bagi Hukum Kegravitian Semesta Newton adalah seperti berikut:
The equation for Newton's Universal Law of Gravitational as follows:

$$F = \frac{GMm}{r^2}$$

iaitu F = daya, G = pemalar kegravitian, M atau m = jisim dan r = jarak.
in which F = force, G= gravitational constant, M or m = mass and r = distance.

(a) Berdasarkan persamaan tersebut, nyatakan satu contoh bagi setiap yang berikut:
Based on the equation, give an example for each of the following:

(i) Kuantiti asas/ *Base quantity*: _____

(ii) Kuantiti terbitan/ *Derived quantity*: _____

(iii) Kuantiti vektor/ *Vector quantity*: _____

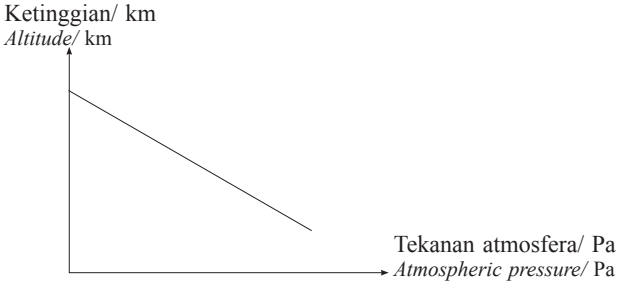
[3 markah/ *marks*]

(b) Terbitkan unit bagi G dalam sebutan unit asas S.I.
Derive the unit of G in terms of S.I. base unit.

[1 markah/ *mark*]

2 Rajah 1 menunjukkan graf ketinggian melawan tekanan atmosfera.
Diagram 1 *shows a graph of altitude against atmospheric pressure.*

VIDEO ULASAN JAWAPAN



Rajah 1/ *Diagram* 1

(a) Berdasarkan Rajah 1, kenal pasti
Based on Diagram 1*, identify*

(i) pemboleh ubah dimanipulasikan/ *manipulated variable.*

_____

(ii) pemboleh ubah bergerak balas/ *responding variable.*

_____

[2 markah/ *marks*]

(b) Nyatakan hubungan antara ketinggian dan tekanan atmosfera.
State the relationship between the altitude and the atmospheric pressure.

_____

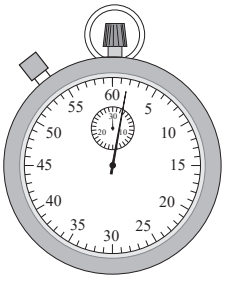
[1 markah/ *mark*]

(c) Nyatakan unit bagi kecerunan graf tersebut.
State the unit for the gradient of the graph.

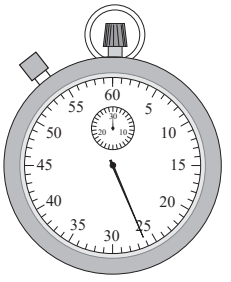
_____

[1 markah/ *mark*]

3 Rajah 2 menunjukkan bacaan jam randik pada awal dan akhir suatu eksperimen. Jam randik ini digunakan untuk mengukur masa 20 ayunan lengkap suatu bandul ringkas yang panjangnya, *l*.
Diagram 2 *shows the reading of a stopwatch at the beginning and end of a experiment. The stopwatch is used to measure the time taken for* 20 *complete oscillations of a simple pendulum of length, l.*



Awal eksperimen
Beginning of experiment



Akhir eksperimen
End of experiment

Rajah 2/ *Diagram* 2

(a) Berapakah masa yang diambil untuk bandul itu melengkapkan 20 ayunan lengkap?
What is the time taken for the pendulum to make 20 *complete oscillations?*

_____

[1 markah/ *mark*]

(b) Mengapakah masa untuk 20 ayunan lengkap perlu diambil?
Why is it necessary to take the time for 20 *complete oscillations?*

_____

[1 markah/ *mark*]

(c) Cadangkan **satu** langkah penambahbaikan untuk eksperimen ini.
Suggest **one** *way to improve this experiment.*

_____

[1 markah/ *mark*]

(d) (i) Tentukan tempoh ayunan lengkap, *T* bagi bandul ini.
Determine the period of oscillation, T of this pendulum.

[2 markah/ *marks*]

(ii) Hubungan antara panjang, *l* dan tempoh, *T*, suatu bandul ringkas diberikan melalui persamaan berikut:
The relationship between length, l and period, T, of a simple pendulum is given by the following equation:

$$l = \frac{g}{4\pi^2} T^2$$

Dengan menggunakan nilai *T* di **3**(d)(i), hitungkan panjang bandul, *l* itu.
Using the value of T in **3**(d)(i)*, calculate the length of the pendulum, l.*
[g = 9.81 m s^{-2}]

[2 markah/ *marks*]

BAB 2

Daya dan Gerakan I
Force and Motion I

NOTA EFEKTIF

1 Gerakan Linear/ *Linear Motion*

Jarak/ *Distance, d*	**Sesaran/ *Displacement, s***
Panjang lintasan yang dilalui oleh pergerakan suatu objek *The total path length travelled by an object*	Jarak terpendek di antara kedudukan awal dengan kedudukan akhir pergerakan suatu objek pada satu arah *Shortest distance between the initial position and the final position in a specific direction*

Laju/ *Speed, v*	**Halaju/ *Velocity, v***
Kadar perubahan jarak/ *The rate of change of distance* Laju/ *Speed* = $\frac{\text{Jarak yang dilalui/ } Distance\ travelled}{\text{Masa diambil/ } Time\ taken}$ $v = \frac{d}{t}$ Unit S.I/ *S.I unit*: m s^{-1}	Kadar perubahan sesaran/ *The rate of change of displacement* Halaju/ *Velocity* = $\frac{\text{Sesaran/ } Displacement}{\text{Masa diambil/ } Time\ taken}$ $v = \frac{s}{t}$ Unit S.I/ *S.I unit*: m s^{-1}

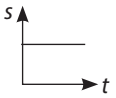
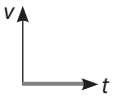
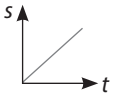
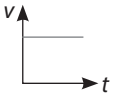
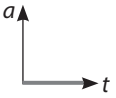
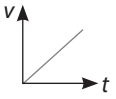
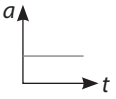
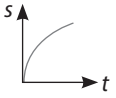
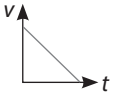
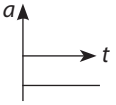
Pecutan/ *Acceleration, a*	**Nyahpecutan/ *Deceleration***
Kadar perubahan halaju/ *The rate of change of velocity.* Unit S.I./ *S.I. unit:* m s^{-2} $a = \frac{\text{Halaju akhir/ } Final\ velocity - \text{Halaju awal/ } Initial\ velocity}{\text{Masa yang diambil/ } Time\ taken}$ $a = \frac{v-u}{t}$ Unit S.I/ *S.I unit*: m s^{-2}	Kadar pengurangan halaju pada arah tertentu. *The rate of decreased in speed in a specified direction.*

Persamaan Gerakan Linear/ *Linear Motion Equation*

Persamaan gerakan linear pertama *First linear motion equation*	Persamaan gerakan linear kedua *Second linear motion equation*
$a = \frac{v-u}{t}$ $at = v - u$ $v = u + at$ ..... (1)	$s = \frac{1}{2}(u+v)t$ ..... (2)

Persamaan gerakan linear ketiga *Third linear motion equation*	Persamaan gerakan linear keempat *Fourth linear motion equation*
$s = \frac{1}{2}[u + (u + at)]\,t$ $s = \frac{1}{2}(2u + at)\,t$ $s = ut + \frac{1}{2}at^2$ ..... (3)	$v^2 = (u + at)^2$ $v^2 = u + 2uat^2$ $v^2 = u^2 + 2a(ut + \frac{1}{2}at^2)$ $v^2 = u^2 + 2as$ ..... (4) Daripada persamaan (3) *From equation* (3) $s = ut + \frac{1}{2}at^2$

Graf Gerakan Linear/ *Linear Motion Graph*

Jenis graf *Type of graph* / Jenis gerakan *Type of motion*	Graf sesaran-masa *Displacement-time graph*	Graf halaju-masa *Velocity-time graph*	Graf pecutan-masa *Acceleration-time graph*
Halaju sifar/ *Pegun* *Zero velocity/ Stationary*			–
Halaju seragam *Uniform velocity*			
Pecutan seragam *Uniform acceleration*			
Nyahpecutan seragam *Uniform deceleration*			
	Kecerunan = halaju *Gradient = velocity*	Kecerunan = pecutan *Gradient = acceleration* Luas di bawah graf = sesaran *Area under graph = displacement*	

2 Gerakan Jatuh Bebas/ *Free Fall Motion*

(a) Pecutan graviti, *g* ialah pecutan yang dialami oleh objek disebabkan tarikan daya graviti.
Gravitational acceleration, g is the acceleration of an object due to the pull of the gravitational force.

(b) Jatuh bebas ialah gerakkan objek yang dipengaruhi oleh graviti sahaja.
Free fall is the motion of the object is affected only by gravitational force.

3 Inersia/ *Inertia*

(a) Inersia adalah kecenderungan suatu objek untuk kekal dalam keadaan asalnya, sama ada pegun atau bergerak dalam garis lurus dalam halaju malar.
Inertia is the tendency of an object remain at rest or, if moving, to continue its motion in a straight line at uniform velocity.

(b) Hukum Gerakan Newton Pertama:
Newton's First Law of Motion:
Setiap objek akan kekal dalam keadaan pegun atau bergerak dengan halaju malar jika tiada daya luar bertindak ke atasnya.
An object will remain at rest or move at uniform velocity unless acted upon by an external force.

(c) Semakin besar jisim, semakin besar inersia.
The larger the mass, the larger the inertia.

5 Momentum/ *Momentum*

(a) Momentum = Jisim × Halaju
Momentum = Mass × Velocity
Unit S.I./ *S.I. unit:* kg m s^{-1}

$$p = mv$$

p = momentum/ *momentum*
m = jisim/ *mass*
v = halaju/ *velocity*

(b) Prinsip Keabadian Momentum adalah jumlah momentum sebelum perlanggaran adalah sama dengan jumlah momentum selepas perlanggaran jika tiada sebarang daya luar bertindak.
Principle of Conservation of Momentum is the total momentum before collision is equal to the total of momentum after collision if no external force is acting on it.

(c) Perlanggaran kenyal/ *Elastic collision*
Jumlah momentum sebelum perlanggaran
= Jumlah momentum selepas perlanggaran
Total momentum before collision
= Total momentum after collision

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

(d) Letupan/ *Explosion*
Jumlah momentum sebelum perlanggaran
= Jumlah momentum selepas perlanggaran
Total momentum before collision
= Total momentum after collision

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$
$$0 = m_1v_1 + m_2v_2$$
$$m_1v_1 = -m_2v_2$$

6 Daya/ *Force*

Hukum Gerakan Newton Kedua:
Newton's Second Law of Motion:
Kadar perubahan momentum berkadar terus dengan daya dan bertindak pada arah tindakan daya.
The rate of change of momentum is directly proportional to the force and acts in the direction of the applied force.

7 Impuls & Daya Impuls
Impulse & Impulsive Force

(a) Impuls, Ft: Perubahan momentum
Impulse, Ft: Change of momentum
Unit/ *Unit*: kg m s^{-1} atau/ *or* N s

$$J = mv - mu = Ft$$

(b) Daya impuls, F: Kadar perubahan momentum dalam perlanggaran atau letupan dalam masa yang singkat.
Impulsive force, F: The rate of change of momentum in a collision or explosion.
Unit/ *Unit*: kg m s^{-2} atau/ *or* N

$$F = \frac{mv - mu}{t}$$

(c) Hukum Gerakan Newton Ketiga:
Newton's Third Law of Motion:
Untuk setiap daya tindakan terdapat satu daya tindak balas yang sama magnitud tetapi bertentangan arah.
For every action force there is a reaction force of same as magnitude but in the opposite direction.

8 Berat/ *Weight*
Berat = Jisim × kekuatan medan graviti
Weight = Mass × Gravitational field strength
Unit S.I/ *S.I unit*: N

$$W = mg$$

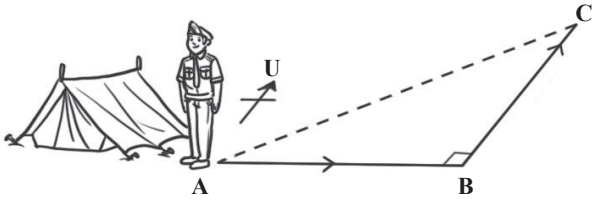
2.1 GERAKAN LINEAR

1 Gerakan linear dijelaskan dengan jarak, sesaran, laju, halaju dan pecutan.
Linear motion can be described in terms of distance, displacement, speed, velocity and acceleration.

(a) Apakah definisi jarak?
What is the definition of distance?

(b) Apakah definisi sesaran?
What is the definition of displacement?

(c) Seorang ahli pengakap memulakan kembara dari stesen A ke stesen B yang terletak 400 m ke timur stesen A. Apabila tiba di stesen B, dia diarahkan untuk ke stesen C yang terletak 400 m ke utara stesen B.
A scout starts his journey from station A *to station* B *which is located* 400 m *to the east of station* A. *When he reached station* B, *he is ordered to go to station* C *which is* 400 m *to the north of station* B.



(i) Apabila ahli pengakap itu tiba di stesen C, berapakah jarak perjalanannya dari stesen A?
When the scout at station C*, what is his distance travelled from station* A*?*

(ii) Apabila pengakap itu di stesen C, berapakah sesaran dari stesen A? Nyatakan magnitud dan arah.
When the scout at station C*, what is his displacement from station* A*? State the magnitude and direction.*

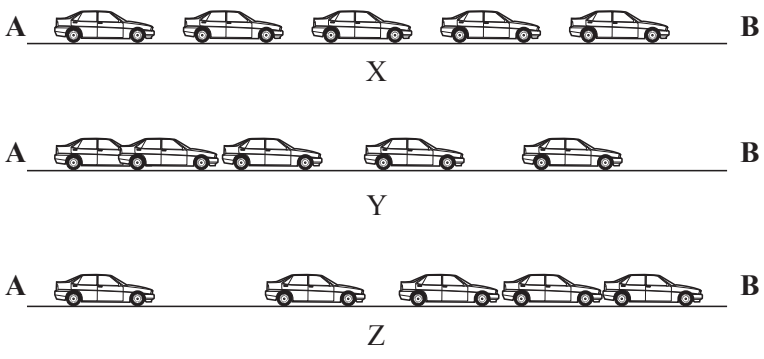
(iii) Mengapakah jawapan di (i) dan (ii) berbeza?
Why does the answers in (i) *and* (ii) *different*?

(d) Jadual menunjukkan perbezaan antara laju dan halaju. Lengkapkan jadual itu.
The table shows the differences between speed and velocity. Complete the table.

Laju ***Speed***	**Halaju** ***Velocity***
Kadar perubahan jarak *Rate of change in distance*	(iii)
(i) Unit S.I: *S.I unit:*	Unit S.I: meter per saat (m s^{-1}) *S.I unit: meter per second* (m s^{-1})
Kuantiti skalar *Scalar quantity*	(iv)
(ii)	$v = \frac{s}{t}$

(e) Apakah definisi dan rumus bagi pecutan?
What is the definition and formula of acceleration?

(f) Rajah menunjukkan fotograf stroboskop bagi sebuah kereta yang bergerak dari A ke B dengan tiga jenis pergerakan berbeza, X, Y dan Z
The diagram show a stroboscopic photograph of a car that moved from A *to* B *with three different movements,* X, Y *and* Z.
Nyatakan perubahan pada sesaran, halaju dan pecutan kereta bagi setiap pergerakan.
State the change in displacement, velocity and acceleration of the car for each movement.



Pergerakan ***Movement***	X	Y	Z
Sesaran ***Displacement***	Malar/ Seragam *Constant/ Uniform*	Bertambah *Increases*	(iii)
Halaju ***Velocity***	Malar/ Seragam *Constant/ Uniform*	(ii)	Berkurang *Decreases*
Pecutan ***Acceleration***	(i)	Memecut *Accelerates*	Nyahpecut *Decelerates*

(g) Seorang penunggang basikal bermula dari keadaan rehat dan menambahkan halajunya pada kadar seragam sehingga dia mencapai halaju 4.0 m s^{-1} dalam 5.0 s. Tentukan
A cyclist starts from rest and increases his velocity at a constant rate until he reaches a speed of 4.0 m s^{-1} *in* 5.0 s. *Determine*

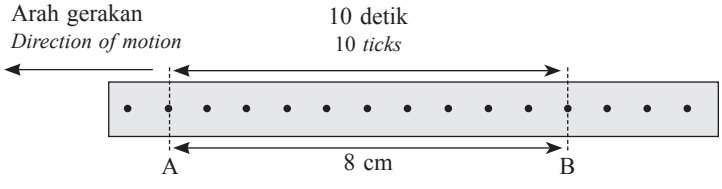
(i) halaju awal =
initial velocity

(ii) halaju akhir =
final velocity

(iii) pecutan =
acceleration

2 Menentukan sesaran, halaju, pecutan dan masa.
To determine displacement, velocity, acceleration and time.

Sebuah pita detik dan jangka masa detik digunakan untuk menyiasat gerakan linear suatu objek. Rajah di bawah menunjukkan bahagian pita detik yang ditarik oleh objek. Jangka masa detik dengan frekuensi 50 Hz menghasilkan 50 titik dalam masa 1 saat.
A ticker timer and a ticker tape are used to investigate the linear motion of an object. The diagram below shows the part of ticker tape that is pulled by the object. The ticker tape with frequency of 50 Hz *makes* 50 *ticks in* 1 *second.*

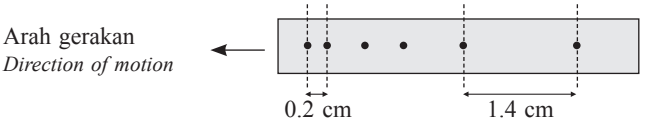


(a) Tentukan masa, t diambil dari A ke B.
Determine the time taken, t from A *to* B.

(b) Tentukan sesaran, s dari A ke B.
Determine the displacement, s from A *to* B.

(c) Tentukan halaju, v dari A ke B.
Determine the velocity, v from A *to* B.

(d) Rajah menunjukkan pita detik dengan 5 detik.
The diagram shows a ticker tape with 5 *ticks.*



Hitung pecutan pita detik itu.
Calculate the acceleration of the ticker tape.

3 Menerbitkan persamaan gerakan linear.
To derive the linear motion equations.

(a) Persamaan pertama
First equation

$a = \frac{v - u}{t}$

$at = v - u$

(b) Persamaan kedua
Second equation

$s = (\frac{u + v}{2}) \times t$

(c) Persamaan ketiga
Third equation

$s = \frac{1}{2}[u + (u + at)]t$

$s = \frac{1}{2}(2u + at)]\ t$

(d) Persamaan keempat
Fourth equation

$v^2 = (u + at)^2$

$v^2 = u^2 + 2uat + a^2t^2$

$v^2 = u^2 + 2a(ut + \frac{1}{2}at^2)$

4 Menyelesaikan masalah melibatkan persamaan gerakan linear.
Solving problem related to linear motion equation.

(a) Seorang budak lelaki mengayuh basikal menuruni sebuah bukit. Halaju awalnya ialah 4 m s^{-1}. Selepas dia bergerak 35 m, halajunya menjadi 10 m s^{-1}.
A boy is cycling down a hill. His initial velocity is 4 m s^{-1}. *After he moves* 35 m, *his velocity becomes* 10 m s^{-1}.

(i) Berapakah masa diambil untuk budak itu mengayuh sejauh 35 m?
What is the time taken for the boy to cycle at a distance 35 m*?*

(ii) Berapakah pecutannya?
What is his acceleration?

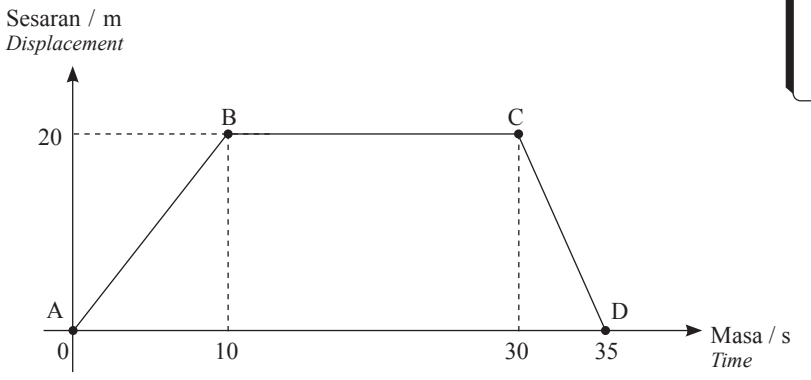
(b) Sebuah kereta bergerak dengan halaju 20 m s^{-1} sepanjang jalan lurus. Pemandu itu menekan brek selama 5 s dan menyebabkan nyahpecutan 3 m s^{-2}.
Berapakah halaju akhir kereta itu?
A car is traveling at 20 m s^{-1} *along a straight road. The driver puts the brakes on for* 5 *s and causes a deceleration of* 3 m s^{-2}.
What is the car's final velocity?

(c) Sebuah kereta memecut dari keadaan rehat pada 3 m s^{-2} di sepanjang suatu jalan lurus.
Berapakah sesaran yang dilalui oleh kereta itu selepas 4 s?
A car accelerates from rest at 3 m s^{-2} *along a straight road.*
What is the displacement of the car travelled after 4 s?

2.2 GRAF GERAKAN LINEAR

1 Rajah menunjukkan graf sesaran-masa bagi suatu objek.
The diagram shows a graph of displacement-time for an object.

VIDEO ULASAN JAWAPAN



(a) Hitung halaju objek di
Calculate the velocity of the object at

(i) AB. (ii) BC. (iii) CD.

(b) Huraikan gerakan objek di
Describe the motion of the object at

(i) AB : _____

(ii) BC : _____

(iii) CD : _____

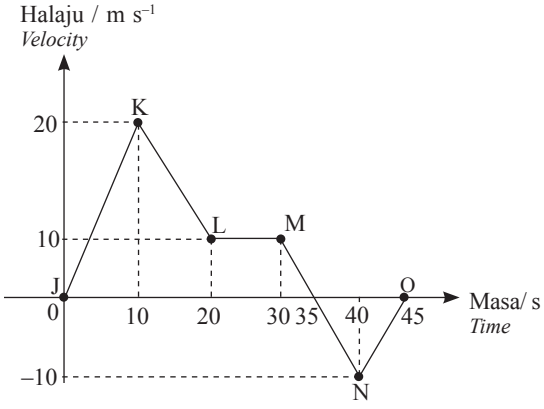
(c) (i) Hitung jumlah jarak pergerakan objek.
Calculate the total distance of the object motion.

(ii) Hitung jumlah sesaran pergerakan objek.
Calculate the total displacement of the object motion.

(d) (i) Cari laju purata objek itu.
Find the average speed of the object.

(ii) Cari halaju purata objek itu.
Find the average velocity of the object.

2 Rajah menunjukkan graf halaju-masa bagi sebuah kereta.
The diagram shows a graph of displacement-time for a car.



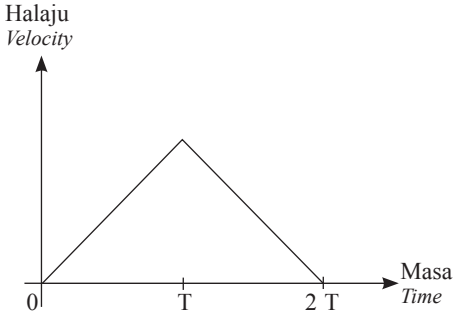
(a) Hitung jumlah jarak perjalanan kereta.
Calculate the total distance travelled by the car.

(b) Hitung jumlah sesaran kereta.
Calculate the total displacement of the car.

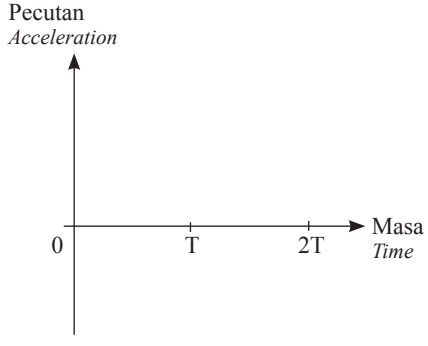
3 Terjemahkan graf berikut untuk melakarkan graf yang dinyatakan.
Interpret the following graphs to sketch the stated graph.

(a)

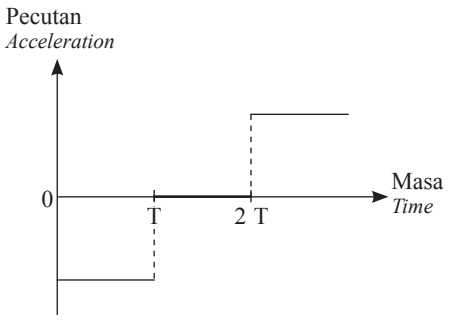
Graf halaju-masa
Graph of velocity-time



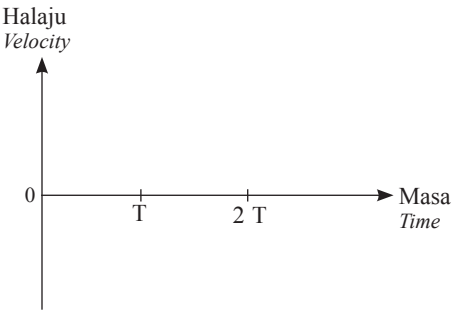
Graf pecutan-masa
Graph of acceleration-time



(b) Graf pecutan -masa
Graph of acceleration-time



Graf halaju-masa
Graph of velocity-time



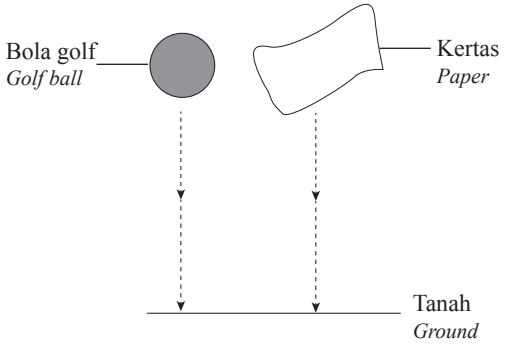
2.3 GERAKAN JATUH BEBAS

INFO

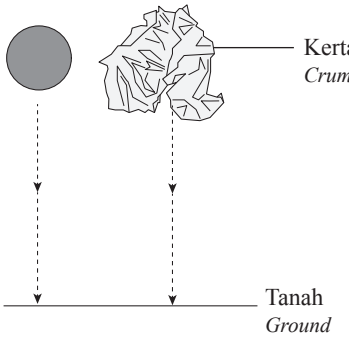
Sebiji epal jatuh ke tanah dari pokoknya. Isaac Newton menyatakan bahawa semua objek ditarik oleh satu daya yang menyebabkan objek jatuh ke permukaan Bumi. Suatu objek dikatakan mengalami gerakan jatuh bebas jika pergerakan objek itu dipengaruhi oleh daya graviti sahaja.
An apple fall on the ground from a tree. Isaac Newton said all objects are pulled by a force which causes them to fall to the surface of the Earth. An object experiences free fall if the motion of the object is affected only by gravitational force.

1 Apakah maksud jatuh bebas?
What is the meaning of free fall?

2 Rajah 1 menunjukkan sebiji bola golf dan sehelai kertas dipegang pada ketinggian yang sama dan dijatuhkan serentak.
Diagram 1 *shows a golf ball and a piece of paper are held at the same height and drop them simultaneously.*



Rajah 1/ *Diagram* 1



Rajah 2/ *Diagram* 2

(a) Berdasarkan Rajah 1, objek yang manakah mencecah tanah dahulu?
Based on Diagram 1, *which object reaches the ground first?*

(b) Jelaskan alasan bagi jawapan di **2**(a).
Explain a reason for the answer in **2**(a).

(c) Aktiviti diulangi dengan bola golf yang sama dan sehelai kertas yang direnyukkan seperti dalam Rajah 2.
The activity is repeated with the same golf ball and a piece of paper which is crumpled as in Diagram 2.

Objek yang manakah mencecah tanah dahulu?
Which object reaches the ground first?

(d) Jelaskan alasan bagi jawapan di **2**(c).
Explain a reason for the answer in **2**(c).

3 Bagi objek yang jatuh dengan pecutan, g, berikut adalah persamaan yang berkaitan:
For an object falling with acceleration g, the following equations apply:

$v = u + gt$ | $s = ut + \frac{1}{2}gt^2$ | $v^2 = u^2 + 2gs$

Objek dilontar ke atas/ *The object is thrown upward*: $a = g = -9.81 \text{ m s}^{-2}$

4 Amir menjatuhkan seketul batu ke dalam perigi. Nilai pecutan graviti adalah 9.81 m s^{-2}. Jika jarak di antara bahagian atas perigi dengan permukaan air ialah 20 m, berapakah masa yang diambil oleh batu itu untuk sampai ke permukaan air?
Amir releases a stone into a well. The gravitational acceleration is 9.81 m s^{-2}. *If the distance between the top of the well and the water surface is* 20 m, *what is the time taken for the stone to reach the surface of the water?*
[$g = 9.81 \text{ m s}^{-2}$]

5 Amirah melontar bola ke atas secara menegak dengan halaju awal 10 m s^{-1}. Hitung tinggi maksimum yang boleh dicapai oleh bola itu.
[Abaikan rintangan udara dan nilai pecutan graviti adalah 9.81 m s^{-2}]
Amirah threw a ball vertically upwards with an initial velocity of 10 m s^{-1}. *Calculate the maximum height that can be reached by the ball.*
[*Ignore the air resistance and the value of gravitational acceleration is* 9.81 m s^{-2}]

2.4 INERSIA

1 Apakah maksud inersia?
What is the meaning of inertia?

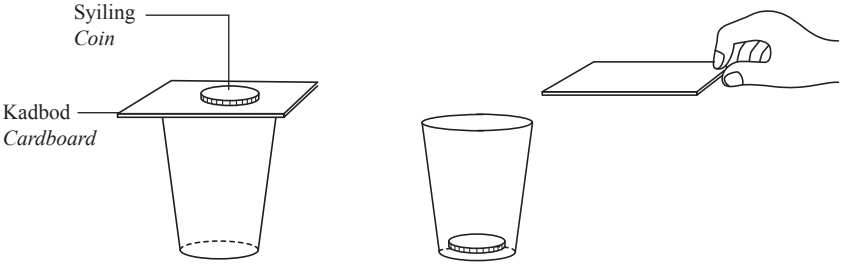
2 Hukum Gerakan Newton Pertama menyatakan bahawa _____

_____

Newton's First Law of Motion states that _____

_____

3 Rajah menunjukkan sekeping kadbod di atas sebuah gelas. Sekeping duit syiling diletakkan di atas kadbod.
The diagram shows a cardboard on a glass. A coin is placed on the cardboard.



(a) Apakah yang berlaku kepada duit syiling itu apabila kadbod ditarik dengan cepat?
What happens to the coin when the cardboard is pulled quickly?

_____

_____

(b) Jelaskan pemerhatian di **3**(a).
Explain the observation in **3**(a).

_____

_____

4 Inersia dalam kehidupan harian.
Inertia in daily life.

(a) Mengapakah sos tomato lebih mudah dikeluarkan daripada botol jika botol digerakkan dengan laju dan berhenti secara mendadak?
Why the tomato sauce can be easily poured out if the bottle is moved down fast with a sudden stop?

(b) Payung yang basah boleh dikeringkan dengan menggerakkan payung dengan cepat dan kemudian diberhentikan dengan tiba-tiba. Terangkan.
Wet umbrella can be dried by moving it very fast and then stop suddenly. Explain.

2.5 MOMENTUM

1 Apakah maksud momentum?
What is the meaning of momentum?

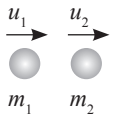
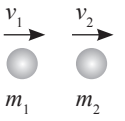
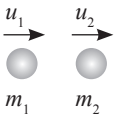
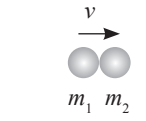
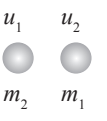
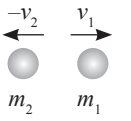
2 Momentum dapat dihitung dengan rumus:
Momentum can be calculated by formula:

di mana/ *where*
p :
m:
v :

3 Unit S.I bagi momentum adalah _____.
The S.I unit for the momentum is _____.

4 Apakah prinsip keabadian momentum?
What is the principle of conservation of momentum?

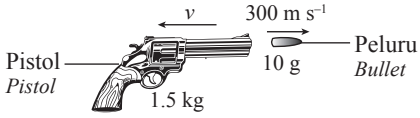
5 Perbandingan antara perlanggaran kenyal, perlanggaran tak kenyal dan letupan.
Comparison between elastic collision, inelastic collision and explosion.

(a) Perlanggaran kenyal *Elastic collision*		**(b) Perlanggaran tak kenyal** *Inelastic collision*		**(c) Letupan** *Explosion*	
					
Selepas perlanggaran bola bergerak dengan halaju berbeza *After collision, the balls move with different velocity*		(i)		(i)	
(i)		Momentum diabadikan *Momentum is conserved*		(ii)	
(ii)		(ii)		Tenaga diabadikan *Energy is conserved*	
(iii)		(iii)		Tenaga kinetik tidak diabadikan/ bertambah *Kinetic enrgy is not conserved/ increases*	
$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$		(iv)		$0 = m_1v_1 + m_2v_2$	

6 (a) Kereta A yang berjisim 1 000 kg bergerak pada 20 m s^{-1} berlanggar dengan kereta B yang berjisim 1 200 kg dan bergerak pada 10 m s^{-1} dalam arah yang sama. Akibatnya, kereta B, bergerak ke depan pada halaju 15 m s^{-1}.
Berapakah halaju, v, bagi kereta A sebaik sahaja selepas perlanggaran?
Car A *of mass* 1 000 kg *moving at* 20 m s^{-1} *collides with a car* B *of mass* 1 200 kg *moving at* 10 m s^{-1} *in same direction. The car* B *is shunted forwards at velocity of* 15 m s^{-1} *due to the impact.*
What is the velocity of the car A *immediately after the crash?*

(b) Sebiji bola yang berjisim 15 kg dibalingkan pada halaju 20 km j^{-1} kepada Meilin yang berjisim 60 kg pada keadaan rehat di atas ais. Dia menangkap bola itu dan kemudian menggelongsor dengan bola di atas ais. Tentukan halaju Meilin dengan bola selepas perlanggaran.
A 15 kg *ball is thrown at a velocity of* 20 km h^{-1} *to Meilin with mass of* 60 kg *who is at rest on ice. She catches the ball and subsequently slides with the ball across the ice.*
Determine the velocity of Meilin with the ball after the collision.

(c) Seorang lelaki menembak sepucuk pistol yang berjisim 1.5 kg. Jika peluru itu berjisim 10 g dan mempunyai halaju 300 m s^{-1} selepas tembakan, berapakah halaju sentakan pistol itu?
A man fires a pistol which has a mass of 1.5 kg. *If the mass of the bullet is* 10 g *and it reaches a velocity of* 300 m s^{-1} *after shooting, what is the recoil velocity of the pistol?*



2.6 DAYA

Hubungan antara daya jisim dan pecutan.
The relationship between force mass and acceleration.

$F \propto ma$ → $F \propto \frac{mv - mu}{t}$

INFO

Perubahan momentum
Change in momentum
$mv - mu$

Kadar perubahan momentum
Rate change in momentum
$\frac{mv - mu}{t}$

1 Hukum Gerakan Newton Kedua menyatakan bahawa

_____

_____

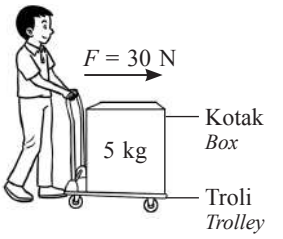
Newton's Second Law of Motion states that _____

_____

2 Persamaan bagi Hukum Gerakan Newton kedua adalah
The equation for Newton's Second Law of Motion is

di mana/ *where*
F :
m:
a :

3 Seorang lelaki menolak troli yang berisi kotak dengan jisim 5 kg di atas permukaan licin. Jika dia menggunakan daya 30 N untuk menolak troli itu, apakah magnitud dan arah pecutan troli itu?
A man pushes a trolley with 5 kg *box on a smooth surface. If he uses a force of* 30 N *to move the trolley, what is the magnitude and direction of the acceleration of the trolley?*



4 Sebuah bas berjisim 2 000 kg bergerak dengan halaju seragam 40 m s^{-1} sejauh 2 500 m sebelum ia berhenti.
Hitungkan
A bus of mass 2 000 kg *travels with a uniform velocity* 40 m s^{-1} *for a distance* 2 500 m *before it comes to rest. Calculate*

(a) pecutan purata bas.
the average acceleration of the bus.

(b) daya purata brek untuk memberhentikan bas.
the average force applied by the brakes to stop the bus.

2.7 IMPULS DAN DAYA IMPULS

1 Apakah maksud impuls?
What is the meaning of impulse?

2 Persamaan untuk impuls adalah
The equation for impulse is

$J = mv - mu$
$= Ft$

di mana/ *where*
J:
m:
u:
v:
F:
t:

3 Apakah maksud daya impuls?
What is the meaning of impulsive force?

4 Persamaan untuk daya impuls adalah
The equation for impulsive force is

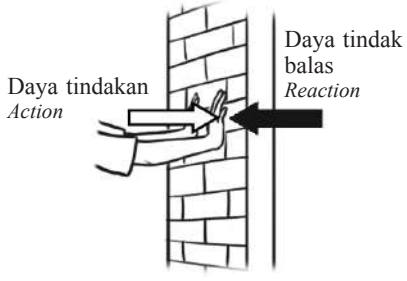
di mana/ *where*
F:
mv – mu:
t:

5 Hukum Gerakan Newton Ketiga menyatakan bahawa _____

_____

Newton's Third Law of Motion states that _____

_____



6 Terangkan mengapa pemain bola sepak melemparkan bola dengan cara seperti dalam rajah diberi.
Explain why the football player throws the ball as shown in the given diagram.

_____

_____

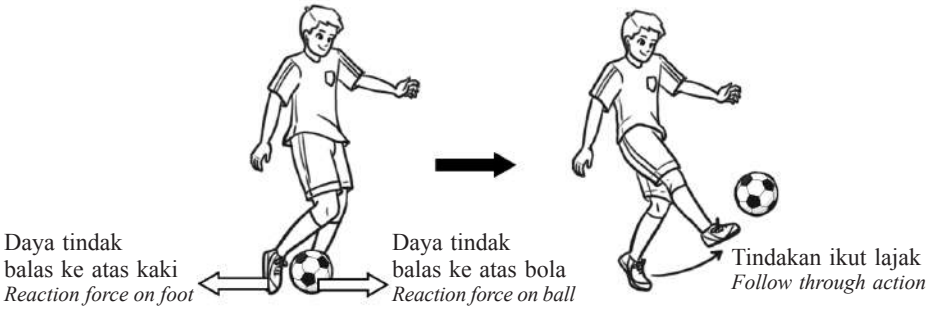
_____

_____

_____

_____

7 (a) Menambah momentum melalui tindakan ikut lajak.
Increasing the magnitude of impulse by follow through action.



(i) Sepakan yang kuat diikuti tindakan ikut lajak menghasilkan impuls yang _____.
A follow through action after a strong kick produces a _____ impulse.

(ii) Daya besar dan masa daya dibekalkan lebih _____.
Large force and _____ time of applied force.

(iii) Bola mengalami perubahan momentum besar dan bergerak dengan halaju _____
The ball experiences a large change in momentum and moves at a _____ velocity.

(b) Mengurangkan daya impuls dengan menambah masa impak.
Reducing the magnitude of impulse by increasing the time of impact.

Situasi ***Situation***	**Penerangan** ***Explanation***
Zon remuk kereta *Crumple zone of a car*	

(c) Meningkatkan daya impuls dengan mengurangkan masa impak.
Increasing the magnitude of impulse by reducing the time of impact.

Situasi ***Situation***	**Penerangan** ***Explanation***
Penggunaan alu dan lesung *The use of pestle and mortar*	

8 Dalam satu perlawanan tenis, pemain memukul bola tenis yang mempunyai jisim 0.2 kg yang menuju ke arahnya dengan halaju 20 m s^{-1}. Bola itu memantul dengan halaju 40 m s^{-1}. Masa yang diambil semasa perlanggaran antara bola dan raket tenis ialah 0.01 s.
In a tennis match, a player hits an on-coming tennis ball with mass of 0.2 kg *and velocity of* 20 m s^{-1}. *The ball rebounds with a velocity of* 40 m s^{-1}. *The time taken in the collision between the tennis ball and the tennis racket is* 0.01 s.

(a) Berapakah impuls yang dialami oleh bola tenis itu?
What is the impulse experienced by the tennis ball?

(b) Berapakah daya impuls yang dikenakan ke atas bola tenis?
What is the impulsive force exerted on the tennis ball?

2.8 BERAT

1 Apakah maksud berat?
What is the meaning of weight?

2 Menurut Hukum Gerakan Newton Kedua,
According to the Newton Second's Law of Motion,

$F = ma$
$W = mg$

di mana/ *where*
W :
m :
g :

3 Unit S.I bagi berat/ *S.I unit for weight* _____.

4 Apakah maksud kekuatan medan graviti, g?
What is the meaning of gravitational field strength, g?

5 Tulis persamaan bagi kekuatan medan graviti, *g*.
Write the equation for gravitational field strength, g.

6 Apakah nilai dan unit bagi g?
What is the value and unit for g?

7 Lengkapkan jadual berikut dengan menghitung berat di Bulan dan di Bumi.
Complete the following table by calculating the mass on Moon and on Earth.

Nilai pecutan graviti, *g* di Bulan ialah $\frac{1}{6}$ daripada nilai *g* di Bumi ***The value of gravitational acceleration, g on the Moon is $\frac{1}{6}$ of the value of g on the Earth***			
Kuantiti fizik ***Physical quantity***	**Di angkasa lepas** ***In the space***	**Di Bulan** ***On the Moon***	**Di Bumi** ***On Earth***
Jisim *Mass*	100 kg	100 kg	100 kg
Berat *Weight*	0 N		

8 Sebuah kapal angkasa bergerak dari Bumi ke Marikh. Kekuatan medan graviti di permukaan Marikh ialah 3.7 N kg^{-1}. Kapal angkasa itu membawa kapsul berjisim 100 kg diukur di Bumi.
A spacecraft moves from Earth to Mars, where the gravitational field strength near the surface of Mars is 3.7 N kg^{-1}. *The spacecraft is carrying capsule which has mass of* 100 kg *when measured on Earth.*

(a) Berapakah berat kapsul di Bumi?
What is the weight of capsule on Earth?

(b) Berapakah jisim kapsul di angkasa lepas?
What is the mass of capsule in the space?

(c) Berapakah jisim kapsul di Marikh?
What is the mass of capsule on Mars?

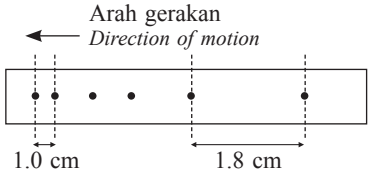
(d) Berapakah berat kapsul di Marikh?
What is the weight of capsule on Mars?

Kertas 1

1 Pecutan kereta yang bergerak dengan halaju seragam adalah
The acceleration of a moving car with uniform velocity will be

A bertambah
increase
B seragam
uniform
C sifar
zero
D berkurang
decrease

2 Rajah 1 menunjukkan pita detik yang ditarik oleh troli melalui jangka masa detik dengan frekuensi 50 Hz.
Diagram 1 *shows a ticker timer pulled by a trolley through ticker tape with frequency of* 50 Hz.

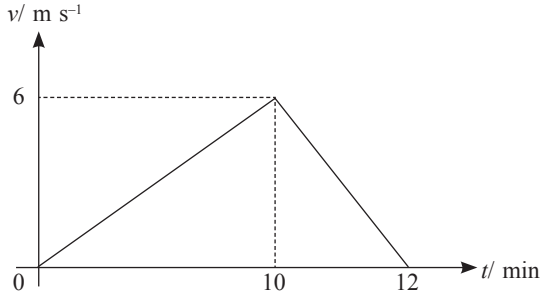


Rajah 1/ *Diagram* 1

Hitung pecutan troli itu.
Calculate the acceleration of the trolley.

A 2 m s^{-2}
B 5 m s^{-2}
C 4 m s^{-2}
D 10 m s^{-2}

3 Rajah 2 menunjukkan graf halaju-masa sebuah bas yang membawa penumpang. Selepas 10 minit, pemandu bas menekan pedal brek untuk menghentikan bas.
Diagram 2 *shows a graph of velocity-time of a bus that carry passengers. After* 10 *minutes, the bus driver pressed the brake pad to stop the bus.*

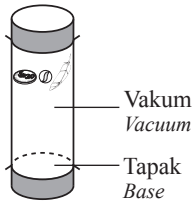


Rajah 2/ *Diagram* 2

Berapakah halaju bas sebaik sahaja pedal brek ditekan?
What is the velocity of the bus after the brake pad is pressed?

A 0 m s^{-1}
B 2 m s^{-1}
C 6 m s^{-1}
D 12 m s^{-1}

4 Rajah 3 menunjukkan duit syiling, guli dan bulu ayam dijatuhkan serentak di dalam silinder vakum.
Diagram 3 *shows a coin, a marble and a feather being released at the same time in a vacuum cylinder.*



Rajah 3/ *Diagram* 3

Pemerhatian manakah yang betul?
Which observation is correct?

A Ketiga-tiga objek terapung di dalam silinder
All three objects float in the cylinder
B Ketiga-tiga objek tiba di tapak pada masa yang sama
All three objects reach the base at the same time
C Guli tiba di tapak lebih awal daripada duit syiling
The marble reaches the base earlier than the coin
D Duit syiling dan guli tiba di tapak lebih awal daripada bulu ayam
The coin and the marble reach the base earlier than the feather

5 Sebiji batu bata jatuh dari ketinggian 10 m. Hitung masa yang diambil untuk batu bata itu tiba ke tanah.
A brick falls from a height of 10 m. *Calculate the time taken for the brick to reach the ground.*

A 0.5 s
B 0.7 s
C 1.0 s
D 1.4 s

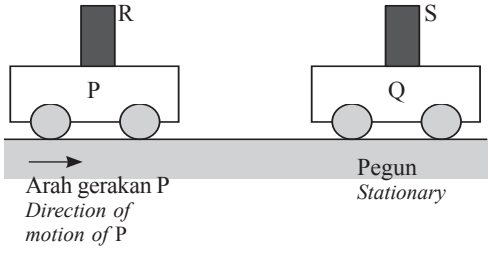
6 Rajah 4 menunjukkan keadaan pembonceng motosikal yang bergerak ke belakang apabila motosikal mula memecut.
Diagram 4 *shows a pillion rider moving backwards when the motorcycle accelerates.*

Rajah 4/ *Diagram* 4

Pergerakan pembonceng yang ke belakang boleh diterangkan oleh
The backwards movement of the pillion rider can be explained by

A konsep inersia
the concept of inertia
B konsep keseimbangan daya
the concept of equilibrium of forces
C prinsip keabadian momentum
the principle of conservation of momentum
D prinsip keabadian tenaga
the principle of conservation of energy

7 Rajah 5 menunjukkan dua blok kayu, R dan S, yang serupa, masing-masing di atas troli P dan Q.
Diagram 5 *shows two identical blocks,* R *and* S*, placed on trolleys* P *and* Q *respectively.*



Rajah 5/ *Diagram* 5

Apakah yang berlaku kepada blok kayu R dan S apabila troli P melanggar troli Q yang pegun?
What happens to the wooden blocks R *and* S *when trolley* P *collides with the stationary trolley* Q*?*

	R	S
A	Terhumban ke kanan *Pushed to the right*	Terhumban ke kanan *Pushed to the right*
B	Terhumban ke kanan *Pushed to the right*	Terhumban ke kiri *Pushed to the left*
C	Terhumban ke kiri *Pushed to the left*	Terhumban ke kiri *Pushed to the left*
D	Terhumban ke kiri *Pushed to the left*	Terhumban ke kanan *Pushed to the right*

8 Sebutir peluru berjisim 10 g ditembak daripada senapang berjisim 490 g. Peluru meninggalkan senapang dengan halaju 120 m s^{-1}.
Cari halaju sentakan senapang itu.
A bullet of mass 10 g *is fired from a gun of mass* 490 g*. The bullet leaves the gun with a speed of* 120 m s^{-1}*. Find the speed of recoil of the gun.*

A 2.4 m s^{-1}
B 4.8 m s^{-1}
C 6.4 m s^{-1}
D 7.4 m s^{-1}

9 Rajah 6 menunjukkan seorang pemain bola lisut menggerakkan tangannya ke belakang semasa menangkap bola yang laju.
Diagram 6 *shows a softball player moves his hand backwards while catching a fast-moving ball.*

Rajah 6/ *Diagram* 6

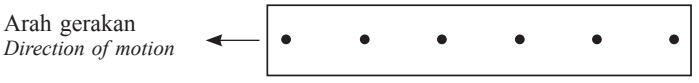
Pergerakan tangan itu bertujuan untuk
This movement of the hand is to

A menambahkan daya impuls
increase the impulsive force
B menambahkan masa hentaman
increase the impact time of the ball
C mengawal bola daripada jatuh
control the ball to stop falling
D mengurangkan impuls
reduce impulse

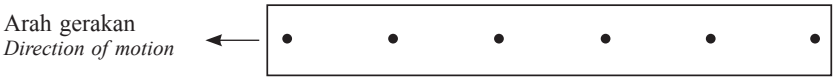
Menguasai Tidak Menguasai

Kertas 2
Bahagian A

1 Rajah 1.1 dan Rajah 1.2 menunjukkan dua pita detik yang berlainan panjang dihasilkan oleh gerakan dua troli.
Diagram 1.1 *and Diagram* 1.2 *show two ticker tapes with different lengths produced by the motion of two trolleys.*



Rajah 1.1/ *Diagram* 1.1



Rajah 1.2/ *Diagram* 1.2

(a) Apakah yang dimaksudkan dengan laju?
What is meant by the speed?

_____

_____

[1 markah/ *mark*]

(b) Berdasarkan Rajah 1.1 dan Rajah 1.2, bandingkan
Based on Diagram 1.1 *and Diagram* 1.2, *compare*

(i) bilangan detik.
the number of ticks.

_____

(ii) panjang pita detik.
the length of the ticker tapes.

_____

_____

(iii) laju purata pita detik.
the average speed of the ticker tapes.

_____

_____

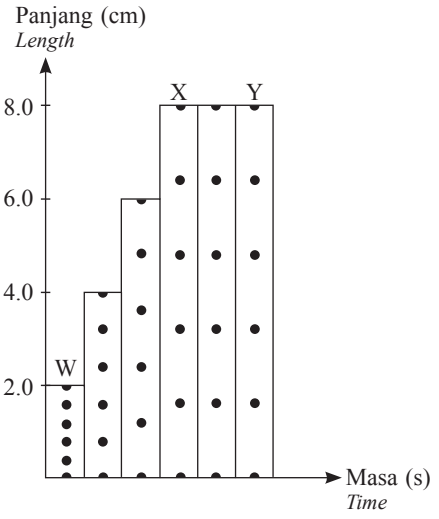
[3 markah/ *marks*]

(c) Menggunakan jawapan anda di **1**(b), nyatakan hubungan antara panjang pita detik dengan laju purata pita detik itu.
Using your answer in **1**(b), *state the relationship between the length of the ticker tape and the average speed of the ticker tape.*

_____

[1 markah/ *mark*]

(d) Rajah 1.3 menunjukkan satu carta pita detik yang dihasilkan daripada gerakan sebuah troli.
Diagram 1.3 *shows a ticker tape chart produced from the motion of a trolley.*



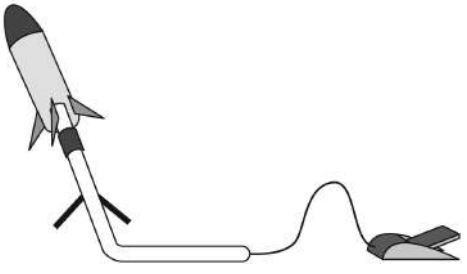
Rajah 1.3/ *Diagram* 1.3

Berdasarkan Rajah 1.3, terangkan jenis gerakan dari W hingga X.
Based on Diagram 1.3, *explain the type of motion from* W *to* X.

[2 markah/ *marks*]

Bahagian B

2 Rajah 2.1 menunjukkan satu roket botol trajektori yang dibina oleh seorang murid.
Diagram 2.1 *shows a trajectory bottle rocket made by a pupil.*



Rajah 2.1/ *Diagram* 2.1

(a) Roket botol tersebut telah dilancarkan dalam satu pertandingan peringkat sekolah
The bottle rocket is launched in a school tournament

(i) Apakah maksud momentum?
What is the meaning of momentum?

[1 markah/ *mark*]

(ii) Terangkan apakah yang menyebabkan roket botol itu bergerak ke depan.
Explain what makes the bottle rocket moved forward.

[4 markah/ *marks*]

(b) Roket botol itu bergerak dengan halaju 10 m s^{-1} dan mencapai ketinggian maksimum dalam masa 5 saat.
The bottle rocket moves with an initial velocity of 10 m s^{-1} *and reach the maximum high in* 5 *seconds.*

(i) Hitung nyahpecutan roket botol tersebut.
Calculate the deceleration of the bottle rocket.

(ii) Hitung jarak yang dilalui oleh roket botol tersebut.
Calculate the distance travelled by the bottle rocket.

[5 markah/ *marks*]

(c) Rajah 2.2 menunjukkan seorang penunggang motosikal Malaysia, Khairul Idham bin Pawi yang telah memenangi Moto 3 *Grand Prix* di Litar Termas de Rio Hondo, Argentina.
Diagram 2.2 *shows a Malaysian motorcycle racer, Khairul Idham bin Pawi had won Moto3 Grand Prix at Termas de Rio Hondo, Argentina.*

Sumber/ *Source*: https://www.mstar.com.my/sukan/2016/04/04/khairul-idham-juara

Rajah 2.2/ *Diagram* 2.2

Anda dikehendaki menentukan motosikal yang paling sesuai iaitu dapat bergerak dengan laju untuk bertanding dalam Perlumbaan Moto 3 *Grand Prix* di Litar Sepang. Jadual 1 menunjukkan spesifikasi-spesifikasi empat buah motosikal.
You are required to determine the most suitable motorcycle which is can move faster to compete in Moto 3 *Grand Prix at Sepang Circuit. Table* 1 *shows specifications of four motorcycles.*

Motosikal ***Motorcycle***	**Rangka** ***Frame***	**Bentuk** ***Shape***	**Kapasiti enjin** ***Capacity of engine***	**Bunga pada tayar** ***Thread on tyre***
A	Ringan dan tegar *Light and stiff*	Aerodinamik *Aerodinamic*	600 cc	Tiada *None*
B	Ringan dan tegar *Light and stiff*	Aerofoil *Aerofoil*	600 cc	Melintang dan menegak *Horizontal and vertical*
C	Berat dan tegar *Heavy and stiff*	Aerodinamik *Aerodinamic*	250 cc	Tiada *None*
D	Berat dan tegar *Heavy and stiff*	Aerofoil *Aerofoil*	250 cc	Melintang dan menegak *Horizontal and vertical*

Jadual 1/ *Table* 1

Kaji spesifikasi semua motosikal dan terangkan kesesuaian aspek-aspek itu. Beri sebab bagi pilihan anda.
Study the specifications of all motorcycles and explain the suitability of those aspects. Give reasons for your choice.

[10 markah/ *marks*]

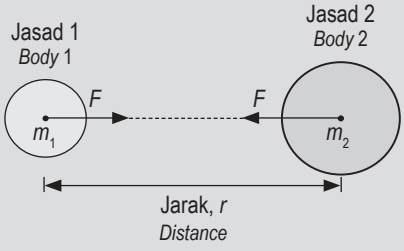
BAB 3

Kegravitian
Gravitation

NOTA EFEKTIF

1 Hukum Kegravitian Semesta/ *Newton's Universal Law of Gravitation*

(a) Daya graviti, F antara dua jasad adalah berkadar terus dengan hasil darab kedua-dua jisim jasad, m_1 dan m_2 dan berkadar songsang dengan kuasa dua jarak di antara pusat kedua-dua jasad, r.
The gravitational force, F between two bodies is directly proportional to the product of the masses, m_1 and m_2 of both bodies and inversely proportional to the square of the distance between the centres of the two bodies, r.



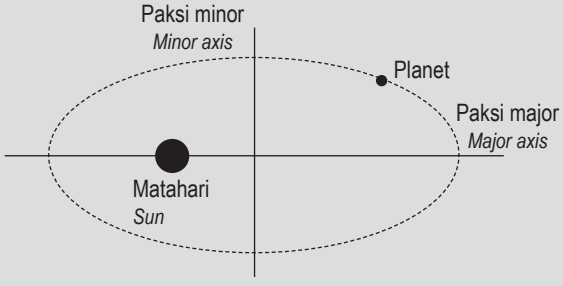
$$F = G\frac{m_1 m_2}{r^2}$$

G = Pemalar kegravitian/ *Gravitational constant*
$(6.6.7 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2})$

(b) Daya memusat: Daya yang bertindak ke atas jasad yang sedang membuat gerakan membulat serta sentiasa ke arah pusat graviti.
Centripetal force: A force acts on the body that in cicular motion and in a direction towards the centre of the circle.

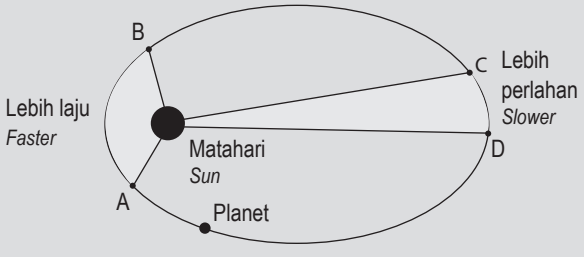
2 Hukum Kepler Pertama/ *Kepler's First Law*

Orbit bagi setiap planet adalah elips dengan Matahari berada di salah satu fokusnya.
All the planets move in elliptical orbits with the Sun at one focus.



3 Hukum Kepler Kedua/ *Kepler's Second Law*

(a) Satu garis yang menyambungkan planet dengan Matahari akan mencakupi luas yang sama dalam selang masa yang sama apabila planet bergerak dalam orbitnya.
A line that connects a planet to the Sun sweeps out equal areas in equal times.



(b) Planet mengambil masa yang sama untuk bergerak dari A ke B dan C ke D. Hal ini kerana planet bergerak lebih laju dari A ke B berbanding dari C ke D.
A planet takes the same time to move from A to B and from C to D. This is because the planet moves faster from A to B rather than from C to D.

4 Hukum Kepler Ketiga/ *Kepler's Third Law*

Kuasa dua tempoh planet adalah berkadar terus dengan kuasa tiga jejari orbitnya, $T^2 \propto r^3$.
The square of the orbital period of any planet is directly proportional to the cube of the radius of its orbit, $T^2 \propto r^3$.

3.1 HUKUM KEGRAVITIAN SEMESTA NEWTON

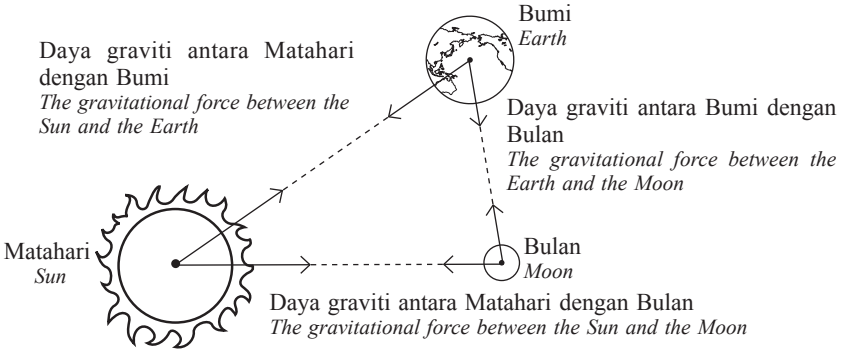
INFO

Sehelai daun gugur ke tanah (Bumi) daripada sebatang pokok. Daun dan Bumi mengalami daya graviti yang sama. Daun dan Bumi bergerak mendekati antara satu sama lain. Namun, disebabkan jisim Bumi jauh lebih besar daripada jisim daun, kita hanya dapat melihat daun itu jatuh ke arah Bumi.
A leaf falls to the ground from a tree. The leaf and the Earth experience the same gravitational force. The leaf and the Earth moves towards one another. As the mass of the Earth is very much larger than the mass of the leaf, we only observe the leaf falling to the ground.

1 Daya graviti dikenali sebagai daya semesta kerana _____

_____

Gravitational force is known as universal force because _____.



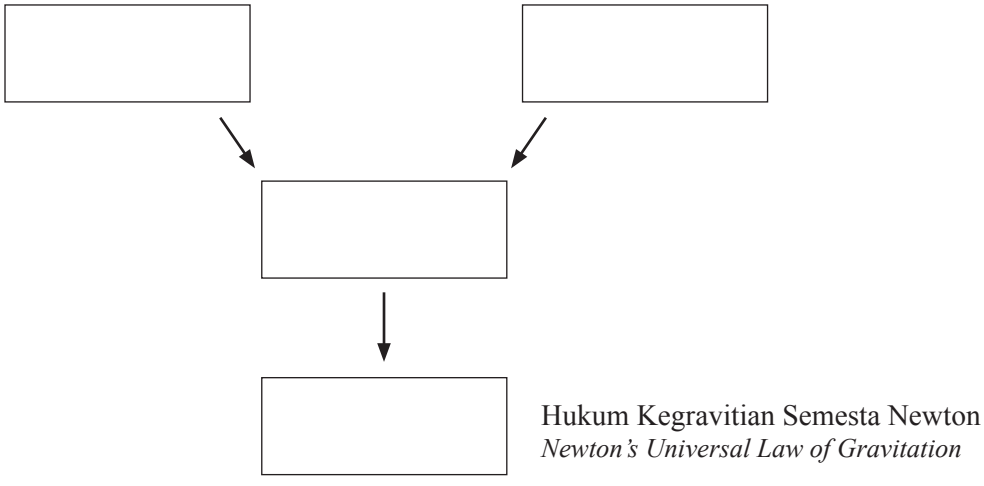
2 Dua hubungan yang melibatkan daya graviti antara dua jasad:
Two relationships involves gravitational force between two bodies:

(i) Daya graviti _____ dengan hasil darab jisim dua jasad.

The gravitational force is _____ *to the product of the masses of the two bodies.*

(ii) Daya graviti _____ dengan kuasa dua jarak di antara pusat dua jasad.

The gravitational force is _____ *to the square of the distance between the centres of the two bodies.*



3 Hukum Kegravitian Semesta Newton menyatakan bahawa _____

_____

_____

_____

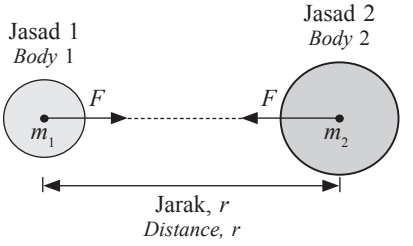
Newton's Universal Law of Gravitation states that _____

_____

_____

4

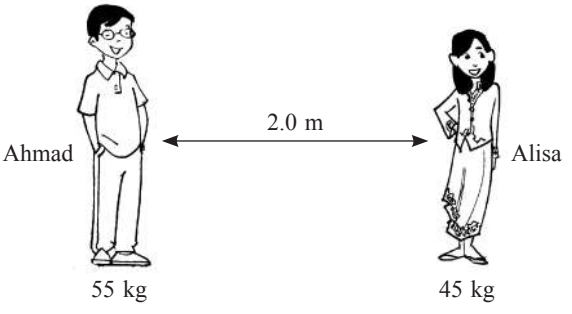
$$F = \frac{Gm_1m_2}{r^2}$$



F	
G	
m_1	
m_2	
r	

5 Menyelesaikan masalah melibatkan Hukum Kegravitian Semesta Newton.
Solve problem involving Newton's Universal Law of Gravitation.

(a) Rajah menunjukkan Ahmad dan Alisa berdiri dengan jarak 2.0 m di antara satu sama lain.
Diagram shows Ahmad and Ali standing in distance of 2.0 m *between each other.*



(i) Hitung daya graviti antara Ahmad dan Alisa.
Calculate the gravitational force between Ahmad and Alisa.

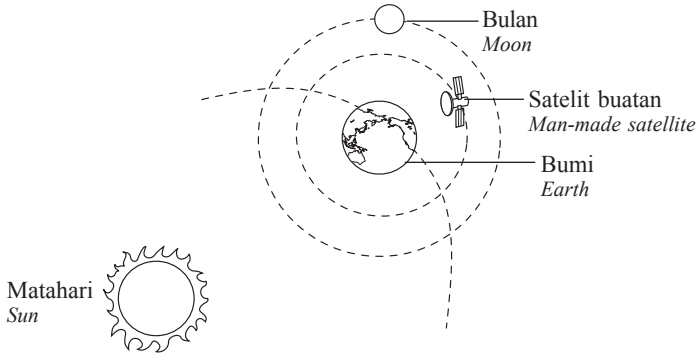
(ii) Hitung daya graviti jika jarak di antara mereka ditambah sehingga 4.0 m.
Calculate the gravitational force if their distance is increased to 4.0 m.

(iii) Nyatakan hubungan antara hasil darab jisim dua jasad dengan daya graviti.
State the relationship between the product of the mass of two bodies and the gravitational force.

(iv) Apakah kesan jarak di antara dua pusat jasad ke atas daya graviti?
What is the effect of distance between two bodies centre on gravitational force?

(b) Rajah menunjukkan kedudukan Matahari, Bulan, Bumi dan satelit buatan.
The diagram shows the position of the Sun, the Moon, the Earth, and the man-made satellite.

VIDEO ULASAN JAWAPAN



Jadual menunjukkan ciri-ciri Matahari, Bulan, Bumi dan satelit buatan.
The table shows the details of the Sun, the Moon, the Earth, and the man-made satellite.

Matahari/ *Sun* Jisim/ *Mass* = 1.99×10^{30} kg Jarak di antara pusat Bumi dan pusat Matahari/ *Distance between the centre of the Earth and the centre of the Sun* = 1.50×10^{11} m	Bumi/ *Earth* Jisim/ *Mass* = 5.97×10^{24} kg Jejari/ *Radius* = 6.37×10^{6} m
Satelit buatan/ *Man-made satellite* Jisim/ *Mass* = 1.20×10^{3} kg Ketinggian satelit buatan/ *The height of the man-made satellite* = 4.22×10^{7} m	Bulan/ *Moon* Jisim/ *Mass* = 7.35×10^{22} kg

(i) Berapakah daya graviti ke atas satelit buatan itu sebelum dilancarkan?
What is the gravitational force on the man-made satellite before it is launched?

(ii) Hitungkan daya graviti antara Bumi dengan satelit buatan.
Calculate the gravitational force between the Earth and the man-made satellite.

(iii) Bandingkan magnitud daya graviti Bumi dan satelit buatan dengan magnitud daya graviti Matahari dan Bumi.
Compare the magnitude of the gravitational force between the Earth and the man-made satellite and the gravitational force between the Sun and the Earth.

(iv) Daya graviti antara Bumi dengan Bulan ialah 2.0×10^{20} N. Berapakah jarak di antara pusat Bumi dengan pusat Bulan?
The gravitational force between the Earth and the Moon is 2.0×10^{20} N. *What is the distance between the centre of the Earth and the centre of the Moon?*

6 Menerbitkan rumus pecutan graviti.
To derive the formula for gravitational acceleration.

(a) (i) Hukum Gerakan Newton Kedua
Newton's Second Law of Motion

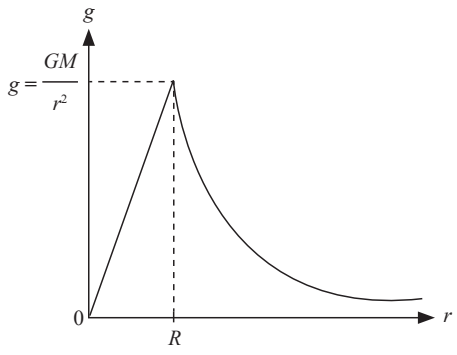
(ii) Hukum Kegravitian Semesta Newton
Newton's Universal Law of Gravitation

(iii) Menyamakan kedua-dua persamaan
Equate two equations

(iv) Maka, pecutan graviti, g
Then, the gravitational acceleration, g

(b) Nyatakan faktor-faktor yang mempengaruhi nilai pecutan graviti.
State the factors that influence the value of gravitational acceleration.

7 Rajah menunjukkan graf bagi variasi nilai pecutan graviti dengan jarak dari pusat Bumi.
Graph shows the variation of gravitational acceleration with the distance from the centre of the Earth.



(a) Bagaimanakah nilai pecutan graviti berubah apabila jarak dari pusat Bumi bagi kedudukan $r < R$?
How does the value of gravitational acceleration change when the distance from the centre of the Earth, $r < R$?

(b) Bagaimanakah nilai pecutan graviti berubah apabila jarak dari pusat Bumi bertambah $r \geq R$?
How does the value of gravitational acceleration change when the distance from the centre of the Earth $r \geq R$?

(c) Sebuah statelit berjisim 80 kg mengorbit Bumi pada ketinggian 1.5×10^3 km dari permukaan Bumi. Hitungkan pecutan graviti pada orbit tersebut.
A satellite has a mass of 80 kg *is orbiting the Earth at a height of* 1.5×10^3 km *from the surface of the Earth. Calculate the gravitational acceleration on the orbit.*
[Jisim Bumi = 5.97×10^{24} kg]
[*Mass of the Earth* = 5.97×10^{24} kg]

8 Apakah maksud daya memusat?
What is the meaning of centripetal force?

9

$F = \frac{mv^2}{r}$	F	
	m	
	v	
	r	

10 (a) Menentukan jisim Bumi dan Matahari.
To determine the mass of the Earth and the Sun.

Hukum Kegravitian Semesta Newton *Newton's Universal Law of Gravitational* $F = \frac{GMm}{r^2}$	Daya memusat *Centripetal force* $F = \frac{mv^2}{r}$

Menyamakan dua persamaan berikut:
Equate the following two equations:

$$\frac{GMm}{r^2} = \frac{mv^2}{r}$$

$$GM = v^2 r \ \ldots\ldots\ldots\ldots (1)$$

Laju linear, $v = \frac{2\pi r}{T}$
Linear speed

Gantikan v ke dalam persamaan (1):
Subtitute v into the equation (1)*:*

$$GM = \left(\frac{2\pi r}{T}\right)^2 r$$

$$GM = \frac{4\pi^2 r^3}{T^2}$$

Maka, rumus jisim Bumi atau Matahari adalah
Then, the formula of the mass of the Earth
$M =$

di mana/ *where*
$G =$
$r =$
$T =$

TIPS

Jarak Bulan membuat satu orbit lengkap mengelilingi Bumi adalah 2π.
Distance of the Moon making one complete orbit around the Earth is 2π.

(b) Tempoh peredaran Bulan mengelilingi Bumi, ialah $T = 2.36 \times 10^6$ s dan jejari orbit Bulan, $r = 3.83 \times 10^8$ m. Hitungkan jisim Bumi, M.
Period of revolution of the Moon around the Earth, $T = 2.36 \times 10^6$ s *and the radius of the Moon's orbit,* $r = 3.83 \times 10^8$ m. *Calculate the mass of the Earth, M.*

(c) Bumi bergerak mengelilingi Matahari dengan tempoh satu tahun dan jejari orbit adalah 1.50×10^{11} m. Hitungkan jisim Matahari.
The Earth revolves the Sun in a period of one year and the radius of the orbit is 1.50×10^{11} m. *Calculate the mass of the Sun.*

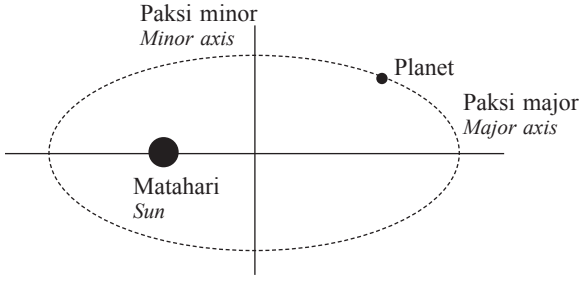
3.2 HUKUM KEPLER

1 (a) Apakah Hukum Kepler Pertama?
What is Kepler's Firs Law?

(b) Bentuk orbit planet-planet dalam Sistem Suria adalah _____.
The shape of orbits used by the planets in the Solar System is _____.

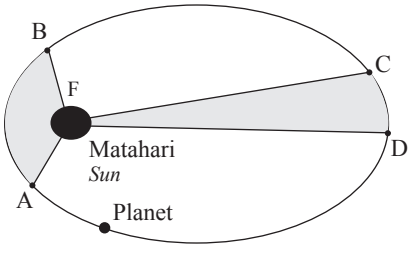
(c) Paksi major lebih _____ daripada paksi minor. Kebanyakan orbit planet mempunyai paksi major hampir _____ panjang dengan paksi minor.
The major axis is _____ *than the minor axis. Most orbits of the planets have minor axis and major axis of almost the* _____ *length.*

(d) _____ adalah nilai purata bagi jarak di antara planet dengan Matahari.
The _____ *is the average value of the distance between the planet and the Sun.*



2 (a) Apakah Hukum Kepler Kedua?
What is Kepler's Second Law?

(b)



Jika sebuah planet mengambil masa yang sama untuk bergerak dari A ke B dan C ke D, maka:
If a planet takes the same amount of time to move from A *to* B *and* C *to* D, *then:*

(i) Luas kawasan AFB adalah _____ luas kawasan CFD.
The area of AFB *is* _____ *the area of* CFD.

(ii) Jarak AB adalah _____ daripada jarak CD.
The distance of AB *is* _____ *than the distance* CD.

(iii) Laju linear A ke B adalah _____ daripada laju linear C ke D.
The linear speed from A *to* B *is* _____ *than the linear speed from* C *to* D.

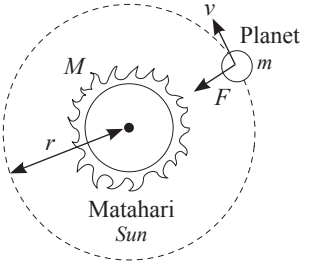
3 (a) Apakah Hukum Kepler Ketiga?
What is Kepler's Third Law?

(b) Hukum Kepler Ketiga secara matematik adalah _____.
Mathematically, the Kepler's Third Law is _____.

(c) Planet yang mengorbit dengan jejari orbit planet besar, mempunyai tempoh orbit lebih _____.
A planet which orbits with a larger radius has a _____ *orbital period.*

(d) Planet yang lebih jauh daripada Matahari mengambil masa lebih _____ untuk melengkapkan satu orbit mengelilingi Matahari.
Planets which are further from the Sun take a _____ *time to complete one orbit around the Sun.*

4 Merumuskan Hukum Kepler Ketiga.
Formulating Kepler's Third Law.



(a) Daya graviti bertindak ke atas planet,
Gravitational force acting on the planet,

(b) Daya memusat planet,
Centripetal force of the planet,

(c) Menyamakan kedua-dua persamaan,
Equate the two equations,

(d) Gantikan ke dalam persamaan:
Subtitute into the equation:

(e) k = pemalar, maka Hukum Kepler Ketiga,
k = *constant, then Kepler's Third Law,*

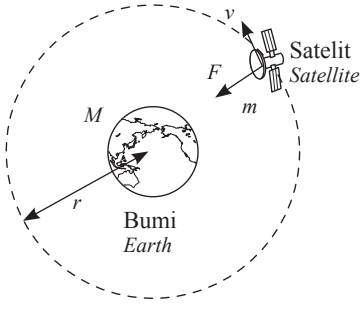
5 Menyelesaikan masalah melibatkan Hukum Kepler Ketiga.
Solve problem involving Kepler's Third Law.

(a) Jika dua planet dibandingkan, persamaan digunakan untuk menghitung tempoh orbit atau jejari orbit adalah
If two planets are compared, the equation used to calculate the orbital period or the radius or orbit is

(b) Sebuah satelit mengorbit pada ketinggian 420 km dari permukaan Bumi. Berapakah tempoh orbit satelit itu?
A satellite orbiting at a height of 420 km *from the surface of the Earth. What is the orbital period of the satellite?*
[Jejari orbit Bulan = 3.83×10^8 m, tempoh orbit Bulan = 655.2 jam, jejari Bumi = 6.37×10^6 m]
[*Radius of the orbit of the Moon* = 3.83×10^8 m, *orbital period of the Moon* = 655.2 *hours, radius of Earth* = 6.37×10^6 m]

3.3 SATELIT BUATAN MANUSIA

1 Rajah menunjukkan orbit sebuah satelit yang mengelilingi Bumi. Satelit yang bergerak dalam orbit mengelilingi Bumi akan mengalami daya memusat, iaitu daya graviti.
The diagram shows the orbit of a satellite around the Earth. A satellite moving in a circular orbit around the Earth experiences centripetal force, which is gravitational force.



Laju linear satelit
Linear speed of satellite

$$v^2 = \frac{GM}{r} \rightarrow v = \sqrt{\frac{GM}{r}}$$

GM adalah malar. Laju linear bergantung kepada jejari orbitnya. Jika sebuah satelit berada pada ketinggian, H di atas permukaan Bumi dan jejari orbit, $r = R + h$. Maka, laju linear satelit:
GM is constant. Linear speed depends on the radius of its orbit. If a satellite is at a height, h above the surface of the Earth and the radius of orbit, r = R + h. Then, the linear speed of the satellite:

INFO

Laju linear satelit adalah kelajuan diperlukan satelit untuk kekal mengorbit pada ketinggian tertentu.
Linear speed of satellite is the speed required by the satellite to remain orbiting at a specific height.

2 (a) Sebuah satelit Sistem Kedudukan Sejagat (GPS) mengorbit Bumi. Hitung laju linear satelit itu jika ia berada pada ketinggian $h = 20\,000$ km.
A GPS satellite is orbiting the Earth. Calculate the linear speed of the satellite if it is at an altitude of $h = 20\,000$ km.
[$R = 6.37 \times 10^6$ m, $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}, $M = 5.97 \times 10^{24}$ kg]

(b) Ramalkan apakah yang bakal berlaku kepada satelit itu jika laju linear kurang daripada jawapan di **2**(a).
Predict what will happen to the satellite if the linear speed lower than the answer in **2**(a).

_____

3 Persamaan antara satelit geopegun dengan satelit bukan geopegun.
Similarities between geostationary satellite and non-geostationary satellite.

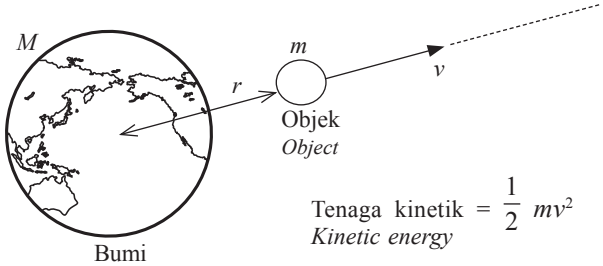
	$v = \sqrt{\frac{GM}{R}}$	$T = \sqrt{\frac{4\pi^2 r^3}{GM}}$

4 Perbezaan antara satelit geopegun dengan satelit bukan geopegun.
Differences between geostationary satellite and non-geostationary satellite.

Satelit geopegun ***Geostationary satellite***	**Satelit** ***Satellite***	**Satelit bukan geopegun** ***Non-geostationary satellite***
	(a) Arah gerakan ***Direction of motion***	
	(b) Tempoh orbit ***Orbital period***	
	(c) Kedudukan di muka Bumi ***Position on the Earth***	
	(d) Fungsi ***Function***	
	(e) Contoh ***Example***	

5 (a) Apakah maksud halaju lepas?
What is the meaning of escape velocity?

(b) Menerbitkan rumus halaju lepas.
Derived the formula for escape velocity.



Tenaga kinetik $= \frac{1}{2} mv^2$
Kinetic energy

INFO

Tenaga keupayaan graviti,
Gravitational potential energy,
$U = \frac{GMm}{r}$

(i) Tenaga kinetik minimum + Tenaga keupayaan = 0
Minimum kinetic energy + Potential energy = 0

(ii) Halaju lepas,
Escape velocity,

(c) Hitung halaju lepas bagi Bumi.
Calculate the escape velocity from the Earth.
[Jisim Bumi, $M = 5.97 \times 10^{24}$ kg, jejari Bumi, $R = 6.37 \times 10^{6}$ m]
[*Mass of the Earth,* $M = 5.97 \times 10^{24}$ kg, *radius of the Earth,* $R = 6.37 \times 10^{6}$ m]

6 Bagaimanakah roket boleh mencapai halaju lepas dari Bumi dan menghantar kapal angkasa ke angkasa lepas?
How can a rocket achieve escape velocity from the Earth and send the spacecraft into outer space?

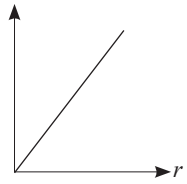
Kertas 1

1 Berdasarkan persamaan berikut,
Based on the following equation,

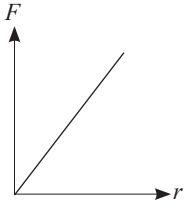
$$F = \frac{Gm_1m_2}{r^2}$$

Graf manakah yang menerangkan hubungan antara F dan r dengan betul?
Which graph describes the relationship between F and r correctly?

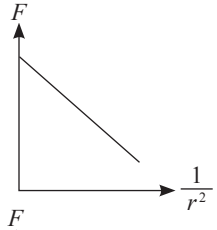
A



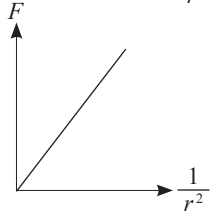
B



C



D

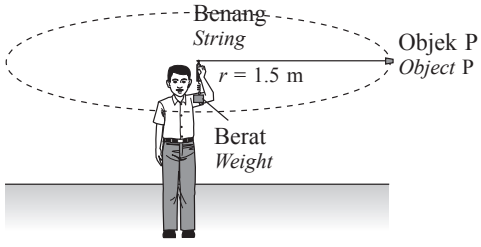


2 Sebuah satelit di permukaan Bumi mengalami daya graviti, W.
Apakah daya graviti yang bertindak ke atas satelit itu apabila ia ditempatkan ke dalam orbit yang ketinggiannya, 3R dari permukaan Bumi di mana R ialah jejari Bumi?
A satellite on the surface of the Earth experiences a gravitational force, W.
What is the gravitational force that acts on the satellite when it is at an orbit of height 3R *from the Earth's surface, where R is the radius of the Earth?*

A $\frac{W}{16}$ **B** $\frac{W}{9}$

C 9W **D** 16W

3 Rajah 1 menunjukkan seorang murid sedang memutarkan objek P yang berjisim 1 kg dalam suatu bulatan ufuk.
Diagram 1 *shows a pupil rotating an object* P *of mass* 1 kg *in a horizontal circle.*



Rajah 1/ *Diagram* 1

Berapakah laju linear putaran objek P apabila daya memusat yang bertindak ke atas objek tersebut ialah 650 N?
What is the linear speed that acts on object P *when the centripetal force that acts on the object is* 650 N?

A 1.50 m s^{-1}
B 31.22 m s^{-1}
C 62.44 m s^{-1}
D 975.00 m s^{-1}

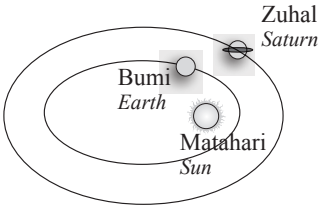
4 Baca pernyataan berikut.
Read the following statement.

> Garis yang menyambungkan planet dengan Matahari akan mencakupi luas yang sama dalam selang masa yang sama apabila planet bergerak dalam orbitnya.
> *A line that connects a planet to the Sun sweeps out equal areas in equal times when the planet moves in their orbit.*

Pernyataan di atas merujuk kepada
The statement above refers to

A Hukum Kepler Pertama
Kepler's First Law
B Hukum Kepler Kedua
Kepler's Second Law
C Hukum Kepler Ketiga
Kepler's Third Law

5 Rajah 2 menunjukkan orbit planet Zuhal dan planet Bumi mengelilingi Matahari.
Diagram 2 *shows the orbit of Saturn and Earth around the Sun.*



Rajah 2/ *Diagram* 2

Diberi tempoh orbit Bumi ialah 1 tahun, jejari orbit Bumi dan Zuhal ialah masing-masing 1.50×10^{11} m dan 1.43×10^{12} m. Hitung tempoh orbit Zuhal dengan menganggap bentuk orbit adalah bulat.
Given the orbital period of the Earth is 1 year, *radius of orbit of the Earth and Saturn is* 1.50×10^{11} m *and* 1.43×10^{12} m *respectively. Calculate the orbital period of Saturn by assuming that the shape of the orbit is round.*

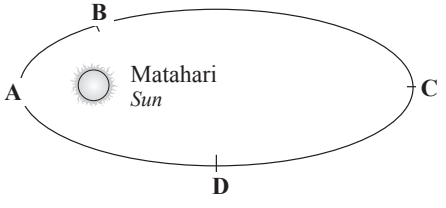
A 866.4 tahun
866.4 *years*

B 288.8 tahun
288.8 *years*

C 29.4 tahun
29.4 *years*

D 9.5 tahun
9.5 *years*

6 Rajah 3 menunjukkan kedudukan suatu planet yang beredar mengelilingi Matahari.
Diagram 3 *shows the position of a planet revolving around the Sun.*



Rajah 3/ *Diagram* 3

Antara kedudukan **A**, **B**, **C** atau **D**, yang manakah paling lambat bagi planet untuk beredar mengelilingi Matahari?
Which position **A**, **B**, **C** *or* **D**, *is the slowest for the planet to revolve around the Sun?*

7 Satelit buatan manusia akan mengorbit Bumi dengan magnitud laju linear yang tinggi. Apakah kesannya jika laju linear satelit berkurang?
Man-made satellites will orbit the Earth at high linear speeds. What is the effect if the linear speed of the satellite decreases?

A Satelit akan terlepas ke angkasa
The satellite will be released into space

B Satelit tidak lagi mengorbit Bumi
The satellite is no longer orbit the Earth

C Satelit akan naik ke orbit lebih tinggi
The satellite will rise to the higher orbits

D Satelit akan masuk ke atmosfera Bumi dan terbakar
The satellite will enter the Earth's atmosphere and burn

8 Hitung halaju lepas bagi objek yang berada di permukaan planet Marikh.
Calculate the escape velocity of an object on the surface of planet Mars.
[Jisim Marikh/ *Mass of Mars* = 0.64×10^{24} kg]
[Jejari Marikh/ *Radius of Mars* = 3.39×10^{3} km]

A 5.0 km s^{-1}

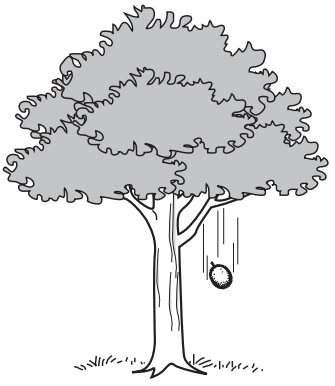
B 3.5 km s^{-1}

C 7.5 km s^{-1}

D 0.5 km s^{-1}

Kertas 2
Bahagian A

1 Rajah 1 menunjukkan sebiji buah durian jatuh dari pokoknya.
Diagram 1 *shows a durian falling from its tree.*



Rajah 1/ *Diagram* 1

(a) Namakan daya yang bertindak di antara Bumi dan buah durian itu.
Name the force acting between the Earth and the durian.

_____

[1 markah/ *mark*]

(b) Hitung daya di antara durian tersebut dan Bumi.
Calculate the force between the durian and the Earth.
[Jisim durian = 2.0 kg, jisim Bumi = 5.97×10^{24} kg, jarak di antara pusat durian dan pusat Bumi = 6.37×10^{6} m]
[*Mass of the durian* = 2.0 kg, *mass of the Earth* = 5.97×10^{24} kg, *distance between the centre of the durian and the centre of the Earth* = 6.37×10^{6} m]

[2 markah/ *marks*]

(c) Apakah yang berlaku pada daya itu jika jarak di antara pusat durian dan pusat Bumi bertambah dua kali ganda? Jelaskan mengapa.
What happens to the force if the distance between the centre of the durian and the centre of the Earth is doubles? Explain why.

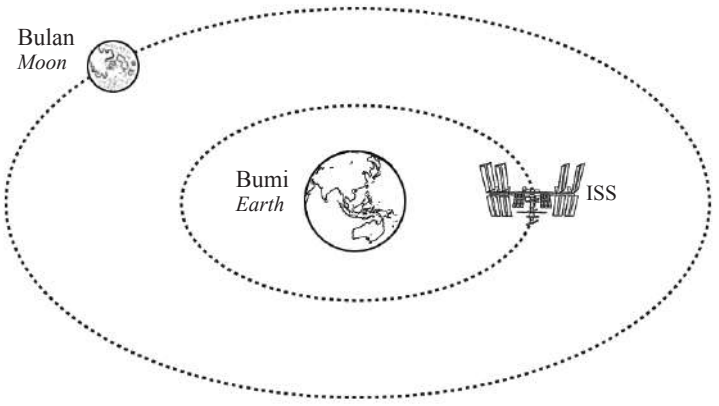
_____

_____

[2 markah/ *marks*]

Bahagian C

2 Rajah 2 menunjukkan Bulan dan Stesen Angkasa Antarabangsa (ISS) mengorbit mengelilingi Bumi.
Diagram 2 *shows the Moon and the International Space Station* (ISS) *are orbiting the Earth.*



Rajah 2/ *Diagram* 2

(a) (i) Berdasarkan Rajah 2, objek manakah yang mempunyai tempoh orbit paling lama? Berikan sebab.
Based on Diagram 2, *which object has the longest orbital period? Give a reason.*

[2 markah/ *marks*]

(ii) Nyatakan hubungan antara tempoh orbit dengan jejari orbit bagi sebuah planet.
State the relationship between the orbital period and radius of orbit of a planet.

[1 markah/ *mark*]

(iii) Nyatakan hukum fizik yang terlibat di **2**(a)(ii).
State the law of physics involved in **2**(a)(ii).

[1 markah/ *mark*]

(iv) Tuliskan persamaan yang menerangkan hukum di **2**(a)(iii).
Write the equation that explains the law in **2**(a)(iii).

[1 markah/ *mark*]

(b) Jadual 1.1 menunjukkan ciri-ciri satelit yang berbeza.
Table 1.1 *shows the characteristics of different satellites.*

Satelit ***Satellite***	**Arah putaran satelit** ***Direction of satellite rotation***	**Tempoh orbit** ***Orbital period***	**Altitud** ***Altitude***	**Tempoh hayat** ***Lifespan***
P	Bertentangan dengan orbit Bumi *Opposite direction of the Earth orbit*	18 jam 18 *hours*	370 km	12 tahun 12 *years*
Q	Mengikut arah orbit Bumi *In the direction of the Earth orbit*	24 jam 24 *hours*	35 786 km	35 tahun 35 *years*
R	Bertentangan dengan orbit Bumi *Opposite direction of the Earth orbit*	6 jam 6 *hours*	35 786 km	2 tahun 2 *years*
S	Mengikut arah orbit Bumi *In the direction of the Earth orbit*	12 jam 12 *hours*	540 km	12 tahun 12 *years*

Jadual 1.1/ *Table* 1.1

Anda adalah seorang jurutera yang ditugaskan untuk menentukan satelit mana yang dapat digunakan sebagai *Geostationary Environment Satellite* (GOES). Dengan menggunakan pengetahuan anda mengenai ciri-ciri satelit geopegun, pilih satelit yang paling sesuai untuk digunakan sebagai GOES seperti yang ditunjukkan dalam Jadual 1.1. Berikan justifikasi untuk pilihan anda.
You are an engineer whom is assigned to determine which satellite that can be used as Geostationary Environment Satellite (GOES). By using your knowledge about the characteristic of geostationary satellite, choose the most suitable satellite to be used as GOES as shown in Table 1.1. Give justifications for your choice.

[10 markah/ *marks*]

(c) Zuhal dan Marikh adalah planet yang berada dalam sistem suria kita. Pecutan graviti dan halaju lepas di kedua-dua planet tersebut adalah berbeza. Jadual 1.2 menunjukkan jisim dan jejari kedua-dua planet tersebut.
Saturn and Mars are planets that located in our solar system. The gravitational acceleration and the escape velocity in both planets are different. Table 1.2 shows the mass and the radius of both planets.
[$G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}]

Planet	**Jisim/ *Mass, m* (kg)**	**Jejari/ *Radius, r* (m)**
Zuhal *Saturn*	5.68×10^{26}	6.03×10^{7}
Marikh *Mars*	6.42×10^{23}	3.40×10^{6}

Jadual 1.2/ *Table* 1.2

(i) Hitung nilai pecutan graviti bagi planet Zuhal dan Marikh.
Calculate the value of gravitational acceleration for planets Saturn and Mars.

[4 markah/ *marks*]

(ii) Apakah faktor-faktor yang menentukan nilai pecutan graviti bagi sesebuah planet?
What are the factors that determine the value of gravitational acceleration of a planet?

[1 markah/ *mark*]

BAB 4

Haba
Heat

NOTA EFEKTIF

1 Keseimbangan terma/ *Thermal equilibrium*

(a) Tiada pemindahan bersih haba antara dua objek yang berada dalam keseimbangan terma.
There is no net flow of heat between two objects that are in thermal equilibrium.

(b) Dua objek yang berada dalam keseimbangan terma mempunyai suhu yang sama.
Two objects in thermal equilibrium have the same temperature.

2 Muatan haba tentu/ *Specific heat capacity, c*

Kuantiti haba yang diperlukan untuk menaikkan suhu sebanyak 1 °C bagi jisim 1 kg bahan.
The quantity of heat needed to raise the temperature of 1 kg *mass of a substance by* 1 °C.

$$c = \frac{Q}{m\Delta\theta}$$

3 Haba pendam tentu/ *Specific latent heat, l*

Kuantiti haba, Q yang diserap atau dibebaskan semasa perubahan fasa bagi 1 kg bahan tanpa perubahan suhu.
The amount of heat, Q absorbed or released during a change of phase of 1 kg *substance without a change in temperature.*

$$l = \frac{Q}{m}$$

(a) **Haba pendam tentu pelakuran**
Specific latent heat of fusion, l_f
Kuantiti haba yang diserap semasa peleburan bagi 1 kg bahan tanpa perubahan suhu.
The amount of heat, Q absorbed during melting phase for 1 kg *substance without a change in temperature.*

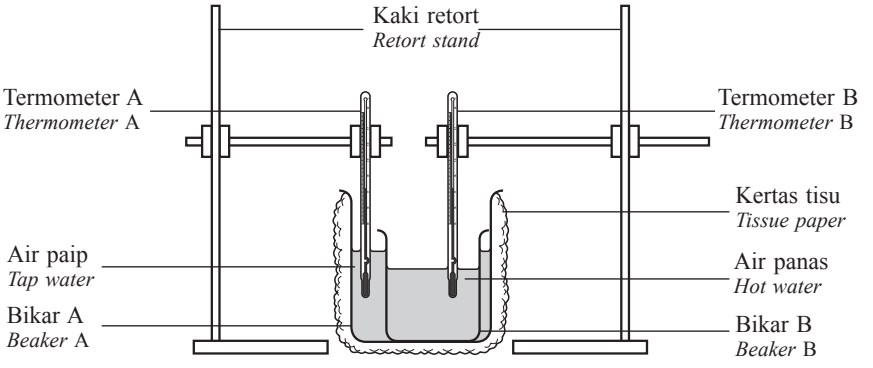
(b) **Haba pendam tentu pengewapan**
Specific latent heat of vaporisation, l_v
Kuantiti haba yang dibebaskan semasa pembekuan bagi 1 kg bahan tanpa perubahan suhu.
The amount of heat, Q released during freezing phase for 1 kg *substance without a change in temperature.*

Hukum Gas/ *Gas Laws*

Hukum Boyle *Boyle's law*	Hukum Charles *Charles' law*	Hukum Gay-Lussac *Gay-Lussac's law*
Bagi suatu gas yang jisimnya tetap, tekanan gas, *P* itu adalah berkadar songsang dengan isi padu, *V* apabila suhu gas, *T* kekal malar. *For a fixed mass of gas, the pressure of the gas, P is inversely proportional to its volume, V when the temperature, T is kept constant.*	Bagi suatu gas yang berjisim tetap, isi padu gas, *V* berkadar terus dengan suhu mutlak, *T* apabila tekanan gas, *P* kekal malar. *For a fixed mass of gas, the volume of the gas, V is directly proportional to its absolute temperature, T when its pressure, P is kept constant.*	Bagi suatu gas yang berjisim tetap, tekanan gas, *P* berkadar terus dengan suhu mutlak, *T* apabila isi padu, *V* gas kekal malar. *For a fixed mass of gas, the pressure of the gas, P is directly proportional to its absolute temperature, T when its volume, V is kept constant.*
$P \propto \frac{1}{V}$ PV = pemalar *constant* $P_1V_1 = P_2V_2$	$V \propto T$ $\frac{V}{T}$ = pemalar *constant* $\frac{V_1}{T_1} = \frac{V_2}{T_2}$	$P \propto T$ $\frac{P}{T}$ = pemalar *constant* $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

4.1 KESEIMBANGAN TERMA

1 Rajah menunjukkan susunan radas bagi membuktikan keseimbangan terma berlaku di antara dua jasad yang bersentuhan secara terma.
The diagram shows the apparatus arrangement to prove the thermal equilibrium took place between two bodies that are thermally in contact.



Selepas 10 minit, bacaan kedua-dua termometer A dan B adalah sama.
After 10 *minutes, the reading of both thermometers* A *and* B *is the same.*

(a) Huraikan perubahan suhu air paip dan air panas.
Explain the change in temperature for tap water and hot water.

(b) Bagaimanakah pemindahan haba berlaku dalam rajah di atas?
How does the heat transfer happened in the diagram above?

(c) Apakah yang berlaku kepada kadar pemindahan haba selepas 10 minit?
What happen to the rate of heat transfer after 10 *minutes?*

(d) Nyatakan nama bagi keadaan di **1**(c).
State the name for the state in **1**(c).

2 Apakah maksud keseimbangan terma?
What is the meaning of thermal equilibrium?

3 Jelaskan keseimbangan terma yang berlaku dalam kehidupan harian berikut.
Explain the thermal equilibrium took place in the following daily life.

Tuala basah diletakkan di atas dahi seseorang yang mengalami demam panas.
A wet towel is placed on the forehead of a person who has high fever.

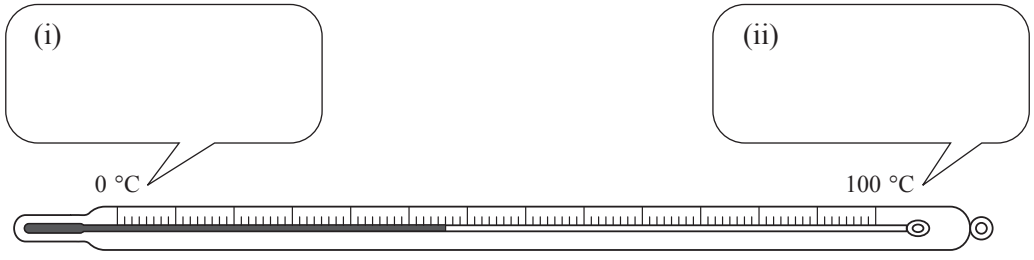
_____

_____

_____

4 Menentu ukur sebuah termometer cecair dalam kaca menggunakan dua takat tetap.
Calibrate a liquid in glass thermometer using two fixed points.

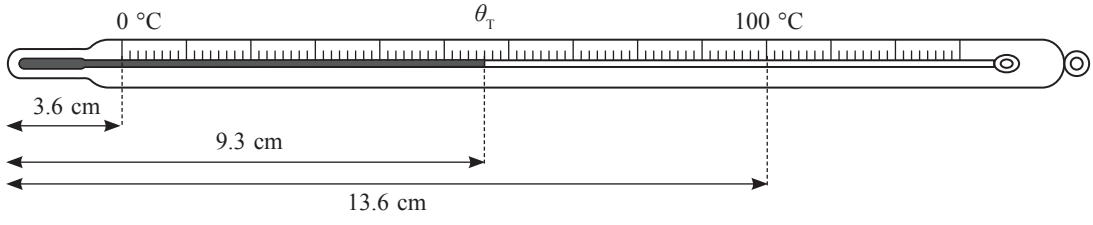
(a) Pada skala Celsius, dua takat tetap suhu dipilih iaitu:
At the scale of degree Celsius, two fixed temperature are chosen which are:



(b) Penentu ukuran adalah _____

Calibration is _____

5 Rajah menunjukkan bacaan sebuah termometer.
The diagram shows a thermometer reading.



Berapakah nilai suhu θ_T?
What is the value of temperature θ_T?

4.2 MUATAN HABA TENTU

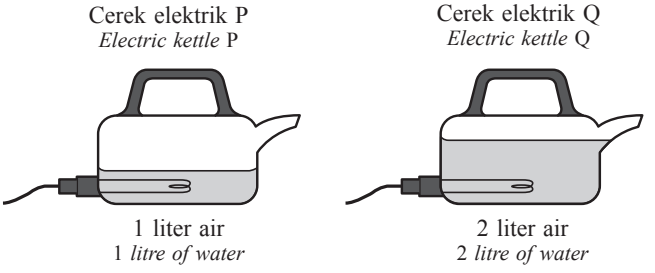
1 Muatan haba, *C* bagi satu objek ialah _____

Heat capacity, C of an object is _____

Q = Kuantiti haba/ *Heat quantity*
$\Delta\theta$ = Perubahan suhu/ *Change in temperature*

Unit bagi muatan haba adalah J $°C^{-1}$.
Unit for heat capacity is J $°C^{-1}$.

2 Rajah menunjukkan dua cerek, P dan Q diisi dengan kuantiti air yang berbeza. Kedua-dua cerek itu dihidupkan untuk panaskan air sehingga mendidih.
The diagram shows two kettles, P *and* Q *filled with difference quantity of water. Both kettles are switched on to heat up water until boiling.*



(a) Cerek manakah memerlukan masa yang lama untuk mendidih?
Which kettle needs a longer time to boil?

_____

(b) Cerek manakah mempunyai muatan haba yang lebih tinggi?
Which kettles has higher heat capacity?

_____

(c) Hubung kait antara jisim bahan dengan muatan haba bahan.
Relate between the mass of substance and the heat capacity of substance.

_____

_____

(d) Apakah faktor yang mempengaruhi muatan haba bahan selain jisim?
What is the factor influences the heat capacity of substance other than mass?

_____

3 Jelaskan bagaimana muatan haba diaplikasikan dalam aktiviti harian.
Explain how the heat capacity applied in daily activities.

(a) Pemegang logam pada kereta lebih cepat panas berbanding kusyen fabrik kereta.
The metal parts of a car get hot faster compared to the fabric cushion of the car.

(b) Di pantai, kanak-kanak lebih suka berjalan di kawasan air laut berbanding di atas pasir semasa cuaca panas terik. Mengapa?
At beach, children prefer to walk on the sea water region compared to the sand during hot day. Why?

4 Muatan haba tentu, *c* ialah _____

Specific heat capacity, c is _____

Q = Kuantiti haba/ *Heat quantity*
m = Jisim/ *Mass*
$\Delta\theta$ = Perubahan suhu/ *Change in temperature*

Unit bagi muatan haba tentu adalah J kg^{-1} $°C^{-1}$ atau J kg^{-1} K^{-1}.
Unit for specific heat capacity is J kg^{-1} $°C^{-1}$ or J kg^{-1} K^{-1}.

5 Satu logam berjisim 2 kg. Hitung kuantiti haba yang dipindahkan ke logam untuk menaikkan suhu daripada 30 °C kepada 70 °C.
A metal has mass of 2 kg. *Calculate the amount of heat that must be transferred to the metal to raise the temperature from* 30 °C *to* 70 °C.
[Muatan haba tentu logam = 500 J kg^{-1} $°C^{-1}$]
[*Specific heat capacity of the metal* = 500 J kg^{-1} $°C^{-1}$]

VIDEO ULASAN JAWAPAN

6 Berapakah kuantiti haba yang diperlukan untuk menaikkan suhu 100 g emas daripada 20 °C kepada 100 °C?
What is the heat quantity that are required to raise the temperature of 100 g *of gold from* 20 °C *to* 100 °C*?*
[Muatan haba tentu emas = 129 J kg^{-1} $°C^{-1}$]
[*Specific heat capacity of gold* = 129 J kg^{-1} $°C^{-1}$]

7 Aplikasi Muatan Haba Tentu
Applications of Specific Heat Capacity

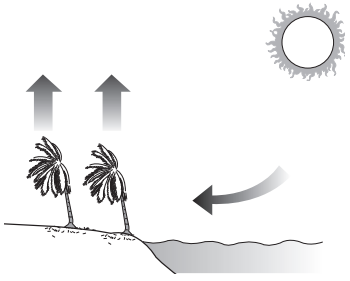
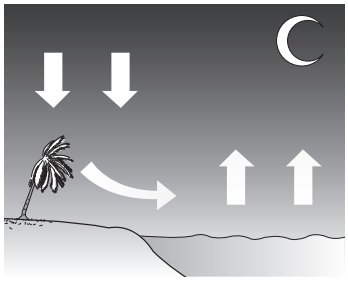
(a) Periuk memasak
Cooking pot

Bahagian periuk ***Part of the pot***	**Bahan** ***Material***	**Muatan haba tentu** ***Specific heat capacity***	**Alasan** ***Reason***
(i) Tapak *Base*			
(ii) Badan *Body*			
(iii) Pemegang *Handle*			

(b) Air digunakan sebagai agen penyejuk dalam sistem radiator kereta kerana:
Water used as cooling agent in car radiator system because of:

Ciri-ciri ***Characteristics***	**Alasan** ***Reason***
(i) Takat didih tinggi *High boiling point*	
(ii) Muatan haba tentu tinggi *High specific heat capacity*	
(iii) Mudah didapati *Available*	

(c) Perbandingan antara bayu laut dan bayu darat.
Comparison between sea breeze and land breeze.

Bayu laut ***Sea breeze***	**Bayu darat** ***Land breeze***
	
Berlaku pada waktu siang. *Occurs during daytime.*	Berlaku pada waktu malam. *Occurs at night.*
Muatan haba tentu laut _____. *Sea has _____ specific of heat capacity.*	Muatan haba tentu laut _____. *Sea has _____ specific of heat capacity.*
Muatan haba tentu daratan _____. *Land has _____ specific of heat capacity.*	Muatan haba tentu daratan _____. *Land has _____ specific of heat capacity.*
Daratan lebih _____ daripada laut. *Land is _____ than sea.*	Laut lebih _____ daripada daratan. *Sea is _____ than land.*
Udara panas di _____ naik ke atas. *Hot air on _____ rises up.*	Udara panas di _____ naik ke atas. *Hot air above the _____ rises up.*
Udara _____ dari laut bergerak ke daratan. _____ *air moves towards the land.*	Udara _____ dari daratan bergerak ke laut. _____ *air moves towards the sea.*

8 Sebuah cerek elektrik mempunyai kuasa 1 000 W. Hitung
An electric kettle is rated 1 000 W. *Calculate*

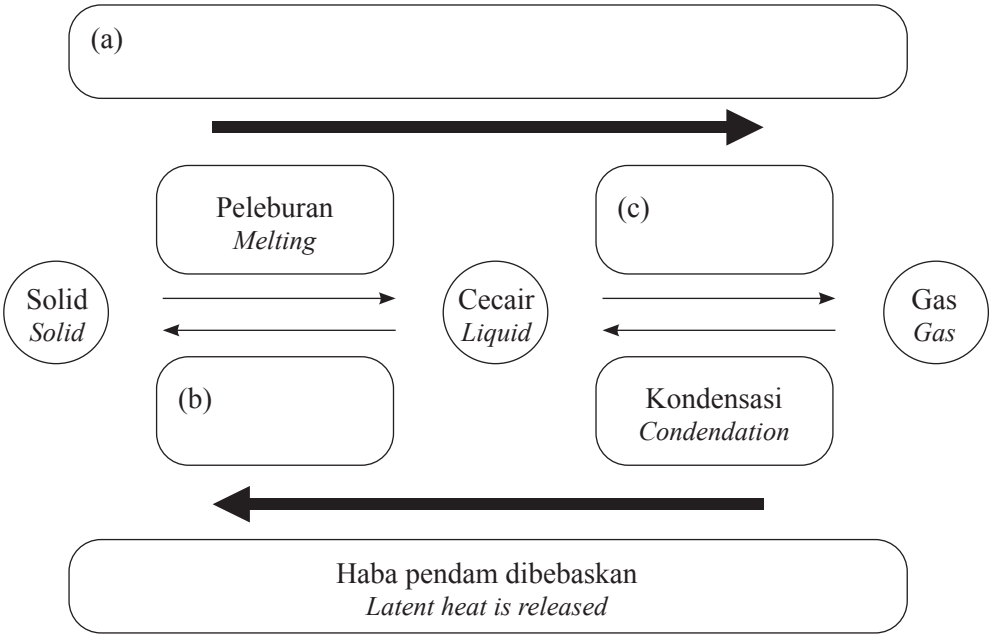
(a) kuantiti haba yang dijanakan dalam masa 5 minit.
the quantity of heat generated in 5 minutes.

(b) kenaikan suhu bagi 750 g air jika cerek elektrik itu dihidupkan selama 5 minit.
the rise in temperature of 750 g of water if the electric kettle is switched on for 5 minutes.
[Muatan haba tentu air = 4 200 J kg^{-1} $°C^{-1}$]
[*Specific heat capacity of water is* 4 200 J kg^{-1} $°C^{-1}$]

4.3 HABA PENDAM TENTU

1 Apakah haba pendam?
What is latent heat?

2 Lengkapkan proses perubahan fasa jirim dalam rajah di bawah.
Complete the process of phase change in the diagram below.



3 Haba pendam tentu, l ialah _____

_____.

Specific latent heat, l is _____.

Q = Kuantiti haba/ *Heat quantity*
m = Jisim objek/ *Mass of object*

Unit bagi haba pendam tentu adalah J kg^{-1}.
Unit for specific latent heat is J kg^{-1}.

4 Haba pendam tentu pelakuran, l_f ialah _____

_____.

Specific latent heat of fusion, l_f *is* _____

_____.

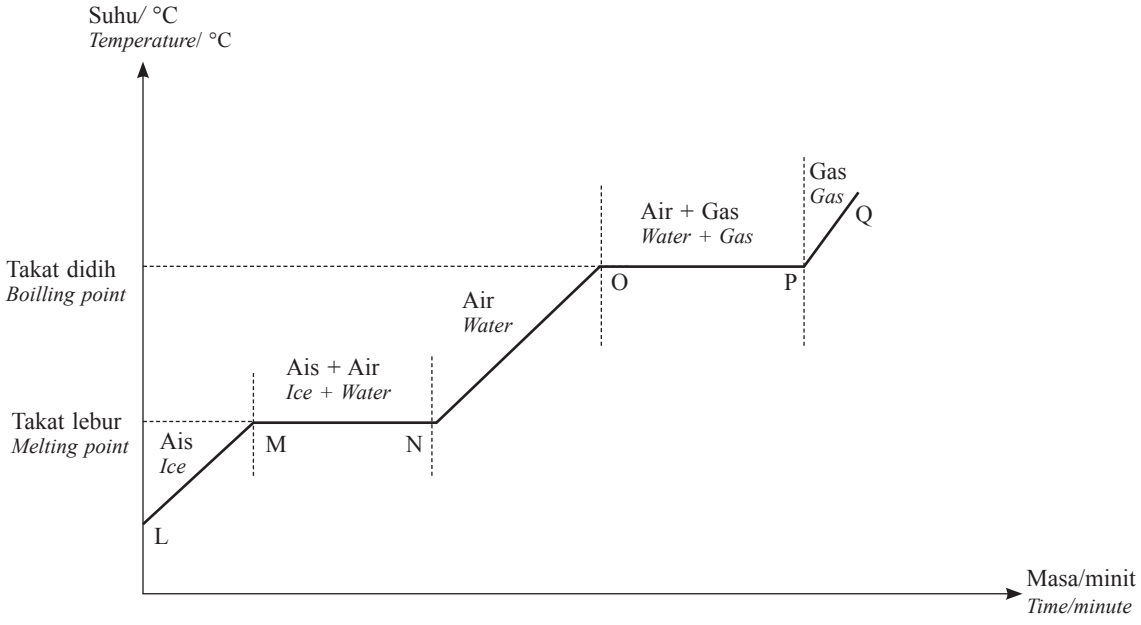
5 Haba pendam tentu pengewapan, l_v ialah _____

_____.

Specific latent heat of vaporisation, l_v *is* _____

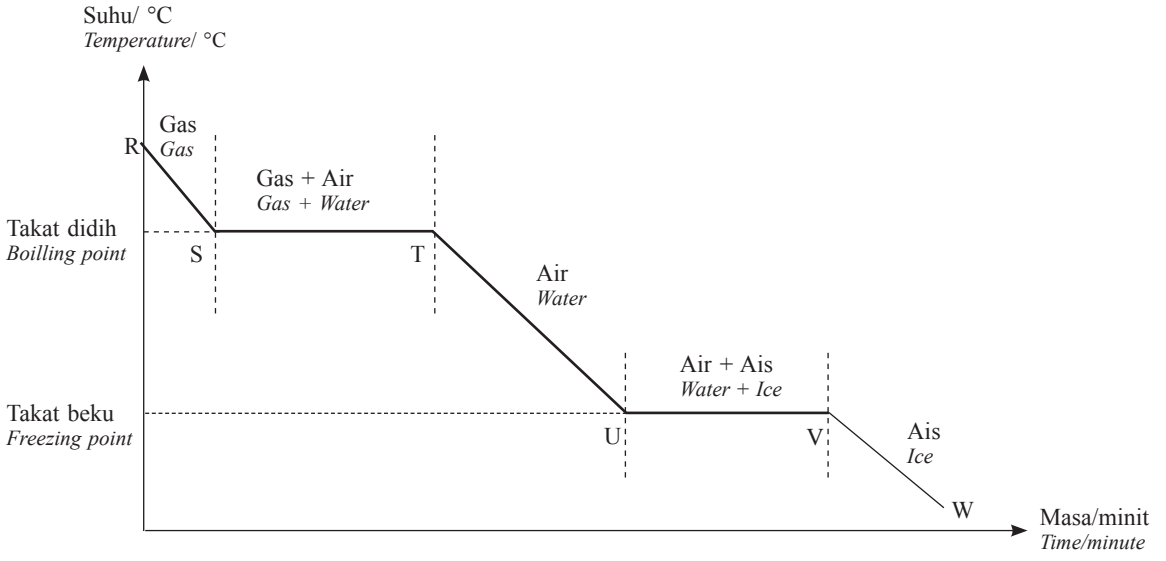
_____.

6 Lengkung pemanasan.
Heating curve.



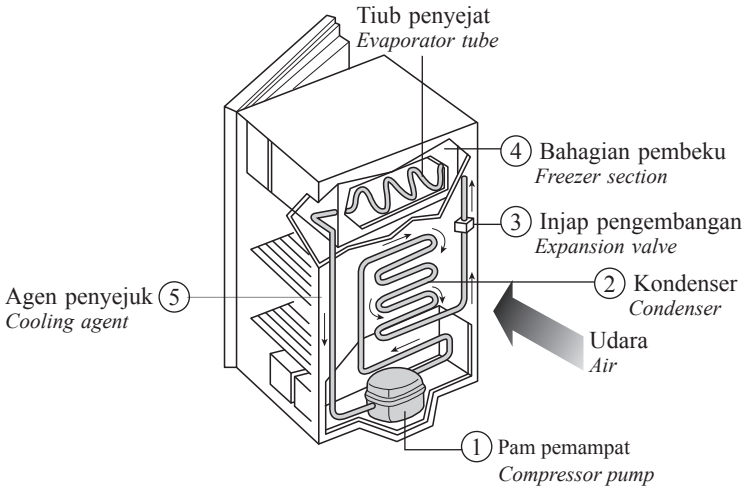
Fasa ***Phase***	**Haba** ***Heat***	**Suhu** ***Temperature***	**Tenaga kinetik molekul** ***Kinetic energy of molecule***	**Keadaan** ***State***
LM	Diserap *Absorbed*	Bertambah *Increases*	Bertambah *Increases*	Pepejal *Solid*
MN				
NO				
OP				
PQ				

7 Lengkung penyejukan.
Cooling curve.



Fasa ***Phase***	**Haba** ***Heat***	**Suhu** ***Temperature***	**Tenaga kinetik molekul** ***Kinetic energy of molecule***	**Keadaan** ***State***
RS	Dibebaskan *Released*	Berkurang *Decreases*	Berkurang *Decreases*	Gas *Gas*
ST				
TU				
UV				
VW				

8 Sistem penyejukan dalam peti sejuk.
Cooling system of refrigerator.



Proses/ ***Process***	**Penerangan/** ***Explanation***
1 Pemampat *Compressor*	(a)
2 Kondenser *Condenser*	(b)
3 Injap pengembangan *Expansion valve*	(c)
4 Bahagian pembeku *Freezer section*	(d)
5 Agen penyejuk *Cooling agent*	(e)

9 Menyelesaikan masalah melibatkan haba pendam tentu.
Solving problem involving specific latent heat.

(a) Sebuah pemanas elektrik 500 W digunakan untuk mendidihkan air. Berapakah masa yang diperlukan untuk mengurangkan jisim air sebanyak 70 g selepas air mencapai takat didihnya.
A 500 W *electric heater is used to boil water. What is the time required to reduce the mass of water by* 70 g *after the water has reached its boiling point?*
[Haba pendam tentu pengewapan air = 2.26×10^6 J kg^{-1}]
[*Specific latent heat of vaporisation of water* = 2.26×10^6 J kg^{-1}]

(b) 0.5 kg air pada suhu 30°C dipanaskan sehingga semuanya bertukar ke stim. Berapakah haba yang dibekalkan itu?
0.5 kg *of water of* 30°C *is heated until all it is converted to steam. What is the amount of heat energy supplied to it?*
[Muatan haba tentu air = 4 200 J kg^{-1} °C^{-1}, haba pendam tentu pengewapan air = 2.26×10^6 J kg^{-1}]
[*Specific heat capacity of water* = 4 200 J kg^{-1} °C^{-1}, *specific latent heat of vaporisation* = 2.26×10^6 J kg^{-1}]

4.4 HUKUM GAS

INFO

Udara di dalam tayar kereta boleh menyokong berat kereta manakala gas nitrogen di dalam beg udara menahan pemandu daripada bergerak ke hadapan semasa perlanggaran. Udara di dalam tayar dan beg udara mengenakan tekanan. Udara yang berada di dalam suatu ruang tertutup mempunyai isi padu dan suhu tetap.
The air in the tyre of a car is able to support the weight of the car while the nitrogen gas in the air bag stops the driver from moving forward during a crash. The air inside the tyre and air bag exerts a pressure. When the air is in a closed space, it has a certain volume and temperature.

1 Tekanan, suhu dan isi padu gas.
Pressure, temperature and volume of gas.

Kuantiti fizik *Physical quantitiy*	**Unit S.I** *S.I unit*	**Simbol unit S.I** *Symbol of S.I unit*	**Unit-unit lain** *Others unit*
(a) Tekanan, *P* *Pressure*			
(b) Isi padu, *V* *Volume*			
(c) Suhu, *T* *Temperature*			

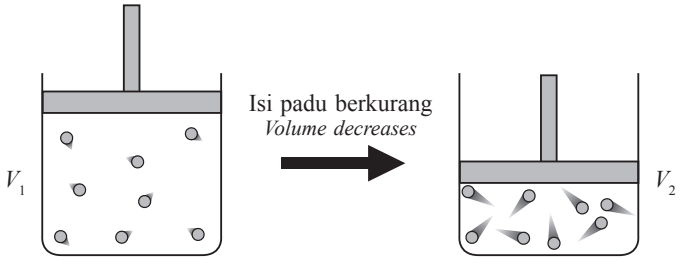
2 Hubungan antara tekanan dengan isi padu bagi suatu gas.
Relationship between pressure and volume of a gas.

(a) Hukum Boyle menyatakan bahawa _____

_____.

Boyle's law states that _____

_____.



(b) Ungkapan matematik bagi hukum Boyle:
The mathematical expression for Boyle's law:

(c) Sebuah belon kaji cuaca diisi dengan gas helium sehingga isi padu 30 liter dan tekanan 1.0 atm. Belon itu kemudiannya dilepaskan. Semasa belon itu naik ke atas langit, isi padunya bertambah. Berapakah tekanan gas helium apabila isi padu belon itu bertambah sehingga 120 liter.
A weather balloon is filled with helium gas to a volume of 30 *litres of* 1.0 atm *pressure. The balloon is then release. As the balloon rises up to the sky, its volume increases.*
What is the pressure of the helium gas when the volume of the balloon increases to 120 *litres?*

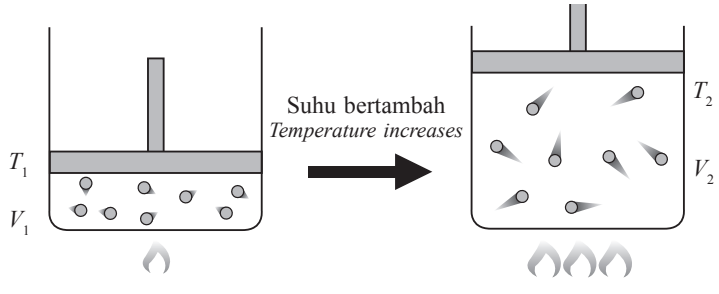
3 Hubungan antara isi padu dengan suhu bagi suatu gas.
Relationship between volume and temperature of a gas.

(a) Hukum Charles menyatakan bahawa _____

_____.

Charles' law states that _____

_____.



(b) Ungkapan matematik bagi hukum Charles:
The mathematical expression for Charles' law:

(c) Satu silinder mengandungi 200 cm^3 gas pada suhu 27 °C. Gas itu dipanaskan sehingga suhunya meningkat sebanyak 30 °C.
Jika omboh silinder mengembang di bawah tekanan yang malar, berapakah isi padu akhir gas?
A cylinder contains 200 cm^3 *of gas at a temperature of* 27 °C. *The gas is heated until its temperature increases by* 30 °C.
If the piston of the cylinder expands under constant pressure, what is the final volume of the gas?

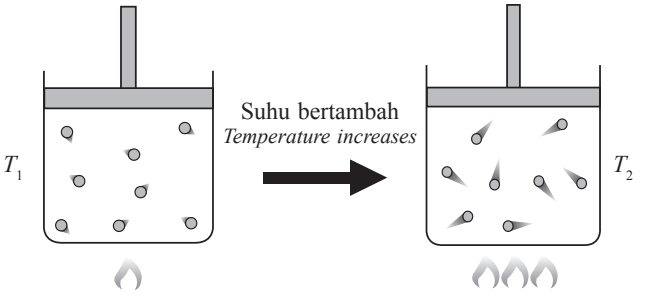
4 Hubungan antara tekanan dengan suhu bagi suatu gas.
Relationship between pressure and temperature of gas.

(a) Hukum Gay-Lussac menyatakan bahawa _____

_____.

Gay Lussac's law states that _____

_____.



(b) Ungkapan matematik bagi hukum Gay-Lussac:
The mathematical expression for Gay-Lussac's law:

(c) Satu tayar motosikal didapati mempunyai tekanan 3.2 atm apabia ia diuji dalam garaj pada suhu 27 °C. Dengan andaian isi padu udara dalam tayar adalah malar, berapakah suhu sekeliling jika tayar itu mempunyai tekanan 2.8 atm?
A motorcycle tyre has a pressure of 3.2 atm *when it was tested in a garage at a temperature of* 27 °C. *By assuming that the volume of the air in the tyre is fixed, what is the surrounding temperature if the tyre has a pressure of* 2.8 atm*?*

Kertas 1

1 Apakah konsep yang digunakan dalam pengukuran suhu badan manusia menggunakan termometer?
What is the concept used in the measurement of human body temperature using a thermometer?

A Muatan haba tentu
Specific heat capacity

B Haba pendam tentu
Specific latent heat

C Keseimbangan terma
Thermal equilibrium

D Perolakan haba
Heat convection

2 Panjang turus merkuri di dalam termometer pada takat ais dan takat stim adalah 5 cm dan 25 cm. Apabila termometer diletakkan di dalam suatu cecair, panjang turus merkuri ialah 12 cm. Berapakah suhu cecair itu?
The lengths of the mercury column in a thermometer at the ice point and the steam point are 5 cm *and* 25 cm *respectively. When the thermometer is placed in a liquid, the length of the mercury column is* 12 cm.
What is the temperature of the liquid?

A 30 °C
B 35 °C
C 55 °C
D 70 °C

3 Muatan haba tentu bagi aluminium ialah 900 J kg^{-1} $°C^{-1}$.
Pernyataan manakah yang menerangkan tentang muatan haba tentu bagi aluminium dengan betul?
The specific heat capacity of aluminium is 900 J kg^{-1} $°C^{-1}$.
Which statement explains the specific heat capacity of aluminium correctly?

A 1 kg aluminium menyerap 900 J tenaga haba semasa pemanasan.
1 kg *of aluminium absorbs* 900 J *of heat energy during heating.*

B Suhu 1 kg aluminium akan meningkat 1 °C apabila ia menyerap 900 J tenaga haba.
The temperature of 1 kg *of aluminium will rise by* 1 °C *when it absorbs* 900 J *of heat energy.*

C Suhu 1 kg aluminium akan menurun 1 °C apabila ia menyerap 900 J tenaga haba.
The temperature of 1 kg *of aluminium will drop by* 1 °C *when it absorbs* 900 J *of heat energy.*

D Aluminium memerlukan 900 J tenaga haba untuk menaikkan suhunya sebanyak 1 °C.
Aluminium requires 900 J *of heat energy to increase its temperature by* 1 °C.

4 P, Q, R dan S adalah empat pepejal berlainan dengan jisim yang sama. Jadual 1 menunjukkan muatan haba tentu dan takat lebur bagi setiap pepejal.
P, Q, R *and* S *are four different solids with the same mass. Table* 1 *shows the specific heat capacity and the melting point of each solid.*

Pepejal ***Solid***	**Muatan haba tentu** ***Specific heat capacity***	**Takat lebur** ***Melting point***
P	800 J kg^{-1} $°C^{-1}$	200 °C
Q	600 J kg^{-1} $°C^{-1}$	230 °C
R	700 J kg^{-1} $°C^{-1}$	400 °C
S	400 J kg^{-1} $°C^{-1}$	300 °C

Jadual 1/ *Table* 1

Jika haba dibekalkan dengan kadar yang sama, pepejal yang manakah akan lebur dahulu?
If heat is supplied at the same rate which solid will be the first to melt?

A P
B Q
C R
D S

5 Haba pendam tentu pelakuran ialah haba yang diperlukan untuk
The specific latent heat of fusion is the heat required to

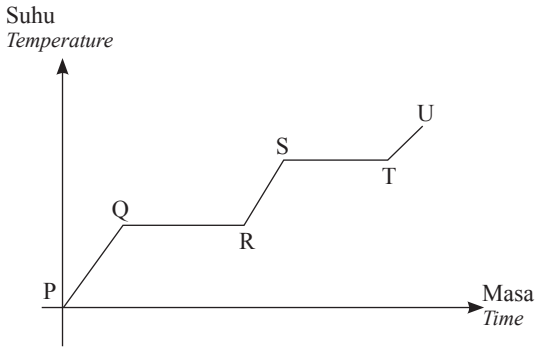
A mengubah 1 kg ais kepada air pada 0 °C.
change 1 kg *of ice into water at* 0 °C.

B mengubah 1 kg air kepada stim pada 100 °C.
change 1 kg *of water steam at* 100 °C.

C mengubah suhu 1 kg ais sebanyak 1 °C.
change the temperature of 1 kg *of ice by* 1 °C.

D mengubah suhu 1 kg air sebanyak 1 °C.
change the temperature of 1 kg *of water by* 1 °C.

6 Rajah 1 menunjukkan graf suhu melawan masa bagi satu bahan Y yang dipanaskan.
Diagram 1 *shows a graph of temperature against time for a substance* Y *which is heated.*



Rajah 1/ *Diagram* 1

Apakah yang berlaku di QR?
What is happening at QR*?*

A Bahan Y sedang dipanaskan
Substance Y *is being heated up*

B Bahan Y mendidih pada takat didihnya
Substance Y *is boiling at its boiling point*

C Bahan Y sedang cair pada takat leburnya
Substance Y *is melting at its melting point*

D Bahan Y mengalami perubahan kimia
Substance Y *undergoes chemical changes*

7 Berapa banyak haba yang perlu dibekalkan untuk mengubah 500 g blok ais pada 0 °C kepada air pada 0 °C?
How much heat is needed to be supplied to change 500 g *of ice block at* 0 °C *to water at* 0 °C*?*
[Haba pendam tentu pelakuran ais $= 3.36 \times 10^5$ J kg^{-1}]
[*Specific latent heat of fusion of ice* $= 3.36 \times 10^5$ J kg^{-1}]

A 6.72×10^2 J
B 1.68×10^5 J
C 6.72×10^5 J
D 1.68×10^8 J

8 Suatu gas berjisim tetap di dalam sebuah bekas berisi padu tetap dipanaskan.
Pernyataan manakah yang betul?
A fixed mass of gas in a container of fixed volume is heated.
Which statement is correct?

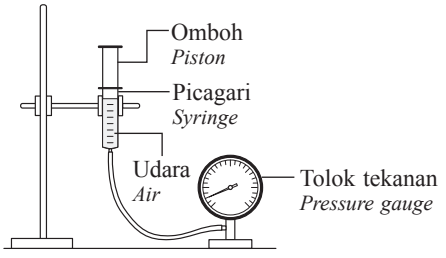
A Tekanan gas adalah malar.
The pressure of the gas is constant.

B Molekul gas bergerak lebih jauh antara satu sama lain.
The gas molecules move further apart.

C Tenaga kinetik molekul gas adalah malar.
The kinetic energy of the gas molecules is constant.

D Molekul gas bergerak dengan halaju yang lebih tinggi.
The gas molecules move with higher velocity.

9 Rajah 2 menunjukkan satu picagari disambungkan kepada tolok tekanan.
Diagram 2 *shows a syringe connected to pressure gauge.*



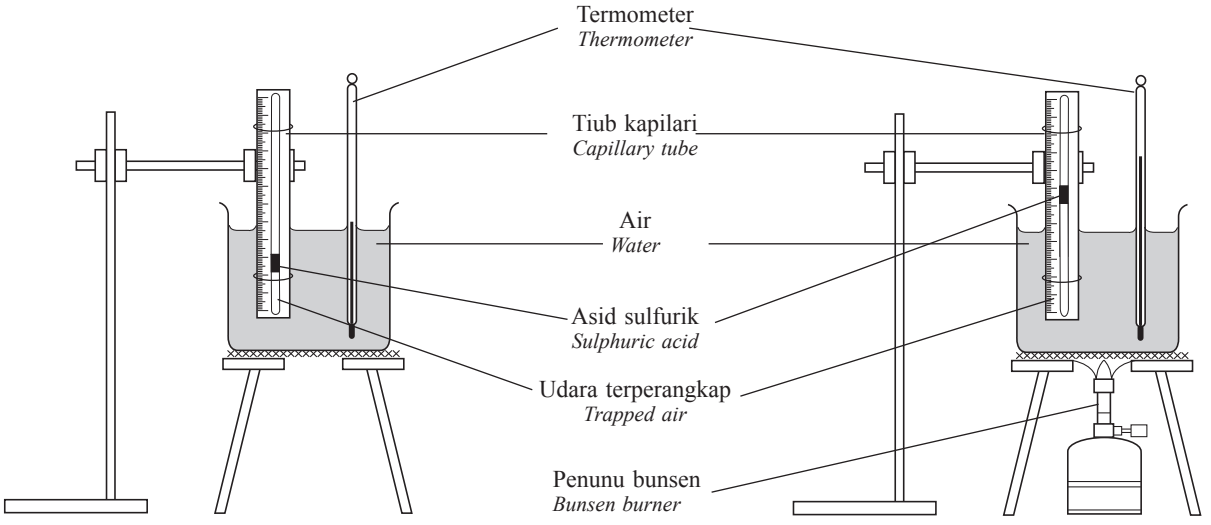
Rajah 2/ *Diagram* 2

Bacaan pada tolok tekanan ialah 1.0×10^5 Pa apabila isi padu udara di dalam picagari ialah 40 cm^3.
Berapakah bacaan baharu apabila isi padu udara ialah 10 cm^3?
The reading on the Pressure gauge is 1.0×10^5 Pa *when the volume of air in the syringe is* 40 cm^3.
What is the new reading on the pressure gauge when the volume of air is 10 cm^3*?*

A 4.0×10^5 Pa
B 2.5×10^5 Pa
C 1.0×10^{-5} Pa
D 4.0×10^{-5} Pa

Kertas 2
Bahagian A

1 Rajah 1.1 dan Rajah 1.2 menunjukkan satu eksperimen dijalankan untuk menyiasat satu hukum gas. Satu turus udara diperangkap dalam tiub kapilari dan dipanaskan untuk beberapa ketika.
Diagram 1.1 *and Diagram* 1.2 *show an experiment is carried out to investigate a law of gas. A column of air is trapped in the capillary tube and is heated for a period of time.*



Rajah 1.1/ *Diagram* 1.1

Rajah 1.2/ *Diagram* 1.2

(a) Apakah maksud haba?
What is the meaning of heat?

_____

_____

[1 markah/ *mark*]

(b) (i) Bandingkan panjang turus udara terperangkap di dalam tiub kapilari dalam Rajah 1.1 dan Rajah 1.2.
Compare the length of the air trapped in the capillary tube in Diagram 1.1 *and Diagram* 1.2.

_____

_____

[1 markah/ *mark*]

(ii) Bandingkan suhu udara terperangkap di dalam tiub kapilari dalam Rajah 1.1 dan Rajah 1.2.
Compare the temperature of air trapped in the capillary tube in Diagram 1.1 *and Diagram* 1.2.

_____

_____

[1 markah/ *mark*]

(iii) Namakan kuantiti fizik yang diwakili oleh panjang turus udara terperangkap.
Name physical quantity represented by the length of trapped air.

_____

[1 markah/ *mark*]

(iv) Apakah hubungan antara kuantiti fizik di **1**(b)(iii) dengan suhu?
What is the relationship between the physical quantity in **1**(b)(iii) *with temperature?*

_____

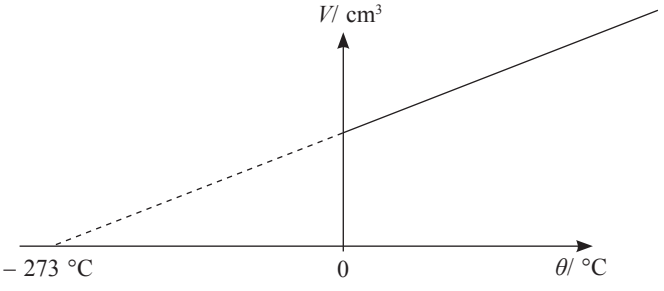
[1 markah/ *mark*]

(c) Namakan hukum fizik yang terlibat di **1**(b)(iv).
Name a physics law involved in **1**(b)(iv).

_____

[1 markah/ *mark*]

(d) Rajah 1.3 menunjukkan graf yang didapati daripada eksperimen. Suhu, θ ialah –273 °C apabila diekstrapolasi dan memotong paksi *x*.
Diagram 1.3 *shows a graph obtained from the experiment. The temperature,* θ *is* –273 °C *when it is extrapolated and intersect x-axis.*



Rajah 1.3/ *Diagram* 1.3

(i) Apakah nama yang diberikan kepada suhu $\theta = -273$ °C?
What is the name given to the temperature $\theta = -273$ °C?

_____

[1 markah/ *mark*]

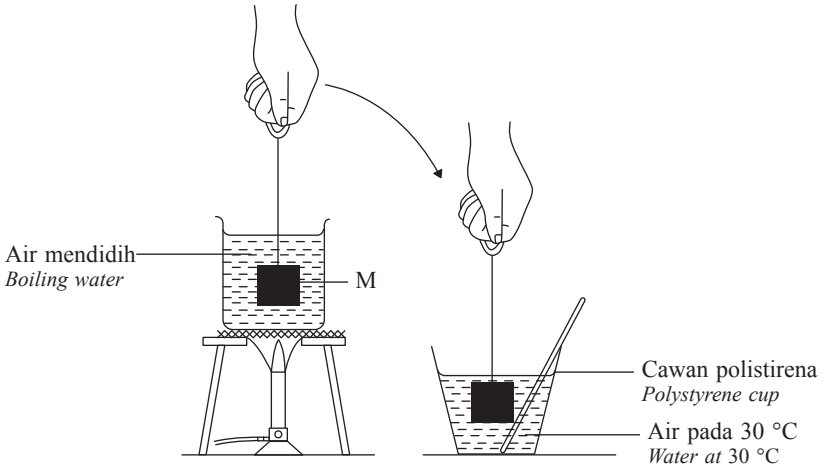
(ii) Nyatakan satu ciri gas pada suhu $\theta = -273$ °C.
State a characteristic of gas at temperature $\theta = -273$ °C.

_____

[1 markah/ *mark*]

Bahagian B

2 Rajah 2.1 menunjukkan satu bongkah logam, M berjisim 500 g dipanaskan dengan cepat ke dalam air yang mendidih bersuhu 100 °C dalam jangka masa yang lama. Bongkah logam M kemudiannya dipindahkan dengan cepat ke dalam cawan polistirena yang berisi 200 g air bersuhu 30 °C. Air itu dikacau sehingga keseimbangan terma tercapai.
Diagram 2.1 *shows a metal block,* M*, of mass* 500 g *heated in boiling water of temperature* 100 °C *for a long time. The metal block* M *is then quickly transferred into* 200 g *of water at* 30 °C *in a polystyrene cup. The water is stirred until thermal equilibrium is achieved.*



Rajah 2.1/ *Diagram* 2.1

(a) (i) Apakah maksud keseimbangan terma?
What is the meaning of thermal equilibrium?

[1 markah/ *mark*]

(ii) Terangkan dalam konteks keseimbangan terma, bagaimana termometer yang diletakkan ke dalam air mendidih memberikan bacaan suhu 100 °C.
Explain, in terms of thermal equilibrium, how a thermometer which is placed into the boiling water reads at the temperature of 100 °C.

[4 markah/ *marks*]

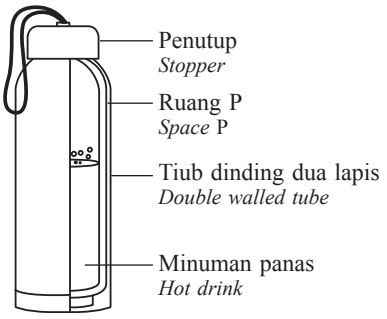
(b) (i) Hitung suhu akhir air di dalam cawan polistirena itu.
Calculate the final temperature of the water in the polystyrene cup.
[Muatan haba tentu M = 800 J kg^{-1} $°C^{-1}$, muatan haba tentu air = 4 200 J kg^{-1} $°C^{-1}$]
[*Specific heat capacity of* M = 800 J kg^{-1} $°C^{-1}$, *specific heat capacity of water* = 4 200 J kg^{-1} $°C^{-1}$]

[4 markah/ *marks*]

(ii) Nyatakan **satu** andaian yang anda buat di **2**(b)(i).
State **one** *assumption that you have made in* **2**(b)(i).

[1 markah/ *mark*]

(c) Rajah 2.2 menunjukkan sebuah kelalang termos digunakan unuk mengekalkan suhu minuman panas untuk jangka masa yang lama.
Diagram 2.2 *shows a thermos flask used to maintain the temperature of a hot drink for a long time.*



Rajah 2.2/ *Diagram* 2.2

Jadual 1 menunjukkan ciri-ciri bagi empat kelalang termos yang berlainan.
Table 1 *shows characteristics for four different thermos flasks.*

Kelalang termos ***Thermos flask***	**Penutup** ***Stopper***	**Ruang P** ***Space* P**	**Tiub dinding dua lapis** ***Double walled tube***	
			Diperbuat daripada ***Made of***	**Disalut oleh** ***Coated by***
W	Plastik berongga *Hollow plastic*	Vakum *Vacuum*	Kaca *Glass*	Cat berkilat *Shiny paint*
X	Plastik berongga *Hollow plastic*	Vakum *Vacuum*	Kuprum *Copper*	Cat hitam *Black paint*
Y	Plastik pepejal *Solid plastic*	Udara *Air*	Kaca *Glass*	Cat hitam *Black paint*
Z	Plastik pepejal *Solid plastic*	Udara *Air*	Kuprum *Copper*	Cat berkilat *Shiny paint*
Maklumat tambahan/ ***Additional information*****:** Muatan haba tentu kaca/ *Specific heat capacity of glass* = 840 J kg^{-1} $°C^{-1}$ Muatan haba tentu kuprum/ *Specific heat capacity of copper* = 387 J kg^{-1} $°C^{-1}$				

Jadual 1/ *Table* 1

Terangkan kesesuaian setiap ciri kelalang termos dan tentukan kelalang termos yang paling sesuai untuk digunakan bagi tujuan mengekalkan suhu minumann panas. Beri sebab bagi pilihan anda.
Explain the suitability of each characteristic of the thermos flasks and determine the most suitable thermos flask to be used for the purpose of maintaining the temperature of the hot drink. Give reasons for your choice.
[10 markah/ *marks*]

BAB 5

Gelombang
Waves

NOTA EFEKTIF

1 Gelombang ialah satu proses memindahkan tenaga daripada satu tempat ke tempat lain yang dihasilkan oleh sistem bergetar atau berayun.
Waves is a process of transferring energy from one location to another which is produced by an oscillating or vibrating.

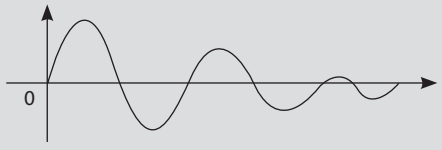
2 Jenis gelombang/ *Types of waves*:
(a) **Gelombang melintang/ *Transverse wave***
Zarah-zarah medium bergetar pada arah berserenjang dengan arah perambatan gelombang.
The particles in the medium vibrates in perpendicular to the direction of the wave.
(b) **Gelombang membujur/ *Longitudinal wave***
Zarah-zarah medium bergetar pada arah selari dengan arah perambatan gelombang.
The particles in the medium vibrates in parallel to the direction of propagation of the wave.

3 Ciri-ciri gelombang/ *Characteristics of waves*:
(a) **Amplitud/ *Amplitude (A)***
Sesaran maksimum sesuatu zarah dari kedudukan keseimbangan.
The maximum displacement of a particle from the equilibrium position.
(b) **Tempoh/ *Period (T)***
Masa yang diambil bagi satu ayunan lengkap.
The time taken for one complete oscillation.
(c) **Frekuensi/ *Frequency (f)***
Bilangan ayunan lengkap dalam masa satu saat.
The number of complete oscillation per second.
(d) **Panjang gelombang/ *Wavelength (λ)***
Jarak antara dua titik sefasa yang berturutan/ dua kawasan mampatan berturutan.
Distance between two consecutive points.
(e) **Laju gelombang/ *Speed of wave (v)***
Jarak yang dilalui sesaat oleh profil gelombang.
Distance travelled per second by a wave profile.

$$v = f\lambda$$

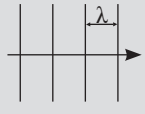
4 **Pelembapan/ *Damping***
Pengurangan amplitud bagi satu sistem ayunan akibat kehilangan tenaga.
The decrease in the amplitude of an oscillating system due to loss of energy.

Sesaran (cm)
Displacement



5 **Resonans/ *Resonance***
Resonans berlaku apabila satu sistem ayunan dikenakan daya luar yang mempunyai frekuensi yang sama dengan frekuensi aslinya. Semasa resonans, sistem berayun dengan frekuensi aslinya dan amplitud maksimum.
Resonance occur when a periodic force is applied to an oscillating system at its natural frequency. During resonance, the system oscillates with its natural frequency and it oscillates with maximum amplitude.

6 **Muka gelombang/ *Wavefront***
Garisan yang menyambungkan titik-titik sefasa dalam suatu gelombang.
Lines joining all the points of the same phase.



Gelombang satah
Plane wave

Gelombang membulat
Circular wave

7 **Pantulan gelombang/ *Reflection of wave***
(a) Gelombang berubah arah perambatan selepas dipantulkan.
Direction of propagation of wave change after reflection.
(b) Frekuensi, panjang gelombang, dan laju tidak berubah selepas pantulan.
Frequency, wavelength and speed remain unchanged after reflection.

8 **Pembiasan gelombang/ *Refraction of wave***
(a) Perubahan arah perambatan gelombang yang disebabkan perubahan halaju gelombang apabila merambat pada dua medium berbeza.
A change in direction propagation as the waves pass through two different mediums due to the speed of the wave change.

(b) Perubahan arah perambatan
Change of direction of propagation
- Kawasan dalam ke kawasan cetek: Dibias mendekati garis normal
Deep region to shallow region: Refracts towards normal line
- Kawasan cetek ke kawasan dalam: Dibias menjauhi garis normal
Shallow region to deep region: Refracts away from normal line

Kawasan ***Region***	**Air dalam** ***Deep water***	**Air cetek** ***Shallow water***
Laju ***Speed***	Laju *Faster*	Perlahan *Slower*
Panjang gelombang ***Wavelength***	Besar *Larger*	Kecil *Small*
Frekuensi ***Frequency***	Tiada perubahan *Unchanged*	Tiada perubahan *Unchanged*

9 Pembelauan gelombang/ *Diffraction of wave*

(a) Penyebaran gelombang apabila gelombang itu merambat melalui suatu celah atau tepi halangan.
The spreading of waves when the waves pass through a gap or round a barrier.

Ciri gelombang ***Characteristics of waves***	**Perubahan selepas belauan** ***Change after diffraction***
Frekuensi ***Frequency***	Tiada perubahan *Unchanged*
Laju ***Speed***	Tiada perubahan *Unchanged*
Panjang gelombang ***Wavelength***	Tiada perubahan *Unchanged*
Arah perambatan ***Direction of propagation***	Muka gelombang tersebar *Wavefront spreads*
Amplitud ***Amplitude***	Berkurang *Decreases*

(b) Faktor-faktor yang mempengaruhi kesan pembelauan.
Factors that influences diffraction of waves.
- Celah kecil: Pembelauan lebih jelas
Narrow slit: Diffraction is more obvious
- Panjang gelombang besar: Pembelauan jelas
Long wavelength: Diffraction more obvious

10 Prinsip superposisi/ *The principle of superposition*

Apabila dua gelombang bersuperposisi, sesaran paduan ialah hasil tambah secara individu bagi dua gelombang itu.
When two waves overlap, the resultant displacement is the sum of the individual of the two waves.

11 Interferens gelombang/ *Interference of waves*

Superposisi dua atau lebih gelombang daripada sumber koheren/ *The superposition of two or more waves from a coherent source of waves.*

12 Sumber koheren/ *Coherent source*

Apabila dua sumber gelombang yang mempunyai frekuensi yang sama dan beza adalah tetap.
When the frequency of both waves is the same and the phase difference is the fixed.

$$\lambda = \frac{ax}{D}$$

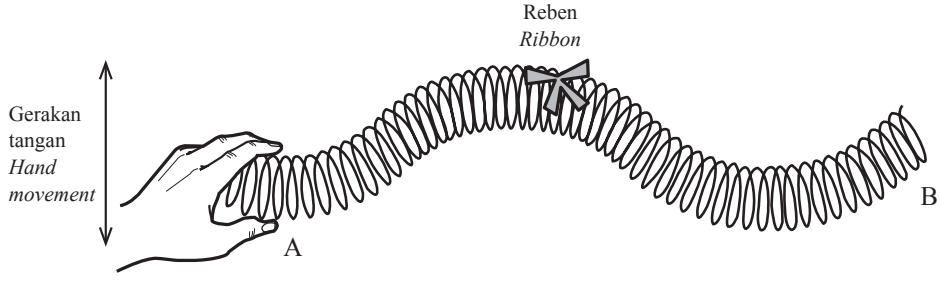
λ = Panjang gelombang/ *Wavelength*
a = Jarak di antara dua sumber koheren
Distance between two coherent sources
x = Jarak di antara dua garis antinod// nod berturutan
Distance between two consecutive antinodes/ nodes
D = Jarak tegak dari sumber koheren ke kedudukan x
The perpendicular distance from two coherent sources to position x

5.1 ASAS GELOMBANG

1 Apakah maksud gelombang?
What is the meaning of wave?

2 Gelombang memindahkan tenaga tanpa memindahkan jirim.
Wave transfer energy without transferring matter.

Rajah menunjukkan satu reben diikat pada spring slinki. Seorang murid menggerakkan hujung A spring slinki secara mengufuk dari sisi ke sisi.
Diagram shows a ribbon is tied to the slinky spring. A pupil moved the end A *of the spring slinky from side to side horizontally.*



Berdasarkan rajah:
Based on the diagram:

(a) Apakah yang dirasai oleh tangan murid di hujung B yang tetap setelah hujung A digerakkan dari sisi ke sisi?
What is felt by the pupil at end B *after the end* A *is moved from side to side?*

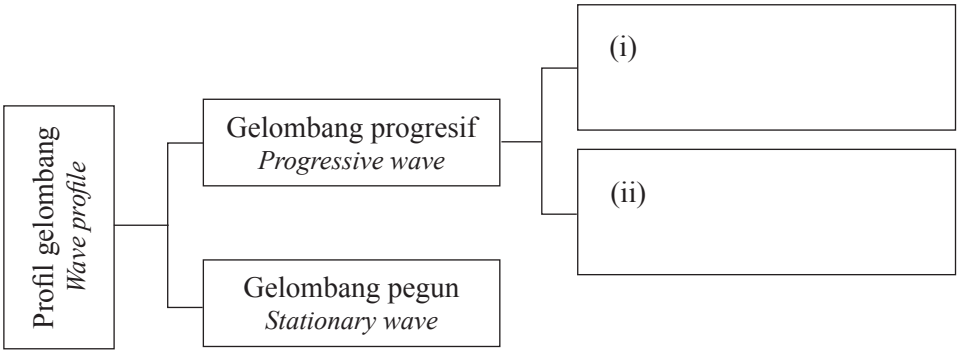
(b) Apakah arah pemindahan tenaga sepanjang spring slinki? Tandakan pada rajah.
What is the direction of energy transfer along the slinky spring? Mark on the diagram.

(c) Huraikan gerakan reben yang diikat pada spring slinki.
Describe the movement of the ribbon on the slinky spring.

3 Jenis-jenis gelombang
Types of waves

(a) Apakah profil gelombang?
What is wave profile?

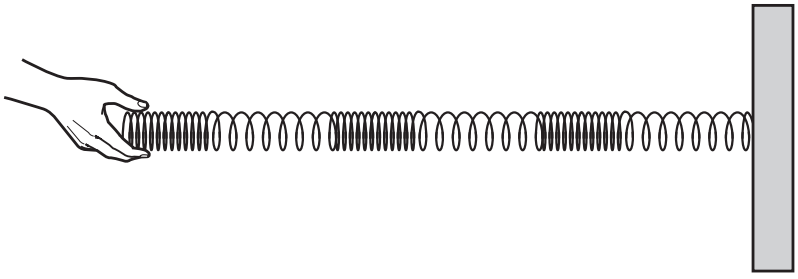
(b) Lengkapkan carta pengelasan gelombang di bawah.
Complete the chart of wave classification below.



(c) Perbandingan antara gelombang mekanikal dan gelombang elektromagnet.
Comparison between mechanical wave and electromagnetic wave.

Gelombang mekanikal ***Mechanical wave***	**Gelombang elektromagnet** ***Electromagnetic wave***
(i)	Tidak memerlukan medium untuk memindahkan tenaga *Does not require a medium to transfer energy*
Terdiri daripada getaran zarah-zarah medium *Made up of vibrating particles of a medium*	(ii)
(iii)	Gelombang radio, gelombang cahaya dan sinar gama *Radio waves, light waves and gamma ray*

(d) Rajah menunjukkan gelombang terhasil apabila spring slinki digerakkan ke depan dan ke belakang secara berulang.
Diagram shows the waves produced when a slinky spring was moved forward and backward repeatedly.



(i) Tandakan (✓) pada jawapan yang betul.
Tick (✓) the correct answer.

Gelombang yang dihasilkan oleh spring slinki dalam rajah di atas adalah
The waves produced by the slinky spring in the diagram above is

gelombang melintang
transverse waves ☐

gelombang membujur
longitudinal waves ☐

(ii) Labelkan mampatan spring (C), regangan spring (R) dan panjang gelombang (λ) terhasil dalam rajah di atas.
Label the compression (C), *rarefaction* (R) *of the spring and the wavelength* (λ) *of the wave produced in the diagram above.*

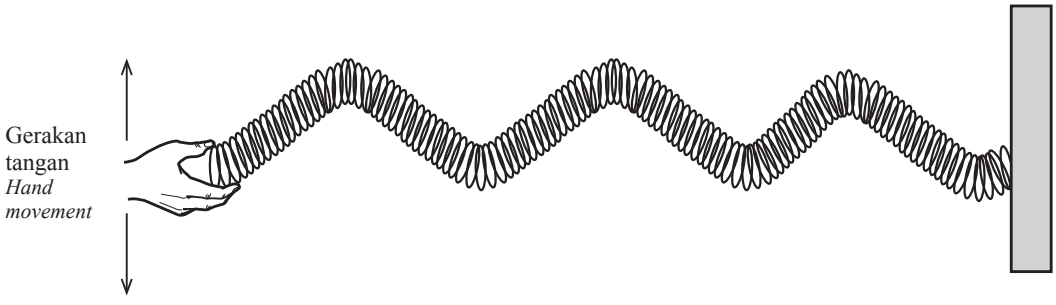
(iii) Gariskan jawapan yang betul berdasarkan rajah di atas.
Underline the correct answer based on the diagram above.

Arah perambatan gelombang spring (selari / berserenjang) dengan arah getaran zarah.
The direction of propagation of the spring waves is (*parallel / perpendicular*) *to the vibration of the particle.*

(iv) Nyatakan satu contoh gelombang bagi jawapan di **3**(d)(i).
State one example of the wave for the answer in **3**(d)(i).

_____

(e) Rajah menunjukkan gelombang terhasil apabila spring slinki digerakkan ke kiri dan ke kanan secara berulang.
Diagram shows the waves produce when a slinky spring was moved to the left and right repeatedly.



(i) Tandakan (✓) pada jawapan yang betul.
Tick (✓) the correct answer.

Gelombang yang dihasilkan oleh spring slinki dalam rajah diberi adalah
The waves produced by the slinky spring in the given diagram is

gelombang melintang
transverse waves ☐

gelombang membujur
longitudinal waves ☐

(ii) Labelkan panjang gelombang terhasil dan tunjukkan arah getaran zarah dan arah perambatan gelombang spring dalam rajah diberi.
Label the wavelength of the wave produced and show the direction of particles vibration and the direction of propagation of the spring waves in the given diagram.

(iii) Gariskan jawapan yang betul berdasarkan rajah diberi.
Underline the correct answer based on the given diagram.

Arah perambatan gelombang spring (selari / berserenjang) dengan arah getaran zarah.
The direction of propagation of the spring waves is (parallel / perpendicular) to the vibration of the particle.

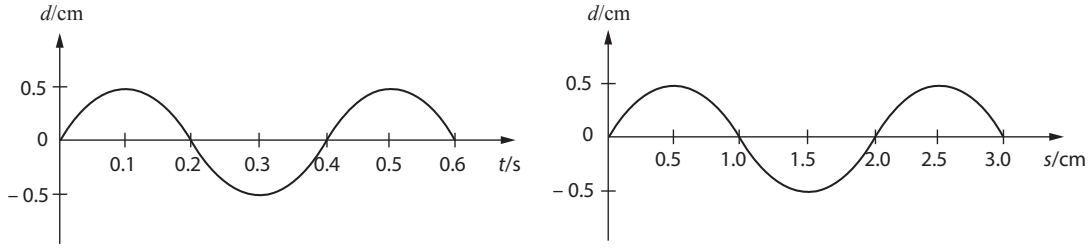
(iv) Nyatakan **satu** contoh gelombang bagi jawapan di **3**(e)(i).
State **one** *example of the wave for the answer in* **3**(e)(i).

_____

4 (a) Lengkapkan jadual ciri-ciri gelombang di bawah.
Complete the table of the characteristics of wave below.

Istilah ***Term***	**Maksud** ***Meaning***
(i) Amplitud (*A*) *Amplitude*	
(ii) Tempoh (*T*) *Period*	
(iii) Frekuensi (*f*) *Frequency*	
(iv) Panjang gelombang (λ) *Wavelength*	
(v) Laju gelombang (*v*) *Wave speed*	

(b) Rajah di bawah menunjukkan graf sesaran-masa dan graf sesaran-jarak bagi suatu gelombang air.
The diagram below shows a graph of displacement-time and a graph of displacement-distance for water waves.



Berdasarkan graf-graf tersebut, tentukan:
Based on the graphs, determine:

(i) Amplitud *Amplitude* =	(ii) Tempoh *Period* =	(iii) Frekuensi *Frequency* =	(iv) Panjang gelombang *Wavelength* =

(c) Diberi persamaan $v = \frac{\lambda}{T}$ di mana v = laju, λ = panjang gelombang dan T = tempoh. Frekuensi gelombang adalah $f = \frac{1}{T}$.

The equation given $v = \frac{\lambda}{T}$ where v = speed, λ = wavelength and T = period. The wave frequency is $f = \frac{1}{T}$.

Maka, laju gelombang adalah
Then, the wave speed is

5.2 PELEMBAPAN DAN RESONANS

1 Apakah maksud pelembapan?
What is the meaning of damping?

2 Huraikan dua jenis pelembapan berikut:
Describe two types of the following damping:

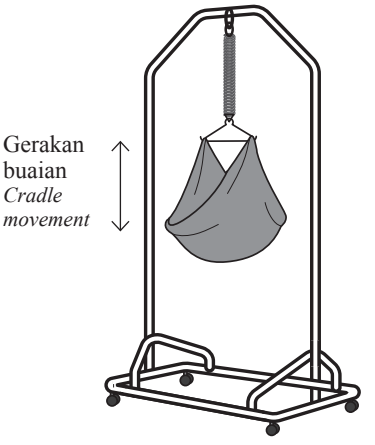
Jenis ***Type***	**Penjelasan** ***Explanation***
(a) Pelembapan luaran *External damping*	
(b) Pelembapan dalaman *Internal damping*	

3 Lakar graf sesaran melawan masa untuk menunjukkan proses pelembapan.
Sketch a graph of displacement against time to show damping process.

INFO

Semasa pelembapan berlaku, frekuensi ayunan adalah kekal manakala amplitud ayunan berkurang.
During damping, the oscillating frequency remains constant while the oscillating amplitude decreases.

4 Seorang ibu meletakkan bayinya untuk tidur di dalam buaian. Dia perlu menggerakkan buaian itu ke atas dan ke bawah secara berterusan.
A mother puts her baby to sleep in a cradle. She needs to continuously move the cradle upward and downward.



(a) Apakah yang berlaku kepada buaian itu apabila ibu memberhentikan gerakan itu?
What happen to the cradle when the mother stops moving the cradle?

_____

(b) Apakah nama fenomena yang berlaku di **4**(a).
What is the name of phenomenon happened in 4(a).

_____

(c) Apakah yang perlu dilakukan untuk meneruskan gerakan buaian? Jelaskan.
What must be done to maintain the movement of the cradle? Explain.

_____

_____

_____

5 Sistem ayunan yang dikenakan daya luar berkala dikatakan sedang melakukan _____.

The oscillating system that applied by the periodic external force is said to be in a _____.

6 Sistem ayunan yang disesar dan kemudian dibiarkan berayun tanpa tindakan daya luar akan berayun dengan satu frekuensi yang tertentu yang dinamakan _____.

An oscillating system that is displaced and then left to oscillate without the action of external forces, will oscillate at its _____.

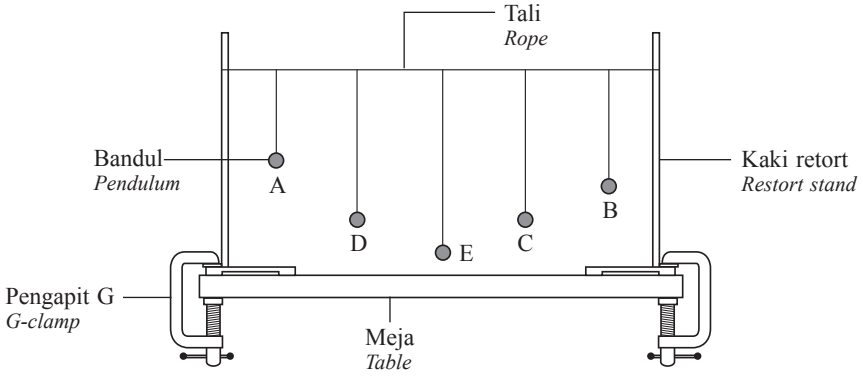
7 _____ berlaku apabila suatu sistem dikenakan daya luar yang mempunyai frekuensi yang sama dengan frekuensi asli sistem ayunan tersebut.

_____ *occurs when a force is applied to an oscillating system at its natural frequency.*

8 Semasa resonans, sistem berayun dengan _____ dan _____.

During resonance, the system oscillates with its _____ *and* _____.

9 Rajah menunjukkan susunan radas untuk mengkaji penghasilan resonans.
The diagram shows the apparatus arrangement to study the production of resonance.



(a) Dua bandul yang manakah mempunyai frekuensi asli yang sama?
Which two pendulums will have the same natural frequency?

_____

(b) Apabila bandul C ditolak, apakah yang berlaku kepada bandul-bandul yang lain? Mengapa?
When pendulum C is pushed, what happen to the other pendulums? Why?

_____

_____

(c) Bandul yang manakah akan berayun dengan amplitud yang paling besar?
Which pendulum oscillates with the largest amplitude?

_____

(d) Dua bandul manakah yang akan terus berayun walaupun bandul-bandul yang lain sudah berhenti? Mengapa?
Which two pendulums will continue to oscillate even when the other pendulums have stopped? Why?

_____

_____

_____

_____

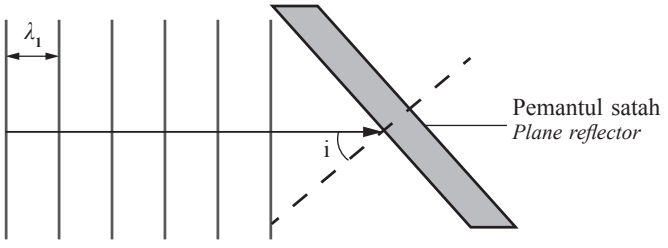
5.3 PANTULAN GELOMBANG

INFO

Pantulan gelombang akan berlaku apabila suatu gelombang tuju mengena dengan permukaan yang keras dan dibalikkan. Permukaan itu memainkan peranan sebagai pemantul.
Reflection of waves occurs when an incidence wave strikes a hard surface and reflected. The surface acts as the reflector.

1 Apakah maksud muka gelombang?
What is the meaning of wavefront?

2 Rajah di bawah menunjukkan gelombang air menuju ke arah sebuah pemantul satah.
The diagram below shows water waves move towards a plane reflector.



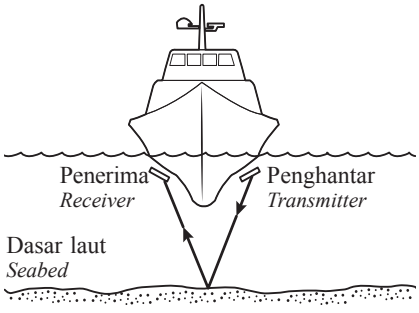
(a) Lukis pantulan gelombang yang terhasil dalam rajah di atas.
Draw the reflection of waves produced in the diagram above.

(b) Bandingkan sudut tuju, *i* dengan sudut pantulan, *r*.
Compare the angle of incidence, i with the angle of reflection, r.

(c) Bandingkan antara gelombang tuju dan gelombang dipantulkan dari segi:
Compare between incident waves and reflected waves in terms of:

Aspek *Aspect*	**Berubah/ Kekal** *Change/ Unchanged*
(i) Laju gelombang *Wave speed*	
(ii) Panjang gelombang *Wavelength*	
(iii) Frekuensi *Frequency*	
(iv) Arah perambatan *Direction propagation*	

3 Rajah menunjukkan sistem sonar digunakan untuk menentukan kedalaman dasar laut.
The diagram shows a sonar system used to determine the depth of the seabed.



INFO

Sonar adalah gelombang ultrasonik yang dipantulkan untuk navigasi, komunikasi dan mengesan objek di bawah permukaan air.
Sonar is a reflected ultrasonic waves that used to navigate, communicate with or detect objects under the surface of the water.

(a) Nyatakan fenomena gelombang bunyi bagi mengukur kedalaman dasar laut.
State the sound wave phenomenon to measure the depth of the seabed.

_____

(b) Terangkan mengapa sonar menggunakan bunyi berfrekuensi tinggi.
Explain why sonar used a high frequency.

_____

(c) Jelaskan bagaimana kedalaman laut diukur.
Explain how to measure the depth of the sea.

_____

_____

_____

4 Menyelesaikan masalah melibatkan pantulan gelombang.
Solve problem involving reflection of wave.

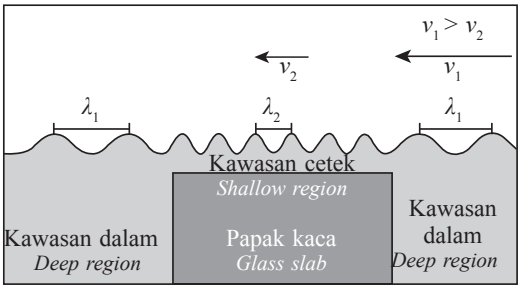
(a) Ahmad menjerit di hadapan dinding tinggi. Dia mendengar bunyi gema suaranya 1.2 s kemudian. Laju bunyi di udara ialah 340 m s^{-1}. Berapakah jarak di antara Ahmad dan dinding?
Ahmad shouts in front of a high wall. He hears the sound of his echoes 1.2 s *later. The speed of sound in air is* 340 m s^{-1}. *What is the distance between Ahmad and the wall?*

(b) Sebuah radar memancarkan isyarat ke arah sebuah kapal terbang. Halaju isyarat itu ialah 3.0×10^8 m s^{-1}. Selepas 4.0×10^{-3} s, radar mengesan isyarat yang dipantulkan. Berapakah jarak kapal terbang itu daripada radar?
A radar transmit a signal to an aeroplane. The velocity of the signal is 3.0×10^8 m s^{-1}. *After* 4.0×10^{-3} s, *the radar detects the reflected signal. What is the distance of the plane from the radar?*

5.4 PEMBIASAN GELOMBANG

1 Apakah maksud pembiasan gelombang?
What is the meaning of refraction of wave?

2 Rajah menunjukkan sekeping papak kaca berbentuk segi empat direndamkan di dalam tangki riak untuk mewujudkan perbezaan kedalaman air.
Diagram shows a square glass slab is immersed in the ripple tank so as to create different depths of water.



(a) Bandingkan frekuensi gelombang air di kawasan dalam dengan di kawasan cetek. Jelaskan.
Compare the frequency of water wave in deep region and in shallow region. Explain.

(b) Bandingkan laju gelombang air di kawasan dalam dengan di kawasan cetek.
Compare the speed of water wave in deep region and in shallow region.

(c) Bandingkan panjang gelombang di kawasan dalam dengan di kawasan cetek.
Compare the wavelength in deep region and in shallow region.

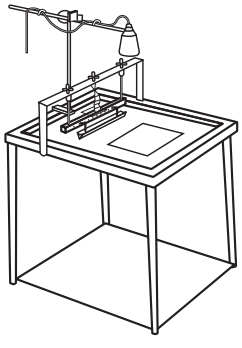
(d) Hubung kait laju gelombang air dengan panjang gelombang air.
Relate the speed of water wave and the wavelength of water wave.

_____

3 Kesan pembiasan ke atas ciri-ciri gelombang.
The effects of refraction on the characteristics of waves.

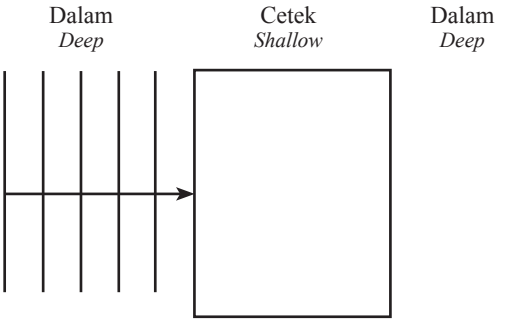
Ciri-ciri ***Characteristics***	**Dari kawasan air dalam ke kawasan air cetek** ***From deep water region to shallow water region***	**Dari kawasan air cetek ke kawasan air dalam** ***From shallow water region to deep water region***
Sudut tuju dan sudut biasan *Incident angle and refraction angle*	(a)	(b)
Laju gelombang *Speed of wave*	(c)	(d)
Panjang gelombang *Wavelength*	(e)	(f)
Frekuensi *Frequency*	(g)	(h)
Arah perambatan *Direction propagation*	(i)	(j)

4 Rajah di bawah menunjukkan susunan radas untuk mengkaji pembiasan gelombang.
The diagram below shows the arrangement to apparatus study the refraction of waves.

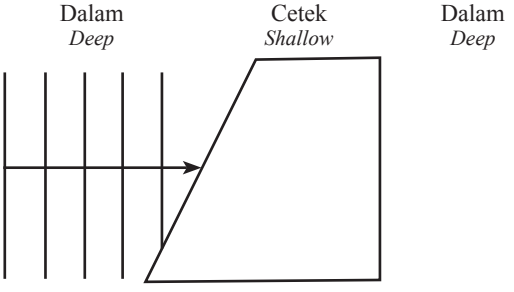


Lengkapkan rajah berikut dengan melukis pembiasan gelombang yang terhasil.
Complete the following diagrams by drawing the refraction of waves.

(a)

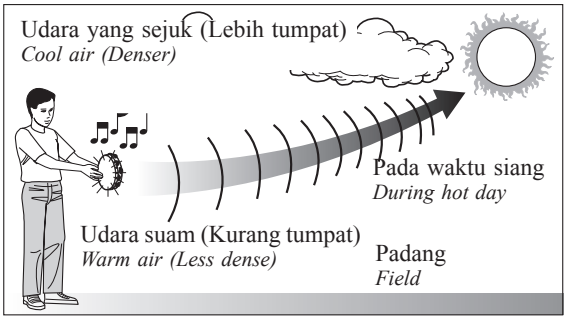


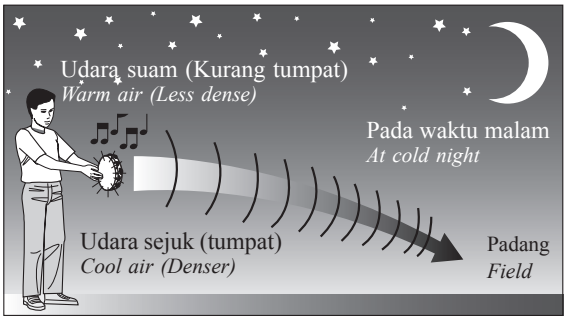
(b)



5 Fenomena Pembiasan Gelombang dalam Kehidupan Harian
Phenomena of Refraction of Waves in Daily Life

Berdasarkan rajah berikut, terangkan mengapa bunyi tidak boleh didengar pada jarak yang jauh pada waktu siang yang panas tetapi boleh didengar dengan jelas pada waktu malam yang sejuk.
Based on the following diagrams, explain why sound cannot be heard over a longer distance during hot day but can be heard clearly over a longer distance at cold night.

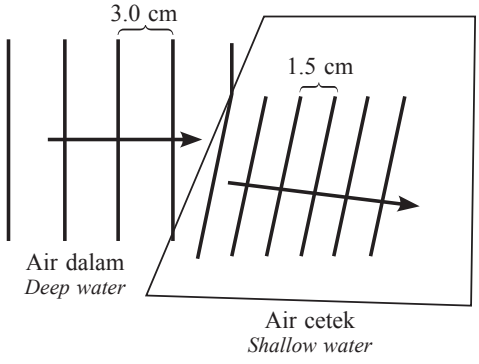




(a) Pada waktu siang:
During hot day:

(b) Pada waktu malam:
At night:

6 Rajah menunjukkan pembiasan gelombang air.
The diagram shows a refraction of a water wave.



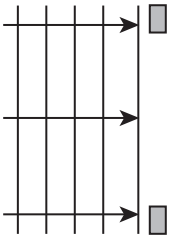
Jika laju gelombang air ialah 5 cm s^{-1} di dalam kawasan air dalam, hitung laju gelombang air di dalam kawasan air cetek.
If the speed of the water waves is 5 cm s^{-1} *in the deep water region, calculate the speed of the water wave in the shallow water region.*

5.5 PEMBELAUAN GELOMBANG

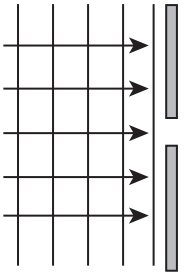
1 Apakah maksud pembelauan gelombang?
What is the meaning of diffraction of wave?

2 Lukis gelombang yang dibelaukan selepas melalui celah atau halangan.
Draw the diffraction waves after passing through a gap or obstacle.

(a)



(b)



3 Nyatakan perubahan yang berlaku kepada gelombang tuju selepas melalui celah.
State the change occurs to the incident wave after passing through a gap.

(a) Frekuensi *Frequency*	
(b) Panjang gelombang *Wavelength*	
(c) Laju gelombang *Speed of wave*	
(d) Arah perambatan *Direction propagation*	
(e) Amplitud *Amplitude*	
(f) Tenaga *Energy*	

4 Huraikan corak gelombang yang berlainan panjang gelombang selepas melalui celah yang sama saiz.
Describe the pattern of the waves with different wavelength after passing through the gap of same size.

Panjang gelombang ***Wavelength***	**Pendek** ***Short***	**Panjang** ***Long***
Corak gelombang ***Pattern of waves***		
Pembelauan ***Diffraction***		

5 Nyatakan **dua** faktor yang menyebabkan kesan pembelauan lebih ketara.
State **two** *factors that cause the diffraction more significant.*

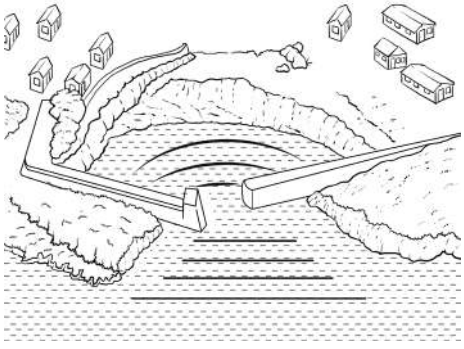
_____

_____

6 Pembelauan Gelombang dalam Kehidupan Harian
Diffraction of Waves in Daily Life

(a) Gelombang air
Water waves

Sepasang benteng dibina untuk melindungi kawasan perumahan di tepi pantai.
A pair of barriers is built to protect housing area near a beach.



(i) Bandingkan amplitud gelombang laut sebelum dan selepas melalui benteng itu.
Compare the amplitude of the sea wave before and after passing through the barriers.

_____

_____

(ii) Dengan menghubungkan saiz ombak dengan tenaga gelombang, terangkan bagaimana kesan hakisan pantai di sekitar kawasan perumahan dapat dikurangkan dengan kehadiran benteng ini.
By relating the size of the wave with the energy, explain how the erosion effect of the beach around the housing area can be reduced by the barriers.

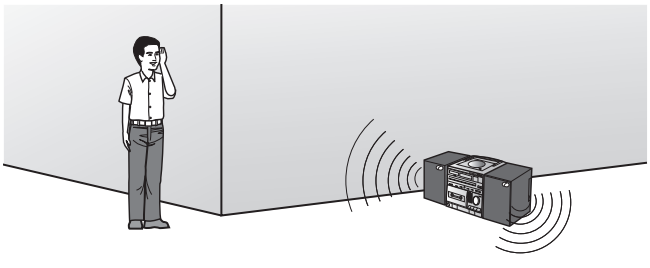
_____

_____

_____

(b) Gelombang bunyi
Sound waves

Rajah menunjukkan Ahmad sedang berdiri di hadapan dinding dan sebuah radio diletakkan di sebalik dinding. Radio itu dihidupkan.
Diagram shows Ahmad stand in front of a wall and a radio is placed behind the wall. The radio is turned on.



(i) Adakah Ahmad dapat melihat radio itu? Berikan inferens anda.
Is Ahmad able to see the radio? Give your inference.

(ii) Bolehkah Ahmad mendengar bunyi radio itu? Berikan inferens anda.
Is Ahmad hear the sound of the radio? Give your inference.

(iii) Hubung kait antara panjang gelombang dengan kesan pembelauan untuk menerangkan mengapa siaran radio dari sebalik dinding boleh didengar tetapi tidak boleh melihatnya.
Relate between wavelengths with effect of diffraction to explain why we can hear the sound of a radio placed nearby a corner of a wall but cannot see the radio.

5.6 INTERFERENS GELOMBANG

INFO

Rajah menunjukkan gelombang air apabila dua biji batu dibaling ke dalam air.
Dua gelombang membulat yang dihasilkan bertindih atau bersuperposisi.
Diagram shows a water waves when two stones are thrown in the water. Two circular waves that are formed on the surface of water are in superposition.

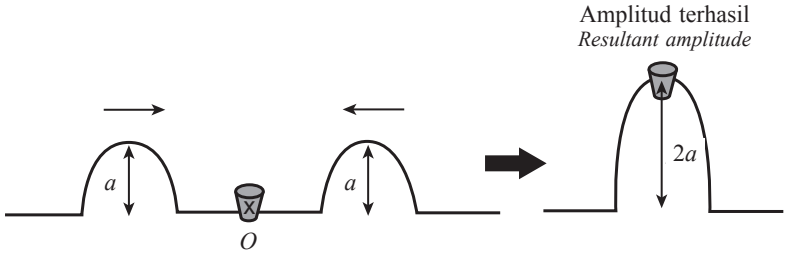
1 Apakah prinsip superposisi?
What is the principle of superposition?

2 Apakah maksud interferens gelombang?
What is the meaning of interference of wave?

3 Nyatakan jenis dan maksud interferens yang betul bagi setiap situasi berikut.
State the type and definition of interference correctly for each of the following situation.

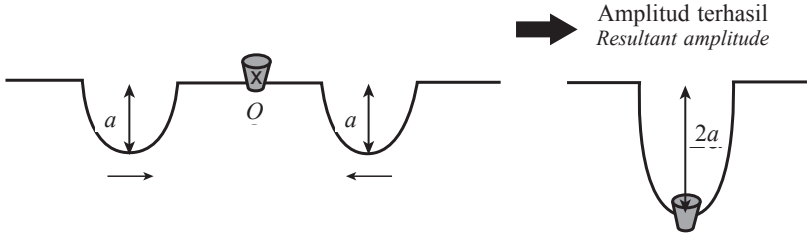
(a) Interferens _____: Superposisi antara dua _____ dan menghasilkan amplitud _____

_____ *interference: Superposition between two* _____ *and the resultant amplitude is* _____



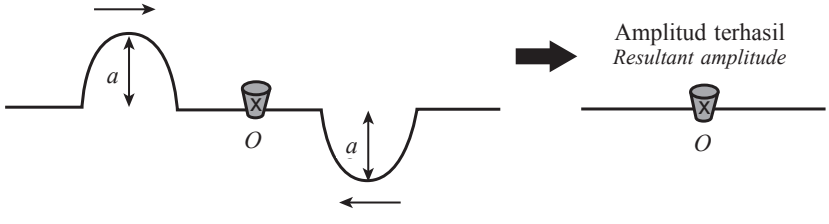
(b) Interferens _____: Superposisi antara dua _____ dan menghasilkan amplitud _____

_____ *interference: Superposition between two* _____ *and the resultant amplitude is* _____

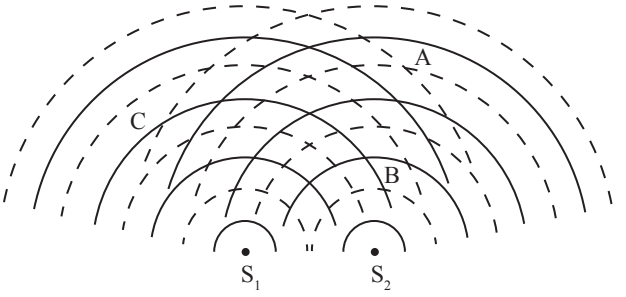


(c) Interferens _____: Superposisi antara _____ dan _____ dan menghasilkan amplitud _____

_____ *interference: Superposition between* _____ *and* _____ *and the resultant amplitude is* _____.



4 Rajah di bawah menunjukkan corak interferens gelombang air yang dihasilkan oleh dua sumber yang koheren.
The diagram below shows interference pattern of water waves produced by two coherent sources.



(a) Lengkapkan jadual di bawah.
Complete the table below.

Keadaan ***State***	**Jenis interferens** ***Type of interference***
Titik A: Dua puncak bertemu *Point* A: *Two crests meet*	
Titik B: Dua lembangan bertemu *Point* B: *Two troughs meet*	
Titik C: Puncak bertemu lembangan *Point* C: *Crests meet troughs*	

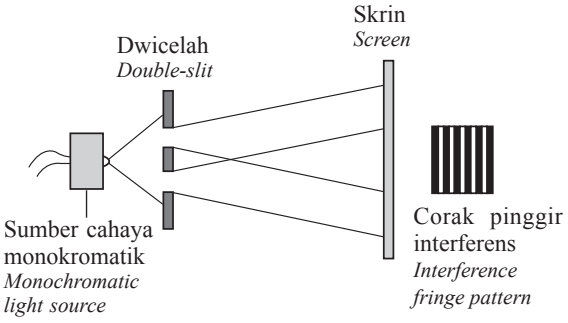
(b) Pada rajah diberi,
On the diagram given,
(i) tandakan titik-titik antinod dan nod.
mark points of antinodes and nodes.
(ii) lukis dan label garis nod dan garis antinod.
draw and label nodal lines and antinodal lines.

(c) Panjang gelombang, λ bagi satu gelombang boleh dihitung dengan menggunakan rumus: $\lambda = \frac{ax}{D}$
The wavelength, λ of the wave can be calculated using formula: $\lambda = \frac{ax}{D}$

a	
x	
D	

5 Rajah di bawah menunjukkan corak interferens suatu gelombang cahaya.
The diagram below shows interference pattern for light wave.

VIDEO ULASAN JAWAPAN



(a) Apakah maksud cahaya monokromatik?
What is meant by monochromatic light?

_____

(b) Huraikan corak interferens yang diperhatikan apabila cahaya melalui dwicelah.
Describe the interference pattern observed when light passes through the double-slit.

_____

(c) Hitung panjang gelombang, λ cahaya merah berdasarkan maklumat di bawah.
Calculate the wavelength, λ of red light based on the information below.
a = 0.5 mm, D = 2.0 m, x = 1.8 mm

(d) Apakah yang terjadi kepada pinggir-pinggir yang terbentuk pada skrin itu apabila
What will happen to the fringes on the screen when

(i) jarak di antara dwicelah dan skrin dikecilkan?
the distance between double-slit and screen is reduced?

_____

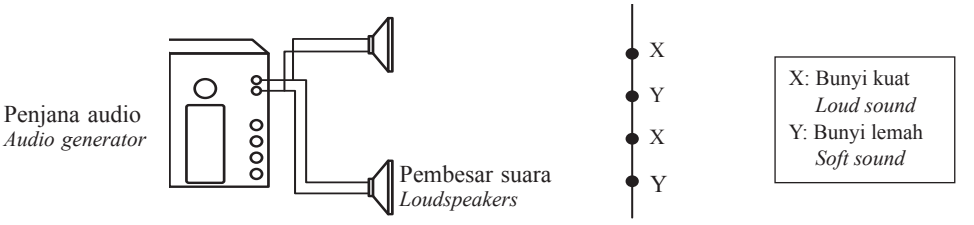
(ii) cahaya merah digantikan dengan cahaya biru?
the red light replaced by blue light?

_____

(iii) jarak pemisahan celah itu diperbesarkan?
the distance of separation between slit is enlarged?

_____

6 Rajah di bawah menunjukkan satu eksperimen dilakukan di sebuah kawasan lapang untuk mengkaji interferens gelombang bunyi.
The diagram below shows an experiment was done in an open area to study the interference of sound wave.



(a) Dua pembesar suara merupakan sumber koheren gelombang bunyi. Mengapa?
Two loudspeakers are coherent sources of sound wave. Why?

(b) Berdasarkan rajah di atas, apakah yang boleh perhatikan apabila dua gelombang bunyi bertindih?
Based on the diagram obove, what can be observed when two sound waves overlap?

(c) Terangkan pemerhatian anda.
Explain your observation.

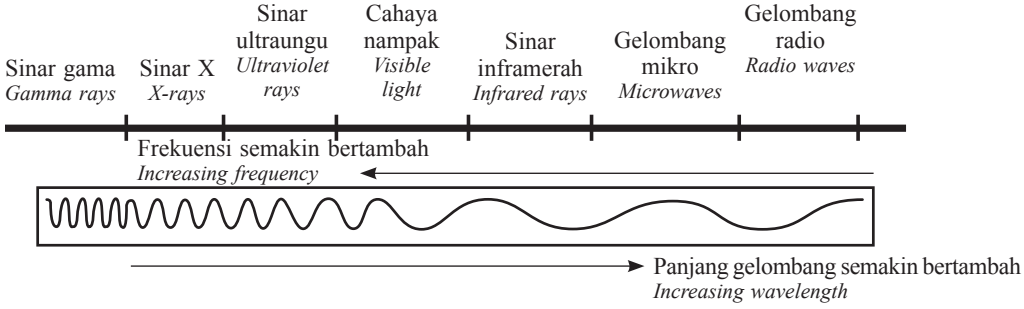
7 Menyelesaikan masalah melibatkan gelombang interferens.
Solve problem involving interference wave.

(a) Dalam satu eksperimen interferens gelombang bunyi, dua pembesar suara diletakkan pada jarak 2.0 m antara satu sama lain. Jarak di antara dua bunyi kuat berturutan ialah 1.0 m dan pendengar berada pada jarak 3.0 m dari pembesar suara.
Berapakah panjang gelombang bunyi yang digunakan?
In an experiment on the interference of sound waves, two loudspeakers are placed at a distance of 2.0 m *from each other. The distance between two consecutive loud sounds is* 1.0 m *and the listener is at a distance of* 3.0 m *from the loudspeakers.*
What is the wavelength of the sound wave used?

(b) Dalam eksperimen dwicelah Young, jarak di antara dwicelah dan skrin ialah 4.0 m dan jarak pemisahan di antara dua celah ialah 0.5 mm. Hitung di jarak antara dua pinggir cerah berturutan untuk cahaya merah yang mempunyai panjang gelombang 7.0×10^{-7} m.
In a Young's double slit experiment, the distance between the double slit and the screen is 4.0 m *and the separation the two slits is* 0.5 mm.
Calculate the distance between two consecutive bright fringes for red light with a wavelength of 7.0×10^{-7} m.

5.7 GELOMBANG ELEKTROMAGNET

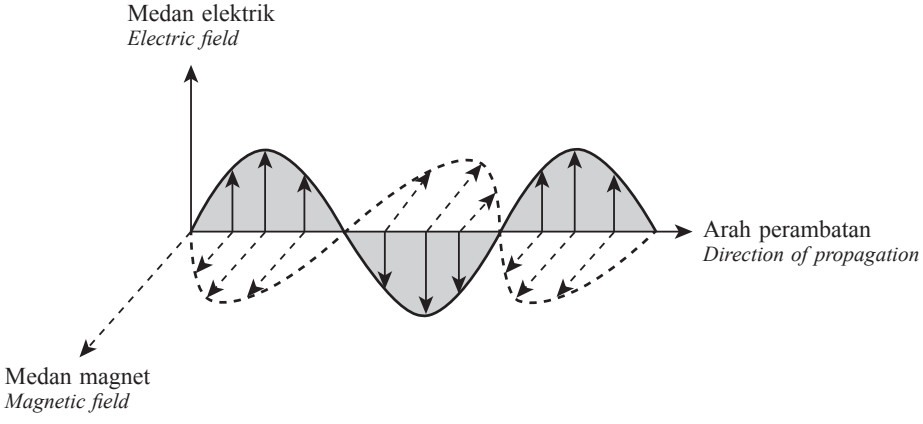
1 Rajah di bawah menunjukkan kumpulan gelombang dalam spektrum elektromagnet berdasarkan frekuensi dan panjang gelombangnya.
The diagram below shows a group of waves in the electromagnetic spectrum based on their frequencies and wavelengths.



(a) Gelombang yang manakah mempunyai frekuensi yang paling rendah?
Which wave has the lowest frequency?

(b) Gelombang yang manakah mempunyai tenaga yang paling tinggi?
Which wave has the highest energy?

2 Rajah di bawah menunjukkan komponen-komponen bagi gelombang elektromagnet.
The diagram below shows components for electromagnetic waves.



(a) Namakan dua komponen bagi gelombang elektromagnet.
Name two components of electromagnetic wave.

(b) Apakah arah getaran kedua-dua komponen itu?
What is the direction of vibration of both components?

(c) Apakah jenis gelombang elektromagnet ditunjukkan dalam rajah?
What is the type of electromagnetic wave shown in the digram?

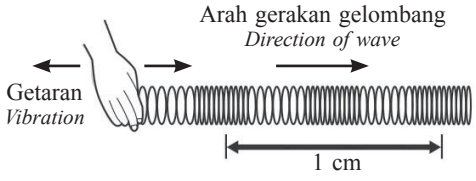
_____

3 Aplikasi gelombang elektromagnet.
Applications of electromagnetic waves.

Sumber ***Source***	**Aplikasi** ***Application***
(a) Sinar gama *Gamma ray*	
(b) Sinar-X *X-ray*	
(c) Sinar ultraungu *Ultraviolet ray*	
(d) Cahaya nampak *Visible light*	
(e) Inframerah *Infrared*	
(f) Gelombang mikro *Microwave*	
(g) Gelombang radio *Radio wave*	

Kertas 1

1 Rajah 1 menunjukkan satu eksperimen spring slinki. Laju getaran ialah 0.2 m s^{-1}.
Diagram 1 *shows an experiment of slinky spring. The vibration speed is* 0.2 m s^{-1}.

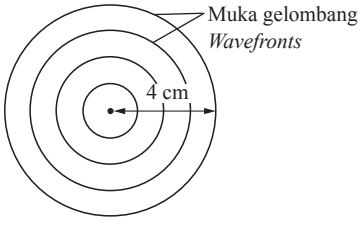


Rajah 1/ *Diagram* 1

Berapakah frekuensi getaran itu?
What is the frequency of the vibration?

A 0.1 Hz **C** 0.4 Hz
B 0.2 Hz **D** 2.5 Hz

2 Rajah 2 menunjukkan corak muka gelombang terhasil oleh pencelup bergetar dengan frekuensi 12 Hz di dalam tangki riak.
Diagram 2 *shows a wavefront pattern produces by a dipper vibrating at a frequency of* 12 Hz *in a ripple tank.*



Rajah 2/ *Diagram* 2

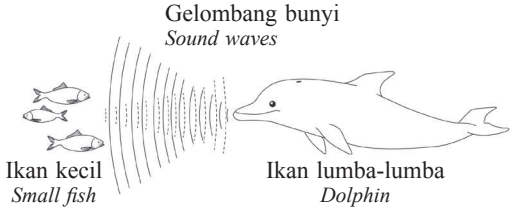
Berapakah laju gelombang?
What is the speed of the waves?

A 2 cm s^{-1}
B 8 cm s^{-1}
C 12 cm s^{-1}
D 18 cm s^{-1}

3 Antara berikut, kuantiti fizik yang manakah berkurang apabila sistem mengalami pelembapan?
Which of the following physical quantity decreases when a system undergoes damping?

A Amplitud/ *Amplitude*
B Halaju/ *Velocity*
C Panjang gelombang/ *Wavelength*
D Frekuensi/ *Frequency*

4 Rajah 3 menunjukkan seekor ikan lumba- lumba menghantar bunyi untuk mengesan kedudukan kumpulan ikan kecil dengan fenomena pantulan bunyi.
Diagram 3 *shows a dolphin sending a sound to detect the position of a group of small fish through a sound reflection phenomenon.*



Rajah 3/ *Diagram* 3

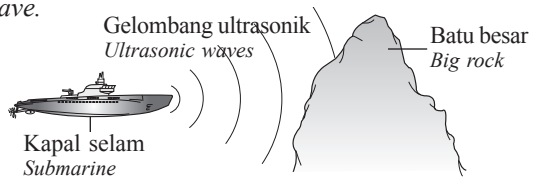
Pernyataan manakah yang betul mengenai bunyi di atas?
Which statement is correct about the sound above?

A Panjang gelombang bunyi bertambah
The sound wavelength increases
B Amplitud gelombang bunyi bertambah
The amplitude of the sound wave increases
C Frekuensi gelombang bunyi berkurang
The frequency of the sound wave decreases
D Laju gelombang bunyi tidak berubah
The speed of the sound wave does not change

5 Satu sistem mempunyai frekuensi asli bersamaan *f*. Satu daya luar memberikan tenaga kepada sistem itu untuk meneruskan ayunan. Resonans akan berlaku dalam sistem itu jika tenaga diberikan kepada sistem itu pada frekuensi yang sama dengan
A system has a natural frequency of oscillation equals to f. An external force is supplying energy to the system to continue the oscillations of the system. Resonance will occur in this system if energy is supplied to the system at a frequency equal to

A f
B $\sqrt{2f}$
C $\frac{f}{\sqrt{2}}$
D $\frac{f}{2}$

6 Rajah 4 menunjukkan sebuah kapal selam memancarkan gelombang ultrasonik ke arah batu besar di dasar laut. Selepas 10 saat, kapal selam itu mengesan gelombang yang dipantulkan.
Diagram 4 *shows a submarine transmitting ultrasonic waves directed at a big rock on the seabed.*
After 10 *seconds, the submarine detects the reflected wave.*

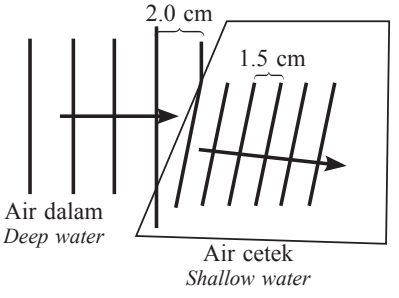


Rajah 4/ *Diagram* 4

Hitung jarak kapal selam dari batu besar itu.
Calculate the distance of the submarine from the big rock.
[Halaju gelombang ultrasonik = 1 560 m s^{-1}]
[*Velocity of ultrasonic wave* = 1 560 m s^{-1}]

A 3.9 km
B 7.8 km
C 15.6 km
D 31.2 km

7 Rajah 5 menunjukkan pembiasan gelombang air.
Diagram 5 *shows a refraction of a water wave.*

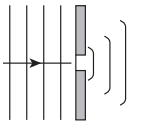


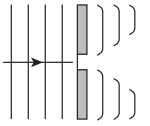
Rajah 5/ *Diagram* 5

Jika laju gelombang air ialah 4 cm s^{-1} di kawasan air dalam, hitung laju gelombang air di kawasan air cetek.
If the speed of the water wave is 4 cm s^{-1} *in the deep water region, calculate the speed of the water wave in the shallow water region.*

A 0.8 cm s^{-1}
B 2.5 cm s^{-1}
C 3.0 cm s^{-1}
D 5.3 cm s^{-1}

8 Rajah manakah menunjukkan gelombang air yang melalui satu celah kecil dengan betul?
Which diagram shows the water waves that passes through a small gap correctly?

A


B


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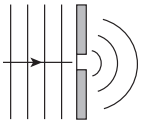
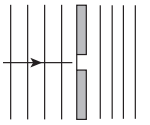


D


9 Dua sumber gelombang yang koheren bermaksud kedua-dua sumber gelombang mempunyai
Two coherent wave sources mean both wave sources have

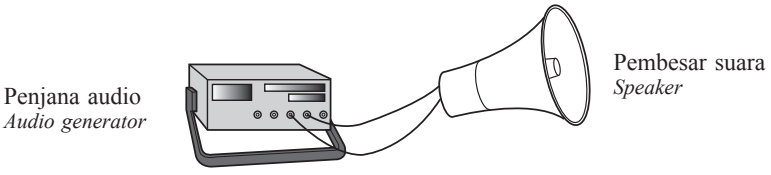
A frekuensi dan amplitud yang sama.
same frequency and amplitude.
B frekuensi sama tetapi berbeza amplitud.
same frequency but different amplitude.
C frekuensi dan beza fasa yang sama.
same frequency and phase difference.
D frekuensi sama tetapi beza fasa berlainan.
same frequency but different phase differences.

10 Sejenis gelombang elektromagnet digunakan secara meluas untuk memasak, mengeringkan cat kereta dan dalam rawatan sakit otot. Apakah jenis gelombang elektromagnet tersebut?
This type of electromagnetic waves is widely used for cooking, drying car paint on and in the treatment of muscle aches. What is the type of electromagnetic wave?

A Sinar gama
Gamma rays
B Sinaran ultraungu
Ultraviolet radiation
C Sinaran inframerah
Infrared radiation
D Gelombang radio
Radio wave

Kertas 2
Bahagian A

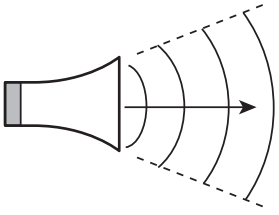
1 Rajah 1.1 menunjukkan sebuah penjana audio disambungkan kepada pembesar suara.
Diagram 1.1 *shows an audio generator connected to a loudspeaker.*



Rajah 1.1/ *Diagram* 1.1

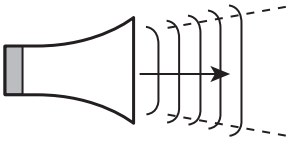
Rajah 1.2 dan Rajah 1.3 masing-masing menunjukkan pembelauan gelombang bunyi daripada pembesar suara apabila bunyi dengan frekuensi rendah dan frekuensi tinggi dihasilkan.
Diagram 1.2 *and Diagram* 1.3 *show the diffraction of sound wave from the loudspeaker when the sound of low and high frequency are produced respectively.*

Bunyi berfrekuensi rendah
Sound of low frequency



Rajah 1.2/ *Diagram* 1.2

Bunyi berfrekuensi tinggi
Sound of high frequency



Rajah 1.3/ *Diagram* 1.3

(a) Apakah yang dimaksudkan dengan pembelauan?
What is the meaning of diffraction?

_____

_____

_____

[1 markah/ *mark*]

(b) Pada Rajah 1.2, tanda dan labelkan panjang gelombang dengan λ.
In Diagram 1.2*, mark and label the wavelength with* λ.

[1 markah/ *mark*]

(c) Perhatikan Rajah 1.2 dan Rajah 1.3.
Observe Diagram 1.2 *and Diagram* 1.3.

(i) Bandingkan panjang gelombang.
Compare the wavelengths.

_____

_____

[1 markah/ *mark*]

(ii) Bandingkan bentuk pembelauan gelombang bunyi.
Compare the patterns of the diffraction of sound waves.

_____

_____

[1 markah/ *mark*]

(d) Apakah yang akan terjadi kepada amplitud gelombang bunyi yang terbelau?
What will be happen to the amplitude of the diffracted sound waves?

_____

[1 markah/ *mark*]

(e) Terangkan jawapan anda di **1**(d).
Explain your answer in **1**(d).

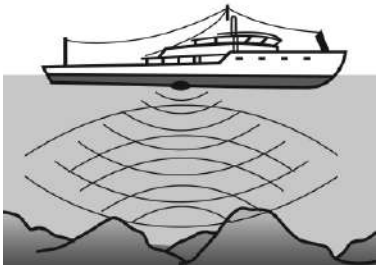
_____

_____

[1 markah/ *mark*]

Bahagian B

2 Rajah 1 menunjukkan pemantul gema di atas kapal menghasilkan gelombang bunyi. Bot nelayan menggunakan pemantul gema untuk menentukan kedalaman laut. Anda ditugaskan untuk menyelidik ciri-ciri gelombang yang sesuai digunakan untuk menentukan kedalaman dasar laut.
Diagram 1 *shows an echo-sounder on a ship produces a pulse of sound. A fishing boat uses the sound echo to determine the depth of seabed. You are assigned to investigate the suitable characteristics of the waves that could be used to determine the depth the seabed.*



Rajah 1/ *Diagram* 1

(a) Nyatakan satu fenomena gelombang yang menghasilkan 'gema'.
State one phenomenon of waves that produces 'echo'.

[1 markah/ *mark*]

(b) Gelombang radio digunakan untuk mengesan kedudukan kapal terbang dan teknik sonar digunakan untuk mengesan kedudukan ikan di bawah kapal.
Radio waves are used to detect the position of an aeroplane and sonar technique is used to detect the shoal of fish below the boat.

(i) Nyatakan perbezaan antara gelombang radio dan gelombang bunyi.
State the difference between radio waves and sound waves.

[2 markah/ *marks*]

(ii) Terangkan kenapa halaju bunyi lebih tinggi dalam air berbanding dalam udara.
Explain why the speed of sound is greater in the water than in the air.

[2 markah/ *marks*]

(c) Jadual 1 menunjukkan spesifikasi lima gelombang P, Q, R, S dan T yang boleh digunakan untuk menentukan kedudukan sekumpulan ikan.
Table 1 *shows the specification of five waves* P, Q, R, S *and* T *that can be used to determine the position of a shoal of fish.*

Gelombang *Waves*	**Jenis gelombang** *Type of waves*	**Frekuensi** *Frequency*	**Kelajuan** *Speed* **(m s^{-1})**	**Kuasa penembusan** *Penetrating power*
P	Melintang *Transverse*	Tinggi *High*	1 000	Rendah *Low*
Q	Melintang *Transverse*	Tinggi *High*	1 500	Tinggi *High*
R	Membujur *Longitudinal*	Rendah *Low*	1 000	Tinggi *High*
S	Membujur *Longitudinal*	Tinggi *High*	1 500	Tinggi *High*

Jadual 1/ *Table* 1

Kamu dikehendaki menentukan gelombang yang paling sesuai digunakan. Kaji gelombang-gelombang itu berdasarkan aspek-aspek berikut:
You are required to determine the most suitable waves. Study the waves based on the following aspects:

(i) Jenis gelombang yang dipancarkan
The type of the waves transmitted

(ii) Frekuensi gelombang
The frequency of the waves

(iii) Kelajuan gelombang
The speed of the waves

(iv) Kuasa penembusan gelombang
Penetrating power of waves

[10 markah/ *marks*]

(d) (i) Masa yang diperlukan untuk gelombang pergi dan balik ialah $\frac{1}{15}$ s. Hitungkan kedalaman kedudukan ikan jika halaju bunyi dalam air ialah 1 500 m s^{-1}.
The time taken for the return of the wave is $\frac{1}{15}$ s. *Calculate the depth of the shoal of fish below the boat if the speed of sound in water is* 1 500 m s^{-1}.

[3 markah/ *marks*]

(ii) Nyatakan **dua** kegunaan lain pemantul gema.
State **two** *other uses of an echo sounder.*

[2 markah/ *marks*]

BAB 6

Cahaya dan Optik
Light and Optics

NOTA EFEKTIF

1 Pembiasan cahaya
Refraction of light

Fenomena cahaya bertukar arah perambatan apabila ia merambat melalui dua medium berlainan ketumpatan optik disebabkan halaju cahaya yang berubah.

A phenomenon when light changes direction when it travels from one medium to another medium of different optical density due to the change of velocity of light.

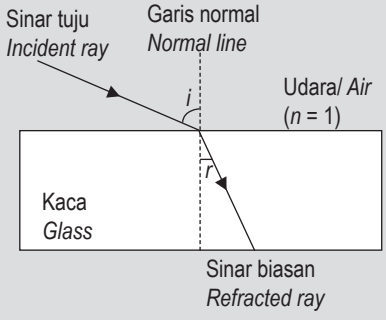
2 Indeks biasan
Refractive index

Nisbah laju cahaya di dalam vakum kepada laju cahaya di dalam medium.

The ratio of speed of light in vacuum to the speed of light in medium.

$$n = \frac{\text{laju cahaya dalam vakum/ udara}}{\text{laju cahaya dalam medium}}$$

$$n = \frac{\textit{speed of light in vacuum/ air}}{\textit{speed of light in medium}} \longrightarrow \boxed{n = \frac{c}{v}}$$



$$\boxed{n = \frac{\sin i}{\sin r}}$$

n : indeks biasan/ *refractive index*
i : sudut kawasan kurang tumpat
angle of less dense region
r : sudut kawasan lebih tumpat
angle of denser region

3 Dalam nyata & dalam ketara
Real depth & apparent depth

Indeks biasan/ *Refractive index*,

$$n = \frac{\text{dalam nyata/ } \textit{real depth}}{\text{dalam ketara/ } \textit{apparent depth}} = \frac{H}{h}$$

$$\boxed{n = \frac{H}{h}}$$

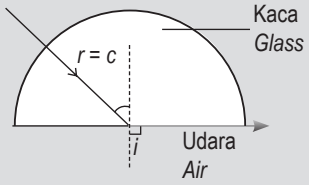
4 Pantulan dalam penuh/ *Total internal reflection*

Semua cahaya dipantulkan dalam medium apabila sudut tuju, i dalam medium yang tumpat melebihi sudut genting, c.

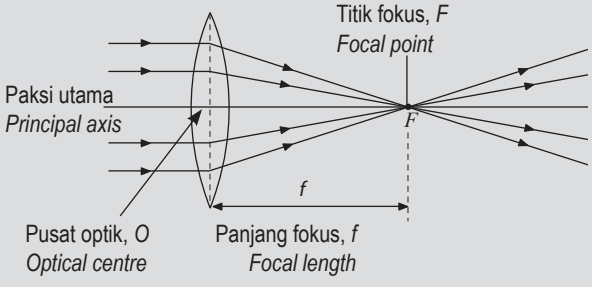
All light are reflected in the medium when incidence angle, i in the denser medium is larger than the critical angle, c.

- Sinar cahaya merambat dari suatu medium yang lebih tumpat ke medium yang kurang tumpat.
  All light propagate from denser medium to less dense medium.
- $i > c$

$$n = \frac{\sin i}{\sin r} = \frac{\sin 90°}{\sin c} = \frac{1}{\sin c}$$

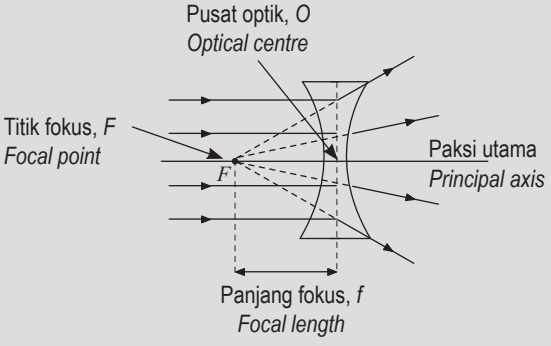


5 Kanta cembung
Convex lens



Jarak objek *Object distance, u*	Ciri-ciri imej *Characteristics of image*
$u = \infty$	Nyata, songsang, diperkecil *Real, inverted, diminished*
$u > 2f$	Nyata, songsang, diperkecil *Real, inverted, diminished*
$u = 2f$	Nyata, songsang, sama saiz *Real, inverted, same size*
$f < u < 2f$	Nyata, songsang, diperbesar *Real, inverted, magnified*
$u = f$	Maya, tegak, diperbesar *Virtual, upright, magnified*
$u < f$	Maya, tegak, diperbesar *Virtual, upright, magnified*

6 Kanta cekung/ *Concave lens*



Jarak objek *Object distance, u*	Ciri-ciri imej *Characteristics of image*
u pada sebarang kedudukan *u at any position*	Maya, tegak, diperkecil *Virtual, upright, diminished*

Pembesaran linear, *m*
Linear magnification, m

$$m = \frac{v}{u} = \frac{h_i}{h_o}$$

u: jarak objek/ *object distance*
v: jarak imej/ *image distance*
h_o: tinggi objek/ *height of object*
h_i : tinggi imej/ *height of image*

Persamaan kanta nipis/ *Thin-lens equation*:

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

7 Alatan optik
Optical instruments

(a) Kanta pembesar
Magnifying glass
(b) Mikroskop majmuk
Compound microscope
(c) Teleskop astronomi
Astronomical telescope

8 Cermin cekung
Concave mirror

Jarak objek *Object distance, u*	Ciri-ciri imej *Characteristics of image*
$u = \infty$	Nyata, songsang, diperkecil *Real, inverted, diminished*
$u > 2f$	Nyata, songsang, diperkecil *Real, inverted, diminished*
$u = 2f$	Nyata, songsang, sama saiz *Real, inverted, same size*
$f < u < 2f$	Nyata, songsang, diperbesar *Real, inverted, magnified*
$u = f$	Maya, tegak, diperbesar *Virtual, upright, magnified*
$u < f$	Maya, tegak, diperbesar *Virtual, upright, magnified*

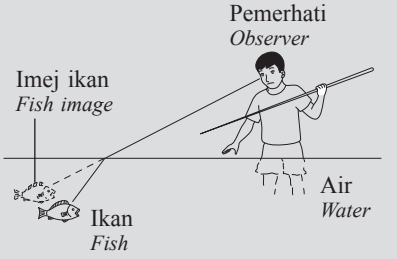
9 Cermin cembung
Convex mirror

Jarak objek *Object distance, u*	Ciri-ciri imej *Characteristics of image*
$u > f$	Maya, tegak, diperkecil *Virtual, upright, diminished*
$u < f$	Maya, tegak, diperkecil *Virtual, upright, diminished*

6.1 PEMBIASAN CAHAYA

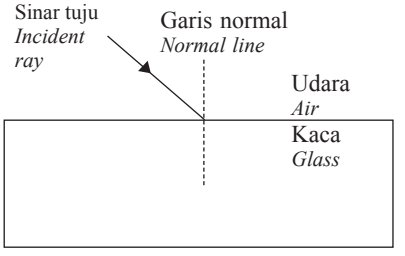
INFO

Rajah menunjukkan ikan kelihatan lebih dekat dengan permukaan air. Apabila cahaya bergerak melalui dua medium yang berlainan ketumpatan, ia akan berubah arah. Fenomena ini dikenali sebagai pembiasan cahaya.
Diagram shows the fish appears closer to the surface of water. When light passes through two materials of different optical densities, it will change direction. The light bent. This phenomenon is called the refraction of light.

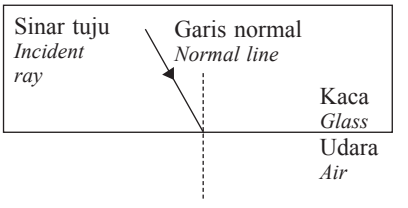


1 Apakah maksud pembiasan cahaya?
What is the meaning of refraction of light?

2 Lukis arah sinar pembiasan. Tandakan sudut tuju, *i* dan sudut biasan, *r*.
Draw the direction of refracted ray. Mark the angle of incidence, i and the angle of refraction, r.



x



y

3 Berdasarkan rajah di **2**, nyatakan perubahan pada laju cahaya setelah pembiasan.
Based on the diagrams in **2**, *state the change in velocity of light after refraction.*

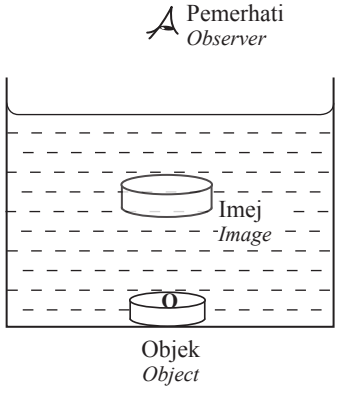
x: _____ *y*: _____

4 Apakah indeks biasan?
What is refractive index?

5 Nyatakan persamaan Hukum Snell.
State the equation of Snell's law.

n_1	
n_2	
θ_1	
θ_2	

6 Rajah menunjukkan sebuah objek di dalam sebuah bikar berisi air dan diperhatikan oleh seorang pemerhati.
The diagram shows an object in a beaker filled with water and observed by an observer.



(a) Lukis rajah sinar dari titik O ke mata pemerhati untuk menunjukkan bagaimana objek kelihatan lebih dekat dengan permukaan air.
Draw a ray diagram from point O to the observer's eye to show how the object appears nearer to the surface of water.

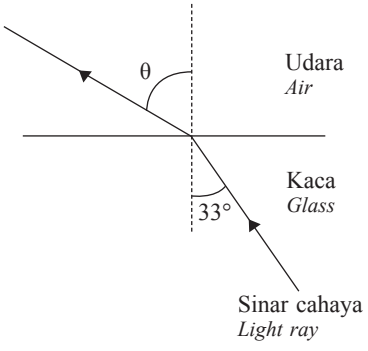
(b) Tanda dan labelkan dalam nyata, *H* dan dalam ketara, *h* pada rajah di atas.
Mark and label real depth, H and apparent depth, h on the diagram above.

(c) Tulis persamaan bagi indeks biasan, *n* yang melibatkan dalam nyata, *H* dan dalam ketara, *h*.
Write an equation for refractive index which involved real depth, H and apparent depth, h

7 Menyelesaikan masalah melibatkan pembiasan cahaya.
Solve problem involving refraction of light.

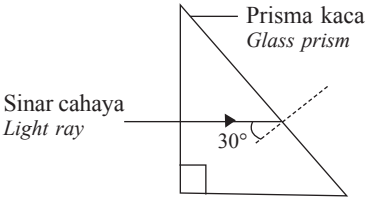
(a) Satu sinar cahaya merambat daripada kaca ke udara. Indeks biasan kaca ialah 1.54 dan laju cahaya di dalam udara ialah 3×10^8 m s^{-1}. Hitung
A light ray travels from glass to air. The refractive index of glass is 1.54 *and the speed of light in air is* 3×10^8 m s^{-1}. *Calculate*

(i) sudut biasan, θ.
the angle of refraction, θ.



(ii) laju cahaya di dalam kaca.
the speed of light in glass.

(b) Satu sinar cahaya tidak lengkap memasuki sebuah prisma kaca yang mempunyai indeks biasan 1.50.
An incomplete light ray entering a glass prism which has a refractive index of 1.50.

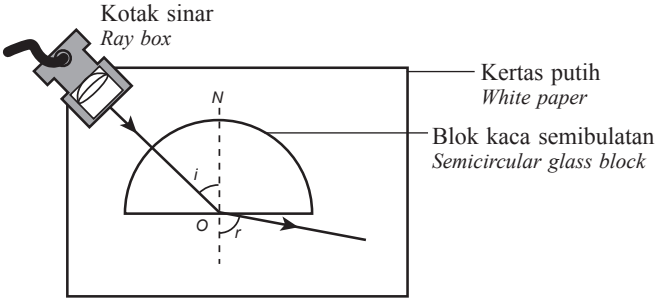


(i) Pada rajah di atas, lengkapkan rajah sinar.
On the diagram above, complete the ray diagram.

(ii) Cari sudut biasan.
Find the angle of refraction.

6.2 PANTULAN DALAM PENUH

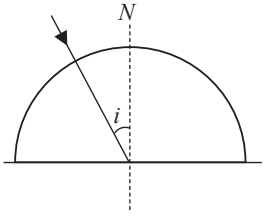
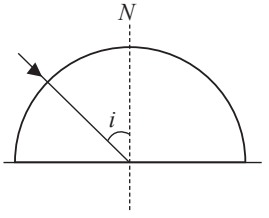
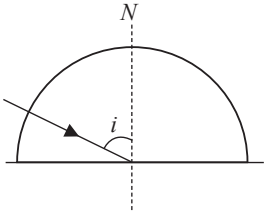
1 Rajah menunjukkan susunan radas untuk memerhati fenomena pantulan dalam penuh dan menentukan sudut genting kaca.
The diagram shows the apparatus arrangement to observe the total internal reflection and to determine the critical angle of glass.



INFO

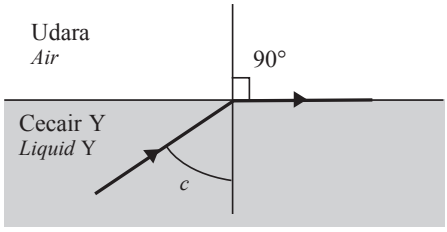
Sebutir intan terkenal dengan kelihatan yang berkilau. Fenomena ini merupakan contoh pantulan dalam penuh.
Diamonds are famous for their sparkle. This phenomenon shows the total internal reflection.

Lengkapkan jadual di bawah dengan melukis dan menerangkan lintasan sinar cahaya bagi tiga keadaan.
Complete the table below by drawing and explain the path of light ray for three states.

Sudut tuju, i dan sudut genting, *c* *Incident angle, i and critical angle, c*	$i < c$	$i = c$	$i > c$
Lintasan sinar cahaya *Path of light ray*			
Penjelasan *Explanation*			

2 Hubung kait antara sudut genting dengan indeks biasan.
Relate between critical angle and refraction indeks.

Rajah menunjukkan sinar cahaya masuk ke dalam cecair Y.
The diagram shows a light ray entering liquid Y.



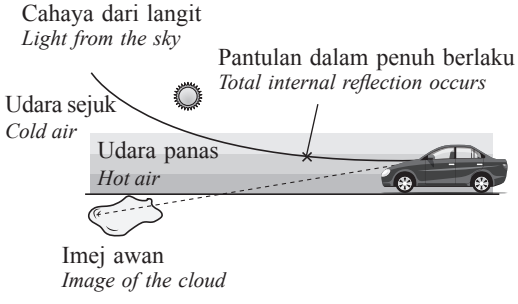
(a) Menggunakan hukum Snell, tulis satu persamaan yang menghubungkan sudut genting, *c*, dan indeks pembiasan, n cecair Y.
Using Snell's law, write an equation that relates between the critical angle, c, and the refractive index, n of liquid Y.

(b) Nyatakan hubungan antara indeks biasan, *n* dengan sudut genting, *c*.
State the relationship between the refractive index, n and the critical angle, c.

_____

3 Fenomena semula jadi dan aplikasi pantulan dalam penuh.
Natural phenomenon and application of total internal reflection.

(a) Seorang pemandu melihat lopak air di hadapannya semasa memandu pada waktu siang yang panas. Namun, lopak air tersebut hilang apabila dia sampai di hadapan. Fenomena ini dikenali sebagai logamaya.
Terangkan bagaimana logamaya berlaku.
A driver see a puddle of water on the road ahead while driving on a hot sunny day. However, the puddle of water went missing when he arrived at the road ahead.
This phenomenon known as mirage.
Explain how mirage occurs.



(i) Pada hari yang panas, suhu udara di bahagian atas _____ berbanding suhu udara di bahagian bawah.

On hot day, the temperature of air at upper layer is _____ than the temperature of air at lower layer.

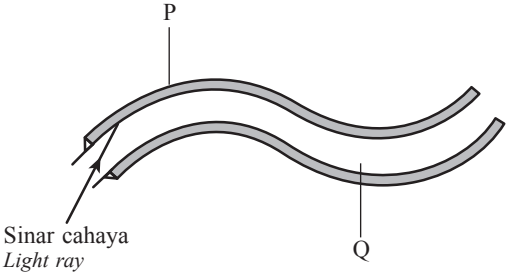
(ii) Udara yang sejuk lebih tumpat dan menyebabkan sinar cahaya dibias _____ garis normal.

The cold air denser and causes the light rays _____ from normal.

(iii) Apabila sudut tuju lebih _____ daripada sudut genting, maka _____ berlaku. Cahaya (imej awan) dipantulkan ke mata pemerhati. Pemerhati melihat imej awan sebagai lopak air di permukaan jalan.

When the incident angle _____ than the critical angle, then _____ occurs. Light (cloud image) reflected to observer's eye. The observer see the cloud image as puddle of water on the road surface.

(b) Rajah menunjukkan satu sinar cahaya memasuki sebuah gentian optik.
The diagram shows a light ray entering an optical fibre.



(i) Nyatakan dua bidang yang menggunakan gentian optik secara meluas.
State two fields that widely used optical fibre.

_____

(ii) Namakan bahan digunakan untuk gentian optik.
Name the material used for optical fiber.

_____

(iii) Pada rajah di atas, lengkapkan lintasan sinar cahaya dalam gentian optik.
On the diagram above, complete the light ray path in the optical fibre.

(iv) Bandingkan antara teras dalam, Q, dengan pembalut luar, P dari aspek berikut:
Compare between the inner core, Q *and the outer cladding,* P *in the following aspects:*

Ketumpatan/ *Density*: _____

Indeks biasan/ *Refractive index*: _____

(v) Terangkan mengapa sinar cahaya mengalami pantulan dalam penuh apabila mengenai dinding di dalam gentian optik.
Explain why the light ray experiences total internal reflection when it hits the inner wall of the optical fibre.

_____

_____

(vi) Berikan dua kelebihan gentian optik.
Give two advantages of the optical fibre.

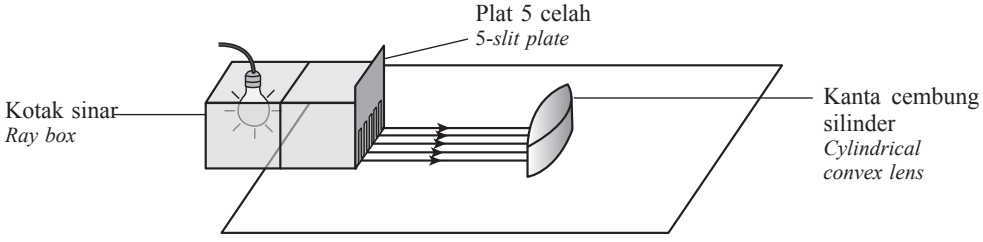
_____

_____

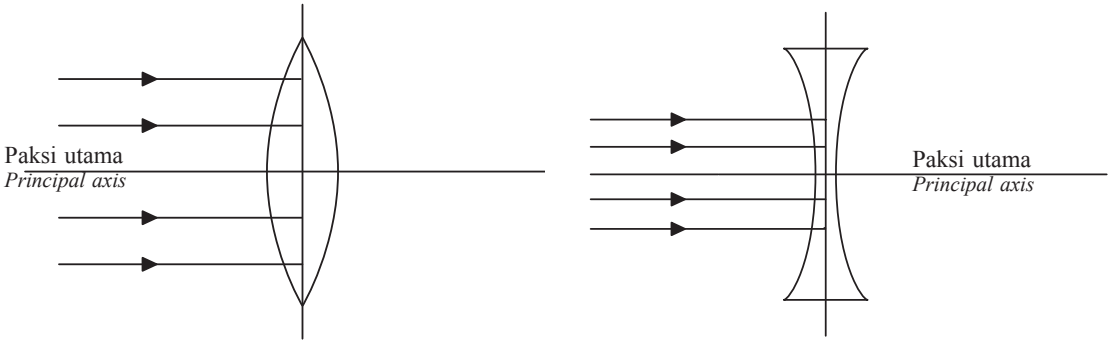
(vii) Nyatakan **dua** aplikasi lain bagi pantulan dalam penuh.
State **two** *other applications for total internal reflection.*

6.3 PEMBENTUKAN IMEJ OLEH KANTA

1 Rajah menunjukkan susunan radas untuk menunjukkan kanta cembung sebagai kanta penumpu dan kanta cekung sebagai kanta pencapah.
The diagram shows the apparatus arrangement to show convex lens as converging lens and concave lens as diverging lens.



(a) Lukis rajah sinar apabila sinar cahaya selari melalui kanta cembung dan kanta cekung. Tandakan titik fokus, *F*, pusat kanta, *O* dan panjang fokus, *f*.
Draw the rays diagram when the parallel lights passes through a convex lens and concave lens. Mark the focal point, F, centre of lens, O and focal point, f.



(b) Apakah berlaku kepada sinar cahaya selari selepas melalui:
What happens to the parallel light rays after passing through:

- Kanta cembung/ *Convex lens*:

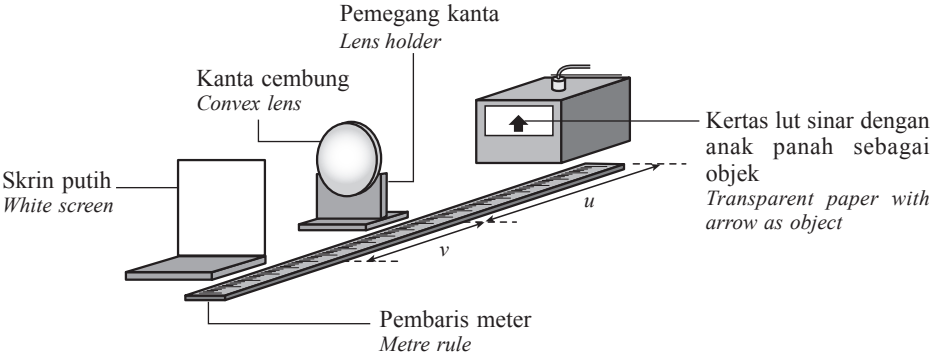
- Kanta cekung/ *Concave lens*:

2 Nyatakan definisi istilah berikut:
State the definition of the following terms.

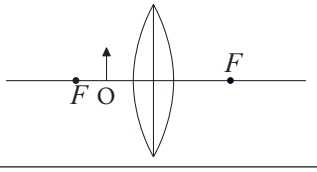
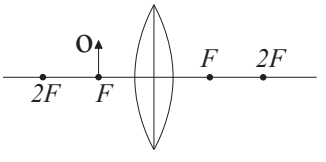
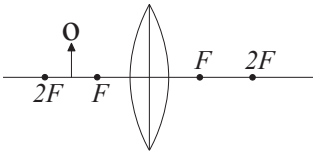
Titik fokus ***Focal point*** **(*F*)**	(a)
Panjang fokus ***Focal length*** **(*f*)**	(b)

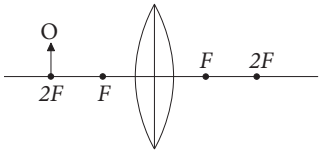
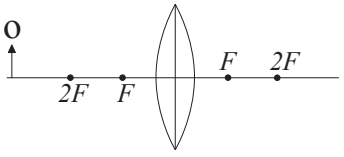
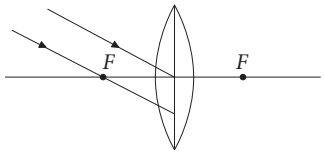
Jarak objek ***Object distance*** **(*u*)**	(c)
Jarak imej ***Image distance*** **(*v*)**	(d)
Pusat optik ***Optical centre*** **(*O*)**	(e)

3 Rajah menunjukkan aktiviti menentukan kedudukan dan ciri-ciri imej yang terhasil.
The diagram shows the activity to determine the position and characteristics of the formed image.

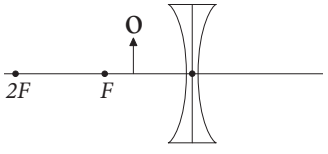
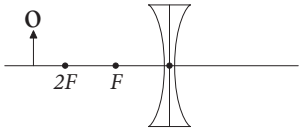


(a) Lukis rajah sinar bagi setiap jarak objek, *u* berikut dan nyatakan ciri imej untuk kanta cembung.
Draw the ray diagram for each of the following object distances, u and state the characteristics of image for convex lens.

u	**Rajah sinar** ***Ray diagram***	**Ciri-ciri imej** ***Characteristics of image***
$u < f$		
$u = f$		
$2f > u > f$		

u	**Rajah sinar** *Ray diagram*	**Ciri-ciri imej** *Characteristics of image*
$u = 2f$		
$u > 2f$		
$u = \infty$		

(b) Lukis rajah sinar bagi setiap jarak objek, *u* berikut dan nyatakan ciri imej untuk kanta cekung.
Draw the ray diagram for each of the following object distances, u and state the characteristic of image for concave lens.

u	**Rajah sinar** *Ray diagram*	**Ciri-ciri imej** *Characteristics of image*
$u < 2f$		
$u > 2f$		

4 Apabila suatu objek dilihat melalui kanta pembesar pada jarak yang kurang daripada panjang fokusnya, imej yang terbentuk diperbesar.
When an object is seen through a magnifying glass at a distance less than its focal length, the image formed is magnified.

Rumus bagi pembesaran linear, $m = \frac{h_i}{h_o} = \frac{v}{u}$ di mana

The formula for linear magnification, $m = \frac{h_i}{h_o} = \frac{v}{u}$ *where*

TIPS
- $m < 1$: Imej diperkecil
  Diminished image
- $m = 1$: Imej sama saiz
  Image same size as object
- $m > 1$: Imej diperbesar
  Magnified image

h_i: _____

h_o: _____

v: _____

u: _____

6.4 FORMULA KANTA NIPIS

1 Formula kanta nipis:
Thin lens formula:

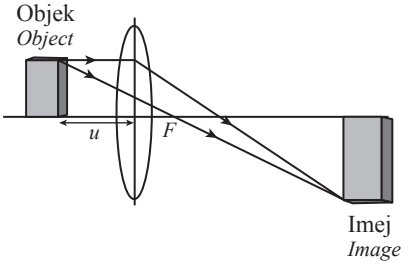
	u: _____ *v*: _____ *f*: _____

2 Peraturan menggunakan formula kanta nipis:
Rules using thin lens formula:

Positif/ Negatif ***Positive/ Negative***	(a)	(b)
u	Objek nyata *Real object*	Objek maya *Virtual object*
v	Imej nyata *Real image*	Imej maya *Virtual image*
f	Kanta cembung *Convex lens*	Kanta cekung *Concave lens*

3 Menyelesaikan masalah melibatkan formula kanta nipis.
Solve problem involving this lens formula.

Satu objek diletakkan 30 cm dari kanta cembung dengan panjang fokus 20 cm.
An object is placed 30 cm *from a convex lens with a focal length of* 20 cm.



(a) Berapakah jarak imej kanta?
What is the image distance of the lens?

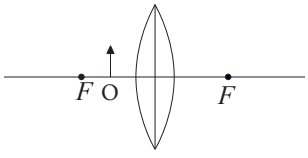
(b) Berapakah pembesaran linear yang dihasilkan?
What is the linear magnification formed?

(c) Apakah ciri-ciri imej yang terhasil?
What is the characteristics of the image formed?

_____

6.5 PERALATAN OPTIK

1 Kanta pembesar.
Magnifying glass.

Kegunaan *Application*	
Ia mempunyai *It consists of*	
Jarak objek *Object distance*	
Ciri-ciri imej *Characteristics of image*	
Rajah sinar *Ray diagram*	

2 Mikroskop majmuk.
Compound microscope.

Kegunaan *Application*	
Ia mempunyai *It consists of*	
Banding f_o dan f_e *Compare f_o and f_e*	
Jarak objek *Object distance*	
Ciri-ciri imej melalui kanta objek *Characteristics of image through objective lens*	
Kedudukan kanta mata *Position of eyepiece lens*	

Ciri-ciri imej akhir *Characteristics of final image*	
Rajah sinar *Ray diagram*	

3 Teleskop astronomi.
Astronomical telescope.

Kegunaan *Application*	
Ia mempunyai *It consists of*	
Banding f_o dan f_e *Compare f_o and f_e*	
Jarak objek *Object distance*	
Bagaimana sinar cahaya melalui kanta objek? *How light rays passes through objective lens*	
Kedudukan imej melalui kanta objek *Position of image through objective lens*	
Ciri-ciri imej melalui kanta objek *Characteristics of image through objective lens*	
Kedudukan kanta mata *Position of eyepiece lens*	
Ciri-ciri imej akhir *Characteristics of final image*	

Pelarasan normal: Jarak di antara f_o dan f_e *Normal adjustment: The distance between f_o and f_e*	
Pembesaran linear *Linear magnification*	
Rajah sinar *Ray diagram*	

INFO

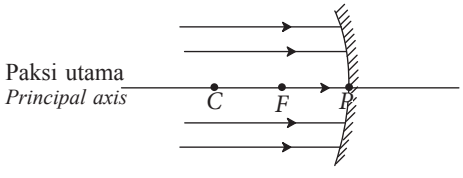
Kanta objek:
The objective lens:

- Diameter besar supaya lebih cahaya masuk dan imej lebih cerah
  Bigger diameter so that more light can enter to get a brighter image
- Pembesaran linear besar supaya imej besar
  Large linear magnification so that it will produce bigger image

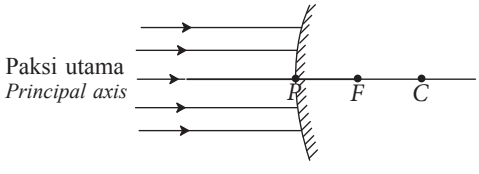
6.6 PEMBENTUKAN IMEJ OLEH CERMIN SFERA

1 Lengkapkan rajah sinar untuk cermin cekung dan cermin cembung. Label panjang fokus, *f* dan jejari kelengkungan, *r*.
Complete the ray diagram for concave mirror and convex mirror. Label the focal length, f and the radius of curvature, r.

(a) Cermin cekung
Concave mirror



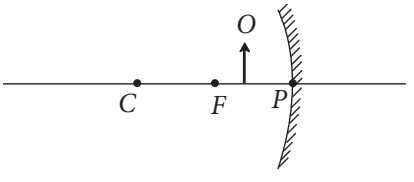
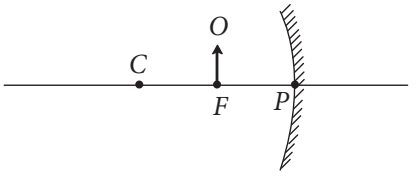
(b) Cermin cembung
Convex mirror

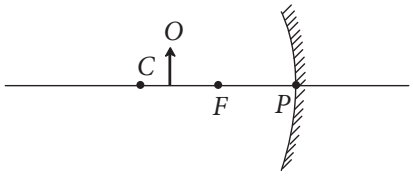
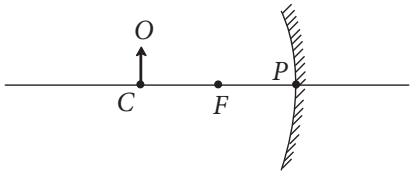
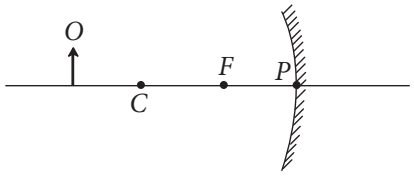
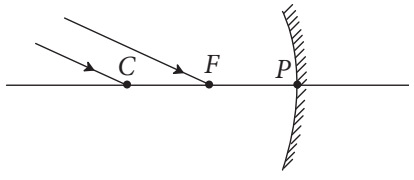


2 Nyatakan definisi istilah berikut:
State the definition of the following terms.

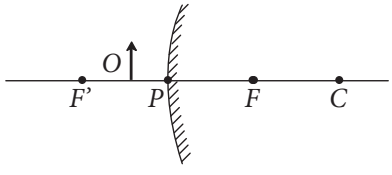
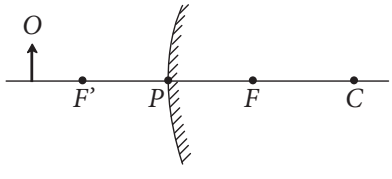
Paksi utama *Principal axis*	(a)
Titik fokus *Focus point* (*F*)	(b)
Panjang fokus *Focal length* (*f*)	(c)
Jarak objek *Object distance* (*u*)	(d)
Jarak imej *Image distance* (*v*)	(e)
Pusat kelengkungan *Center of curvature* (*O*)	(f)
Jejari kelengkungan *Radius of curvature* (*r*)	(g)

3 Lukis rajah sinar bagi setiap jarak objek, u berikut dan nyatakan ciri imej untuk cermin cekung.
Draw the ray diagram for each of the following object distances, u and state the characteristics of image for concave mirror.

u	**Rajah sinar** ***Ray diagram***	**Ciri-ciri imej** ***Characteristics of image***
$u < f$		
$u = f$		

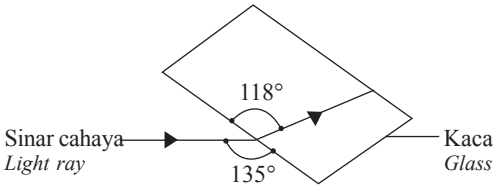
u	**Rajah sinar** ***Ray diagram***	**Ciri-ciri imej** ***Characteristics of image***
$2f > u > f$		
$u = 2f$		
$u > 2f$		
$u = \infty$		

4 Lukis rajah sinar bagi setiap jarak objek, u berikut dan nyatakan ciri imej untuk cermin cembung.
Draw the ray diagram for each of the following object distances, u and state the characteristics of image for convex mirror.

u	**Rajah sinar** ***Ray diagram***	**Ciri-ciri imej** ***Characteristics of image***
$u < f$		
$u > f$		

Kertas 1

1 Rajah 1 menunjukkan sinar cahaya merambat dari udara ke kaca.
Diagram 1 *shows a light ray propagates from air to glass.*

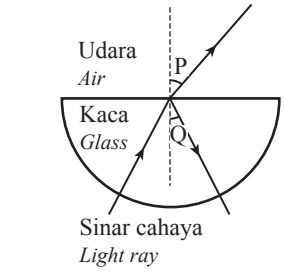


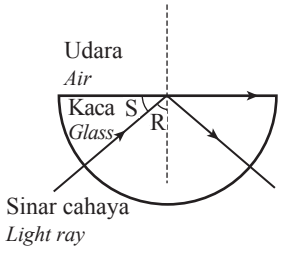
Rajah 1/ *Diagram* 1

Berapakah indeks pembiasan bagi kaca itu?
What is the refractive index for the glass?

A 1.38
B 1.51
C 1.45
D 1.62

2 Rajah 2 menunjukkan sinar cahaya merambat dari kaca ke udara pada sudut tuju yang berbeza.
Diagram 2 *shows light ray propagates from glass to air at different angles of incident.*





Rajah 2/ *Diagram* 2

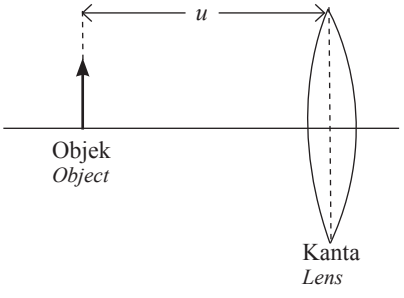
Sudut manakah mewakili sudut genting kaca?
Which angle represents the critical angle of the glass?

A P
B Q
C R
D S

3 Instrumen manakah menggunakan konsep pantulan dalam penuh?
Which instrument uses the concept of total internal reflection?

A Mikroskop
Microscope
B Kanta pembesar
Magnifying glass
C Binokular berprisma
Prism binocular
D Teleskop astronomi
Astronomical telescope

4 Rajah 3 menunjukkan objek diletakkan pada *u* cm dari kanta cembung. Panjang fokus kanta ialah 20 cm.
Diagram 3 *shows an object placed at u* cm *from the concave lens. The focal length of the lens is* 20 cm.



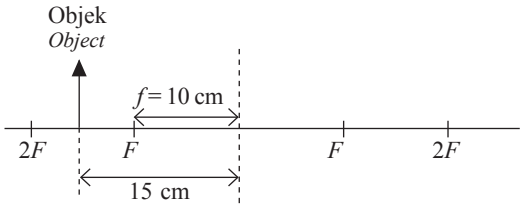
VIDEO ULASAN JAWAPAN

Rajah 3/ *Diagram* 3

Antara berikut, ciri manakah **tidak** benar apabila *u* ialah 10 cm, 15 cm, 35 cm dan 45 cm dari kanta?
Which of the following characteristics of image is **not** *true when u are* 10 cm, 15 cm, 35 cm *and* 5 cm *from the lens?*

	u	**Imej/ *Image***
A	10 cm	Maya dan diperbesar *Virtual and magnified*
B	15 cm	Maya dan diperbesar *Virtual and magnified*
C	35 cm	Nyata dan diperkecil *Real and diminished*
D	45 cm	Nyata dan diperkecil *Real and diminished*

5 Rajah 4 menunjukkan sebuah objek di hadapan sebuah kanta cembung.
Diagram 4 shows an object in front of a convex lens.



Rajah 4/ *Diagram 4*

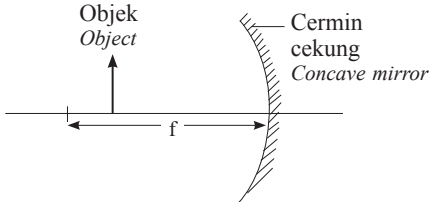
Berapakah jarak imej
What is the image distance?

A 15 cm
B 20 cm
C 25 cm
D 30 cm

6 Ciri manakah sesuai untuk dijadikan kanta pembesar?
Which characteristic suitable for magnifying glass?

	Kanta ***Lens***	**Jarak objek** ***Object distance***
A	Cembung *Convex*	Kurang daripada *f* *Less than f*
B	Cembung *Convex*	Di antara *f* dan 2*f* *Between f and 2 f*
C	Cekung *Concave*	Kurang daripada *f* *Less than f*
D	Cekung *Concave*	Di antara *f* dan 2*f* *Between f and 2 f*

7 Rajah 5 menunjukkan satu objek diletakkan di hadapan satu cermin cekung. Jarak objek itu adalah kurang daripada panjang fokus, *f* cermin itu.
Diagram 5 shows an object is placed in front of a concave mirror. The distance of the object is less than the focal length, f of the mirror.

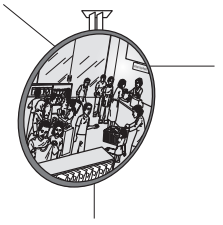


Rajah 5/ *Diagram 5*

Apakah ciri-ciri imej yang terbentuk?
What are the characteristics of the image formed?

A Nyata, tegak, lebih besar daripada objek
Real, upright, magnified
B Nyata, songsang, lebih kecil daripada objek
Real, inverted, diminished
C Maya, tegak, lebih besar daripada objek
Virtual, upright, magnified
D Maya, songsang, lebih kecil daripada objek
Virtual, inverted, diminished

8 Rajah 6 menunjukkan sebuah cermin melengkung yang digunakan di pasar raya untuk tujuan pengawasan.
Diagram 6 shows a curved mirror used in supermarkets for surveillance purposes.



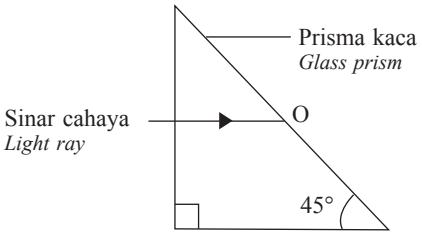
Rajah 6/ *Diagram 6*

Ciri imej yang manakah dihasilkan oleh cermin melengkung itu?
Which characteristic of image is formed by a curved mirror?

A Lebih kecil, maya, tegak
Diminished, virtual, upright
B Lebih kecil, nyata, songsang
Diminished, real, inverted
C Lebih besar, maya, tegak
Magnified, virtual, upright
D Lebih besar, maya, songsang
Magnified, virtual, inverted

Kertas 2
Bahagian A

1 Rajah 1.1 menunjukkan lintasan sinar cahaya memasuki suatu prisma kaca. Indeks biasan prisma kaca itu adalah 1.5.
Diagram 1.1 *shows a light ray path entering a glass prism. The refractive index of the glass prism is* 1.5.



Rajah 1.1/ *Diagram* 1.1

(a) Hitung sudut genting prisma kaca itu.
Calculate the critical angle of the glass prism.

[2 markah/ *marks*]

(b) Pada Rajah 1.1, lengkapkan lintasan sinar cahaya dari titik O.
On Diagram 1.1*, complete the light ray path from point* O.

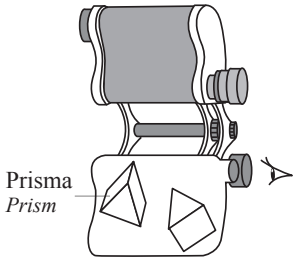
[2 markah/ *marks*]

(c) Berdasarkan jawapan di **1**(b), namakan fenomena cahaya yang terlibat.
Based on the answer in **1**(b)*, name the light phenomenon involved.*

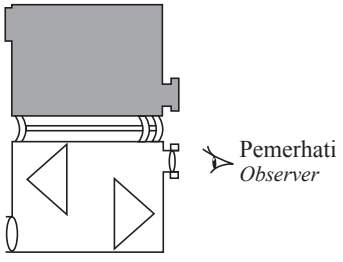
_____

[1 markah/ *marks*]

(d) Rajah 1.2 menunjukkan binokular berprisma dengan kedudukan dua prisma pada satu sisi binokular. Rajah 1.3 adalah rajah skematik bagi Rajah 1.2.
Diagram 1.2 *shows prism binoculars with two prisms on one side of the binoculars. Diagram* 1.3 *is a schematic diagram of Diagram* 1.2.



Rajah 1.2/ *Diagram* 1.2



Rajah 1.3/ *Diagram* 1.3

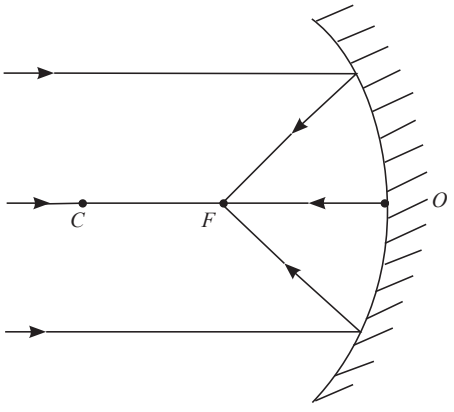
Pada Rajah 1.3, lukis lintasan sinar cahaya yang memasuki kedua-dua prisma itu.
On Diagram 1.3*, draw the light ray path entering both prisms.*

[2 markah/ *marks*]

Bahagian B

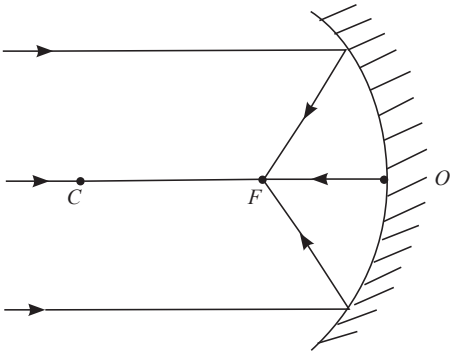
2 Rajah 2.1 dan Rajah 2.2 menunjukkan sinar cahaya yang selari merambat terhadap cermin cekung, G dan H. *C* ialah pusat lengkungan, *CO* ialah jejari lengkungan, *F* ialah titik fokus dan *FO* ialah panjang fokus bagi cermin.
Diagram 2.1 *and Diagram* 2.2 *show the parallel rays of light travel towards the concave mirrors,* G *and* H. *C is the centre of curvature, CO is the radius of curvature, F is the focal point and FO is the focal length of the mirrors.*

Cermin cekung G
Concave mirror G



Rajah 2.1/ *Diagram* 2.1

Cermin cekung H
Concave mirror H



Rajah 2.2/ *Diagram* 2.2

(a) (i) Apakah yang dimaksudkan dengan titik fokus?
What is meant by focal point?

[1 markah/ *mark*]

(ii) Nyatakan nama lain bagi cermin cekung.
State the other name for concave mirror.

[1 markah/ *mark*]

(b) Dengan menggunakan Rajah 2.1 dan Rajah 2.2, bandingkan lengkungan bagi cermin G dan H, panjang fokus dan arah cahaya selepas dipantulkan. Nyatakan hubungan antara lengkungan cermin dan panjang fokus.
Using Diagram 2.1 *and Diagram* 2.2, *compare the curvature of mirrors* G *and* H, *the focal length and the direction of light ray after reflection. State the relationship between the curvature of the mirrors and their focal lengths.*

[4 markah/ *marks*]

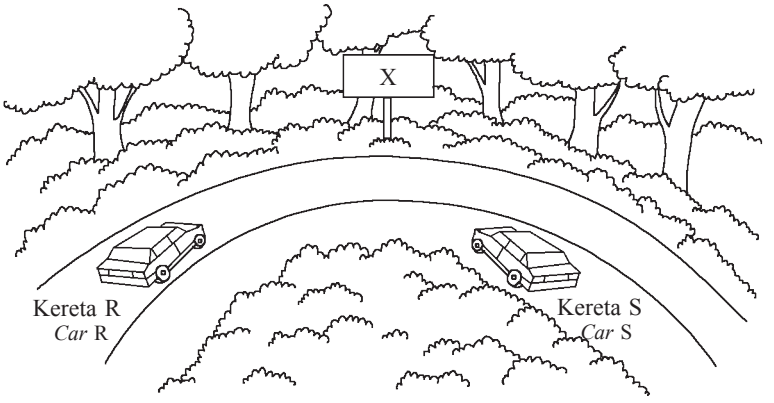
(c) Rajah 2.3 menunjukkan seorang wanita sedang menggunakan sebuah cermin sfera ketika bersolek. Imej di dalam cermin adalah lebih besar berbanding mukanya yang sebenar.
Diagram 2.3 *shows a lady is using a spherical mirror while doing her makeup. The image in the mirror is bigger than her actual face.*

Rajah 2.3/ *Diagram* 2.3

Terangkan bagaimana imej yang diperbesarkan dibentuk oleh cermin sfera.
Explain how a magnified image of the lady is formed by the spherical mirror.

[4 markah/ *marks*]

(d) Rajah 2.4 menunjukkan dua kereta, R dan S, bergerak ke arah yang bertentangan, melalui selekoh tajam. Cermin diletakkan di X.
Diagram 2.4 *shows two cars,* R *and* S*, travelling in the opposite directions, passing through a sharp corner. A mirror is placed at* X.



Rajah 2.4/ *Diagram* 2.4

Terangkan ciri cermin yang sesuai untuk digunakan sebagai cermin keselamatan luar di sudut jalan.
Explain the suitable characteristic of the mirror to be use as outdoor safety mirror at the corner of the road.

[10 markah/ *marks*]

KERTAS 1 **Masa: 1 jam 15 minit**

[40 markah/ *marks*]

Jawab **semua** soalan.
Answer **all** *questions*

1 Antara pasangan berikut, yang manakah kedua-duanya adalah kuantiti skalar?
Which of the following pairs are both scalar quantities?

A Jarak dan kerja
Distance and work

B Laju dan berat
Speed and weight

C Daya dan momentum
Force and momentum

D Sesaran dan luas
Displacement and area

2 Kuantiti yang manakah adalah kuantiti terbitan?
Which quantity is a derived quantity?

A Masa
Time

B Daya
Force

C Jisim
Mass

D Arus elektrik
Electric current

3 Rumus bagi ayunan bandul ringkas adalah seperti berikut
The formula for a simple pendulum oscillation is as follows

$$T = \sqrt{\frac{4\pi^2 l}{g}}$$

di mana T = tempoh ayunan, l = panjang bandul dan g = pecutan graviti.
where T = oscillation period, l = length of pendulum and g = gravitational acceleration.

Berdasarkan rumus yang diberi, pertanyaan yang manakah adalah betul?
Based on the given formula, which statement is correct?

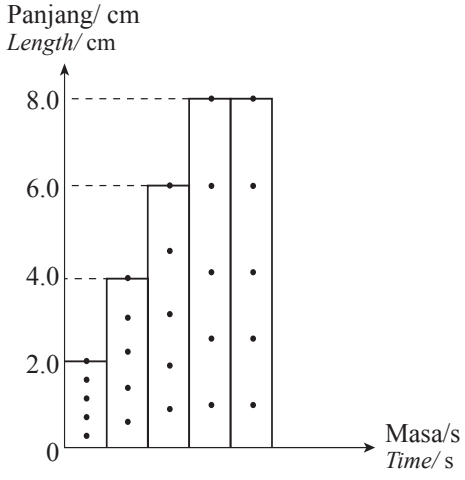
A T berkadar terus dengan l
T is directly proportional to l

B T berkadar songsang dengan g
T is inversely proportional to g

C Graf T melawan l mewakili graf garis lurus
Graph T against l represents linear graph

D Graf T^2 melawan l mewakili graf garis lurus
Graph T^2 against l represents linear graph

4 Rajah 1 menunjukkan satu carta pita bagi sebuah troli yang bergerak.
Diagram 1 *shows a tape chart of a movig trolley.*

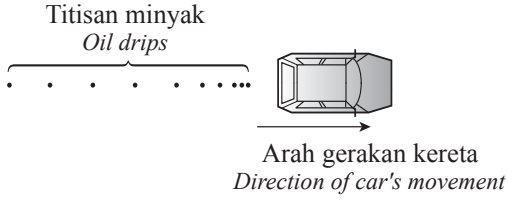


Rajah 1/ *Diagram* 1

Berapakah jumlah sesaran troli tersebut?
What is the total displacement the trolley?

A 8 cm
B 12 cm
C 20 cm
D 28 cm

5 Rajah 2 menunjukkan corak titisan minyak daripada sebuah kereta yang bergerak di atas jalan raya. Didapati minyak itu tertitis pada kadar yang malar.
Diagram 2 *shows the pattern of the oil drips from a moving car on the road. It was found that oil dripped at a constant rate.*



Rajah 2/ *Diagram* 2

Pernyataan yang manakah menerangkan pergerakan kereta tersebut?
Which statement describes the motion of the car?

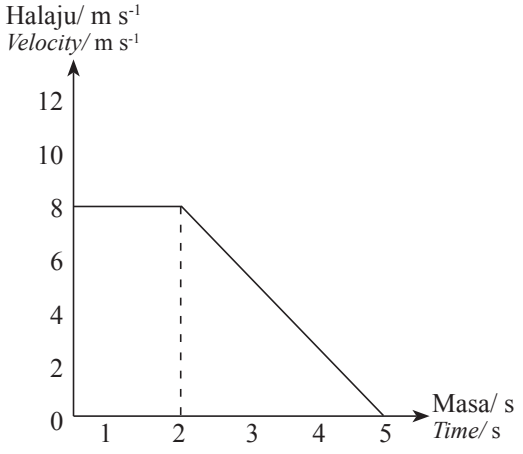
A Memecut dan kemudian bergerak dengan laju seragam
It accelerated and then moved at a uniform speed

B Memecut dan kemudian nyahpecut
It accelerated and then decelerated

C Bergerak dengan laju seragam dan kemudian nyahpecut
It moved at a uniform speed and then decelerated

D Bergerak dengan laju seragam dan kemudian memecut
It moved at a uniform speed and then accelerated

6 Rajah 3 menunjukkan graf halaju sebuah kereta berubah dengan masa.
Diagram 3 shows a graph of the velocity of a car changes with time.



Rajah 3/ *Diagram 3*

Pernyataan yang manakah betul mengenai pergerakan kereta itu?
Which of the following statements is correct about the motion of the car?

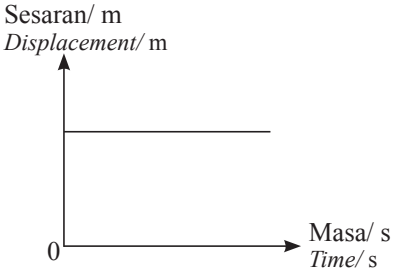
A Kereta itu pegun dari 0 s hingga 2 s
The car is stationary from 0 s *to* 2 s

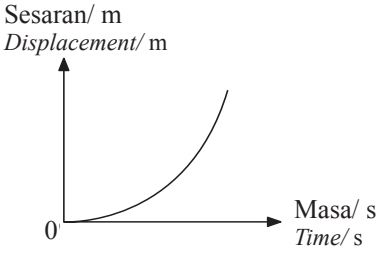
B Jumlah sesaran kereta itu ialah 28 m
The total displacement of the car is 28 m

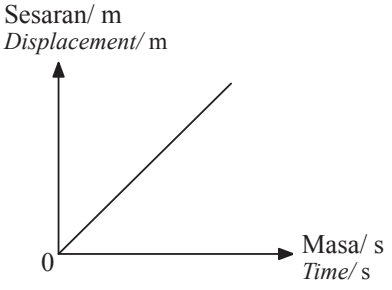
C Kereta itu memecut dari 2 s hingga 5 s
The car is accelerating from 2 s *to* 5 s

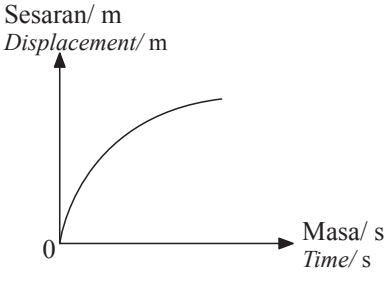
D Pecutan kereta itu adalah malar dari 0 s hingga 2 s
The acceleration of the car is constant from 0 s *to* 2 s

7 Antara graf sesaran-masa berikut, yang manakah mewakili nyahpecutan seragam suatu objek?
Which of following displacement-time graphs represents uniform deceleration of an object?

A


B


C


D


8 Apakah yang dimaksudkan dengan jatuh bebas?
What is meant by free fall?

A Jatuh dengan pecutan sifar
Falling with zero acceleration

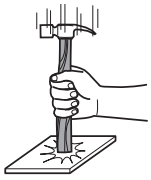
B Jatuh dengan daya paduan sifar
Falling with zero resultant force

C Jatuh disebabkan oleh tarikan daya graviti tanpa rintangan udara
Falling due to gravitational force attraction without air resisance

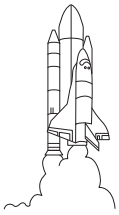
D Jatuh dalam persekitaran yang mempunyai rintangan udara
Falling in an environment that has air resistance

9 Situasi yang manakah menunjukkan kesan inersia?
Which situation shows the effect of inertia?

A



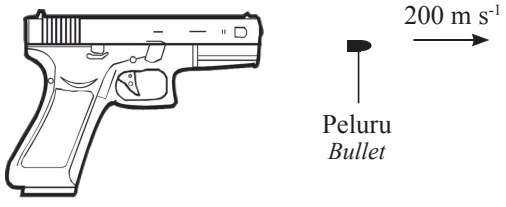
B



C

D

10 Rajah 4 menunjukkan sebutir peluru yang berjisim 15 g ditembak pada halaju 200 m s^{-1} daripada sepucuk pistol berjisim 2.0 kg.
Diagram 4 *shows a bullet of mass* 15 g *is fired at velocity of* 200 m s^{-1} *from a pistol of mass* 2.0 kg.

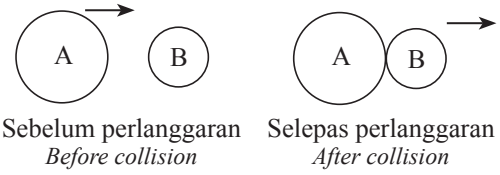


Rajah 4/ *Diagram* 4

Berapakah halaju sentakan pistol itu?
What is the recoil velocity of the pistol?

A –1.5 m s^{-1}
B 1.5 m s^{-1}
C 3.0 m s^{-1}
D 5.0 m s^{-1}

11 Rajah 5 menunjukkan satu objek bulat A bergerak mendekati lalu melanggar satu objek bulat B yang pegun di atas suatu permukaan licin. Selepas perlanggaran, kedua-dua objek bulat itu bergerak bersama-sama.
Diagram 5 *shows a circular object* A *moving towards a stationary circular object* B *and then collides on a smooth surface. After the collision, the two circular objects move together.*



Sebelum perlanggaran
Before collision

Selepas perlanggaran
After collision

Rajah 5/ *Diagram* 5

Kuantiti fizik yang manakah menjadi lebih kecil selepas perlanggaran tersebut?
Which physical quantity becomes smaller after the collision?

A Jisim
Mass
B Halaju
Velocity
C Momentum
Momentum
D Pecutan
Acceleration

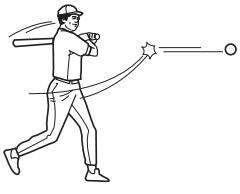
12 Situasi yang manakah menunjukkan kesan daya?
Which situation shows the effect of force?

A

B

C

D



13 Antara situasi berikut, yang manakah tidak menunjukkan daya impuls digunakan secara bermanfaat?
Which of the following situations does not show impulsive force is being used beneficially?

A Memaku sebatang paku pada papan kayu
Hammering a nail into a wooden plank
B Perlanggaran antara dua buah kenderaan
Collision between two vehicles
C Menendang sebiji bola
Kicking a ball
D Memukul bola menggunakan raket
Hitting a ball using a racket

14 Mengapakah bahagian hadapan dan bahagian belakang kereta direka bentuk supaya mudah remuk?
Why do the front and rear sections of a car are designed to crumple easily?

A Untuk mengurangkan impuls
To decrease the impulse

B Untuk mengurangkan momentum
To decrease the momentum

C Untuk menambahkan geseran
To increase the friction

D Untuk menambahkan masa hentaman
To increase the impact time

15 Berapakah jarak sebuah satelit berjisim 4 500 kg dari pusat Bumi jika satelit itu mengalami daya graviti dengan magnitud 1.52×10^7 N?
What is the distance of a satellite with a mass of 4 500 kg *from the center of the Earth when it experiences gravitational force of magnitude* 1.52×10^7 N*?*
[Jisim Bumi = 5.97×10^{24} kg]
[*Mass of Earth* = 5.97×10^{24} kg]

A 3.43×10^5 m **B** 1.34×10^9 m
C 5.90×10^{10} m **D** 1.18×10^{11} m

16 Hitung halaju lepas bagi objek yang berada di permukaan planet Marikh.
Calculate the escape velocity of an object on the surface of planet Mars.
[Jisim Marikh = 0.64×10^{24} kg;
Jejari Marikh = 3.39×10^3 km]
[*Mass of Mars* = 0.64×10^{24} kg*;*
Radius of Mars = 3.39×10^3 km]

A 1.59×10^5 km s^{-1}
B 10.0×10^2 km s^{-1}
C 11.2×10^2 km s^{-1}
D 12.4×10^2 km s^{-1}

17 Apakah faktor yang mempengaruhi halaju lepas bagi suatu objek dari permukaan Bumi?
What is the factor that affects the escape velocity of an object from the surface of the Earth?

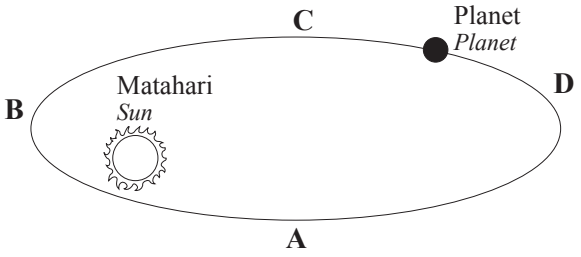
A Jisim Bumi
Mass of the Earth

B Jisim objek
Mass of the object

C Daya graviti satelit
Gravitational force of the satellite

D Pecutan graviti
Gravitational acceleration

18 Rajah 6 menunjukkan empat kedudukan bagi sebuah planet yang bergerak mengelilingi Matahari mengikut orbit yang berbentuk elips.
Diagram 6 *shows four positions of a planet that is moving around the Sun in an elliptical orbit.*



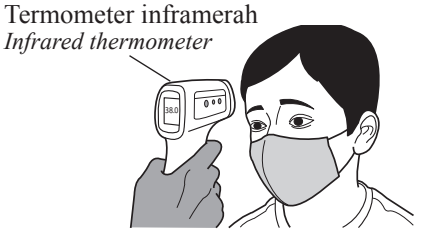
Rajah 6/ *Diagram* 6

Antara kedudukan **A**, **B**, **C** dan **D**, yang manakah halaju planet tersebut adalah maksimum?
At which position **A**, **B**, **C** *or* **D**, *the velocity of the planet is maximum?*

19 Sebuah satelit sentiasa berada di permukaan Bumi pada tempat yang sama sepanjang tahun. Berapakah tempoh orbit untuk satelit itu bergerak dalam orbitnya?
A satellite is always on the surface of the Earth in the same place throughout the year.
What is the orbital period for the satellite to move in its orbit?

A 3 jam/ *hours* **B** 24 jam/ *hours*
C 100 hari/ *days* **D** 365 hari/ *days*

20 Rajah 7 menunjukkan sebuah termometer inframerah digunakan untuk mengukur suhu badan pesakit.
Diagram 7 *shows an infrared thermometer is used to measure the body temperature of patient.*



Rajah 7/ *Diagram* 7

Konsep yang manakah menerangkan prinsip kerja termometer inframerah itu?
Which concept explains the working principle of the infrared thermometer?

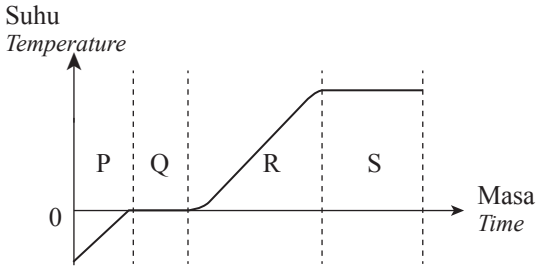
A Muatan haba tentu
Specific heat capacity

B Keseimbangan terma
Thermal equilibrium

C Sentuhan terma
Thermal contact

D Pemindahan haba
Heat transfer

21 Rajah 8 menunjukkan lengkung pemanasan suatu bahan pepejal.
Diagram 8 shows a heating curve of a solid substance.



Rajah 8/ *Diagram 8*

Antara pernyataan berikut, yang manakah benar?
Which of the following statements is true?

I Pada peringkat P, tenaga kinetik molekul bahan pepejal tidak berubah
At stage P, the kinetic energy of molecules of the solid substance is unchanged

II Pada peringkat Q, bahan pepejal melebur menjadi cecair
At stage Q, the solid substance melts to liquid

III Pada peringkat R, bahan pepejal berubah menjadi stim
At stage R, the solid substance changes to steam

IV Pada peringkat S, haba pendam pengewapan diserap oleh bahan itu
At stage S, latent heat of vaporisation is absorbed by the substance

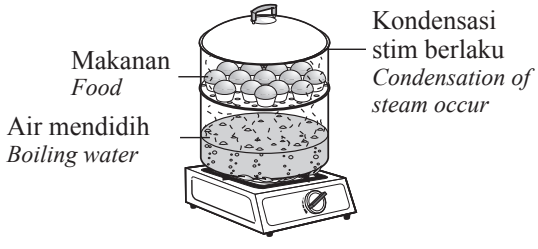
A I dan II sahaja
I *and* II *only*

B I dan III sahaja
I *and* III *only*

C II dan IV sahaja
II *and* IV *only*

D III dan IV sahaja
III *and* IV *only*

22 Rajah 9 menunjukkan air yang mendidih di dalam sebuah pengukus.
Diagram 9 shows the water is boiling in a steamer.



Rajah 9/ *Diagram 9*

Apakah yang berlaku semasa pengukusan makanan?
What happens during the food steaming?

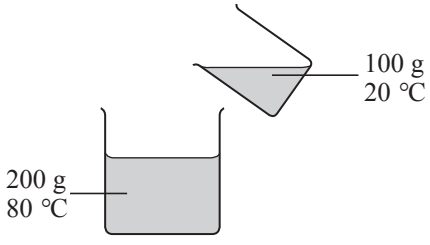
A Suhu stim berkurang semasa kondensasi
The temperature of steam decreases during condensation

B Tenaga kinetik molekul air bertambah semasa pendidihan
The kinetic energy of water molecules increases during boiling

C Haba yang dibebaskan oleh stim terkondensasi digunakan untuk memasak
Heat released by the condensed steam is used for cooking

D Daya ikatan antara molekul-molekul air bertambah semasa kondensasi
The intermolecular binding force of water molecules increases during condensation

23 Rajah 10 menunjukkan 100 g air pada 20 °C dituang ke dalam bikar yang mengandungi 200 g air pada 80 °C.
Diagram 10 shows 100 g of water at 20 °C is poured into a beaker containing 200 g of water at 80 °C.



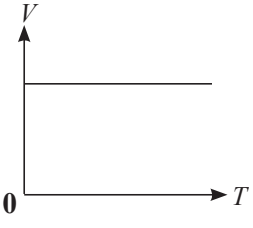
Rajah 10/ *Diagram 10*

Berapakah suhu akhir campuran air itu?
What is the final temperature of the mixture of water?

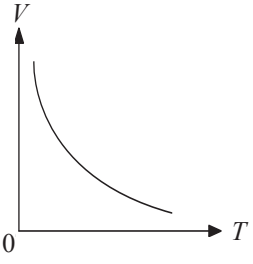
A 30 °C
B 50 °C
C 60 °C
D 70 °C

24 Antara graf berikut, yang manakah menunjukkan hubungan antara isi padu dan suhu mutlak bagi suatu gas berjisim tetap pada tekanan malar?
Which of the following graphs shows the relationship between the volume and absolute temperature of a fixed mass of gas at constant pressure?

A

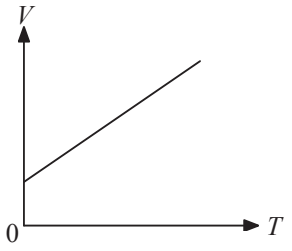


B

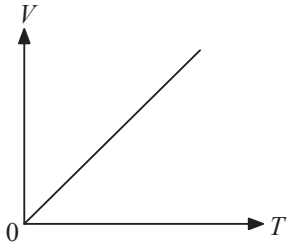


Penilaian Akhir Tahun

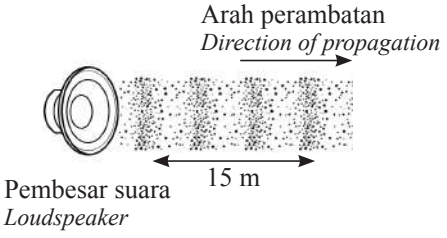
C



D



25 Rajah 11 menunjukkan gelombang bunyi yang dihasilkan oleh sebuah pembesar suara.
Diagram 11 *shows the sound waves produced by a loudspeaker.*

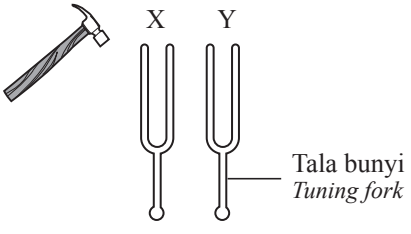


Rajah 11/ *Diagram* 11

Jika halaju gelombang bunyi itu ialah 250 m s^{-1}, hitung frekuensi pembesar suara tersebut?
If the velocity of the sound wave is 250 m s^{-1}, *calculate the frequency of the loudspeaker?*

A 15 Hz
B 25 Hz
C 50 Hz
D 75 Hz

26 Rajah 12 menunjukkan dua tala bunyi yang serupa, X dan Y, diletakkan bersebelahan. Tala bunyi X diketuk supaya bergetar. Kemudian, tala bunyi Y turut bergetar.
Diagram 12 *shows two identical tuning forks,* X *and* Y, *are placed side by side. Tuning fork* X *is struck to vibrate. Then, tuning fork* Y *also vibrates.*



Rajah 12/ *Diagram* 12

Kesan ini dikenali sebagai
This effect is known as

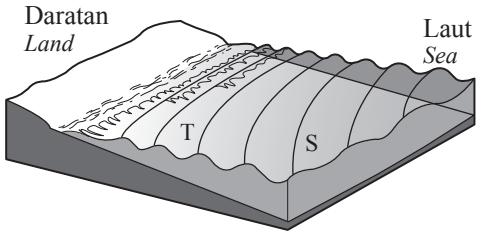
A kelangsingan *pitch*
B pelembapan *damping*
C resonans *resonance*
D ayunan *oscillation*

27 Apabila gelombang air satah dipantulkan oleh pemantul satah, maka
When the plane water waves are reflected by a plane reflector, then

I frekuensinya tidak berubah
their frequency does not change
II panjang gelombangnya berubah
their wavelength changes
III arah perambatannya berubah
their direction of propagation changes

A I dan II sahaja
I *and* II *only*
B I dan III sahaja
I *and* III *only*
C II dan III sahaja
II *and* III *only*
D I, II dan III
I, II *and* III

28 Rajah 13 menunjukkan corak pembiasan bagi gelombang air dari S ke T.
Diagram 13 *shows the refraction pattern of water waves from* S *to* T.

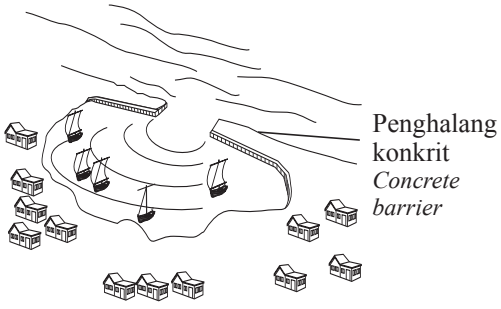


Rajah 13/ *Diagram* 13

Perbandingan manakah yang betul tentang ciri-ciri gelombang di S dan T?
Which comparison is correct about the characteristics of waves at S *and* T?

	Frekuensi *Frequency*	**Laju** *Speed*
A	T lebih rendah daripada S T *is lower than* S	T lebih perlahan daripada S T *is slower than* S
B	T lebih rendah daripada S T *is lower than* S	T lebih cepat daripada S T *is faster than* S
C	T sama dengan S T *is same as* S	T lebih perlahan daripada S T *is slower than* S
D	T sama dengan S T *is same as* S	T lebih cepat daripada S T *is faster than* S

29 Rajah 14 menunjukkan gelombang air melepasi celah di antara penghalang konkrit berhampiran pantai.
Diagram 14 *shows water waves passing through a gap between concrete barriers near the beach.*



Rajah 14/ *Diagram* 14

Fenomena gelombang yang berlaku adalah
The wave phenomenon occurs is

A pantulan
reflection
B pembiasan
refraction
C pembelauan
diffraction
D interferens
interference

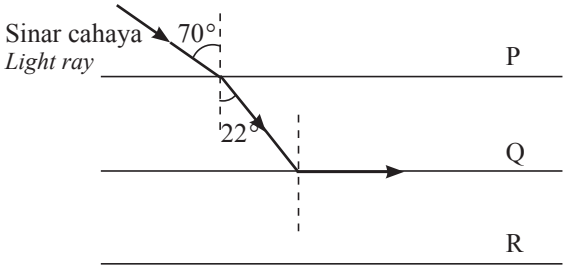
30 Satu cahaya monokromatik melalui dwicelah. Pinggir-pinggir cerah dan gelap terbentuk di atas skrin disebabkan oleh
A monochromatic light passes through a double-slit. Bright and dark fringes are formed on the screen due to

A pantulan gelombang cahaya.
reflection of light waves.
B pembiasan gelombang cahaya.
refraction of light waves.
C pembelauan gelombang cahaya.
diffraction of light waves.
D interferens gelombang cahaya.
interference of light waves.

31 Antara susunan berikut, yang manakah menunjukkan jenis gelombang elektromagnet disusun dalam urutan frekuensi menurun?
Which of the following arrangements shows the types of electromagnetic waves are arranged in descending order of frequency?

A Sinar-X, gelombang radio, gelombang mikro
X-rays, radio waves, microwaves
B Gelombang mikro, cahaya nampak, sinar-X
Microwaves, visible light, X-rays
C Sinar gama, sinar-X, gelombang radio
Gamma rays, X-rays, radio waves
D Sinar-X, sinar ultraungu, sinar gama
X-rays, ultraviolet rays, gamma rays

32 Rajah 15 menunjukkan satu sinar cahaya bergerak melalui tiga medium P, Q dan R yang berbeza ketumpatan optik.
Diagram 15 *shows a light ray travel through three mediums* P, Q *and* R *of different optical densities.*



Rajah 15/ *Diagram* 15

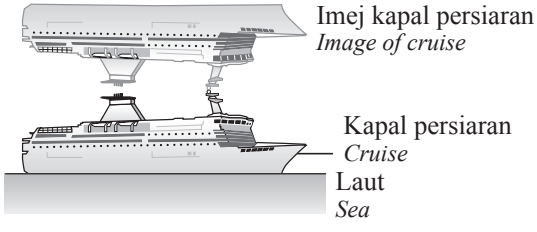
Antara pasangan berikut, yang manakah adalah betul?
Which of the following pairs is correct?

	Ketumpatan optik *Optical density*	**Sudut genting** *Critical angle*
A	P < Q < R	70°
B	P > Q > R	22°
C	P > Q > R	70°
D	P < Q > R	22°

33 Halaju cahaya di dalam vakum ialah 3×10^8 m s^{-1}. Indeks biasan bagi air ialah 1.30.
Berapakah halaju cahaya di dalam air?
The velocity of light in vacuum is 3×10^8 m s^{-1}. *The refractive index of water is* 1.30.
What is the velocity of light in water?

A 2.11×10^8 m s^{-1}
B 2.31×10^8 m s^{-1}
C 3.11×10^8 m s^{-1}
D 4.26×10^8 m s^{-1}

34 Rajah 16 menunjukkan sebuah kapal persiaran dan imejnya di atas permukaan laut yang sejuk. Imej itu terbentuk disebabkan oleh logamaya superior.
Diagram 16 *shows a cruise and its image on a cold sea surface. The image is formed due to superior mirage.*



Rajah 16/ *Diagram* 16

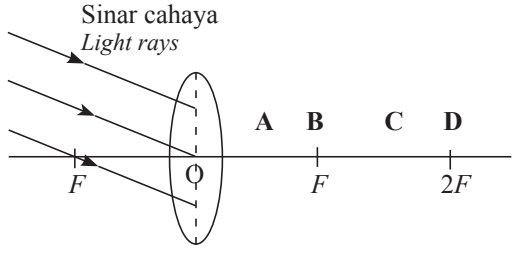
Fenomena cahaya manakah yang membentuk imej kapal persiaran itu?
Which light phenomenon forms the image of cruise?

A Pembiasan
Refraction
B Pembelauan
Diffraction
C Pantulan cahaya
Reflection of light
D Pantulan dalam penuh
Total internal reflection

35 Peralatan yang manakah mengaplikasikan konsep pantulan dalam penuh?
Which equipment applies concept of total internal reflection?

A Binokular
Binocular
B Teleskop
Telescope
C Mikroskop
Microscope
D Projektor slaid
Slide projector

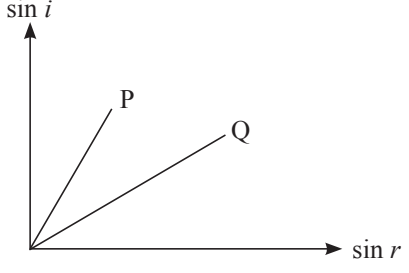
36 Rajah 17 menunjukkan sinar cahaya bergerak dari objek jauh ke sebuah kanta cembung.
Diagram 17 *shows light rays travel from a distant object to a convex lens.*



Rajah 17/ *Diagram* 17

Antara kedudukan **A**, **B**, **C** dan **D**, kedudukan manakah imej terbentuk?
At which position **A**, **B**, **C** *or* **D**, *the image is formed?*

37 Rajah 18 menunjukkan satu graf sin *i* melawan sin *r* bagi dua jenis bongkah kaca yang berlainan, P dan Q.
Diagram 18 *shows a graph of sin i against sin r for two different glass blocks,* P *and* Q.

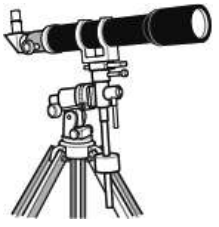


Rajah 18/ *Diagram* 18

Kecerunan graf bagi bongkah kaca P lebih besar daripada Q. Hal ini menunjukkan
The gradient of the graph for glass block P *is greater than* Q. *This shows that*

A Q lebih tumpat daripada P.
Q *is denser than* P.
B indeks biasan P lebih besar daripada Q.
the refractive index for P *is greater than* Q.
C kelajuan cahaya di dalam P lebih pantas daripada di dalam Q.
the speed of light in P *is faster than in* Q.
D frekuensi cahaya di dalam P lebih tinggi daripada di dalam Q.
the frequency of light in P *is faster than in* Q.

38 Rajah 19 menunjukkan sebuah teleskop astronomi dengan 100 cm dalam pelarasan normal.
Diagram 19 *shows an astronomical telescope with* 100 cm *in normal adjusment.*

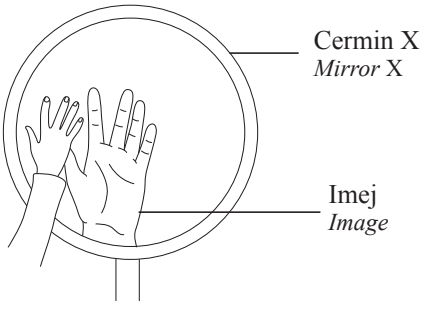


Rajah 19/ *Diagram* 19

Diberi panjang fokus kanta mata ialah 40 cm, hitung pembesaran linear teleskop tersebut.
Given that the focal length of the eyepiece is 40 cm, *calculate the linear magnification of the telescope.*

A 2.5
B 2.4
C 1.5
D 1.3

39 Rajah 21 menunjukkan imej dalam cermin X.
Diagram 21 *shows an image in mirror* X.



Rajah 21/ *Diagram* 21

Apakah jenis cermin X?
What is the type of mirror X*?*

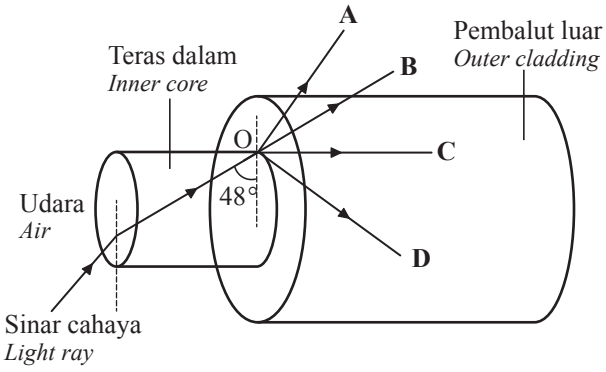
A Cermin satah
Plane mirror

B Cermin cembung
Convex mirror

C Cermin cekung
Concave mirror

D Cermin solek
Make up mirror

40 Rajah 21 menunjukkan sinar cahaya melalui satu gentian optik. Sudut genting teras dalam ialah 46° dan θ ialah 48°.
Diagram 21 *shows the light ray passes through an optical fibre. The critical angle of the inner core is* 46° *and* θ *is* 48°.



Rajah 21/ *Diagram* 21

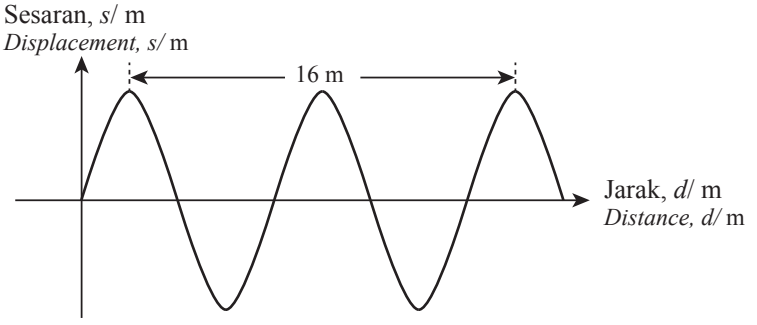
Antara sinar cahaya **A**, **B**, **C** dan **D**, sinar cahaya manakah yang betul selepas melalui titik O?
Which light rays, **A**, **B**, **C** *or* **D**, *is correct after passing through point* O*?*

Bahagian A

[60 markah/ *marks*]

Jawab **semua** soalan.
Answer **all** *questions.*

1 Rajah 1 menunjukkan graf sesaran melawan jarak bagi gelombang air dengan frekuensi 5 Hz.
Diagram 1 *shows a graph of displacement against distance for a water wave with frequency of* 5 Hz.



Rajah 1/ *Diagram* 1

(a) Apakah yang dimaksudkan dengan gelombang melintang?
What is meant by transverse wave?

_____

[1 markah/ *mark*]

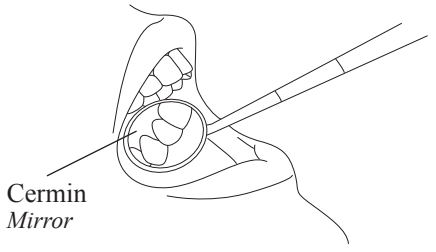
(b) Pada Rajah 1, tanda dan label amplitud dengan simbol 'A'.
On Diagram 1*, mark and label amplitude with symbol* 'A'.

[1 markah/ *mark*]

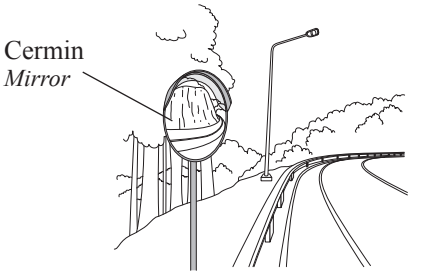
(c) Hitung halaju gelombang air tersebut.
Calculate the velocity of the water wave.

[2 markah/ *marks*]

2 Rajah 2.1 menunjukkan satu cermin yang digunakan untuk memeriksa gigi pesakit dan Rajah 2.2 menunjukkan satu cermin yang diletakkan di selekoh yang tajam di sebatang jalan.
Diagram 2.1 *shows a mirror used to inspect a patient's teeth and Diagram* 2.2 *shows a mirror is placed at a sharp bend of a road.*



Rajah 2.1/ *Diagram* 2.1



Rajah 2.2/ *Diagram* 2.2

(a) Namakan jenis cermin yang digunakan dalam
Name the type of mirror used in

(i) Rajah 2.1.
Diagram 2.1.

[1 markah/ *mark*]

(ii) Rajah 2.2.
Diagram 2.2.

[1 markah/ *mark*]

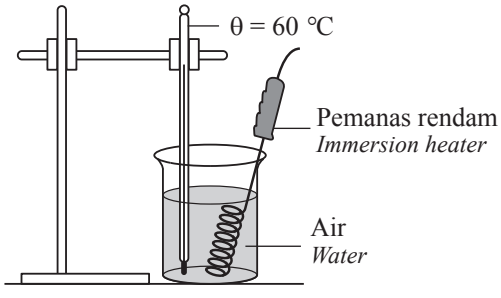
(b) (i) Berdasarkan Rajah 2.1 dan Rajah 2.2, bandingkan ciri-ciri imej yang terbentuk.
Based on Diagram 2.1 *and Diagram* 2.2, *compare the characteristics of the images formed.*

[2 markah/ *marks*]

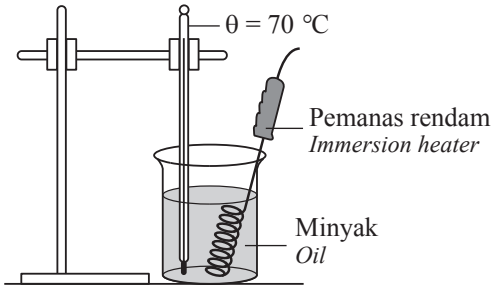
(ii) Berikan kegunaan lain bagi cermin dalam Rajah 2.2.
Give other application of the mirror in Diagram 2.2.

[1 markah/ *mark*]

3 Rajah 3.1 dan Rajah 3.2 menunjukkan dua pemanas rendam yang serupa digunakan untuk memanaskan air dan minyak yang sama jisim. Kedua-dua bekas yang digunakan untuk mengisi air dan minyak adalah daripada jenis yang sama.
Diagrams 3.1 *and Diagram* 3.2 *show two similar immersion heaters that are used to heat the same mass of water and oil. Both containers used to fill the water and the oil are of the same type of material.*



Rajah 3.1/ *Diagram* 3.1



Rajah 3.2/ *Diagram* 3.2

(a) Apakah yang dimaksudkan dengan muatan haba tentu?
What is the meaning of specific heat capacity?

[1 markah/ *mark*]

(b) Bandingkan bacaan termometer dalam Rajah 3.1 dan Rajah 3.2.
Compare the thermometer readings in Diagram 3.1 *and Diagram* 3.2.

[1 markah/ *mark*]

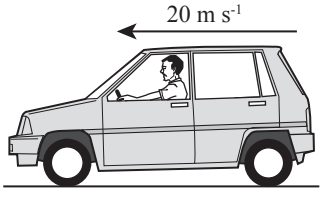
(c) Terangkan bagaimana perbezaan di **3**(b) berlaku.
Explain how the difference in **3**(b) *occurs.*

[2 markah/ *marks*]

(d) Jika 1 kg air digunakan, perubahan suhu adalah sebanyak 10 °C.
Hitung kuantiti haba yang digunakan untuk memanaskan air tersebut.
If 1 kg *of water is used, the change in temperature is* 10 °C.
Calculate the heat quantity used to heat the water.
[Muatan haba tentu air = 4 200 J kg^{-1} $°C^{-1}$]
[*Specific heat capacity of water* = 4 200 J kg^{-1} $°C^{-1}$]

[2 markah/ *marks*]

4 Rajah 4.1 menunjukkan seorang lelaki sedang memandu sebuah kereta di sepanjang jalan lurus dengan halaju malar 20 m s^{-1}. Jumlah jisim lelaki dan kereta itu ialah 1 440 kg.
Diagram 4.1 *shows a man driving a car along a straight road with a constant velocity of* 20 m s^{-1}. *The total mass of the driver and the car is* 1 440 kg.



Rajah 4.1/ *Diagram* 4.1

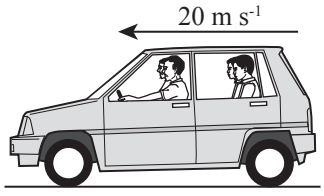
(a) Apakah maksud momentum?
What is the meaning of momentum?

[1 markah/ *mark*]

(b) Berapakah momentum kereta yang sedang bergerak itu?
What is the momentum of the moving car?

[2 markah/ *marks*]

(c) Rajah 4.2 menunjukkan kereta yang sama dalam Rajah 4.1 diisi sehingga muatan maksimumnya dan bergerak di sepanjang jalan lurus yang sama dengan halaju malar 20 m s^{-1}. Jumlah jisim kereta dan semua penumpangnya ialah 1 700 kg.
Diagram 4.2 *shows the same car in Diagram* 4.1 *is then loaded to its maximum capacity and travels along the same straight road with the constant velocity of* 20 m s^{-1}. *The total mass of the car and all passengers is* 1 700 kg.



Rajah 4.2/ *Diagram* 4.2

(i) Berapakah momentum kereta dalam Rajah 4.2?
What is the momentum of the car in Diagram 4.2*?*

[2 markah/ *marks*]

(ii) Apakah yang berlaku kepada momentum dan inersia kereta tersebut apabila bilangan penumpang bertambah?
What happens to the momentum and inertia of the car when the number of passengers increases?

_____

_____

[2 markah/ *marks*]

(d) Jika kereta dalam Rajah 4.1 dan Rajah 4.2 mengalami keadaan kecemasan, keadaan kereta yang manakah lebih berbahaya? Terangkan jawapan anda.
If the car in Diagram 4.1 *and Diagram* 4.2 *is in an emergency, which car is more in dangerous condition? Explain your answer.*

_____

_____

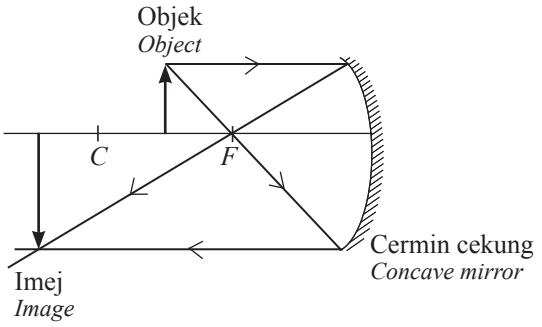
_____

_____

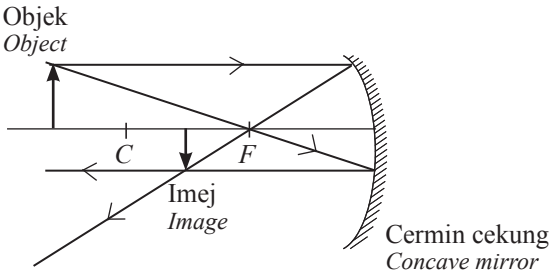
_____

[2 markah/ *marks*]

5 Rajah 5.1 dan Rajah 5.2 menunjukkan rajah sinar bagi dua cermin cekung yang sama. *C* ialah pusat kelengkungan dan *F* ialah titik fokus.
Diagram 5.1 *and Diagram* 5.2 *show the ray diagrams for two identical concave mirrors. C is centre of curvature and F is focal point.*



Rajah 5.1/ *Diagram* 5.1



Rajah 5.2/ *Diagram* 5.2

(a) Apakah yang dimaksudkan dengan titik fokus?
What is the meaning of focal point?

_____

_____

[1 markah/ *mark*]

(b) Berdasarkan Rajah 5.1 dan Rajah 5.2,
Based on Diagram 5.1 *and Diagram* 5.2,

(i) bandingkan jarak objek.
compare the object distance.

_____

_____

[1 markah/ *mark*]

(ii) bandingkan jarak imej.
compare the image distance.

_____

_____

[1 markah/ *mark*]

(iii) hubung kait jarak objek dengan jarak imej.
relate the object distance to the image distance.

_____

_____

[1 markah/ *mark*]

(iv) nyatakan hubungan antara jarak objek dengan jarak imej.
state the relationship between the object distance and the image distance.

_____

_____

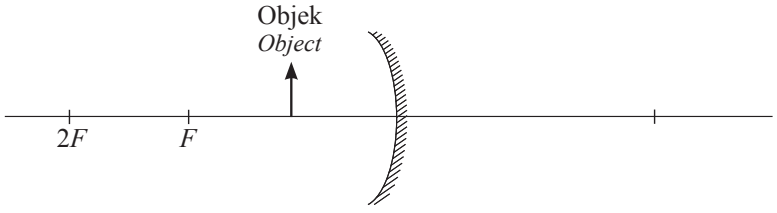
[1 markah/ *mark*]

(v) namakan fenomena cahaya yang terlibat.
name the light phenomenon involved.

_____

[1 markah/ *mark*]

(c) Rajah 5.3 menunjukkan rajah sinar yang tidak lengkap.
Diagram 5.3 shows an incomplete ray diagram.

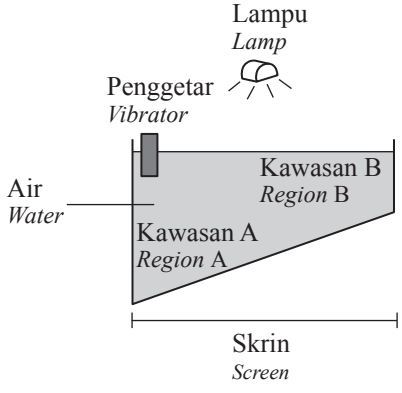


Rajah 5.3/ *Diagram 5.3*

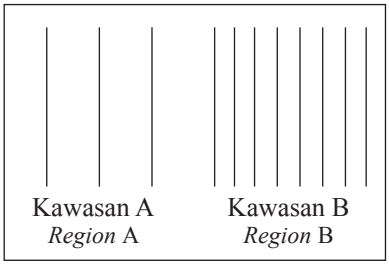
Pada Rajah 5.3, lengkapkan rajah sinar itu untuk menunjukkan bagaimana imej terbentuk.
On Diagram 5.3, complete the ray diagram to show how the image is formed.

[3 markah/ *marks*]

6 Rajah 6.1 menunjukkan sebuah tangki riak dengan dasar condong. Satu penggetar satah digetarkan dengan sebuah motor elektrik untuk menghasilkan corak gelombang melintang. Rajah 6.2 menunjukkan corak gelombang yang terbentuk di atas skrin.
Diagram 6.1 shows a ripple tank with a sloping base. A plane vibrator is vibrated with an electric motor to produce a transverse waves pattern. Diagram 6.2 shows the waves pattern formed on the screen.



Rajah 6.1/ *Diagram 6.1*



Rajah 6.2/ *Diagram 6.2*

(a) Apakah yang dimaksudkan dengan gelombang melintang?
What is the meaning of transverse wave?

_____

_____

[1 markah/ *mark*]

(b) Dengan menggunakan Rajah 6.1 dan Rajah 6.2, bandingkan
Using Diagram 6.1 and Diagram 6.2, compare

(i) kedalaman air di kawasan A dan kawasan B.
the depths of water in region A and region B.

_____

_____

[1 markah/ *mark*]

(ii) panjang gelombang air di kawasan A dan kawasan B.
the wavelengths of the water wave in region A *and region* B.

[1 markah/ *mark*]

(iii) hubung kait kedalaman air dengan panjang gelombang bagi gelombang air itu.
relate the depth of water to the wavelength of the water wave.

[1 markah/ *mark*]

(c) (i) Namakan kuantiti fizik lain yang berubah semasa perambatan gelombang air itu dari kawasan A ke kawasan B.
Name other physical quantity that changed during the propagation of the water wave from region A *to region* B.

[1 markah/ *mark*]

(ii) Berdasarkan kuantiti fizik di **6**(c)(i), terangkan corak gelombang dalam Rajah 6.2.
Based on the physical quantity in **6**(c)(i)*, explain the waves pattern in Diagram* 6.2.

[2 markah/ *marks*]

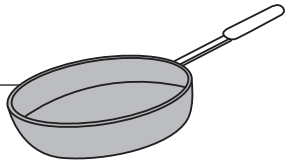
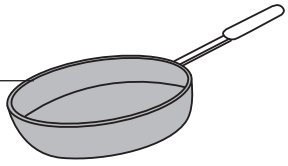
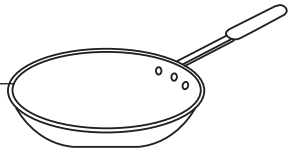
(d) Apakah yang berlaku kepada panjang gelombang di kawasan A jika frekuensi penggetar satah itu bertambah?
What happens to the wavelength in region A *if the frequency of the plane vibrator increases?*

[1 markah/ *mark*]

(e) Hubung kait panjang gelombang dengan frekuensi jika kedalaman air di dalam tangki riak adalah sama.
Relate the wavelength to the frequency if the depths of water in the ripple tank are the same.

[1 markah/ *mark*]

7 Jadual 1 menunjukkan tiga jenis kuali dan ciri-cirinya.
Table 1 shows three types of pans and their characteristics.

Kuali *Pan*	**Bahan kuali** *Material of the pan*	**Jisim** *Mass*	**Muatan haba tentu** *Specific heat capacity*
M	Tembaga *Copper* 	2.2 kg	387 J kg^{-1} $°C^{-1}$
N	Besi *Iron* 	2.5 kg	500 J kg^{-1} $°C^{-1}$
O	Aluminium *Aluminium* 	2.9 kg	900 J kg^{-1} $°C^{-1}$

Jadual 1/ *Table 1*

(a) Berdasarkan Jadual 1, nyatakan ciri-ciri sesuai bagi kuali yang digunakan untuk menggoreng keropok lekor dengan cepat. Berikan sebab bagi setiap ciri berikut.
Based on Table 1, state the suitable characteristics of the pan that used to fry 'keropok lekor' quickly. Give reason for each of the following characteristics.

(i) Muatan haba tentu.
Specific heat capacity.

_____

Sebab:
Reason:

_____

[2 markah/ *marks*]

(ii) Jisim kuali.
Mass of the pan.

_____

Sebab:
Reason:

_____

[2 markah/ *marks*]

(b) Ketiga-tiga kuali itu dipanaskan dengan menggunakan plat pemanas elektrik berkuasa 500 W. Berdasarkan maklumat dalam Jadual 1, hitung masa yang diambil untuk meningkatkan suhu sebanyak 50°C bagi
The three pans is heated by using an electric hot plate of power 500 W. *Based on the information in Table* 1*, calculate the time taken to achieve the temperature rise of* 50°C *for*

(i) kuali M/ *pan* M;

[2 markah/ *marks*]

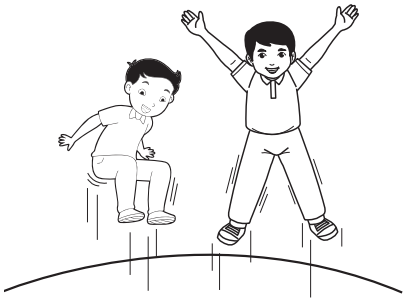
(ii) kuali N/ *pan* N.

[2 markah/ *marks*]

(c) Berdasarkan jawapan di **7**(b), kuali yang manakah lebih sesuai digunakan untuk menggoreng keropok lekor dalam masa yang singkat?
Basd on the answer in **7**(b)*, which pan is more suitable to be used to fry 'keropok lekor' in the shortest period of time?*

[1 markah/ *mark*]

8 Rajah 8.1 menunjukkan dua orang murid sedang melakukan aktiviti mendarat yang berbeza.
Diagram 8.1 *shows two pupils are making different landing activity.*



Rajah 8.1/ *Diagram* 8.1

(a) Kedua-dua murid itu terjun dari ketinggian yang sama dan mendarat di kawasan yang sama.
Both pupils jumped from the same height and fall on the same ground.

(i) Namakan daya yang menyebabkan kedua-dua murid itu jatuh.
Name the force that causes both pupils to fall down.

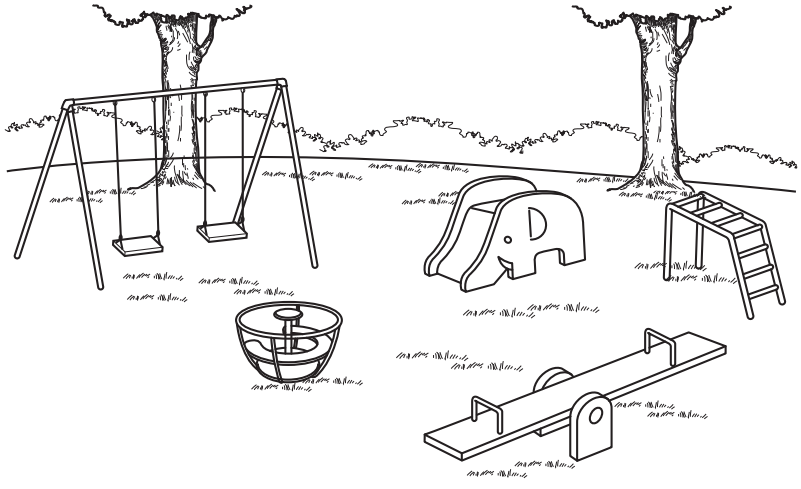
[1 markah/ *mark*]

(ii) Apakah fenomena yang berlaku berdasarkan jawapan di **8**(a)(i)?
What is the phenomenon occurs based on the answer in **8**(a)(i)*?*

_____

[1 markah/ *mark*]

(b) Rajah 8.2 menunjukkan satu set peralatan permainan yang diletakkan di sebuah taman permainan kanak-kanak.
Diagram 8.2 *shows a set of playing equipments placed in a children's playground.*



Rajah 8.2/ *Diagram* 8.2

Jadual 2 menunjukkan tiga reka bentuk peralatan permainan yang diletakkan di taman permainan kanak-kanak.
Table 2 *shows three designs of the playing equipments placed in a children's playground.*

Reka bentuk ***Design***	**Ketinggian buaian** ***Height of the swing***	**Ciri tapak taman permainan** ***Characteristic of the playground's base***	**Bahan untuk peralatan permainan** ***Material for playing equipments***
P	Rendah *Low*	Getah *Rubber*	Keluli *Steel*
Q	Tinggi *High*	Konkrit *Concrete*	Plastik *Plastic*
R	Rendah *Low*	Getah *Rubber*	Plastik *Plastic*

Jadual 2/ *Table* 2

Berdasarkan tiga reka bentuk peralatan permainan yang ditunjukkan dalam Jadual 2, nyatakan ciri-ciri yang paling sesuai supaya lebih selamat untuk kegunaan kanak-kanak. Berikan sebab bagi setiap ciri berikut.
Based on the three designs of the playing equipments shown in Table 2, state the suitable characteristics so that it is safer for the children. Give reasons for each of the following characteristics.

(i) Ketinggian buaian.
Height of the swing.

_____

Sebab:
Reason:

_____

_____

[2 markah/ *marks*]

(ii) Ciri tapak taman permainan.
Characteristic of the playground's base.

_____

Sebab:
Reason:

_____

_____

[2 markah/ *marks*]

(iii) Bahan yang digunakan untuk peralatan permainan.
Material used for the playing equipments.

_____

Sebab:
Reason:

_____

_____

[2 markah/ *marks*]

(c) Berdasarkan jawapan anda di **8**(b), pilih reka bentuk peralatan permainan yang paling sesuai untuk diletakkan di taman permainan kanak-kanak.
Based on your answer in **8**(b)*, choose the most suitable design of the playing equipments to be placed in the children's playground.*

_____

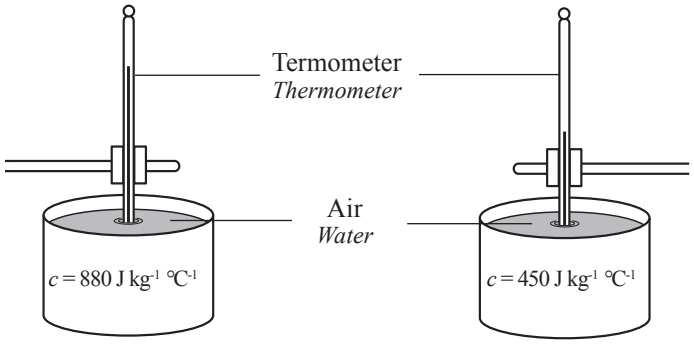
[1 markah/ *mark*]

Bahagian B

[20 markah/ *marks*]

Jawab mana-mana **satu** soalan daripada bahagian ini.
*Answer any **one** question from this section.*

9 Rajah 9.1 dan Rajah 9.2 menunjukkan dua bekas yang diisi dengan air mendidih yang sama isi padu selepas 10 minit. Jisim kedua-dua bekas adalah sama dan diperbuat daripada bahan yang berbeza muatan haba tentu.
Diagram 9.1 *and Diagram* 9.2 *show two containers are filled with same volume of boiling water after* 10 *minutes. The mass of both containers are the same and are made of different materials of specific heat capacity.*



Rajah 9.1/ *Diagram* 9.1 Rajah 9.2/ *Diagram* 9.2

(a) Namakan konsep fizik yang terlibat apabila termometer itu mengukur suhu air.
Name the physics concept involved when the thermometer measures the temperature of water.

[1 markah/ *mark*]

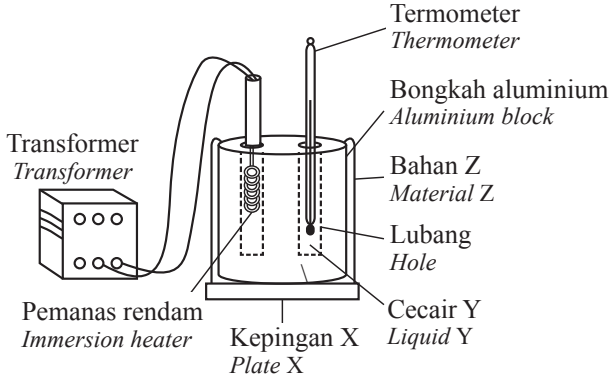
(b) Menggunakan Rajah 9.1 dan Rajah 9.2, bandingkan jumlah haba awal air, muatan haba tentu, suhu air selepas 10 minit dan kadar kehilangan haba bagi kedua-dua bekas itu. Kemudian, hubung kait muatan haba tentu bekas dengan kadar kehilangan haba.
Using Diagram 9.1 *and Diagram* 9.2*, compare the amount of initial heat of water, the specific heat capacity, the temperature of water after* 10 *minutes and the rate of heat loss for both containers. Then, relate the specific heat capacity of containers to the rate of heat loss.*

[5 markah/ *marks*]

(c) Selepas beberapa minit, suhu air dan suhu bekas dalam Rajah 9.1 adalah sama. Terangkan bagaimana hal ini boleh berlaku.
After several minutes, the temperature of water and the temperature of the container in Diagram 9.1 *are the same. Explain how does it happen.*

[4 markah/ *marks*]

(d) Rajah 9.3 menunjukkan susunan radas untuk menentukan muatan haba tentu bongkah aluminium.
Diagram 9.3 *shows the apparatus arrangement to determine the specific heat capacity of an aluminium block.*



Rajah 9.3/ *Diagram* 9.3

Jadual 3 menunjukkan bahan-bahan yang digunakan dalam susunan radas itu.
Table 3 shows the materials used in the apparatus arrangement.

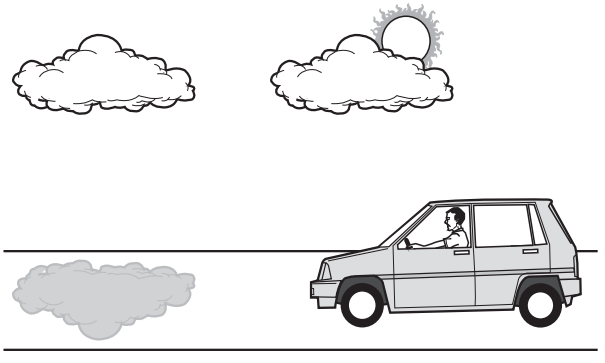
Set radas *Set of apparatus*	**Bahan** *Material*			
	Kepingan X *Plate X*	**Cecair Y** *Liquid Y*	**Bahan Z** *Material Z*	**Kuasa pemanas rendam** *Power of immersion heater*
P	Kayu *Wood*	Air *Water*	Kertas tisu *Tissue*	12 W
Q	Asbestos *Asbestos*	Alkohol *Alcohol*	Kertas biasa *Plain paper*	48 W
R	Kayu *Wood*	Minyak *Oil*	Kertas biasa *Plain paper*	24 W
S	Asbestos *Asbestos*	Minyak *Oil*	Kertas tisu *Tissue*	48 W
T	Kuprum *Copper*	Air *Water*	Kertas tisu *Tissue*	24 W

Jadual 3/ *Table 3*

Terangkan kesesuaian setiap bahan dalam Jadual 3 dan tentukan set radas yang paling sesuai untuk menentukan muatan haba tentu pepejal aluminium itu. Berikan sebab untuk jawapan anda.
Explain the suitability of each material in Table 3 and determine the most suitable set of apparatus used to determine the specific heat capacity of aluminium. Give reasons for your answer.

[10 markah/ *marks*]

10 Rajah 10.1 menunjukkan Farid melihat satu kawasan lopak air di atas jalan raya semasa memandu pada waktu panas terik. Namun, apabila dia sampai ke kawasan itu dia mendapati lopak air itu tidak wujud.
Diagram 10.1 shows Farid saw a puddle of water on the road while driving during a hot day. However, when he reached that location, he found that the puddle of water did not exist.



Rajah 10.1/ *Diagram 10.1*

(a) Berdasarkan situasi dalam Rajah 10.1,
Based on the situation in Diagram 10.1,

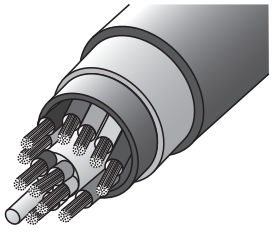
(i) namakan konsep fizik yang terlibat dalam fenomena di atas.
name the physics concept involved in the above phenomenon.

[1 markah/ *mark*]

(ii) terangkan mengapa lopak air itu tidak wujud apabila Farid sampai di kawasan itu.
explain why did the puddle of water not exist when Farid reached at that location.

[4 markah/ *marks*]

(b) Rajah 10.2 menunjukkan kabel gentian optik yang digunakan dalam bidang perubatan dan komunikasi.
Diagram 10.2 *shows an optical fibre cable that is used in medical and telecommunications fields.*



Rajah 10.2/ *Diagram* 10.2

Anda diminta untuk mengkaji ciri-ciri gentian optik yang digunakan dalam bidang-bidang ini seperti ditunjukkan dalam Jadual 4.
You are required to study the characteristics of the optical fibre used in these fields as shown in Table 4.

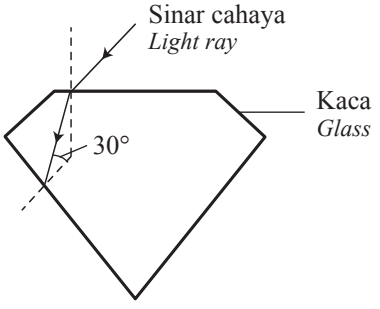
Gentian optik ***Optical fibre***	**Sifat gentian optik** ***Characteristic of optical fibre***	**Kelenturan** ***Flexibility***	**Ketebalan** ***Thickness***	**Perbandingan antara indeks biasan lapisan dalam, n_i dan lapisan luar, n_o** ***Comparison between refractive index of the inner layer, n_i and the outer layer, n_o***
R	Gentian optik tunggal yang halus *Single fine optical fibres*	Tinggi *High*	Tebal *Thick*	$n_i > n_o$
S	Berkas gentian optik halus yang selari *Bundle of fine parallel optical fibres*	Rendah *Low*	Nipis *Thin*	$n_o > n_i$
T	Berkas gentian optik halus yang selari *Bundle of fine parallel optical fibres*	Tinggi *High*	Nipis *Thin*	$n_i > n_o$
U	Gentian optik tunggal yang halus *Single fine optical fibres*	Rendah *Low*	Tebal *Thick*	$n_o > n_i$

Jadual 4/ *Table* 4

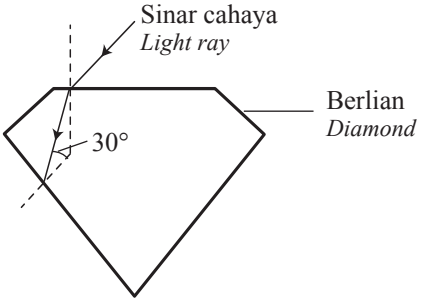
Terangkan kesesuaian setiap ciri gentian optik dalam Jadual 4. Tentukan gentian optik yang paling sesuai untuk digunakan dalam bidang komunikasi dan perubatan dengan berkesan. Berikan sebab untuk pilihan anda.
Explain the suitability of each characteristic of the optical fibre in Table 4. Determine the most suitable optical fibre used in telecommunications and medicine effectively. Give reasons for your choice.

[10 markah/ *marks*]

(c) Rajah 10.3 dan Rajah 10.4 masing-masing menunjukkan satu sinar cahaya melalui kaca dan berlian.
Diagram 10.3 *and Diagram* 10.4 *show a ray of light passing into a glass and a diamond respectively.*
[Indeks biasan kaca = 1.50; Indeks biasan berlian = 2.42]
[*Refractive index of glass* = 1.50*; Refractive index of diamond* = 2.42]



Rajah 10.3/ *Diagram* 10.3



Rajah 10.4/ *Diagram* 10.4

(i) Hitung sudut genting bagi kaca dan berlian.
Calculate the critical angles of the glass and the diamond.

[2 markah/ *marks*]

(ii) Salin Rajah 10.3 dan Rajah 10.4 dan lengkapkan lintasan sinar cahaya dalam kaca dan dalam berlian sehingga sinar cahaya itu akhirnya keluar dari setiap objek.
Copy Diagram 10.3 *and Diagram* 10.4 *and complete the path of the light ray in the glass and in the diamond until it finally emerges from each object.*

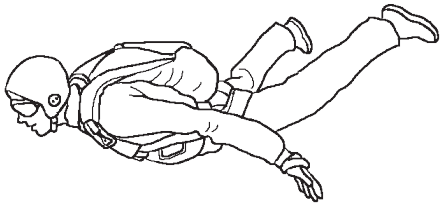
[3 markah/ *marks*]

Bahagian C

[20 markah/ *marks*]

Jawab **semua** soalan.
*Answer **all** questions.*

11 Rajah 11.1 menunjukkan seorang peluncur udara selepas dia terjun dari sebuah kapal terbang dan payung terjunnya masih belum dibuka.
Diagram 11.1 *shows an air glider after he jumped from an airplane and his parachute is still unopened.*



Rajah 11.1/ *Diagram* 11.1

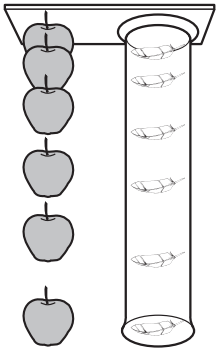
(a) Apakah jenis gerakan yang dialami oleh peluncur udara tersebut semasa dia menjunam ke bawah?
What is the type of motion experience by the air glider when he plunges down?

[1 markah/ *mark*]

(b) Terangkan jenis gerakan seperti yang dinyatakan di **11**(a). Apakah yang akan terjadi kepada gerakan tersebut jika dia mendepakan tangan dan kakinya? Berikan sebab bagi penerangan anda.
Explain the motion type as stated in **11**(a)*. What would happen to that motion if he spread his hands and legs? Give reasons for your description.*

[4 markah/ *marks*]

(c) Rajah 11.2 menunjukkan sebiji epal dilepaskan dari satu ketinggian dalam udara, manakala bulu pelepah dilepaskan serentak dalam keadaan vakum.
Diagram 11.2 *shows an apple is released from a height in the air, while a feather is released simultaneously in a vacuum state.*

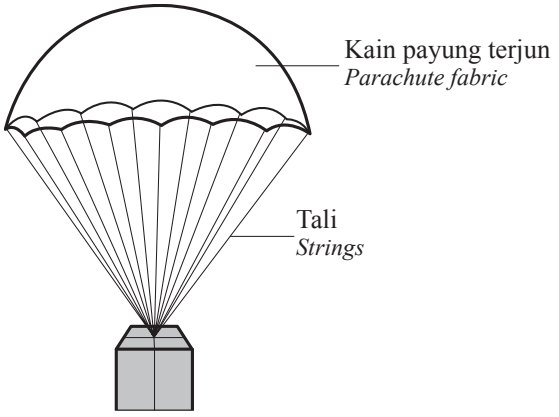


Rajah 11.2/ *Diagram* 11.2

Berdasarkan Rajah 11.2, bandingkan jisim, masa untuk sampai ke dasar dan pecutan bagi kedua-dua objek tersebut. Hubung kait jisim dengan pecutan untuk mendeduksikan satu konsep fizik yang telah anda pelajari.
Based on Diagram 11.2*, compare the mass, time to reach the base and the acceleration for both objects. Relate the mass with the acceleration to deduce a physical concept you have learned.*

[5 markah/ *marks*]

(d) Rajah 11.3 menunjukkan satu objek berat yang dijatuhkan dari udara dengan menggunakan payung terjun.
Diagram 11.3 *shows a heavy object is dropped from the air using a parachute.*



Rajah 11.3/ *Diagram* 11.3

Anda dikehendaki mengubah suai payung terjun tersebut supaya objek tersebut dapat mendarat dengan selamat. Terangkan pengubahsuaian anda berdasarkan jenis kain payung terjun, saiz kain payung terjun, jenis tali, bilangan tali dan bahan tambahan yang boleh ditambah.
You are required to modify the parachute so that the object can land safely. Describe your modifications based on the parachute fabric type, parachute fabric size, string type, number of strings and the additional materials that can be added.

[10 markah/ *marks*]

Soalan 9 atau 10
***Question* 9 *or* 10**

Soalan 11
***Question* 11**

KERTAS 3 **Masa: 45 minit**

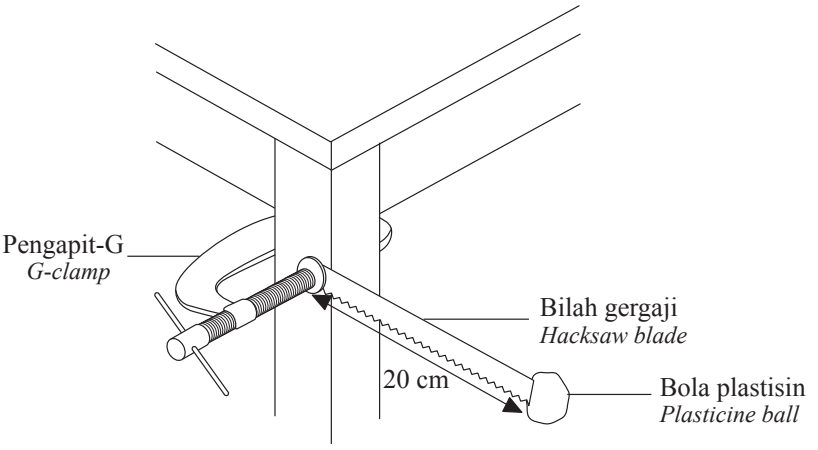
[15 markah/ *marks*]

Anda tidak dibenarkan bekerja dengan radas bagi lima minit pertama. Tempoh ini hendaklah digunakan untuk menyemak senarai radas, membaca soalan dan merancang eksperimen yang akan dijalankan. Tandakan (✓) pada ruangan kotak yang disediakan untuk menyemak bahan dan radas yang disediakan dan dibekalkan.
You are not allowed to work with apparatus in first five minutes. This period is used to check the apparatus list, read the question and plan the experiment which will carry out. Mark (✓) *in the box provided to check the materials and apparatus prepared and supplied.*

Soalan 1
***Question* 1**

Bil *Number*	**Radas / Bahan** *Apparatus / Material*	**Kuantiti** *Quantity*	**Ya (✓) / Tidak (✗)** *Yes* (✓) */ No* (✗)
1	Bilah gergaji *Hacksaw blade*	1	
2	Pengapit-G *G-clamp*	1	
3	Bola plastisin berjisim 10 g, 20 g, 30 g, 40 g dan 50 g *Plasticine balls with mass of* 10 g, 20 g, 30 g, 40 g *and* 50 g	1	
4	Jam randik (analog / digital) *Stopwatch* (*analog / digital*)	1	

1 Anda dikehendaki menjalankan satu eksperimen untuk menyiasat hubungan antara jisim, *m* dan tempoh ayunan, *T* bagi satu neraca inersia.
You are required to carry out an experiment to investigate the relationship between mass, m and the period of oscillation, T*, of an inertia balance.*



Rajah 1/ *Diagram* 1

Jalankan eksperimen dengan menggunakan langkah-langkah di bawah:
Carry out the experiment by using the steps below:

(i) Susun radas dengan mengapitkan sebilah gergaji pada satu hujung menggunakan pengapit-G. Letakkan satu bola plastisin berjisim 10 g pada satu hujung. Jarak di antara bola plastisin dengan pengapit ialah 20.0 cm. Susunan radas untuk eksperimen ditunjukkan dalam Rajah 1.
Arrange the apparatus by clamping a piece of hacksaw blade at one end using a G-clamp. Fixed a 10 g *plasticine ball at the other end. The arrangement of the apparatus for the experiment is shown in Diagram* 1.

(ii) Sesarkan bilah gergaji secara mengufuk ke satu bahagian dan lepaskan supaya ia berayun. Catat masa diambil untuk 10 ayunan, *t* menggunakan jam randik.
Displace the hacksaw blade horizontally to one side and release so that it oscillates. Record the time taken for 10 *oscillations,* t *using a stopwatch.*

(iii) Ulang langkah (i) dan (ii) dengan menggunakan jisim bola plastisin, *m* = 20 g, 30 g, 40 g dan 50 g.
Repeat steps (i) *and* (ii) *by using masses of plasticine ball, m* = 20 g, 30 g, 40 g *and* 50 g.

(iv) Berdasarkan eksperimen yang dijalankan, anda dikehendaki untuk;
Based on the experiment conducted, you are required to;

(a) Nyatakan
State

(i) pemboleh ubah dimanipulasikan.
the manipulated variable.

_____

[1 markah/ *mark*]

(ii) pemboleh ubah bergerak balas.
the responding variable.

_____

[1 markah/ *mark*]

(b) Hitung tempoh ayunan bilah gergaji, T, dengan menggunakan persamaan di bawah bagi setiap jisim bola plastisin, m. Kemudian hitung T^2.
Calculate the period of oscillation of hacksaw blade, T, by using the equation below for each mass of the plasticine ball, m. Then, calculate T^2.

$$T = \frac{t}{10}$$

Jadualkan nilai t, T dan T^2 bagi setiap m dalam ruang yang disediakan.
Tabulate the value of t, T and T^2 for each value of m in the space provided.

[6 markah/ *marks*]

(c) Pada kertas graf yang disediakan, plot graf T^2 melawan m.
On the graph paper provided, plot a graph of T^2 against m.

[3 markah/ *marks*]

(d) Berdasarkan graf anda di (c), nyatakan hubungan antara T^2 dengan m.
Based on your graph in (c)*, state the relationship between T^2 and m.*

_____

_____

[1 markah/ *mark*]

(e) Hitung kecerunan, k bagi graf T^2 melawan m.
Calculate the gradient, k for the graph of T^2 against m.

k = _____

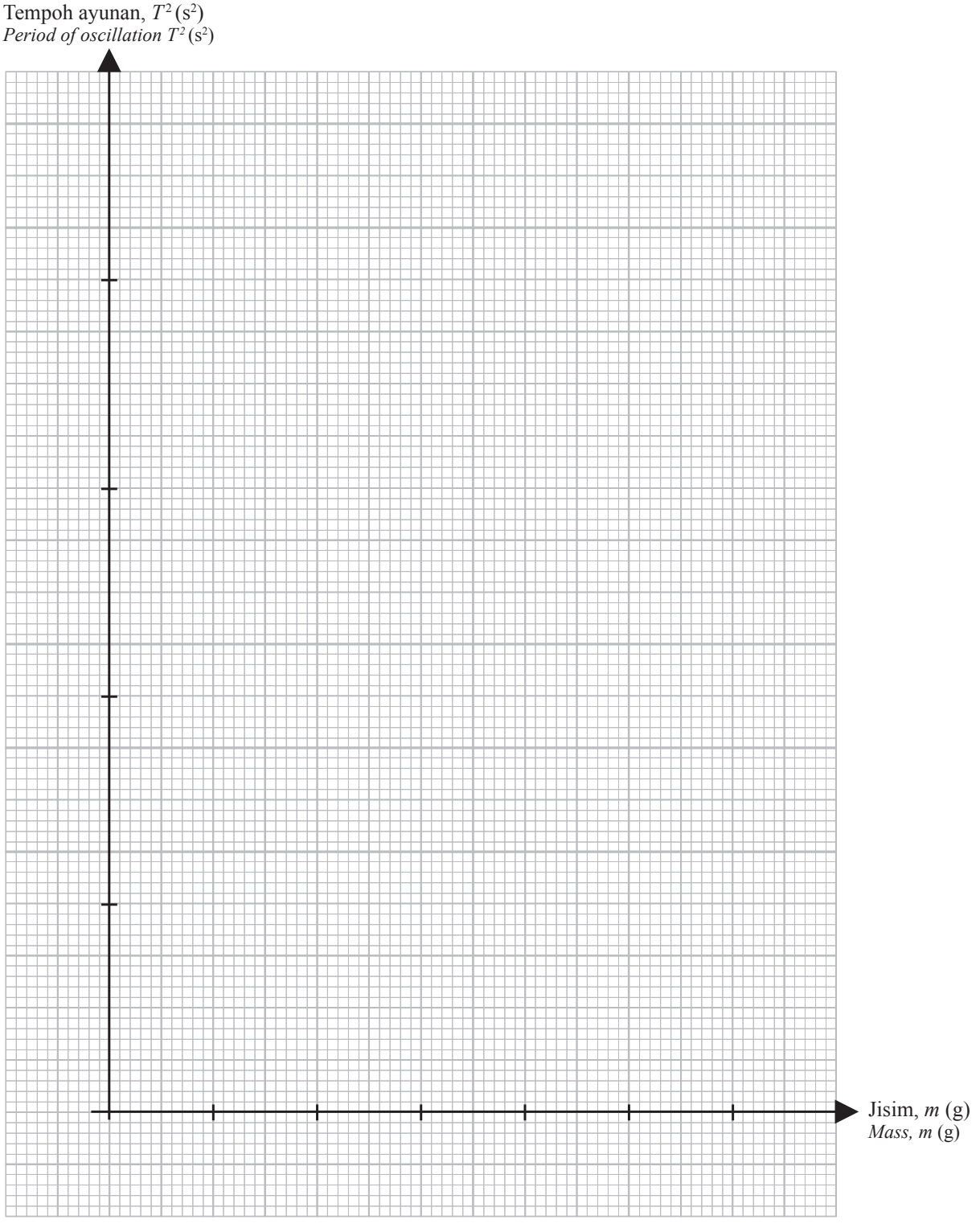
[2 markah/ *marks*]

(f) Apakah yang akan berlaku kepada inersia bola plastisin apabila jisim bola plastisin semakin bertambah?
What will happen to the inertia of the plasticine ball when the mass of the plasticine ball increases?

_____

[1 markah/ *mark*]

Graf T^2 melawan m
Graph of T^2 against m



JAWAPAN

BAB 1 Pengukuran
Measurement

1.1 Kuantiti Fizik
Physical Quantities

1 Kuantiti yang boleh diukur atau dikira pada sesuatu objek atau fenomena.
The quantity that can be measured or calculated on an object or phenomena.

2 (a) Kuantiti fizik/ *Physical quantity*
(b) Magnitud/ *Magnitude*
(c) Unit S.I/ *S.I unit*

3 Kuantiti yang tidak dapat ditakrifkan dalam sebutan kuantiti-kuantiti fizik yang lain.
A quantity that cannot be defined in terms of other physical quantities.

4

(a) Masa *Time*	*t*	saat *second*	s
(b) Panjang *Length*	*l*	meter *metre*	m
(c) Suhu *Temperature*	*T*	kelvin	K

5 Gabungan kuantiti-kuantiti asas secara pendaraban atau pembahagian atau gabungan kedua-duanya.
Combination of base quantities by multiplication, division or both these operations.

6 (a) $m \times m = m^2$
(b) $m \times m \times m = m^3$
(c) $\frac{kg}{m^3} = kg\ m^{-3}$
(d) $\frac{m}{s} = m\ s^{-1}$
(e) $kg \times m\ s^{-1} = kg\ m\ s^{-1}$
(f) $\frac{m\ s^{-1}}{s} = m\ s^{-2}$
(g) $kg \times m\ s^{-2} = kg\ m\ s^{-2}$ atau/ *or* N
(h) $\frac{N}{m^2} = N\ m^{-2}$ atau/ *or* Pa
(i) $N \times m = N\ m$ atau/ *or* J
(j) $A \times s = A\ s$ atau/ *or* C

7 (a) Kuantiti fizik yang mempunyai magnitud sahaja.
Physical quantity which has magnitude only.
(b) Kuantiti vektor
Vector quantities
(c) Sesaran, halaju, pecutan, momentum, tekanan, daya
Displacement, velocity, acceleration, momentum, pressure, force

1.2 Penyiasatan Saintifik
Scientific Investigation

1 (a) Jenis: lurus; melalui; positif
Type: straight; passing; positive
Tafsiran: berkadar terus
Interpret: directly proportional
(b) Jenis: lurus; tidak melalui; positif
Type: straight; does not pass; positive
Tafsiran: bertambah secara linear
Interpret: increases linearly
(c) Jenis: lurus; tidak melalui; negatif
Type: straight; does not pass; negative
Tafsiran: berkurang secara linear
Interpret: decreases linearly
(d) Jenis: melengkung; melalui; positif
Type: curve; passing; positive
Tafsiran: bertambah
Interpret: increases
(e) Jenis: melengkung; tidak melalui; negatif
Type: curve; does not pass; negative
Tafsiran: berkurang
Interpret: decreases
(f) Jenis: melengkung; tidak memintas; negatif;
Type: curve; does not pass; negative
Jenis: lurus; melalui; positif
Type: straight; passing; positive
Tafsiran: berkadar songsang
Interpret: inversely proportional

PRAKTIS Bab 1

Kertas 1

1 B **2** C **3** B **4** A **5** D
6 D **7** C

Kertas 2
Bahagian A

1 (a) (i) Jisim // Jarak
Mass // Distance
(ii) Daya // Pemalar kegravitian
Force // Gravitational constant
(iii) Daya / *Force*
(b) $G = \frac{Fr^2}{Mm} \rightarrow \frac{N\ m^2}{kg \times kg} = N\ m^2\ kg^{-2}$

2 (a) (i) Tekanan atmosfera
Atmospheric pressure
(ii) Ketinggian/ *Height*
(b) Ketinggian berkurang secara linear dengan tekanan atmosfera
The height decreasing linearly with the atmospheric pressure
(c) $km\ Pa^{-1}$

3 (a) $t = 26 - 2 = 24$ s

(b) Untuk mendapatkan bacaan lebih jitu.
To increase the accuracy of the measurement.

(c) Ayunkan bandul dahulu dan kemudian hidupkan jam randik serta mula kira bilangan ayunan lengkap.
Swing the pendulum first, then start the stopwatch and start counting the complete oscillation.

(d) (i) $T = \frac{24.0}{20}$
$= 1.2$ s

(ii) $l = \frac{gT^2}{4\pi^2}$
$= \frac{9.81(1.2)^2}{4\pi^2}$
$= 0.36$ m

BAB 2 Daya dan Gerakan I
Force and Motion I

2.1 Gerakan Linear
Linear Motion

1 (a) Panjang lintasan yang dilalui oleh suatu objek yang bergerak.
The total path length travelled by an object.

(b) Jarak terpendek di antara kedudukan awal dengan kedudukan akhir pergerakan suatu objek pada satu arah tertentu.
Shortest distance between initial position and final position of an object motion in a specific direction.

(c) (i) $d = 800$ m

(ii) $s = \sqrt{(400)^2 + (400)^2}$
$= 565.69$ m pada arah AC/ *in the direction of* AC

(iii) Kerana sesaran mempunyai magnitud dan arah.
Because displacement has magnitude and direction.

(d) (i) meter per saat (m s^{-1})
meter per second (m s^{-1})

(ii) $v = \frac{d}{t}$

(iii) Kadar perubahan sesaran
Rate of change in displacement

(iv) Kuantiti vektor
Vector quantity

(e) Kadar perubahan halaju
Rate of change in velocity

$$\text{Pecutan} = \frac{\text{Halaju akhir} - \text{Halaju awal}}{\text{Masa}}$$

$$\textit{Acceleration} = \frac{\textit{Final velocity} - \textit{Initial velocity}}{\textit{Time}}$$

$$a = \frac{v - u}{t}$$

(f) (i) Sifar/ *Zero*
(ii) Bertambah/ *Increases*
(iii) Berkurang/ *Decreases*

(g) (i) 0
(ii) 4.0 m s^{-1}
(iii) $\frac{4.0 - 0}{5.0} = 0.8$ m s^{-2}

2 (a) 50 detik/ *ticks* = 1 s → 1 detik/ *ticks* = 0.02 s
A ke B : 10 detik
A *to* B : 10 *ticks*
$t = 10 \times 0.02$
$= 0.2$ s

(b) $s = 8$ cm

(c) $v = \frac{8.0}{0.2} = 40.0$ cm s^{-1}

(d) Halaju awal, $u = \frac{0.2}{0.02} = 10.0$ cm s^{-1}
Initial velocity
Halaju akhir, $v = \frac{1.4}{0.02} = 70.0$ cm s^{-1}
Final velocity
Masa, $t = (5 - 1) \times 0.02 = 0.08$ s
Time
Pecutan, $a = \frac{v - u}{t} = \frac{70.0 - 10.0}{0.08}$
Acceleration
$= 750$ cm s^{-2}
$\therefore a = 750$ cm s^{-2}

3 (a) $v = u + at$

(b) $s = \frac{1}{2}(v + u)t$

(c) $s = ut + \frac{1}{2}at^2$

(d) $v^2 = u^2 + 2as$

4 (a) (i) $u = 4$ m s^{-1}, $v = 10$ m s^{-1}, $s = 35$ m
$s = \frac{1}{2}(v + u)t$
$35 = \frac{1}{2}(10 + 4)t$
$t = \frac{35}{7}$
$= 5$ s

(ii) $v^2 = u^2 + 2as$
$10^2 = 4^2 + 2a(35)$
$70a = 84$
$a = 1.2$ m s^{-2}

(b) $u = 20$ m s^{-1}, $t = 5$ s, $a = -3$ m s^{-2}
$v = u + at$
$= 20 + (-3)(5)$
$= 5$ m s^{-1}

(c) $u = 0$, $a = 3$ m s^{-2}, $t = 4$ s,
$s = ut + \frac{1}{2}at^2$
$= 0(4) + \frac{1}{2}(3)(4)^2$
$= 24$ m

2.2 Graf Gerakan Linear
Linear Motion Graphs

1 (a) (i) $v = \frac{20}{10}$
$= 2$ m s^{-1}

(ii) $v = 0$

(iii) $v = \frac{-20 - 0}{35 - 30}$
$= -4$ m s^{-1}

(b) (i) Halaju malar// Pecutan sifar
Constant velocity// Zero acceleration

(ii) Pegun// Halaju sifar
Stationary // Zero velocity

(iii) Halaju malar pada arah bertentangan
Constant velocity in opposite direction

(c) (i) $20 + 0 + 20 = 40$ m

(ii) $20 + 0 + (-20) = 0$

(d) (i) $\frac{40}{35} = 1.14$ m s^{-1}

(ii) 0

2 (a) Jarak = Luas di bawah graf, A
Distance = Area under the graph, A

$A_1 = \frac{1}{2}(20 \times 10)$ $A_2 = \frac{1}{2}(10 + 20)10$

$= 100$ m $= 150$ m

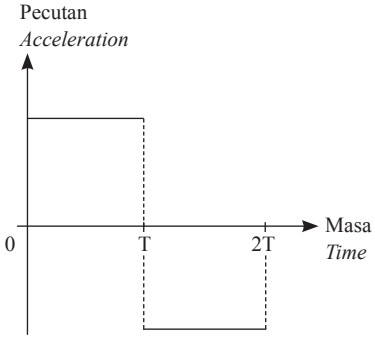
$A_3 = \frac{1}{2}(10 + 15)10$ $A_4 = \frac{1}{2}(10 + 10)$

$= 125$ m $= 50$ m

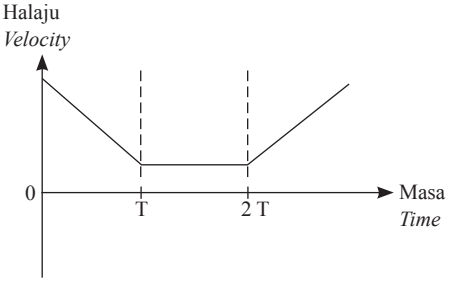
Jumlah jarak/ *Total distance*
$= 100 + 150 + 125 + 50$
$= 425$ m

(b) Jumlah sesaran/ *Total displacement*
$= 100 + 150 + 125 - 50$
$= 325$ m

3 (a)



(b)



2.3 Gerakan Jatuh Bebas
Free Fall Motion

1 Keadaan di mana objek jatuh disebabkan oleh daya tarikan graviti sahaja.
An object is falling freely when it is falling under the gravitational force only.

2 (a) Bola golf/ *Golf ball*

(b) Luas permukaan kertas lebih besar, maka rintangan udara lebih besar.
The surface area of the paper larger, then the air resistance larger.

(c) Kedua-duanya mencecah tanah pada masa yang sama.
Both objects reach the ground at the same time.

(d) Luas permukaan kertas renyuk menjadi kecil, maka rintangan udara turut kecil.
The surface area of the crumpled paper become smaller, then the air resistance also small.

4 $a = g = 9.81$ m s^{-2}

$s = ut + \frac{1}{2}gt^2$

$20 = 0 + \frac{1}{2}(9.81)(t^2)$

$t^2 = \frac{20}{4.905}$

$t = 2.0193$ s

5 $a = g = -9.81$ m s^{-2}

$v^2 = u^2 + 2gs$

$0 = 10^2 + 2(-9.81)s$

$s = 5.10$ m

2.4 Inersia
Inertia

1 Sifat suatu objek yang cenderung untuk kekal dalam keadaan asalnya sama ada keadaan pegun atau bergerak dengan halaju seragam dalam satu garis lurus.
The tendency of the object to remain at rest or, if moving, to continue its uniform velocity in a straight line.

2 sesuatu objek akan kekal dalam keadaan rehat atau bergerak dengan halaju malar jika tiada daya luar bertindak ke atasnya.
every object continues in its state of rest, or of uniform motion in a straight line, unless it is acted on by an external force.

3 (a) Duit syiling jatuh terus ke dalam gelas.
The coin drops straight into the glass.

(b) Inersia duit syiling kekal pegun. Duit syiling jatuh ke dalam gelas disebabkan daya tarikan graviti.
The inertia of the coin maintains its state at rest. The coin falls into the glass due to gravitational force.

4 (a) Sos tomato bergerak bersama-sama dengan botol. Apabila botol dihentikan secara mendadak, inersia sos terus bergerak dan keluar daripada botol.
The sauce moves together with the bottle. When the bottle stops suddenly, the inertia of the sauce continues to move and poured out of the bottle.

(b) Air hujan dan payung bergerak bersama-sama. Apabila payung diberhentikan dengan tiba-tiba, inersia air hujan ingin terus bergerak dan meninggalkan payung.
The water droplet move together with the umbrella. When the umbrella is stopped suddenly, the inertia of the droplet continues its state of motion and left the umbrella.

2.5 Momentum
Momentum

1 Momentum ialah hasil darab jisim dan halaju
Momentum is the product of mass and velocity

2 $p = mv$
di mana/ *where*
p = Momentum objek/ *Momentum of object*
m = Jisim objek/ *Mass of object*
v = Halaju objek/ *Velocity of object*

3 kg m s^{-1}

4 Jumlah momentum sebelum perlanggaran sama dengan jumlah momentum selepas perlanggaran jika tiada daya luar yang bertindak ke atas sistem itu.
Total momentum before collision same as total momentum after collision if no external force acts on the system.

5 (a) (i) Momentum diabadikan
Momentum is conserved.

(ii) Tenaga diabadikan
Energy is conserved.

(iii) Tenaga kinetik diabadikan
Kinetic energy is conserved.

(b) (i) Bergerak bersama dengan halaju yang sama
Move together with the same velocity
(ii) Tenaga diabadikan
Energy is conserved.
(iii) Tenaga kinetik tidak diabadikan // berkurang
Kinetic energy is not conserved // decredses
(iv) $m_1u_1 + m_2u_2 = v(m_1 + m_2)$

(c) (i) Bergerak pada arah bertentangan
Move in opposite direction
(ii) Momentum diabadikan
Momentum is conserved.

6 (a) Perlanggaran kenyal/ *Elastic collision*

$$m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$$
$$(1\,000)(20) + (1\,200)(10) = (1\,000)v_1 + (1\,200)(15)$$
$$1\,000v_1 = 14\,000$$
$$v_1 = 14 \text{ m s}^{-1}$$

(b) Perlanggaran tak kenyal/ *Inelastic collision*

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v$$
$$(15)(20) + 0 = (15 + 60)v$$
$$75v = 300$$
$$v = 4 \text{ km j}^{-1}$$

(c) Jumlah momentum sebelum letupan
= jumlah momentum selepas letupan
Total momentum before explosion
= total momentum after explosion
0 = momentum peluru + momentum pistol
0 = *momentum of bullet + momentum of pistol*

$$0 = m_1v_1 + m_2v_2$$
$$0 = (0.01)(300) + (1.5)v_2$$
$$1.5v_2 = -3.0$$
$$v_2 = -2.0 \text{ m s}^{-1}$$

(Pistol tersentak ke belakang)
(Pistol recoiled backwards)

2.6 Daya
Force

1 kadar perubahan momentum berkadar terus dengan daya dan bertindak pada arah tindakan daya.
the rate of change of momentum is directly proportional to the force and acts in the direction of the applied force.

2 $F = ma$
di mana/ *where*
F : Daya/ *Force*
m : Jisim objek/ *Mass of object*
a : Pecutan objek/ *Acceleration of object*

3 $F = ma$

$$a = \frac{F}{m} = \frac{30}{5}$$
$$a = 6 \text{ m s}^{-2} \text{ (ke kanan/ } \textit{to the right)}$$

4 (a) $v^2 = u^2 + 2as$
$0 = (40)^2 + 2a(2\,500)$
$5\,000a = -1\,600$
$a = -0.32 \text{ m s}^{-2}$ (nyahpecutan/ *deceleration*)

(b) $F = ma$
$= 2\,000 \times (-0.32)$
$= -640$ N

2.7 Impuls dan Daya Impuls
Impulse and Impulsive Force

1 Perubahan momentum
Change of momentum

2 J: Impuls/ *Impulse*
m: Jisim/ *Mass*
u: Halaju awal/ *Initial velocity*
v: Halaju akhir/ *Final velocity*
F: Daya/ *Force*
t: Masa impak/ *Impact time*

3 Kadar perubahan momentum semasa perlanggaran atau hentaman dalam masa yang singkat.
The rate of change of momentum in a collision or impact in a short period of time.

4 $$F = \frac{mv - mu}{t}$$
di mana/ *where*
F: Daya impuls/ *Impulsive force*
$mv - mu$: Perubahan momentum/ *Change in momentum*
t: Masa impak/ *Impact time*

5 untuk setiap daya tindakan terdapat satu daya tindak balas yang sama magnitud tetapi bertentangan arah.
for every action force there is a reaction force of equal magnitude, but in the opposite direction.

6 Masa daya dibekalkan lama, impuls besar.
Longer time applied force, large impulse.
Perubahan momentum lebih besar.
Larger change in momentum.
Bola bergerak dengan halaju tinggi dan bergerak jauh.
Ball moves at higher velocity and moves further.

7 (a) (i) besar/ *larger*
(ii) lama/ *longer*
(iii) tinggi/ *high*

(b) Perlanggaran menyebabkan kereta dihentikan dan mengalami suatu perubahan momentum.
Collision causes a car to stop and experience a change in momentum.
Bahagian hadapan kereta yang mudah remuk memanjangkan masa impak semasa perlanggaran.
The crumple zone of the car extends the impact time during collision.
Daya impuls ke atas kereta dikurangkan.
The impulsive force on the car is reduced.

(c) Alu bergerak ke lesung yang keras permukaannya.
The pestle moving at high speed to a hard mortar.
Alu berhenti dalam masa yang singkat.
The pestle to be stopped in a very short time.
Daya impuls besar dihasilkan menyebabkan cili mudah dihancurkan.
A large impulsive force is produced and causes these spices to be crushed easily.

8 (a) $J = Ft = mv - mu$
$= 0.2(40) - (0.2)(-20)$
$= 8 + 4$
$J = 12 \text{ kg m s}^{-1}$

(b) $$F = \frac{mv - mu}{t}$$
$$= \frac{12}{0.01}$$
$$= 1\,200 \text{ N}$$

2.8 Berat
Weight

1 Daya tarikan graviti yang bertindak ke atas objek.
Gravitational force acting on an object.

2 W : Berat/ *Weight*
m : Jisim/ *Mass*
g : Kekuatan medan graviti/ *Gravitational field strength*

3 Newton, N.

4 Daya tarikan graviti yang bertindak ke atas jisim 1 kg.
Gravitational force acts on a 1 kg *of mass.*

5 $$g = \frac{W}{m}$$

6 $g = 9.81 \text{ N kg}^{-1}$

7 Di Bulan:
On the Moon:

$$100 \times 9.81 \times \frac{1}{6} = 163.5 \text{ N}$$

Di Bumi:
On the Earth:
$100 \times 9.81 = 981$ N

8 (a) $W = 100 \times 9.81$
$= 981$ N
(b) $m = 100$ kg
(c) $m = 100$ kg
(d) $W = 100 \times 3.7$
$= 370$ N

PRAKTIS Bab 2

Kertas 1

1	C	**2**	B	**3**	C	**4**	B	**5**	D
6	A	**7**	B	**8**	A	**9**	B		

Kertas 2

Bahagian A

1 (a) Kadar perubahan jarak
The rate change of distance

2 (b) (i) Sama/ *Same*
(ii) Panjang pita detik Rajah 1.2 lebih besar daripada pita detik Rajah 1.1.
The length of the ticker tape in Diagram 1.2 *is larger than the ticker tape in Diagram* 1.1.
(iii) Laju purata pita detik dalam Rajah 1.2 lebih tinggi daripada dalam Rajah 1.1.
The average speed of the ticker tape in Diagram 1.2 *is higher than in Diagram* 1.1.
(c) Semakin bertambah panjang pita detik, semakin bertambah laju purata pita detik.
The longer the length of the ticker tape, the highert the average speed of the ticker tape.
(d) Halaju seragam // Pecutan sifar
Uniform velocity // Zero acceleration

Bahagian B

2 (a) (i) Hasil darab jisim dan halaju
Products of mass and velocity
(ii) – Udara dipam menyebabkan tekanan tinggi di dalam botol
The pump air caused high pressure in the bottle
– Air terpancut dengan halaju yang tinggi
Water spurts out with high velocity
– Menghasilkan momentum yang besar pada arah bertentangan
Produces large momentum in opposite direction
– Mengikut prinsip keabadian momentum, momentum bertentangan sama magnitud menolak roket air ke depan
According to the principle of conservation of momentum, the opposite momentum same as the magnitude that pushed the water rocket forward
(b) (i) Pecutan/ *Acceleration*

$$a = \frac{v - u}{t}$$
$$= \frac{0 - 10}{5}$$
$$= -2 \text{ m s}^{-2} \text{ (Nyahpecutan/ } \textit{Deceleration)}$$

(ii) Jarak/ *Distance*

$$s = ut + \frac{1}{2}at^2$$
$$= 10(5) + \frac{1}{2}(-2)(5)^2$$
$$= 25 \text{ m}$$

(c)

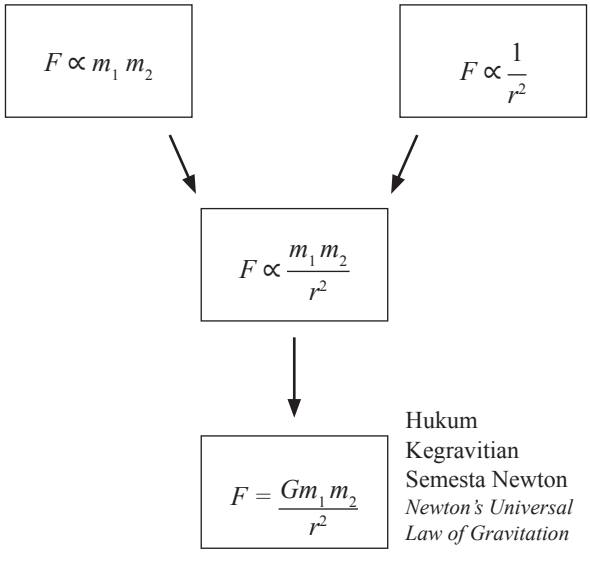
Aspek *Aspect*	Alasan *Reason*
Rangka: Ringan dan tegar *Frame: Light and durable*	– Pecutan tinggi *High acceleration* – Kuat *Strong*
Reka bentuk: Aerodinamik *Design: Aerodinamic*	– Rintangan udara rendah *Low air resistance* – Pecutan tinggi *High acceleration*
Kapasiti enjin: Tinggi *Capacity of engine: High*	– Kuasa tinggi *High power* – Pecutan tinggi *High acceleration*
Bunga pada tayar: Tiada *Thread on tyre: No*	– Kurang geseran *Less friction*
Motosikal A kerana mempunyai rangka ringan dan tegar, reka bentuk aerodinamik, kapasiti enjin yang tinggi dan tiada bunga pada tayar *Motorcycle* A *because it has light and durable frame, aerodynamic design, high capacity of engine and has no thread on tyre*	

BAB 3 Kegravitian
Gravitation

3.1 Hukum Kegravitian Semesta Newton
Newton's Universal Law of Gravitation

1 daya graviti bertindak antara mana-mana dua jasad dalam alam semesta.
it acts between any two bodies in the universe.

2 (a) berkadar terus
directly proportional
(b) berkadar songsang
inversely proportional



3 daya graviti antara dua jasad adalah berkadar terus dengan hasil darab jisim kedua-dua jasad dan berkadar songsang dengan kuasa dua jarak di antara pusat dua jasad tersebut.
the gravitational force between two bodies is directly proportional to the product of the masses of both bodies and inversely proportional to the square of the distance between the centers of the two bodies.

4

F	Daya graviti antara dua jasad *Gravitational force between two bodies*
G	Pemalar kegravitian/ *Gravitational constant*
m_1	Jisim jasad 1/ *Mass of body* 1
m_2	Jisim jasad 2/ *Mass of body* 2
r	Jarak di antara pusat dua jasad *Distance between centres of two bodies*

5 (a) (i) $F = \dfrac{Gm_1m_2}{r^2} = \dfrac{(6.67 \times 10^{-11})(55)(45)}{(2.0)^2}$

$F = 4.1 \times 10^{-8}$ N

(ii) $F = \dfrac{Gm_1m_2}{r^2} = \dfrac{(6.67 \times 10^{-11})(55)(45)}{(4.0)^2}$

$F = 1.0 \times 10^{-8}$ N

(iii) Hasil darab jisim dua jasad bertambah, daya graviti bertambah.
The product of the mass of two bodies increases, the gravitational force incereases.

(iv) Jika jarak di antara dua jasad bertambah, daya graviti berkurang.
The distance between two bodies centre increases, the gravitational force decreases.

(b) (i) $F = \dfrac{GM_1m_2}{r^2}$

$= \dfrac{(6.67 \times 10^{-11})(5.97 \times 10^{24})(1.20 \times 10^{3})}{(6.37 \times 10^{6})^2}$

$F = 11\,776.13$ N

(ii) $F = \dfrac{GM_1m_2}{[R+h]^2}$

$= \dfrac{(6.67 \times 10^{-11})(5.97 \times 10^{24})(1.20 \times 10^{3})}{[(6.37 \times 10^{6}) + (4.22 \times 10^{7})]^2}$

$F = 2.03 \times 10^{2}$ N

(iii) Daya graviti antara Matahari dana Bumi adalah lebih besar berbanding daya graviti Bumi dan satelit buatan.
The gravitational force between the Sun and the Earth is bigger.

(iv) $r = \sqrt{\dfrac{GMm}{F}}$

$= \sqrt{\dfrac{(6.67 \times 10^{-11})(5.97 \times 10^{24})(7.35 \times 10^{22})}{2.0 \times 10^{20}}}$

$= 3.82 \times 10^{8}$ m

6 (a) (i) $F = mg$

(ii) $F = \dfrac{GMm}{r^2}$

(iii) $mg = \dfrac{GMm}{r^2}$

(iv) $g = \dfrac{GM}{r^2}$

(b) Jisim planet/ *Mass of the planet*
Jarak di antara pusat Bumi dengan pusat objek
Distance between the center of planet and the center of object

7 (a) Berkadar terus
Directly proportional

(b) Berkadar songsang
Inversely proportional

(c) $g = \dfrac{GM}{(R+h)^2}$

$= \dfrac{(6.67 \times 10^{-11})(5.97 \times 10^{24})}{[(6.37 \times 10^{6}) + (1.5 \times 10^{6})]^2}$

$g = 6.429$ m s^{-2}

8 Suatu daya yang bertindak ke atas suatu jasad yang melakukan gerakan membulat dengan arah yang sentiasa menuju ke pusat bulatan itu.
Force acts on the body in a direction towards the center of the circle for a body in circular motion.

9

F	Daya memusat/ *Centripetal force*
m	Jisim jasad/ *Mass of body*
v	Laju linear/ *Linear speed*
r	Jejari orbit/ *Radius of orbit*

10 (a) $M = \dfrac{4\pi^2 r^3}{GT^2}$

G = Pemalar kegravitian
Gravitational constant

r = Jejari orbit planet// Bulan// satelit
Radius of orbit of planet// Moon// satellite

T = Tempoh peredaran/ *Period of revolution*

(b) $M = \dfrac{4\pi^2 r^3}{GT^2} = \dfrac{4\pi^2(3.83 \times 10^{8})^3}{(6.67 \times 10^{-11})(2.36 \times 10^{6})^2}$

$M = 5.97 \times 10^{24}$ kg

(c) $M = \dfrac{4\pi^2 r^3}{GT^2}$

$= \dfrac{4\pi^2(1.50 \times 10^{11})^3}{(6.67 \times 10^{-11})(365 \times 24 \times 60 \times 60)^2}$

$M = 2.0 \times 10^{30}$ kg

3.2 Hukum Kepler
Kepler's Laws

1 (a) Orbit setiap planet adalah elips dengan Matahari berada di satu daripada fokusnya.
All planets move in elliptical orbits with the Sun at one focus.

(b) elips/ *ellipse*

(c) panjang; sama/ *longer; same*

(d) Jejari orbit/ *radius of orbit*

2 (a) Garis yang menyambungkan planet dengan Matahari akan mencakupi luas yang sama dalam selang masa yang sama apabila planet bergerak dalam orbitnya.
A line that connect a planet to the Sun sweeps out equal areas in equal times when planet moves in its orbit.

(b) (i) sama dengan/ *same as*

(ii) lebih jauh/ *further*

(iii) lebih tinggi/ *higher*

3 (a) Kuasa dua tempoh orbit planet adalah berkadar terus dengan kuasa tiga jejari orbitnya.
The square of the orbital period of any planet is directly proportional to the cube of the radius of its orbit.

(b) $T^2 \propto r^3$

(c) panjang/ *longer*

(d) panjang/ *longer*

4 (a) $F = \dfrac{GMm}{r^2}$

(b) $F = \dfrac{mv^2}{r}$

(c) $\dfrac{GMm}{r^2} = \dfrac{mv^2}{r} \rightarrow v^2 = \dfrac{GM}{r}$

(d) $\left(\dfrac{2\pi r}{T}\right)^2 = \dfrac{GM}{r}$

$T^2 = \left(\dfrac{4\pi^2}{GM}\right) r^3$

(e) $T^2 = kr^3$

5 (a) $\dfrac{T_1^2}{T_2^2} = \dfrac{r_1^3}{r_2^3}$

(b) Jejari orbit satelit/ *Radius of orbit of the satellite,* $r_1 = (6.37 \times 10^6) + (420 \times 10^3) = 6.8 \times 10^6$ m
Tempoh orbit satelit/ *Orbital period of the satellite* $= T_1$
Jejari orbit Bulan/ *Radius of orbit of the Moon,* $r_2 = 3.83 \times 10^8$ m
Tempoh orbit Bulan/ *Orbital period of the Moon,* $T_2 = 655.2$ jam/ *hours*

$\dfrac{T_1^2}{T_2^2} = \dfrac{r_1^3}{r_2^3}$

$T_1^2 = \dfrac{(6.8 \times 10^6)^3 \times (655.2)^2}{(3.83 \times 10^8)^3}$

$T_1 = 1.55$ jam/ *hours*

3.3 Satelit Buatan Manusia
Man-made Satellites

1 $v = \sqrt{\dfrac{GM}{R + h}}$

2 (a) $v = \sqrt{\dfrac{GM}{R + h}}$

$= \sqrt{\dfrac{(6.67 \times 10^{-11})(5.97 \times 10^{24})}{(6.37 \times 10^6) + (2 \times 10^7)}}$

$= 3.886 \times 10^3$ m s^{-1}

(b) Satelit akan jatuh ke orbit yang lebih rendah
The satellite will fall to a lower orbit.

3 Orbit mengelilingi Bumi
Orbiting around the Earth

4

	Satelit geopegun ***Geostationary satellite***	**Satelit bukan geopegun** ***Non-geostationary satellite***
(a)	Arah gerakan sama dengan arah putaran Bumi *Direction of motion same as the direction of Earth rotation*	Arah gerakan tidak perlu sama dengan arah putaran Bumi *Direction of motion need not be the same as the direction of Earth rotation*
(b)	$T = 24$ jam *$T = 24$ hours*	T lebih singkat atau lebih lama daripada 24 jam *T is shorter or longer than 24 hours*
(c)	Di atas lokasi geografi yang sama *Above the same geopraphical location*	Di atas lokasi geografi yang berbeza *Above different geographical location*
(d)	Satelit komunikasi *Communication satellite*	Pengimejan Bumi // GPS // Kaji Cuaca *Earth imaging // GPS// Weather forecast*
(e)	MEASAT	TiungSAT // RazakSAT // Pipit ISS

5 (a) Halaju minimum yang diperlukan oleh objek di permukaan Bumi untuk mengatasi daya graviti dan terlepas ke angkasa lepas.
The minimum velocity needed by an object on the surface of the Earth to overcome the gravitational force and escape.

(b) (i) $\dfrac{1}{2}mv^2 + \left(-\dfrac{GMm}{r}\right) = 0$

$v^2 = \dfrac{2GM}{r}$

(ii) $v = \sqrt{\dfrac{2GM}{r}}$

(c) $v = \sqrt{\dfrac{2GM}{r}}$

$= \sqrt{\dfrac{2\,(6.67 \times 10^{-11})(5.97 \times 10^{24})}{(6.37 \times 10^6)}}$

$v = 1.12 \times 10^4$ m s^{-1}

6 Pelancaran roket memerlukan kuantiti bahan api yang besar. Pembakaran bahan api perlu menghasilkan kuasa rejang yang tinggi bagi membolehkan roket mencapai halaju lepas dari Bumi dan menghantar kapal angkasa ke angkasa lepas.
The launching of rockets requires large quantities of fuel to produce high thrust that enables the rocket to achieve escape velocity of the Earth and can send the spacecraft into outer space.

PRAKTIS Bab 3

Kertas 1

1 D **2** A **3** B **4** B **5** C
6 C **7** D **8** A

Kertas 2

Bahagian A

1 (a) Daya graviti/ *Gravitational force*

(b) $F = \dfrac{Gm_1 m_2}{r^2}$

$= \dfrac{(6.67 \times 10^{-11}) \times 2 \times (5.97 \times 10^{24})}{(6.37 \times 10^6)^2}$

$= 19.63$ N

(c) Berkurang. Hal ini kerana daya graviti berkadar songsang dengan kuasa dua jarak di antara pusat objek
Decreases. This is due to the gravitational force inversely proportional to the square of distance between the centre of objects

Bahagian C

2 (a) (i) Bulan kerana jejari orbit Bulan lebih besar dari jejari orbit sistem angkasa antarabangsa.
Moon because the radius of orbit of the Moon is larger than the radius of orbit of international space system.

(ii) Jejari orbit bagi sebuah planet bertambah, tempoh orbit bertambah.
The radius of orbit of a planet increases, the orbital period increases.

(iii) Hukum Kepler Ketiga/ Kepler's Third Law

(iv) $\frac{T_1^2}{T_2^2} = \frac{r_1^3}{r_2^3}$

(b)

Ciri-ciri *Characteristics*	**Sebab** *Reason*
Arah putaran satelit mestilah mengikut arah orbit Bumi *The direction of satellite rotation must be in the direction of the Earth orbit*	Satelit sentiasa berada pada kedudukan geografi yang sama dengan pemerhati di permukaan Bumi *The direction of the satellite is always at the same position with observer on the Earth surface*
Tempoh orbit adalah 24 jam *Orbital period is 24 hours*	Supaya sama dengan tempoh putaran Bumi *It will same with the period of the Earth's rotation*
Altitud tinggi *Altitude is higher*	Supaya tempoh orbit bagi satelit akan menyamai tempoh putaran Bumi *Its orbital period is equal to the Earth's rotational period*
Tempoh hayat yang panjang *Long lifespan*	Menjimatkan kos pembuatan satelit yang baharu *To save new satellite manufacturing cost*
Q ialah satelit yang paling sesuai kerana arah putaran satelit mengikut arah orbit Bumi, tempoh orbit yang panjang, altitud yang tinggi dan tempoh hayat yang panjang. *Q is the most suitable satellite because the direction of satellite rotation is in the direction of the Earth orbit, orbital period is longer, altitude is higher and long lifespan.*	

(c) (i) Zuhal/ *Saturn*:

$$g = \frac{(6.67 \times 10^{-11}) \times (5.68 \times 10^{26})}{(6.03 \times 10^{7})^2}$$

$= 10.42 \text{ m s}^{-2}$

Marikh/ *Mars*:

$$g = \frac{(6.67 \times 10^{-11}) \times (6.42 \times 10^{23})}{(3.40 \times 10^{6})^2}$$

$= 3.70 \text{ m s}^{-2}$

(ii) Jisim dan jejari planet
Mass and the radius of the planet

Haba
Heat

4.1 Keseimbangan Terma
Thermal Equilibrium

1 (a) Apabila air panas dan air paip bersentuhan secara terma, suhu air panas akan menurun, manakala suhu air sejuk akan meningkat sehingga suhukedua-dua air menjadi sama.
When the tap water and the hot water are in thermal contact, the temperature of the hot water decreases while the temperature of tap water increases until the temperature of both water become the same.

(b) Haba dipindahkan daripada air panas di dalam bikar ke air paip dengan kadar tinggi. Haba dipindahkan daripada air paip ke air panas di dalam bikar dengan kadar rendah.
Heat is transferred from hot water in the beaker to the tap water with high rate. Heat is transferred from the tap water to the hot water in the beaker with low rate.

(c) Haba dipindahkan pada kadar yang sama antara air panas dan air paip.
Heat is transferred at the same rate between the hot water and the tap water.

(d) Keseimbangan terma
Thermal equilibrium

2 Tiada pemindahan haba bersih antara dua objek// Pemindahan bersih haba sifar
There is no net flow of heat between two objects// The net flow of heat is zero

3 Pada awalnya, suhu tuala basah lebih rendah daripada suhu badan seseorang. Haba dipindahkan daripada dahi ke tuala sehingga capai keseimbangan terma. Maka, tenaga haba seseorang dikurangkan. Suhu badan akan turut berkurang.
Initially the temperature of the wet towel is lower than the body temperature of the person. Heat energy is transferred from the forehead to the towel until thermal equilibrium is reached. Then, the heat energy of the person will reduce. The body temperature also will reduce.

4 (a) (i) Takat lebur ais
Melting point of ice

(ii) Takat didih air
Boiling point of water

(b) proses penskalaan pada termometer untuk membuat pengukuran suhu.
a process of making a scale of reading on a thermometer.

5 $L_0 = 3.6$ cm; $L_{100} = 13.6$ cm; $L_T = 9.3$ cm

$$\theta_T = \frac{L_T - L_0}{L_{100} - L_0} \times 100$$

$$= \frac{9.3 - 3.6}{13.6 - 3.6} \times 100$$

$= 57\ ^\circ\text{C}$

4.2 Muatan Haba Tentu
Specific Heat Capacity

1 kuantiti haba yang diperlukan untuk menaikkan suhunya sebanyak 1 °C.
the quantity of heat needed to raise the temperature of the object by 1 °C.

$$C = \frac{Q}{\Delta\theta}$$

2 (a) Cerek Q/ *Kettle* Q
(b) Cerek Q/ *Kettle* Q
(c) Semakin besar jisim bahan, semakin besar muatan haba bahan itu.
The greater the mass of a substance, the greater the heat capacity of the substance.
(d) Peningkatan suhu/ *Rise of temperature*

3 (a) Bahagian logam pada kereta mempunyai muatan haba yang lebih kecil berbanding kusyen fabrik. Penyerapan haba daripada sinaran Matahari menyebabkan logam mengalami peningkatan suhu yang lebih tinggi berbanding kusyen fabrik.
The metal parts of a car has a lower heat capacity compared to the cushion. Absorption of heat energy from the Sun causes the metal to get hot faster compared to the fabric cushion.
(b) Pasir mempunyai muatan haba yang rendah dan cepat menjadi panas manakala air laut mempunyai muatan haba yang tinggi dan lambat menjadi panas.
Sand has low heat capacity and heats up faster. Water has high heat capacity and heats up slowly.

4 haba yang diperlukan bagi 1 kg bahan untuk menaikkan suhu sebanyak 1 °C.
the quantity of heat needed to raise the temperature of 1 kg *mass of the substance by* 1 °C.

$$c = \frac{Q}{m\Delta\theta}$$

5 $m = 2$ kg; $\Delta\theta = 70 - 30 = 40$ °C; $c = 500$ J kg^{-1} °C^{-1}
$Q = mc\Delta\theta$
$= 2(500)(40)$
$= 40\,000$ J

6 $m = 100$ g $= 0.1$ kg; $\Delta\theta = 100 - 20 = 80$ °C; $c = 129$ J kg^{-1} °C^{-1}
$Q = mc\Delta\theta$
$= 0.1(129)(80)$
$= 1\,032$ J

7 (a)

	Bahan *Material*	**Muatan haba tentu** *Specific heat capacity*	**Alasan** *Reason*
(i)	Kuprum *Copper*	Rendah *Low*	Cepat panas *Heats up very quickly*
(ii)	Aluminium *Aluminium*	Rendah *Low*	Cepat panas *Heats up very quickly*
(iii)	Plastik *Plastic*	Tinggi *High*	Konduktor haba lemah *Poor heat conductor*

(b)

	Alasan *Reason*
(i)	Tidak mudah menjadi gas *Not change to gas easily*
(ii)	Menyerap lebih banyak haba *Absorb more heat*
(iii)	Murah dan jimat *Cheap and cost saving*

(c)

Bayu laut *Sea breeze*	**Bayu darat** *Land breeze*
Muatan haba tentu laut **tinggi**. *Sea has **high** specific of heat capacity.*	Muatan haba tentu laut **rendah**. *Sea has **low** specific of heat capacity.*
Muatan haba tentu daratan **rendah**. *Land has **low** specific of heat capacity.*	Muatan haba tentu darat **tinggi**. *Land has **high** specific of heat capacity.*
Daratan lebih **panas** daripada laut. *Land is **warmer** than sea.*	Laut lebih **panas** daripada daratan. *Sea is **warmer** than land*
Udara panas di **daratan** naik ke atas. *Hot air on **land** rises up.*	Udara panas di **laut** naik ke atas. *Hot air above the **sea** rises up.*
Udara **sejuk** dari laut bergerak ke daratan. ***Cold** air moves towards the land.*	Udara **sejuk** dari daratan bergerak ke laut. ***Cold** air moves towards the sea.*

8 (a) $Q = Pt = 1\,000 \times 5 \times 60$
$= 300\,000$ J
(b) $Q = mc\theta$
$300\,000 = (0.75)(4\,200)\theta$
$\theta = 95.24$ °C

4.3 Haba Pendam Tentu
Specific Latent Heat

1 Haba yang diserap atau dibebaskan semasa perubahan fasa tanpa perubahan suhu.
Heat that is absorbed during melting and boiling without change in temperature.

2 (a) Haba pendam diserap
Latent heat is absorbed
(b) Pembekuan/ *Freezing*
(c) Pendidihan/ *Boiling*

3 haba diserap atau dibebaskan oleh 1 kg bahan untuk berubah fasa tanpa perubahan suhu .
heat absorbed or released for 1 kg *substance to change phase without change in temperature.*

4 haba diserap bagi 1 kg bahan untuk berubah dari pepejal ke cecair tanpa perubahan suhu
heat absorbed for 1 kg *substance to change from solid to liquid without change in temperature.*

5 haba diserap oleh 1 kg bahan untuk berubah dari cecair ke gas tanpa perubahan suhu.
heat absorbed for 1 kg *substance to change from liquid to gas wout change in temperature.*

6

Fasa *Phase*	Haba *Heat*	Suhu *Temperature*	Tenaga kinetik molekul *Kinetic energy of molecule*	Keadaan *State*
MN	Diserap *Absorbed*	Malar *Constant*	Malar *Constant*	Pepejal dan cecair *Solid and liquid*
NO	Diserap *Absorbed*	Bertambah *Increases*	Bertambah *Increases*	Cecair *Liquid*
OP	Diserap *Absorbed*	Malar *Constant*	Malar *Constant*	Cecair dan gas *Liquid and gas*
PQ	Diserap *Absorbed*	Bertambah *Increases*	Bertambah *Increases*	Gas *Gas*

7

Fasa *Phase*	Haba *Heat*	Suhu *Temperature*	Tenaga kinetik molekul *Kinetic energy of molecule*	Keadaan *State*
ST	Dibebaskan *Released*	Malar *Constant*	Malar *Constant*	Gas dan cecair *Gas and liquid*
TU	Dibebaskan *Released*	Berkurang *Decreases*	Berkurang *Decreases*	Cecair *Liquid*
UV	Dibebaskan *Released*	Malar *Constant*	Malar *Constant*	Cecair dan pepejal *Liquid and solid*
VW	Dibebaskan *Released*	Berkurang *Decreases*	Berkurang *Decreases*	Pepejal *Solid*

8 (a) Memampatkan agen penyejuk (gas) untuk menambah tekanan dan suhunya.
Compresses cooling agent (gas) to increase pressure and temperature.

(b) Agen penyejuk (gas) membebaskan haba pendam semasa proses kondensasi.
Cooling agent (gas) releases latent heat during condensation.

(c) Agen penyejuk (cecair) mengalir melalui injap pengembang. Injap ini mempunyai satu lubang kecil yang membenarkan cecair pada tekanan tinggi disembur ke dalam tiub penyejat yang bertekanan rendah. Cecair berubah menjadi gas.
Cooling agent (liquid) flows through expansion valve. This valve has tiny hole which allows liquid at high pressure is ejected into the evaporator tube which is at lower pressure. Liquid changes to gas.

(d) Dalam penyejat, agen penyejuk (cecair) menyejat dan menyerap haba pendam daripada udara di dalam peti sejuk. Bahagian pembeku akan menjadi dingin.
In the evaporator, cooling agent (liquid) evaporates and absorbs latent heat from inside the refrigerator.

(e) Agen penyejuk (gas) mengalir keluar daripada penyejat ke pemampat.
Cooling agent in gas flows out from evaporator to the compressor.

9 (a) $Pt = ml_v$

$$t = \frac{ml_v}{P}$$

$$= \frac{(0.07)(2.26 \times 10^6)}{500}$$

$$= 316.4 \text{ s}$$

(b) Air (30 °C) $\xrightarrow{Q_1}$ Air (100 °C) $\xrightarrow{Q_2}$ Stim (100 °C)
Water *Water* *Steam*

$Q_1 = mc\theta$
$= 0.5 \times 4\,200 \times 70$
$= 147\,000$ J

$Q_2 = ml_v$
$= 0.5 \times 2.26 \times 10^6$
$= 1\,130\,000$ J

$Q = Q_1 + Q_2$
$= 147\,000 + 1\,130\,000$
$= 1\,277\,000$ J

4.4 Hukum Gas
Gas Laws

1

	Unit S.I *S.I unit*	Simbol unit S.I *Symbol of S.I unit*	Unit lain *Others unit*
(a)	Pascal	Pa	cm Hg
(b)	Kelvin	K	°C, °F
(c)	$(\text{meter})^3$	m^3	mm^3, cm^3

2 (a) isi padu gas berkadar songsang dengan tekanan bagi suatu gas tetap pada suhu malar.
the volume of the gas is inversely proportional to gas pressure if its mass and temperature are constant.

(b) $P_1V_1 = P_2V_2$

(c) Mengikut Hukum Boyle/ *According to Boyle's law:*

$$P_1V_1 = P_2V_2$$
$$1 \times 30 = P_2 \times 120$$
$$P_2 = 0.25 \text{ atm}$$

3 (a) isi padu berkadar terus dengan suhu mutlak bagi suatu gas berjisim tetap pada tekanan dimalarkan.
the volume is directly proportional to its absolute temperature for a fixed mass of gas at constant pressure.

(b) $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

(c) $T_1 = 27 + 273 = 300$ K; $T_2 = 30 + 273 = 303$ K
Mengikut hukum Charles/ *According to Charles' law:*

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$
$$\frac{200}{300} = \frac{V_2}{303}$$
$$V_2 = 202 \text{ cm}^3$$

4 (a) tekanan berkadar terus dengan suhu mutlak bagi suatu gas berjisim tetap pada isi padu dimalarkan.
the pressure is directly proportional to its absolute temperature for a fixed mass of gas at constant volume.

(b) $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

(c) $T_1 = 27 + 273 = 300$ K

Mengikut hukum Gay-Lussac/ *According to Gay-Lussac's law:*

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$
$$\frac{3.2}{300} = \frac{2.8}{T_2}$$
$$T_2 = 262.5 \text{ K}$$
$$= 262.5 - 273$$
$$= -10.5°\text{C}$$

PRAKTIS Bab 4

Kertas 1

1 C **2** B **3** B **4** B **5** A
6 C **7** B **8** D **9** A

Kertas 2

Bahagian A

1 (a) Satu bentuk tenaga/ *A form of energy*

(b) (i) Panjang turus udara terperangkap di dalam tiub kapilari dalam Rajah 1.2 lebih panjang daripada Rajah 1.1.
The length of air trapped in the capillary tube in Diagram 1.2 *is longer than in Diagram* 1.1.

(ii) Suhu udara terperangkap di dalam tiub kapilari dalam Rajah 1.2 lebih tinggi daripada Rajah 1.1
The temperature of air trapped in the capillary tube in Diagram 1.2 *is higher than Diagram* 1.1.

(iii) Isi padu/ *Volume*

(iv) Berkadar terus/ *Directly proportional*

(c) Hukum Charles/ *Charles' law*

(d) (i) Sifar mutlak/ *Absolute zero*

(ii) Molekul gas pegun/ *Gas molecules stationary*

Bahagian B

2 (a) (i) Dua jasad dikatakan dalam keseimbangan terma apabila tiada pemindahan haba bersih antara dua jasad dan kedua-dua jasad mempunyai suhu yang sama.
Two bodies are said to be in thermal equilibrium when the net heat flow between the two bodies is zero and both bodies are at the same temperature.

(ii) Haba mengalir daripada air panas ke termometer.
Heat flow from hot water to thermometer.
Sehingga ia mencapai keseimbangan terma.
Until it reaches thermal equilibrium.
Suhu air sama dengan suhu yang ditunjukkan oleh termometer.
The temperature of water is the same as temperature shown by thermometer.
Tiada haba bersih mengalir.
No net heat flows.

(b) (i) Haba dibebaskan oleh M
= Haba diserap oleh air
Heat released by M
= Heat absorbed by water

$$m_1c_1\theta_1 = m_2c_2\theta_2$$
$$(0.5)\,(800)\,(100 - T) = (0.2)\,(4\,200)\,(T - 30)$$
$$T = 52.58\ °\text{C}$$

(ii) Tiada haba hilang ke persekitaran
No heat released to surrounding

(c)

Aspek *Aspect*	**Alasan** *Reason*
Penutup plastik berongga *Hollow plastic stopper*	Boleh perangkap udara// Konduktor haba lemah *Can trapped air// Weak heat conductor*
Ruang P: Vakum *Space* P*: Vacuum*	Elak haba hilang *Prevent heat lost*
Tiub dinding dibuat daripada gelas *Double walled tube made of glass*	Muatan haba tentu besar// Lambat panas *High specific heat capacity// Heat slowly*
Tiub dinding disalut oleh cat berkilat *Double walled tube coated by shiny paint*	Pantul haba daripada dinding termos *Reflect heat from the wall of the thermos*
Kelalang termos W kerana penutup plastik berongga, ruang P adalah vakum, tiub dinding kaca dan disalut cat berkilat. *Thermos flask* W *because of hollow plastic stopper, space* P *is vacuum, the glass walled tube and coated by shiny paint.*	

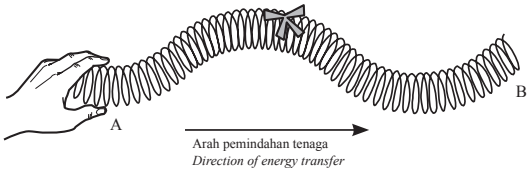
BAB 5 Gelombang
Waves

5.1 Asas Gelombang
Fundamental of Waves

1 Satu proses memindahkan tenaga daripada satu tempat ke tempat lain yang dihasilkan oleh sistem bergetar atau berayun tanpa pemindahan jirim medium.
A process of transferring energy from one location to another which is produced by an oscillating of vibrating system without transferring matter of the medium.

2 (a) Getaran spring slinki
Vibration of the slinky spring

(b) Dari kiri ke kanan// Dari A ke B
From left to right// From A *to* B



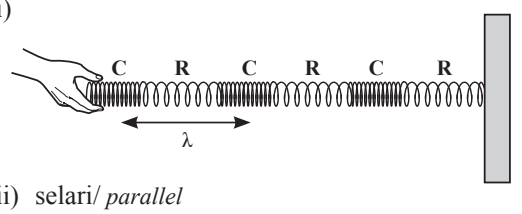
(c) Reben cuma bergetar ke atas dan ke bawah di kedudukan tetap.
The ribbon only vibrates up and down at a fixed position.

3 (a) Rupa bentuk spring slinki semasa gelombang merambat melaluinya.
The shape of the slinky spring as waves propagate through it.

(b) (i) Gelombang melintang
Transverse wave
(ii) Gelombang membujur
Longitudinal wave

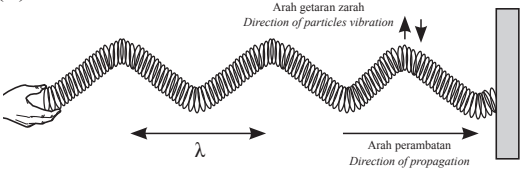
(c) (i) Memerlukan medium untuk memindahkan tenaga dari satu titik ke titik yang lain
Requires a medium to transfer energy from one point to another
(ii) Terdiri daripada ayunan medan elektrik dan medan magnet yang berserenjang antara satu sama lain
Made up of oscillating electric and magnetic fields perpendicular to one another
(iii) Gelombang air dan gelombang bunyi
Water waves and sound waves

(d) (i) gelombang membujur/ *longitudinal wave*
(ii)



(iii) selari/ *parallel*
(iv) Gelombang bunyi/ *Sound wave*

(e) (i) gelombang melintang/ *transverse wave*
(ii)



(iii) serenjang/ *perpendicular*
(iv) Gelombang cahaya/ *Light wave*

4 (a) (i) Sesaran maksimum sesuatu zarah dari kedudukan keseimbangan
The maximum displacement of the particle from its equilibrium position
(ii) Masa bagi satu ayunan// lengkap
The time taken for one complete oscillation
(iii) Bilangan ayunan lengkap dalam masa satu saat
Number of complete oscillation per second
(iv) Jarak di antara dua titik sefasa yang berturutan
The distance between two consecutive points in phase
(v) Jarak yang dilalui oleh profil gelombang dalam sesaat
The distance travelled by a wave profile in a second

(b) (i) 0.5 cm
(ii) 0.4 s
(iii) 2.5 Hz
(iv) 2.0 cm

(c) $v = f\lambda$

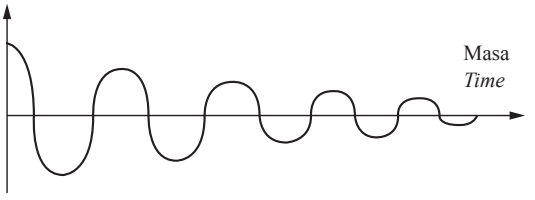
5.2 Pelembapan dan Resonans
Damping and Resonance

1 Pengurangan amplitud suatu sistem ayunan akibat kehilangan tenaga.
The reduction in amplitude in an oscillating system due to loss of energy.

2 (a) Sistem ayunan kehilangan tenaga bagi mengatasi daya geseran atau rintangan udara
Oscillating system loses energy to overcome friction or air resistance

(b) Sistem ayunan kehilangan tenaga kerana renggangan dan mampatan zarah-zarah yang bergetar dalam sistem tersebut
Oscillating system loses energy because of the stretching and compression of the vibrating particles in the system

3 Sesaran
Displacement



4 (a) Amplitud ayunan buaian semakin berkurang dan berhenti.
Amplitude of oscillation of the cradle decreases and stops.

(b) Pelembapan/ *Damping*

(c) Mengenakan daya luar pada buaian. Daya luar yang dikenakan itu membekalkan tenaga tambahan ke atas ayunan buaian untuk menggantikan tenaga yang hilang disebabkan daya geseran.
Apply external force to the cradle. The external force gives extra energy to the oscillating cradle as to compensate for the energy dissipated by frictional force.

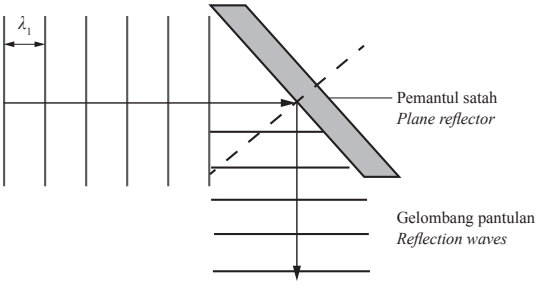
5 ayunan paksa/ *forced oscillation*
6 frekuensi asli/ *natural frequency*
7 Resonans/ *Resonance*
8 frekuensi asli; amplitud maksimum
natural frequency; maximum amplitude

9 (a) C dan D/ C *and* D
(b) Bandul-bandul yang lain turut berayun kerana tenaga dipindahkan melalui tali.
The other pendulums start to oscillate because energy is transferred through the rope.
(c) D
(d) Bandul C dan D. Kedua-duanya mempunyai panjang yang sama dan frekuensi asli yang sama. Apabila satu bandul diayunkan , bandul C dan D menerima tenaga maksimum dan terus berayun. Resonans berlaku.
Pendulums C *and* D. *Both pendulums have the same length and same natural frequency. When a pendulum oscillates, pendulums* C *and* D *receive maximum energy and continue to oscillate. Resonance occurs.*

5.3 Pantulan Gelombang
Reflection of Waves

1 Garisan yang menyambungkan titik-titik pada fasa yang sama.
Lines joining all points of the same phase.

2 (a)



(b) $i = r$
(c) (i) Kekal/ *Unchanged*
(ii) Kekal/ *Unchanged*
(iii) Kekal/ *Unchanged*
(iv) Berubah/ *Change*

3 (a) Pantulan/ *Reflection*
(b) Tenaga tinggi dan boleh bergerak jauh/ *High energy and can move further*
(c) Pemancar mengeluarkan gelombang ultrasonik ke dasar laut. Gelombang itu dipantulkan oleh dasar laut dan dikesan oleh penerima. Sela masa, t bagi gelombang bergerak pergi dan balik dasar laut diukur. Kedalaman laut, s diukur dengan $s = \frac{vt}{2}$ di mana v ialah halaju gelombang ultrasonik dalam air.
A transmitter emits ultrasonic wave to the seabed. The ultrasonic wave is reflected by the transmitter and detected by a receiver. Time interval, t, for the ultrasonic wave to propagate back and forth from the seabed is measured. The depth of the seabed, s is measured by $s = \frac{vt}{2}$ *where v is the speed of ultrasonic wave in water.*

4 (a) $s = \frac{vt}{2}$

$= \frac{340 \times 1.2}{2}$

$= 204$ m

(b) $s = \frac{vt}{2}$

$= \frac{3 \times 10^8 \times 4 \times 10^{-3}}{2}$

$= 600\,000$ m

$= 600$ km

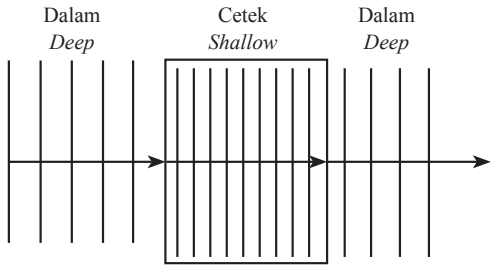
5.4 Pembiasan Gelombang
Refraction of Waves

1 Perubahan arah perambatan gelombang yang disebabkan oleh perubahan halaju gelombang apabila gelombang itu merambat dari satu medium ke medium yang lain.
The change in direction of propagation waves caused by the change in the velocity of waves when the waves propagate from one medium to another.

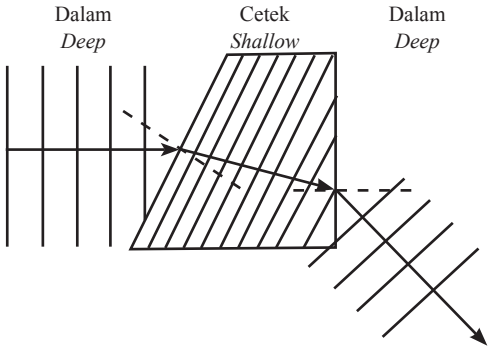
2 (a) Sama kerana menggunakan motor penggetar satah yang sama.
Same because using the same plane vibration motor.
(b) Laju gelombang air di kawasan dalam lebih besar daripada di kawasan cetek.
The speed of water wave in deep region is larger than in shallow region.
(c) Panjang gelombang di kawasan dalam lebih besar daripada di kawasan cetek.
The wavelength in deep region is larger than in shallow region.
(d) Semakin besar panjang gelombang, semakin besar laju gelombang.
The larger the wavelength, the larger the speed of the wave

3 (a) $i > r$
(b) $i < r$
(c) Berkurang/ *Decreases*
(d) Bertambah/ *Increases*
(e) Berkurang/ *Decreases*
(f) Bertambah/ *Increases*
(g) Kekal/ *Unchanged*
(h) Kekal/ *Unchanged*
(i) Dibias mendekati garis normal
Refract towards normal line
(j) Dibias menjauhi garis normal
Refract away from normal line

4 (a)



(b)



5 (a) Lapisan udara berhampiran permukaan Bumi lebih panas. Bunyi bergerak daripada udara panas ke udara sejuk. Laju bunyi berkurang. Bunyi dibias mendekati garis normal. Bunyi tidak dapat didengar dengan jelas.
The air layer near the surface to be warmer. Sound travels from hot to cold air. The speed of sound decreases. Sound is refracted towards normal line. Sound cannot be heard clearly.

(b) Lapisan udara berhampiran Bumi lebih sejuk. Bunyi bergerak lebih perlahan dalam udara sejuk berbanding dalam udara panas.. Laju bunyi bertambah. Bunyi dibias menjauhi garis normal. Bunyi dapat didengar dengan jelas.
The air layer near the ground colder. Sound travels slower in cold air compared to hit air. The speed of sound increases. Sound refracted away from the normal line. Sound can be heard clearly.

6 $v_1 = 5$ cm s^{-1}; $\lambda_1 = 3.0$ cm; $\lambda_2 = 1.5$ cm

$\frac{v_1}{\lambda_1} = \frac{v_2}{\lambda_2}$

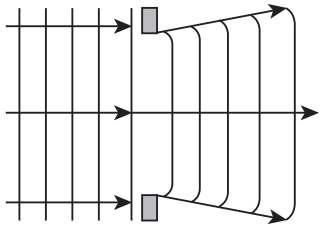
$\frac{5}{3.0} = \frac{v_2}{1.5}$

$v_2 = 2.5$ cm s^{-1}

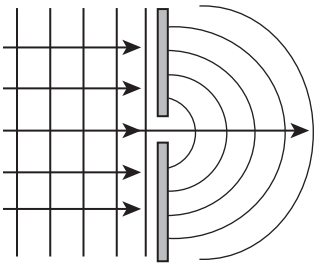
5.5 Pembelauan Gelombang
Diffraction of Waves

1 Penyebaran gelombang apabila merambat melalui celah atau halangan.
Spreading of waves when the waves propagate through a slit or barrirer.

2 (a)

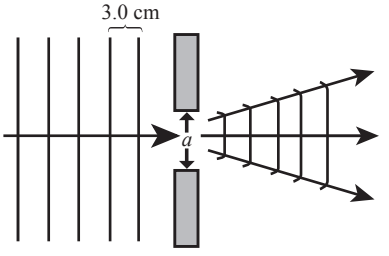
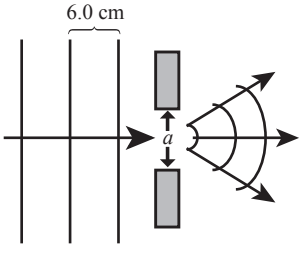


(b)



3 (a) Sama/ *Equal*
(b) Sama/ *Equal*
(c) Sama/ *Equal*
(d) Disebarkan/ *Spread out*
(e) Berkurang/ *Decrease*
(f) Berkurang/ *Decrease*

4

Panjang gelombang ***Wavelength***	**Pendek** ***Short***	**Panjang** ***Long***
Corak gelombang ***Pattern of waves***		
Pembelauan ***Diffraction***	Kurang ketara *Less significant*	Lebih ketara *More significant*

5 Saiz celah yang kecil/ *Small size of gap*
Panjang gelombang yang besar/ *Larger wavelength*

6 (a) (i) Amplitud gelombang selepas melalui bukaan benteng lebih kecil daripada amplitud sebelumnya.
The amplitude after passing through the opening barrier smaller than the amplitude before.

(ii) Membina benteng dengan celah kecil supaya pembelauan berlaku. Tenaga gelombang disebarkan ke kawasan yang luas selepas melalui celah dan akan berkurang. Hal ini akan mengurangkan amplitud gelombang.
Build barriers with small gap so that diffraction can occur. Energy of the waves is spread out to larger area after passing the gap and will be reduced. Thus, the amplitude of the waves will be decreased.

(b) (i) Tidak dapat melihat radio kerana gelombang cahaya tidak dibelaukan.
Cannot see the radio because light waves cannot be diffracted.

(ii) Boleh mendengar radio kerana bunyi boleh dibelaukan.
Can hear the sound because sound waves can be diffracted.

(iii) Bunyi mudah dibelaukan kerana panjang gelombang bunyi lebih besar daripada panjang gelombang cahaya.
Sound waves are more easily diffracted because its wavelength is larger than the wavelength of light wave.

5.6 Interferens Gelombang
Interference of Waves

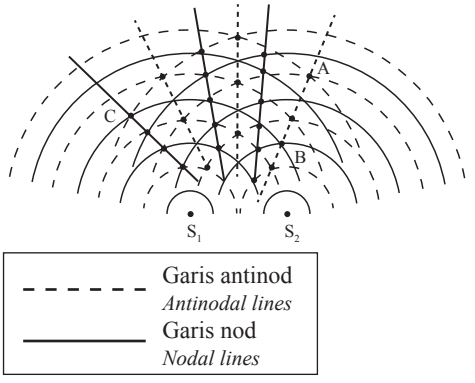
1 Apabila dua gelombang bersuperposisi, sesaran paduan ialah hasil tambah sesaran individu bagi dua gelombang tersebut.
When two waves superposed, the resultant displacement is the sum of the individual displacement of the two waves.

2 Superposisi dua gelombang atau lebih yang koheren.
The superposition of two or more coherent waves.

3 (a) membina; puncak; maksimum
Constructive; crests; maximum
(b) membina; lembangan; maksimum
Constructive; troughs; maximum
(c) memusnah; puncak; lembangan; sifar
Destructive; crests; troughs; zero

4 (a) Titik A: Interferens membina
Point A*: Constructive interference*
Titik B: Interferens membina
Point B*: Constructive interference*
Titik C: Interferens memusnah
Point C*: Destructive interference*

(b)



(c) *a*: Jarak di antara dua sumber koheren
Distance between two coherent sources
x: Jarak di antara dua garis antinod// nod berturutan
Distance between two consecutive antinodal lines// nodal lines
D: Jarak tegak dari dua sumber koheren ke kedudukan *x*
The perpendicular distance from two coherent sources to position x

5 (a) Cahaya dengan satu warna dan satu panjang gelombang.
Light with one colour and one wavelength.

(b) Pinggir cerah dan gelap berselang-seli dan seragam.
Bright and dark fringes alternately and uniformly.

(c) $\lambda = \frac{ax}{D} = \frac{(0.5 \times 10^{-3}) \times (1.8 \times 10^{-3})}{2}$
$= 0.45 \times 10^{-6}$ m

(d) (i) Berkurang/ *Decreases*
(ii) Berkurang/ *Decreases*
(iii) Berkurang/ *Decreases*

6 (a) Kedua-dua pembesar suara disambung ke penjana audio yang sama.
Both loudspeakers are connected to the same audio generator.

(b) Menghasilkan bunyi kuat dan bunyi lemah secara berselang-seli.
Produce loud sound and soft sound alternately.

(c) Bunyi kuat terhasil di kawasan interferens membina manakalan bunyi lemah terhasil di kawasan interferens memusnah.
Loud sound produced at constructive interference region while soft sound produced at destructive interference region.

7 (a) $\lambda = \frac{ax}{D} = \frac{(2.0) \times (1.0)}{3.0}$
$= 0.67$ m

(b) $\lambda = \frac{ax}{D}$
$x = \frac{\lambda D}{a} = \frac{(7.0 \times 10^{-7}) \times (4.0)}{0.5 \times 10^{-3}}$
$= 0.0056$ m
$= 5.6$ mm

5.7 Gelombang Elektromagnet
Electromagnetic Waves

1 (a) Gelombang radio/ *Radio waves*
(b) Sinar gama/ *Gamma rays*

2 (a) Medan elektrik dan medan magnet
Electric field and magnetic field
(b) Berserenjang/ *Perpendicular*
(c) Gelombang melintang
Transverse waves

3 (a) Membunuh sel kanser dalam radioterapi
Kills cancer cells in radiotherapy
Digunakan dalam industri pemprosesan makanan supaya makanan tahan lebih lama
Used in food processing industry so that food can last longer

(b) Mengesan retakan atau patah pada tulang dan pemeriksaan organ dalaman
Detects fractures or broken and examines internal organs
Pengimbas bagasi di lapangan terbang
Baggage scanning at airport

(c) Mengeraskan bahan tampalan gigi
Hardens tooth filling material
Menentukan kesahihan wang kertas
Determines authenticity of currency notes

(d) Membolehkan benda hidup untuk melihat
Enables living things to see
Fotografi
Photography
Fotosintesis
Photsynthesis

(e) Untuk memasak (ketuhar, pemanggang dan pembakar)
For cooking (oven, grill and toaster)
Alat kawalan jauh untuk televisyen dan pemain DVD
Remote control device for television and DVD player

(f) Komunikasi antara alat elektronik (wifi, bluetooth, zigbee)
Communication between electronic devices (wifi, bluetooth, zigbee)
Pengesanan radar pesawat dan pemerangkap laju
Detection of plane radar and speed trap

(g) Rangkaian telefon bimbit
Mobile phone framework
Komunikasi radio jarak jauh
Long distance radio communication
Mesin gelombang millimeter untuk mengimbas badan penumpang di lapangan terbang
Millimeter-wave machine to scan body of passengers at airport

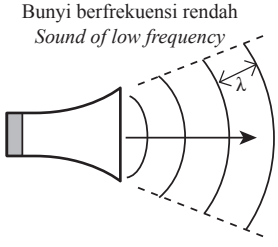
PRAKTIS Bab 5

Kertas 1

1	C	**2**	C	**3**	A	**4**	D	**5**	A
6	B	**7**	C	**8**	C	**9**	C	**10**	C

Kertas 2
Bahagian A

1 (a) Penyebaran gelombang apabila gelombang itu merambat melalui satu celah atau tepi suatu penghalang.
The spreading of waves when the waves propagate through a slit or side of a barrier.

(b)


(c) (i) Panjang gelombang dalam Rajah 1.2 lebih besar daripada dalam Rajah 1.3.
The wavelength in Diagram 1.2 *is larger than in Diagram* 1.3.
(ii) Bentuk pembelauan gelombang bunyi dalam Rajah 1.2 lebih membulat daripada dalam Rajah 1.3.
The pattern of the diffraction of sound wave in Diagram 1.2 *is more circular than in Diagram* 1.3.

(d) Berkurang/ *Decreases*
(e) Tenaga berkurang
Energy decreases

Bahagian B

2 (a) Pantulan gelombang/ *Reflection of waves*
(b) (i)

Gelombang radio ***Radio waves***	**Gelombang bunyi** ***Sound waves***
Gelombang melintang *Transverse waves*	Gelombang membujur *Longitudinal waves*

Boleh merambat tanpa medium *Can travel without medium*	Perlu merambat dengan medium *Needs medium to travel*
Mempunyai panjang gelombang yang panjang *Have long wavelength*	Mempunyai panjang gelombang yang pendek *Have short wavelength*

(ii) – Ketumpatan air lebih besar daripada ketumpatan udara
The density of water is greater than the density of air
– Molekul dalam air lebih rapat antara satu sama lain berbanding molekul dalam udara
Molecules in water are closer to each other compared to molecules in air.
– Bunyi dapat dipindahkan dengan lebih cepat apabila getaran bunyi berlaku
Sound can be transferred faster when sound vibrations occur

(c)

Ciri-ciri ***Characteristics***	**Sebab** ***Reason***
Gelombang membujur *Longitudinal waves*	Zarah bergetar pada arah yang selari dengan arah perambatan gelombang *Particle vibrates in a direction parallel to the direction of wave propagation.*
Frekuensi tinggi *High frequency*	Mempunyai tenaga tinggi// Boleh menembusi lebih dalam ke dalam laut *Has high energy//Can penetrate deeper into the sea*
Kuasa penembusan yang tinggi *High penetrating power*	Boleh merambat jauh *Can propagate further*
Kelajuan lebih tinggi *Higher speed*	Kehilangan tenaga yang rendah *Less loss of energy*
Gelombang S kerana mempunyai gelombang membujur, frekuensi tinggi, kuasa penembusan tinggi dan kelajuan tinggi. *Waves* S *because have longitudinal waves, high frequency, high penetrating power and high speed.*	

(d) (i) $d = \frac{vt}{2}$

$= \frac{1\,500 \times \frac{1}{15}}{2}$

$= 50$ m

(ii) Untuk mengesan kedalaman dasar laut
To detect the depth of seabed
Untuk megesan kedudukan minyak mentah atau kapal karam
To detect the position of crude oil or sunken ship
Untuk mengesan keadaan bayi dalam kadungan rahim
To detect the condition of baby in the womb

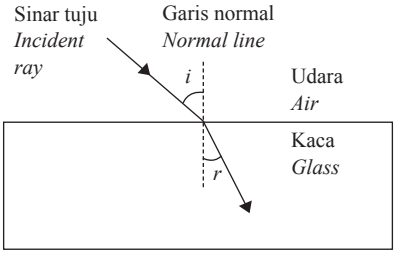
BAB 6

Cahaya dan Optik
Light and Optics

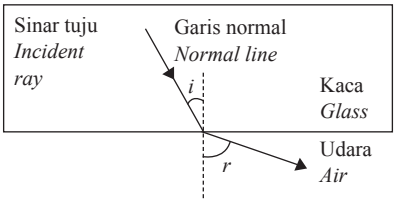
6.1 Pembiasan Cahaya
Refraction of Light

1 Fenomena di mana arah cahaya berubah apabila bergerak melalui dua bahan berlainan ketumpatan optik.
Phenomenon where the direction of light changes when it travels through two materials of different optical densities.

2 *x*:



y:



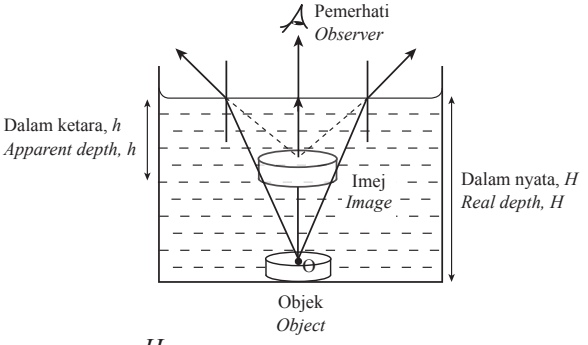
3 *x*: Berkurang/ *Decreases*
y: Bertambah/ *Increases*

4 Nisbah laju cahaya di dalam vakum kepada laju cahaya di dalam medium.
The ratio of speed of light in vacuum to the speed of light in medium.

5 $n_1 \sin \theta_1 = n_2 \sin \theta_2$

n_1	indeks biasan di dalam medium 1/ *refractive index in medium* 1
n_2	indeks biasan di dalam medium 2/ *refractive index in medium* 2
θ_1	sudut tuju di dalam medium 1/ *angle of incidence in medium* 1
θ_2	sudut biasan di dalam medium 2/ *angle of refraction in medium* 2

6 (a) dan (b)



(c) $n = \frac{H}{h}$

7 (a) (i) $n = \frac{\sin \theta}{\sin 33°} = 1.54$

$\sin \theta = 1.54 \times \sin 33°$

$= 0.838$

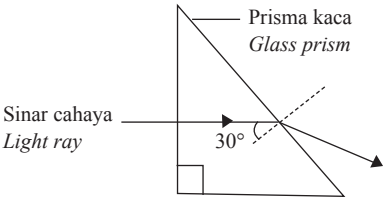
$\theta = 57°$

(ii) $n = \frac{3 \times 10^8}{v} = 1.54$

$v = \frac{3 \times 10^8}{1.54}$

$= 1.94 \times 10^8 \text{ m s}^{-1}$

(b) (i)



(ii) $n = \frac{\sin r}{\sin 30°} = 1.50$

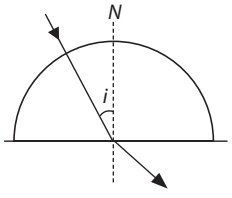
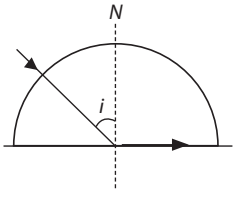
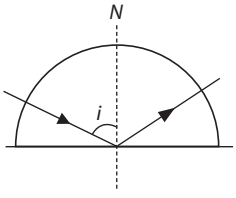
$\sin r = 1.50 \times \sin 30°$

$= 0.75$

$r = 48.6°$

6.2 Pantulan Dalam Penuh
Total Internal Reflection

1

Sudut tuju, *i* dan sudut genting, *c* *Incident angle, i and critical angle, c*	***i* < *c***	***i* = *c***	***i* > *c***
Lintasan sinar cahaya *Path of light ray*			
Penjelasan *Explanation*	Dibias menjauhi garis normal *Refracted away from normal*	Dibias dengan sudut 90° dengan garis normal *Refracted at an angle of 90° to the normal*	Pantulan dalam penuh berlaku *Total internal reflection occured*

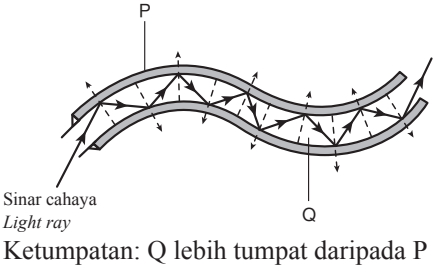
2 (a) $n = \frac{\sin r}{\sin i} = \frac{\sin 90°}{\sin c}$

$n = \frac{1}{\sin c}$

(b) *n* berkadar songsang dengan sin *c*
n inversely proportional to sin c

3 (a) (i) lebih sejuk/ *colder*
(ii) menjauhi/ *refracted away*
(iii) besar; pantulan dalam penuh
large; total internal reflection

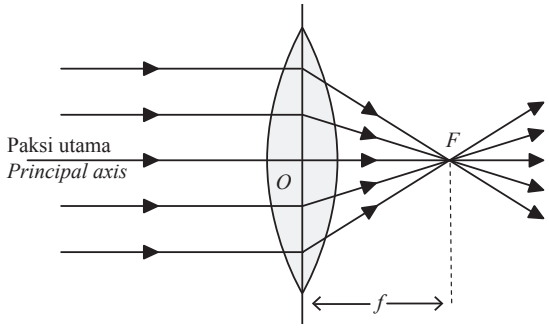
(b) (i) Komunikasi dan perubatan
Communication and medical
(ii) Kaca/ *Glass*
(iii)

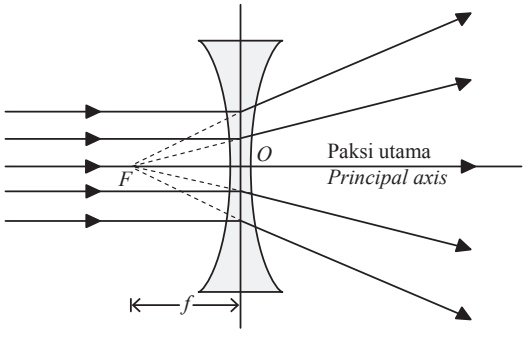


(iv) Ketumpatan: Q lebih tumpat daripada P
Density: Q *denser than* P
Indeks biasan: Q lebih besar daripada P
Refractive index: Q *larger than* P
(v) Sudut tuju lebih besar daripada sudut genting
// *i* > *c* //*Incident angle larger than critical angle*
(vi) Ringan dan kelenturan tinggi
Lighter and high flexibility.
Lebih banyak maklumat boleh dihantar pada satu masa
A large number of signals can be sent at one time
(vii) Periskop prisma
Prism periscope
Pemantul mata kucing
Cat's eye reflector

6.3 Pembentukan Imej oleh Kanta
Image Formation by Lenses

1 (a)





(b) Kanta cembung: Sinar cahaya selari ditumpukan ke titik fokus.
Convex lens: The parallel light rays is converged to a focal point.
Kanta cekung: Sinar cahaya selari dicapahkan seperti datang dari titik fokus.
Concave lens: The parallel light rays is diverged as they come from a point F in front of the lens.

2 (a) Titik di mana semua sinar cahaya selari ditumpukan selepas dibiaskan.
A point where all parallel light rays are converged after refraction.

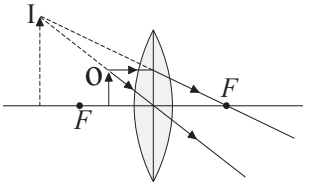
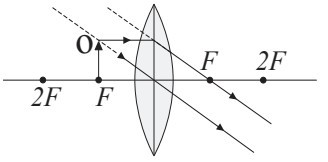
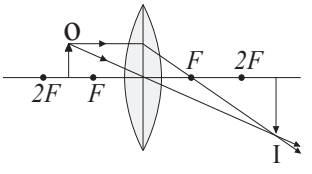
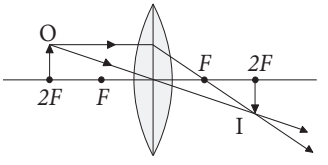
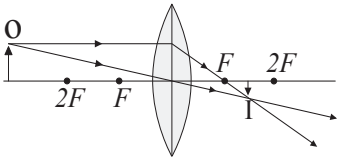
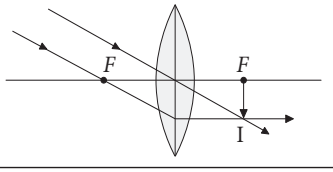
(b) Jarak di antara pusat kanta, *O* dengan titik fokus, *F*.
Distance between the optical centre, O with focal point, F.

(c) Jarak di antara pusat kanta, *O* dengan objek.
Distance between the optical centre, O with object.

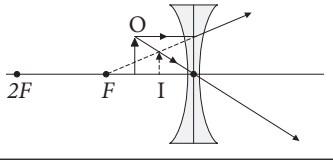
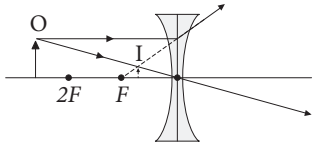
(d) Jarak di antara pusat kanta, *O* dengan imej.
Distance between the optical centre, O with image.

(e) Titik di pusat kanta. Sinar cahaya yang melalui pusat optik tidak dibiaskan.
Point at the centre of the lens. Light rays passing through it are not refracted.

3 (a)

u	**Rajah sinar** *Ray diagram*	**Ciri-ciri imej** *Characteristics of image*
$u < f$		• Maya/ *Virtual* • Tegak/ *Upright* • Diperbesar/ *Magnified* • Imej di/ *Image at: v > u*
$u = f$		• Maya/ *Virtual* • Tegak/ *Upright* • Diperbesar/ *Magnified* • Imej di infiniti/ *Image at infinity*
$2f > u > f$		• Nyata/ *Real* • Songsang/ *Inverted* • Diperbesar/ *Magnified* • Imej di/ *Image at: v > 2f*
$u = 2f$		• Nyata/ *Real* • Songsang/ *Inverted* • Sama saiz/ *Same size* • Imej di/ *Image at: v = 2f*
$u > 2f$		• Nyata/ *Real* • Songsang/ *Inverted* • Diperkecil/ *Diminished* • Imej di/ *Image at: f < v < 2f*
$u = \infty$		• Nyata/ *Real* • Songsang/ *Inverted* • Diperkecil/ *Diminished* • Imej di *F*/ *Image at F*

(b)

u	**Rajah sinar** *Ray diagram*	**Ciri-ciri imej** *Characteristics of image*
$u < 2f$		• Maya/ *Virtual* • Tegak/ *Upright* • Diperkecil/ *Diminished* • Imej di/ *Image at: v < f*
$u > 2f$		• Maya/ *Virtual* • Tegak/ *Upright* • Diperkecil/ *Diminished* • Imej di/ *Image at: v < f*

4 h_i: ketinggian imej/ *height of image*
h_o: ketinggian objek/ *height of object*
v: jarak imej/ *image distance*
u: jarak objek/ *object distance*

6.4 Formula Kanta Nipis
Thin Lens Formula

1 $$\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$$
u: jarak objek/ *object distance*
v: jarak imej/ *image distance*
f: panjang fokus/ *focal length*

2 (a) Positif/ *Positive*
(b) Negatif/ *Negative*

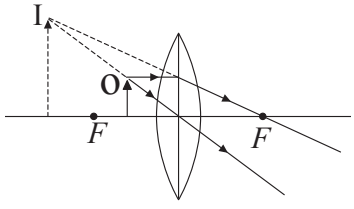
3 (a) $\frac{1}{f}=\frac{1}{u}+\frac{1}{v} \rightarrow \frac{1}{20}=\frac{1}{30}+\frac{1}{v}$
$v = 2$

(b) $m=\frac{v}{u} \rightarrow m=\frac{60}{30}$
$= 20$ cm

(c) Nyata, songsang, diperbesar
Real, inverted, magnified

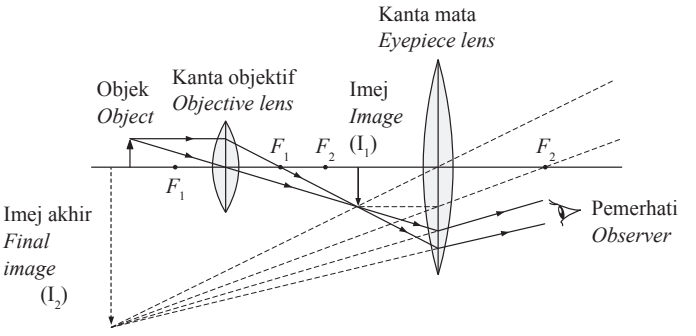
6.5 Peralatan Optik
Optical Instruments

1

Kegunaan ***Application***	Membesarkan imej *Enlarge the image*
Ia mempunyai ***It consists of***	1 kanta cembung 1 *convex lens*
Jarak objek ***Object distance***	$u < f$
Ciri-ciri imej ***Characteristics of image***	Maya, tegak, diperbesar *Virtual, upright, magnified*
Rajah sinar ***Ray diagram***	

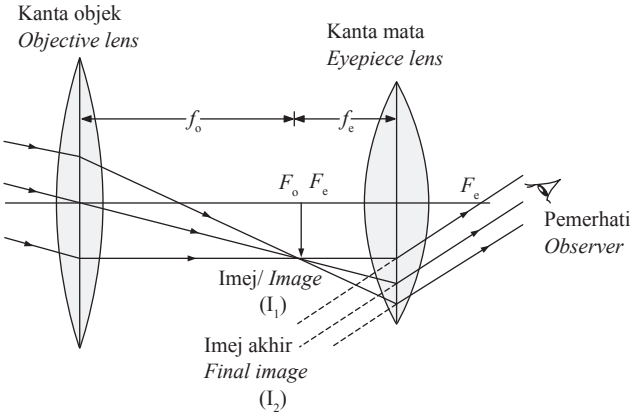
2

Kegunaan ***Application***	Melihat objek seni *To see small object*
Ia mempunyai ***It consists of***	2 kanta cembung 2 *convex lenses*
Banding f_o dan f_e ***Compare f_o and f_e***	$f_o < f_e$
Jarak objek ***Object distance***	$f_o < u < 2f_o$
Ciri-ciri imej melalui kanta objek ***Characteristics of image through objective lens***	Nyata, songsang, diperbesar *Real, inverted, magnified*
Kedudukan kanta mata ***Position of eyepiece lens***	$u < f_e$
Ciri-ciri imej akhir ***Characteristics of final image***	Maya, tegak, diperbesar *Virtual, upright, magnified*

Rajah sinar ***Ray diagram***	

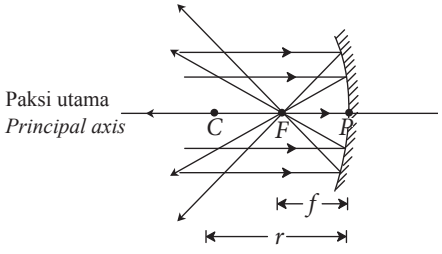
3

Kegunaan ***Application***	Melihat objek jauh *To see distant object*
Ia mempunyai ***It consists of***	2 kanta cembung 2 *convex lenses*
Banding f_o dan f_e ***Compare f_o and f_e***	$f_o > f_e$
Jarak objek ***Object distance***	Infiniti// Jauh *Infinity// Distant*
Bagaimana sinar cahaya melalui kanta objek? ***How light rays passes through objective lens?***	Sinar selari *Parallel rays*
Kedudukan imej melalui kanta objek ***Position of image through objective lens***	Pada titik fokus, f_o *At focus point, f_o*
Ciri-ciri imej melalui kanta objek ***Characteristics of image through objective lens***	Nyata, songsang, diperkecil *Real, inverted, diminished*
Kedudukan kanta mata ***Position of eyepiece lens***	$u = f_e$
Ciri-ciri imej akhir ***Characteristics of final image***	Maya, songsang, diperbesar *Virtual, inverted, magnified*
Pelarasan normal: Jarak di antara f_o dan f_e ***Normal adjustment: The distance between f_o and f_e***	$f_o + f_e$
Pembesaran linear ***Linear magnification***	$m = \frac{f_o}{f_e}$

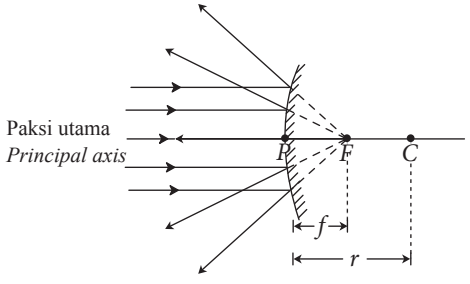
Rajah sinar ***Ray diagram***	

6.6 Pembentukan Imej oleh Cermin Sfera
Image Formation by Spherical Mirrors

1 (a)



(b)



2 (a) Garis lurus menerusi pusat kelengkungan, *C* dan kutub cermin, *P*.
Straight line passing through the centre of curvature, C and pole of the mirror, P.

(b) Titik di mana semua sinar selari menumpu selepas dipantulkan.
A point where all parallel lights converge after reflection.

(c) Jarak di antara titik fokus, *F* dengan kutub cermin, *P*.
Distance between focal point, F and the pole of the mirror, P.

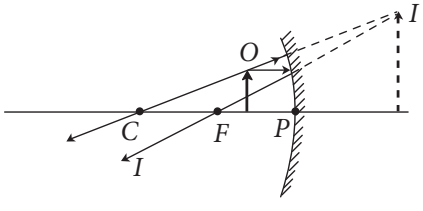
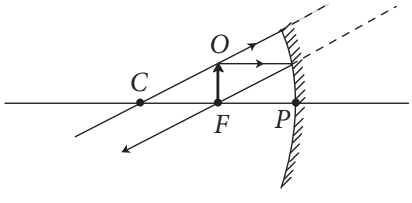
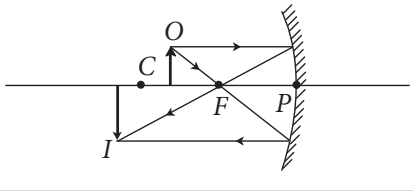
(d) Jarak dari objek ke kutub cermin.
Distance between object and the pole of the mirror.

(e) Jarak dari imej ke kutub cermin.
Distance between image and the pole of the mirror.

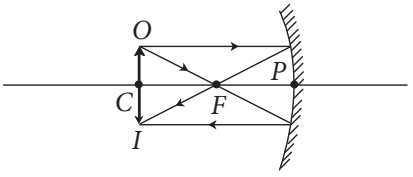
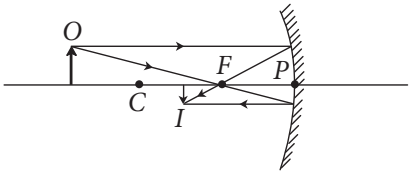
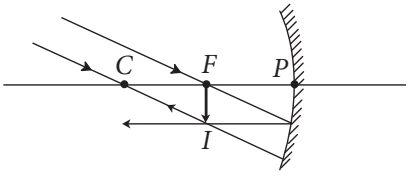
(f) Pusat sfera yang menghasilkan cermin cekung atau cermin cembung.
Centre of sphere which produces a concave or convex mirror.

(g) Jarak di antara kutub cermin, *P* dengan pusat kelengkungan, *C*.
Distance between the pole of the mirror, P and the centre of curvature, C.

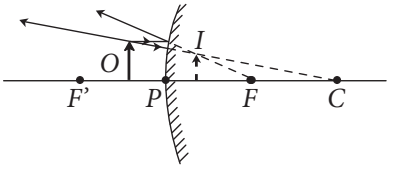
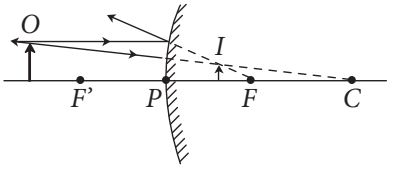
3

u	**Rajah sinar** ***Ray diagram***	**Ciri-ciri imej** ***Characteristics of image***
$u < f$		• Maya/ *Virtual* • Tegak/ *Upright* • Diperbesar/ *Magmified* • Imej di/ *Image at: v > u*
$u = f$		• Maya/ *Virtual* • Tegak/ *Upright* • Diperbesar/ *Magmified* • Imej di infiniti/ *Image at infinity*
$2f > u > f$		• Nyata/ *Real* • Songsang/ *Inverted* • Diperbesar/ *Magmified* • Imej di/ *Image at: v > 2f*

3

u	**Rajah sinar** *Ray diagram*	**Ciri-ciri imej** *Characteristics of image*
$u = 2f$		• Nyata/ *Real* • Songsang/ *Inverted* • Sama saiz/ *Same size* • Imej di/ *Image at*: $v = 2f$
$u > 2f$		• Nyata/ *Real* • Songsang/ *Inverted* • Diperkecil/ *Diminished* • Imej di/ *Image at*: $f < v < 2f$
$u = \infty$		• Nyata/ *Real* • Songsang/ *Inverted* • Diperkecil/*Diminished* • Imej di *F*/ *Image at F*

4

u	**Rajah sinar** *Ray diagram*	**Ciri-ciri imej** *Characteristics of image*
$u < f$		• Maya/ *Virtual* • Tegak/ *Upright* • Diperkecil/ *Diminished* • Imej di/ *Image at*: $v < f$
$u > f$		• Maya/ *Virtual* • Tegak/ *Upright* • Diperkecil/ *Diminished* • Imej di/ *Image at*: $v < f$

PRAKTIS Bab 6

Kertas 1

1 B **2** C **3** C **4** C **5** D
6 A **7** C **8** A

Kertas 2

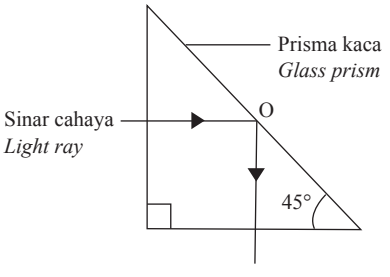
Bahagian A

1 (a) $n = \frac{1}{\sin c} \rightarrow 1.5 = \frac{1}{\sin c}$

$\sin c = \frac{1}{1.5}$

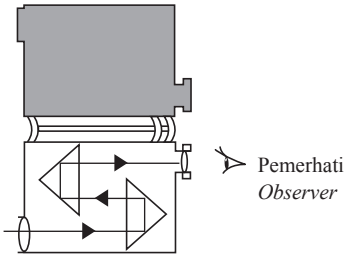
$c = 41.81°$

(b)



(c) Pantulan dalam penuh
Total internal reflection

(d)



Bahagian B

2 (a) (i) Titik menumpu bagi sinar tuju yang selari
Point of convergence of parallel incident rays

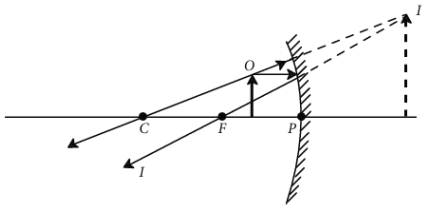
(ii) cermin menumpu/ *converge mirror*

(b) – Kelengkungan cermin H lebih besar daripada cermin G
The curvature of mirror H *is larger than mirror* G.

– Panjang fokus G lebih panjang daripada H
The focal length of G *is longer than* H

– Arah cahaya cermin H dan G selepas dipantulkan akan menumpu pada titik fokus, F
The ligh rays of mirrors G *and* H *after reflection will converge at focal point,* F
– Lengkungan semakin bertambah, panjang fokus semakin berkurang
The curvature increases, the focal length decreases

(c)



Nota/ *Notes*:
– Jarak objek < panjang fokus
Object distance < focal length
– Imej: membesar, maya dan tegak
Image: magnified, virtual and upright

(d)

Ciri-ciri ***Characteristics***	**Penerangan** ***Explanation***
Gunakan cermin cembung *Use convex mirror*	Medan penglihatan yang lebih luas *Wider field of view*
Rintangan cuaca yang sangat baik *Excellent weather resistance*	Mampu menahan cuaca buruk *Able to withstand bad weather*
Rintangan hentaman bahan yang sangat baik *Excellent impact resistance of material*	Tidak pecah, tahan lama *Not broken, everlasting*
Cermin dengan saiz lebih besar *Bigger size mirror*	Untuk membolehkan medan penglihatan yang lebih luas dan imej yang lebih tajam *To enable a wider field of view and sharper image*
Bahan pantulan yang lebih baik *Good reflectivity of material*	Imej lebih jelas walaupun dalam cuaca buruk *Clearer image even in bad weather*
Letakkan di selekoh tajam *Place at sharp corners*	Untuk mengurangkan kemalangan berlaku, dengan membolehkan pemandu melihat lalu lintas akan datang *To reduce the occurrence of accidents, by allowing drivers to see oncoming traffic*
Pasang bumbung kecil *Install a small roof*	Lindungi dari hujan turun untuk imej yang lebih baik *Protect from rain drop for better image*

Penilaian Akhir Tahun

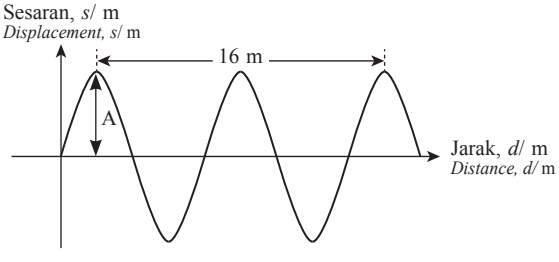
Kertas 1

1 A	**2** B	**3** D	**4** D	**5** C
6 B	**7** D	**8** C	**9** A	**10** A
11 B	**12** D	**13** B	**14** D	**15** A
16 A	**17** A	**18** B	**19** B	**20** B
21 C	**22** C	**23** C	**24** D	**25** C
26 C	**27** B	**28** C	**29** C	**30** D
31 C	**32** D	**33** B	**34** D	**35** A
36 B	**37** B	**38** C	**39** C	**40** D

Kertas 2
Bahagian A

1 (a) Arah getaran zarah berserenjang dengan arah perambatan gelombang
Direction of vibration of particles is perpendicular to the direction of propagation of wave

(b)



(c) $\lambda = 8$ m
$v = f\lambda$
$= 5 \times 8$
$= 40$ m s^{-1}

2 (a) (i) Cermin cekung/ *Concave mirror*
(ii) Cermin cembung/ *Convex mirror*
(b) (i) – Saiz imej dalam Rajah 2.1 lebih besar daripada dalam Rajah 2.2
Size of image in Diagram 2.1 *is larger than in Diagram* 2.2
– Luas medan penglihatan dalam Rajah 2.2 lebih luas daripada dalam Rajah 2.1
Field of view in Diagram 2.2 *is wider than in Diagram* 2.1

(ii) Cermin pandang belakang// Cermin kawalan
Rear view mirror// Surveillance mirror

3 (a) Tenaga haba yang diperlukan untuk menaikkan suhu 1 kg bahan itu sebanyak 1 °C
The quantity of heat required to raise the temperature of 1 kg *of substance by* 1 °C

(b) Bacaan termometer dalam Rajah 3.1 lebih kecil berbanding dalam Rajah 3.2
Thermometer reading in Diagram 3.1 *is lower than in Diagram* 3.2

(c) Muatan haba tentu air adalah besar. Maka, kadar kenaikan suhu adalah perlahan.
The specific heat capacity of water is greater. Hence, the rate of temperature rise is slower.

(d) $Q = mc\theta$
$= 1 \times 4\,200 \times 10$
$= 42\,000$ J

4 (a) Hasil darab jisim dan halaju
Product of mass and velocity

(b) $p = mv$
$= 1\,440 \times 20$
$= 2.88 \times 10^4$ kg m s^{-1}

(c) (i) $p = mv$
$= 1\,700 \times 20$
$= 3.4 \times 10^4$ kg m s^{-1}

(ii) Momentum bertambah
The momentum increases
Inersia bertambah/ *The inertia increases*

(d) Keadaan kereta dalam Rajah 4.2 adalah lebih berbahaya kerana daya yang lebih besar diperlukan untuk memberhentikan kereta itu. Jika daya membrek adalah sama, kereta itu akan bergerak lebih jauh sebelum ia berhenti.
The car situation in Diagram 4.2 *is more dangerous because a greater force is needed to stop the car. If the car braking force is the same, the car will move further before it comes to stop.*

5 (a) Satu titik pada paksi utama iaitu semua cahaya selari tertumpu selepas dipantulkan oleh cermin
A point at principal axis where all the parallel light are focused//converged after reflected by a mirror

(b) (i) Jarak objek dalam Rajah 5.1 lebih dekat daripada dalam Rajah 5.2
The object distance in Diagram 5.1 *is nearer than in Diagram* 5.2

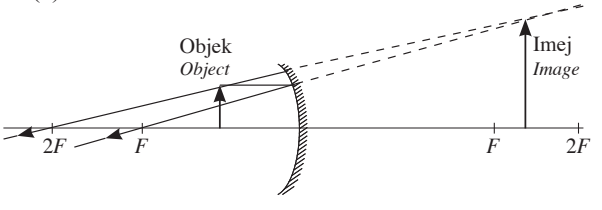
(ii) Jarak imej dalam Rajah 5.1 lebih jauh daripada dalam Rajah 5.2
The image distance in Diagram 5.1 *is further than in Diagram* 5.2

(iii) Semakin dekat jarak objek, semakin jauh jarak imej// Berkadar songsang
The nearer the object distance, the further the image distance// Inversely proportional

(iv) Berkadar songsang/ *Inversely proportional*

(v) Pantulan/ *Reflection*

(c)



6 (a) Zarah-zarah medium bergetar pada arah yang berserenjang dengan arah perambatan gelombang
Particles of the medium vibrate in the direction perpendicular to the direction of propagation of the wave

(b) (i) Kedalaman air di kawasan A lebih dalam berbanding di kawasan B
The depth of water in region A *is deeper than inregion* B

(ii) Panjang gelombang bagi gelombang di kawasan A lebih besar berbanding di kawasan B
The wavelength of the wave in region A *is bigger than in region* B

(iii) Apabila kedalaman air bertambah, panjang gelombang turut bertambah
When the depth of water increases, the wavelength of the wave also increases

(c) (i) Laju gelombang
Speed of wave

(ii) – Kedalaman berkurang, laju gelombang bertambah
As the depth decreases, the speed of wave decreases
– Daripada $v = f\lambda$, kedalaman berkurang, panjang gelombang berkurang
According to $v = f\lambda$, *the depth decreases, the wavelength decreases*

(d) Berkurang/ *Decreases*

(e) Berkadar songsang/ *Inversely proportional*

7 (a) (i) Muatan haba tentu rendah
Low specific heat capacity
Sebab/ *Reason*:
Cepat panas/ *Heats up quickly*

(ii) Jisim rendah/ *Small mass*
Sebab/ *Reason*: Kerana lebih mudah untuk dikendalikan semasa memasak
Because it is easier to handle while cooking

(b) (i) $t = \dfrac{mc\theta}{P}$
$= \dfrac{2.2 \times 387 \times 50}{500}$
$= 85.14$ s

(ii) $t = \dfrac{mc\theta}{P}$
$= \dfrac{2.9 \times 900 \times 50}{500}$
$= 261$ s

(c) Kuali M/ *Pan* M

8 (a) (i) Daya graviti
Gravitational force

(ii) Gerakan jatuh bebas
Free fall motion

(b) (i) Rendah/ *Lower*
Sebab: Pusat graviti rendah // Lebih stabil
Reason: Lower centre of gravity // More stable

(ii) Diperbuat daripada getah
Made up from rubber
Sebab: Memanjangkan masa kesan hentaman// Mengurangkan daya impuls
Reason: To lengthen the time of impact// To reduce the impulsive force

(iii) Diperbuat daripada plastik
Made up from plastic

Sebab: Memanjangkan masa kesan hentaman// Mengurangkan daya impuls
Reason: To lengthen the time of impact// To reduce the impulsive force

(c) Reka bentuk R/ *Design* R

Bahagian B

9 (a) Keseimbangan terma/*Thermal equilibrium*

(b)
– Jumlah haba awal air dalam kedua-dua rajah adalah sama
The amount of initial heat of water for both diagrams are same
– Muatan haba tentu bekas dalam Rajah 9.1 lebih besar daripada dalam Rajah 9.2
The specific heat capacity of container in Diagram 9.1 *is larger than in Diagram* 9.2
– Suhu air selepas 10 minit dalam Rajah 9.1 lebih tinggi daripada dalam Rajah 9.2
The temperature of water after 10 *minutes in Diagram* 9.1 *is higher than in Diagram* 9.2
– Kadar kehilangan haba dalam Rajah 9.1 adalah lebih rendah daripada dalam Rajah 9.2
The rate of heat loss in Diagram 9.1 *is lower than in Diagram* 9.2
– Semakin besar muatan haba tentu bekas, semakin rendah kadar kehilangan haba
The larger the specific heat capacity of container, the lower the rate of heat loss

(c)
– Pada permulaan, lebih banyak haba mengalir dari air ke bekas berbanding dari bekas ke air
Initially, more heat flow from water to the container rather than from container to the water
– Aliran haba bersih adalah dari air ke bekas
The net heat flow is from water to the container
– Apabila keseimbangan terma dicapai, aliran haba bersih adalah sifar
When thermal equilibrium is reached, the net heat flow is zero
– Suhu air adalah sama dengan suhu bekas
The temperature of water is same as the temperature of container

(d)

Ciri-ciri ***Characteristics***	**Huraian** ***Explanation***
Kepingan X ialah asbestos *Plate* X *is asbestos*	Penebat haba yang baik *Good heat insulator*
Cecair Y ialah minyak *Liquid* Y *is oil*	Sentuhan terma yang baik antara termometer dan bongkah aluminium// Untuk memastikan keseimbangan terma antara termometer dan bongkah aluminium tercapai *Good thermal contact between thermometer and the aluminium block// To ensure thermal equilibrium between thermometer and aluminium block achieved*
Bahan Z ialah kertas tisu *Material* Z *is tissue*	Mengurangkan// Menghalang kehilangan haba ke persekitaran *Reduce// Prevent heat lost to the surrounding*
Kuasa pemanas rendam yang tinggi *Power of immersion heater is high*	Boleh meningkatkan suhu dengan cepat// Cepat panas// Bekalkan lebih banyak tenaga haba *Can increase the temperature faster// Fast to heat// Supply more heat energy*

Set radas yang paling sesuai digunakan ialah set radas S kerana kepingan X ialah asbestos, cecair Y ialah minyak, bahan Z ialah kertas tisu dan kuasa pemanas rendam yang tinggi.
The most suitable set of apparatus used is set S *because plate* X *is asbestos, liquid* Y *is oil, material* Z *is tissue and power of immersion heater is high.*

10 (a) (i) Pantulan dalam penuh/ *Total internal reflection*

(ii)
– Lapisan udara di permukaan jalan raya lebih panas daripada lapisan udara di atas
The layer of air above the road surface is hotter than the upper layer of air
– Lapisan udara panas mempunyai ketumpatan optik yang lebih kecil daripada udara sejuk
The layer of hot air has smaller optical density than cold air
– Cahaya yang merambat dari lapisan atas ke lapisan bawah akan dibias secara beransur-ansur menjauhi garis normal
Light which travels from the upper layer to the lower layer are gradually refracted away from the normal
– Apabila sudut tuju lebih besar daripada sudut genting udara, pantulan dalam penuh akan berlaku
When the angle of incidence is greater than the critical angle of air, total internal reflection occurs

(b)

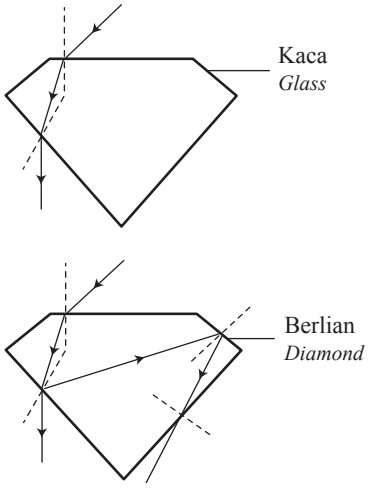
Ciri-ciri ***Characteristics***	**Huraian** ***Explanation***
Sifat gentian optik ialah berkas gentian optik halus yang selari *Characteristic of optical fibre is bundle of fine parallel optical fibres*	Lebih banyak maklumat// signal *More information data// signals*
Kelenturan yang tinggi *High flexibility*	Boleh dibengkokkan *Can be bend*
Gentian optik nipis *Thin optical fibre*	Boleh digunakan di kawasan yang kecil *Can be used in small area*
Perbandingan antara indeks biasan lapisan dalam, n_i dan lapisan luar, n_o ialah $n_i > n_o$ *Comparison between refractive index of the inner layer,* n_i *and the outer layer,* n_o *is* $n_i > n_o$	Berlaku pantulan dalam penuh *Total internal reflection occurs*

Gentian optik yang paling sesuai untuk digunakan ialah gentian optik T kerana sifat gentian optik ialah berkas gentian optik halus yang selari, kelenturan yang tinggi, nipis dan perbandingan antara indeks biasan lapisan dalam, n_i dan lapisan luar, n_o ialah $n_i > n_o$.
The most suitable optical fibre used is optical fibre T *because the characteristic of optical fibre is bundle of fine parallel optical fibres, high flexibility, thin and comparison between refractive index of the inner layer, n_i and the outer layer, n_o is $n_i > n_o$.*

(c) (i) Bagi kaca/ *For glass*: $c = \sin^{-1}\left(\frac{1}{1.5}\right)$
$= 41.8°$

Bagi berlian/ *For diamond*: $c = \sin^{-1}\left(\frac{1}{2.42}\right)$
$= 24.4°$

(ii)



[Lebih daripada satu pantulan dalam penuh bagi berlian]
[*More than one total internal reflection for diamond*]

Bahagian C

11 (a) Jatuh bebas/ *Free fall*

(b) – Peluncur jatuh dengan pecutan seragam
He falls with uniform acceleration
– Nilai pecutan graviti Bumi, g = 9.81 m s^{-2}
The value of gravitational acceleration of Earth, g = 9.81 m s^{-2}
– Apabila tangan dan kakinya didepakan, geseran udara bertambah
When his hands and legs is opened, air resistance increases,
– Maka, nilai pecutan akan berkurang
Then, the value of acceleration will decrease

(c) – Jisim epal lebih besar berbanding bulu pelepah
Mass of the apple is greater than the feather
– Masa mencecah dasar bagi kedua-dua objek adalah sama
Time to reach the base for both objects is same
– Kedua-dua objek mengalami pecutan yang sama
Both objects have same acceleration
– Jisim tidak mempengaruhi pecutan object
Mass is not influencing the acceleration of object
– Konsep yang dikaitan adalah gerakan jatuh bebas
The related concept is free fall motion

(d)

Pengubahsuaian *Modification*	**Penerangan** *Explanation*
Kain nilon atau kain tebal *Nylon fabric or thick fabric*	Kuat, tidak mudah koyak dan kalis air *Strong, not easy to tear and water proof*
Kain besar atau lebar *Bigger or wider fabric*	Meningkatkan rintangan udara *To increase the air resistance*
Tali yang banyak *More strings*	Mengurangkan tegangan tali *To reduce string tension*
Tali yang tebal atau nilon *Thick or nylon strings*	Kuat, tidak mudah putus dan tahan lama *Strong, not easily break and long lasting*
Pelapik lembut di bawah objek *Soft liner under the object*	Mengurangkan daya impuls dan memanjangkan masa hentaman apabila mendarat *Reduce the impulsive force and to lengthen the time of impact during landing*

Kertas 3

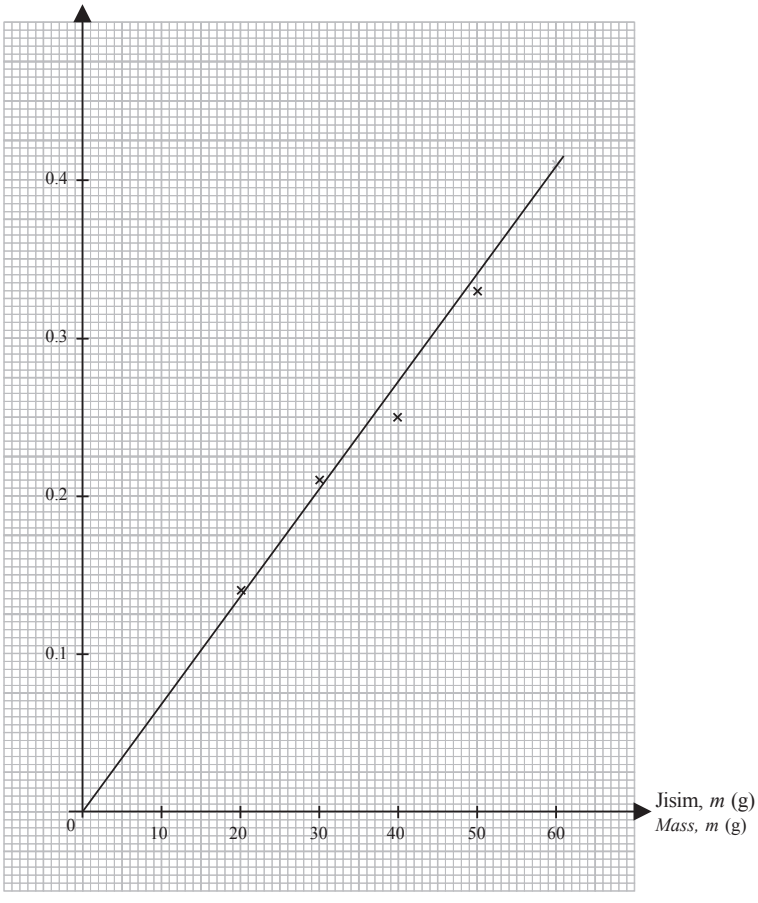
1 (a) (i) Jisim plastisin/ *Mass of plasticine*

(ii) Tempoh ayunan/ *Period of oscillation*

(b)

m (g)	t (s)	T (s)	T^2 (s^2)
20	3.7	0.37	0.14
30	4.6	0.46	0.21
40	5.0	0.50	0.25
50	5.8	0.58	0.33
60	6.4	0.64	0.41

(c) Tempoh ayunan, T^2 (s^2)
Period of oscillation T^2 (s^2)



(d) T^2 berkadar terus dengan m
T^2 *is directly proportional to* m

(e) $k = \dfrac{0.41 - 0}{60 - 0}$
$= 6.8 \times 10^{-3}$ s^2 g^{-1}

(f) Bertambah/ *Increases*

KEMENTERIAN PENDIDIKAN
JABATAN PENDIDIKAN NEGERI SELANGOR

TUISYEN RAKYAT PTRS SELANGOR

PROGRAM TUISYEN RAKYAT SELANGOR 2026

KATA ALUAN YAB DATO' MENTERI BESAR SELANGOR

Program Tuisyen Rakyat Selangor (PTRS) terus menjadi antara intervensi pendidikan strategik Kerajaan Negeri Selangor dalam memperkukuh prestasi akademik pelajar sekolah menengah, khususnya bagi menghadapi peperiksaan Sijil Pelajaran Malaysia (SPM).

Memasuki tahun 2026, pelaksanaan PTRS memberi tumpuan kepada pendekatan berasaskan hasil (outcome-based intervention) dengan sasaran meningkatkan penguasaan lapan (8) mata pelajaran teras iaitu Bahasa Melayu, Bahasa Inggeris, Matematik, Sejarah, Sains, Matematik Tambahan, Fizik dan Kimia dalam kalangan pelajar Tingkatan 4 dan Tingkatan 5.

Bagi tahun ini, program menyasarkan manfaat kepada sekurang-kurangnya 150,000 pelajar di seluruh Negeri Selangor, dengan penekanan kepada akses saksama, peningkatan kompetensi subjek kritikal serta pengurangan jurang pencapaian akademik antara sekolah dan daerah.

YAB DATO' SERI AMIRUDIN BIN SHARI
DATO' MENTERI BESAR SELANGOR

Sejak diperkenalkan pada tahun 2009 dan melalui fasa transformasi digital pascapandemik, modul latihan PTRS kini distrukturkan dalam bentuk hibrid; fizikal dan dalam talian bagi memastikan keberkesanan penyampaian serta kebolehcapaian yang lebih meluas. Platform digital yang dibangunkan telah membolehkan lebih ramai pelajar mengakses bahan pembelajaran secara fleksibel melalui peranti mudah alih, selaras dengan aspirasi pendigitalan pendidikan negeri.

Bagi memastikan kejayaan pelaksanaan PTRS tahun ini, Kerajaan Negeri Selangor telah memperuntukkan sebanyak RM11 juta, dengan pembiayaan serta pelaksanaan bersama oleh Jawatankuasa Tetap Pendidikan dan Modal Insan Negeri Selangor, Menteri Besar Selangor (Pemerbadanan) MBI serta Jabatan Pendidikan Negeri Selangor.

Kerajaan Negeri yakin bahawa PTRS 2026 bukan sahaja meningkatkan pencapaian akademik, malah memperkukuh kesiapsiagaan pelajar untuk melangkah ke pendidikan tinggi dan pasaran kerja yang semakin kompetitif. Pembangunan modal insan berkualiti kekal menjadi teras kepada agenda menjadikan Selangor sebagai negeri termaju, berdaya tahan dan berdaya saing di peringkat nasional dan serantau.

Komitmen ini mencerminkan iltizam Kerajaan Negeri dalam memastikan setiap anak Selangor diberi peluang yang adil untuk berjaya.

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