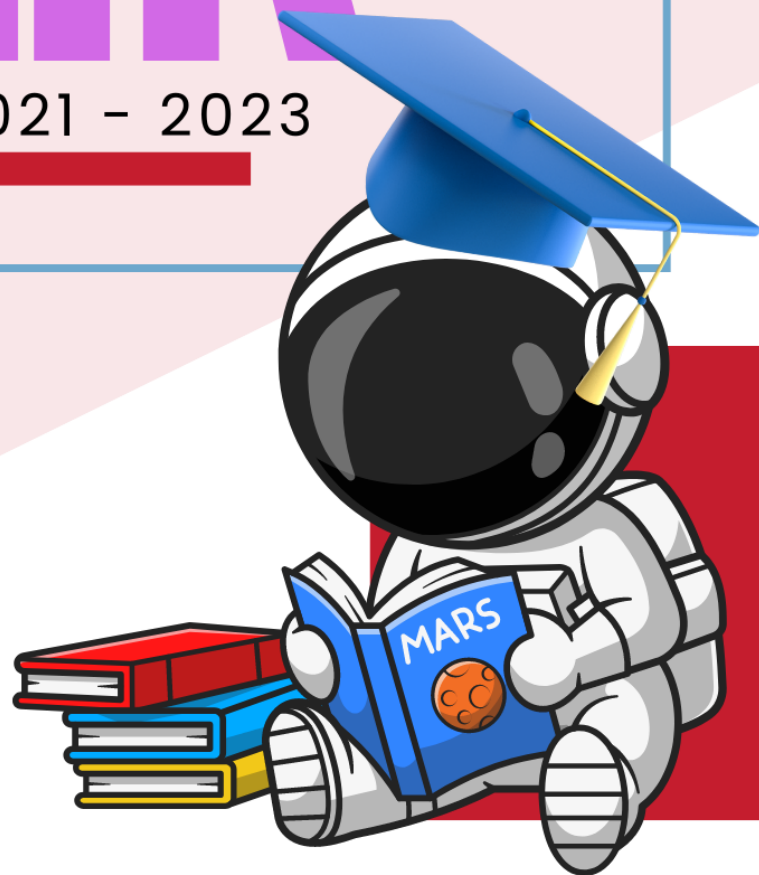ALINA IMAN ARIF

"Excellence is not a singular act. but a habit. You are what you do repeatedly."

KOLEKSI SOALAN

FIZIK

SPM

SPM KSSM: 2021 - 2023

SKEMA JAWAPAN
(UNTUK RUJUKAN)

SOALAN DISUSUN MENGIKUT BAB F4 & F5

TIDAK DIBENARKAN JUAL BELI

"Ilmu itu didapati dengan lidah yang gemar bertanya dan akal yang suka berfikir"
-Abdullah Ibnu Abbas-

PHYSICS formula

Maklumat berikut mungkin berfaedah. Simbol-simbol mempunyai makna yang biasa.
The following information may be useful. The symbols have their usual meaning.

1. FORCE AND MOTION I

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

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

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

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

$$Momentum = mv$$

$$F = ma$$

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

$$Ek = \frac{1}{2}mv^2$$

$$Ep = mgh$$

2. GRAVITATION

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

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

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

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

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

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

$$U = -\frac{Gm_1m_2}{r}$$

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

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

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

g = 9.81 ms⁻² @ N kg⁻¹
$$g = 9.81 \text{ ms}^{-2} @ \text{ N kg}^{-1}$$
$$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{kg}^{-2}$$

3. HEAT

$$Q = mc\theta$$

$$Q = ml$$

$$Q = Pt$$

$$P_1V_1 = P_2V_2$$

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

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

4. WAVES

$$f = \frac{1}{T}$$

$$v = f\lambda$$

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

5. LIGHT & OPTICS

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

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

$$n = \frac{1}{\sin C}$$

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

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

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

Linear magnification, $m = \frac{v}{u}$

The **KEY** to **SUCCESS** is to start **BEFORE** you are **READY**

6. FORCE AND MOTION II

$F = kx$

$E = \frac{1}{2} Fx$

$E = \frac{1}{2} kx^2$

7. PRESSURE

$P = \frac{F}{A}$

$P = h\rho g$

$\rho = \frac{m}{V}$

$\frac{F_1}{A_1} = \frac{F_2}{A_2}$

$A_1 h_1 = A_2 h_2$

$F_b = \rho V g$

8. ELECTRICITY

$E = \frac{F}{Q}$

$I = \frac{Q}{t}$

$V = \frac{E}{Q}$

$V = IR$

$R = \frac{\rho l}{A}$

$E = V + Ir$

$P = IV$

$P = \frac{V^2}{R}$

$P = I^2 R$

$P = \frac{E}{t}$

$E = \frac{F}{d}$

9. ELECTROMAGNETISME

$\frac{V_S}{V_P} = \frac{N_S}{N_P}$

$n = \frac{\text{Output power}}{\text{Input power}} \times 100\%$

10. ELECTRONIC

$E = eV$

$E = \frac{1}{2} mv^2$

$\beta = \frac{I_C}{I_B}$

$e = 1.66 \times 10^{-19}$ C

11. PHYSICS NUCLEAR

$N = \left(\frac{1}{2}\right)^n N_o$

$E = mc^2$

$c = 3.00 \times 10^8$ m s^{-1}

1 a.m.u. $= 1.66 \times 10^{-27}$ kg

12. QUANTUM PHYSICS

$E = hf$

$f = \frac{c}{h}$

$\lambda = \frac{h}{p}$

$\lambda = \frac{h}{mv}$

$E = \frac{hc}{\lambda}$

$P = nhf$

$hf = W + \frac{1}{2} mv^2{}_{\text{maks}}$

$W = hf_o$

$h = 6.63 \times 10^{-34}$ J s

$e = 1.66 \times 10^{-19}$ C

F4 BAB 2: DAYA & GERAKAN 1

SPM 2021 (SET 2)

7   Rajah 7.1 menunjukkan tukul berjisim 0.8 kg digunakan untuk mengetuk paku. Paku itu bergerak masuk ke dalam kayu disebabkan oleh daya impuls.
Diagram 7.1 shows a 0.8 kg hammer used to hit the nail. The nail moves inside the word because of impulsive force.
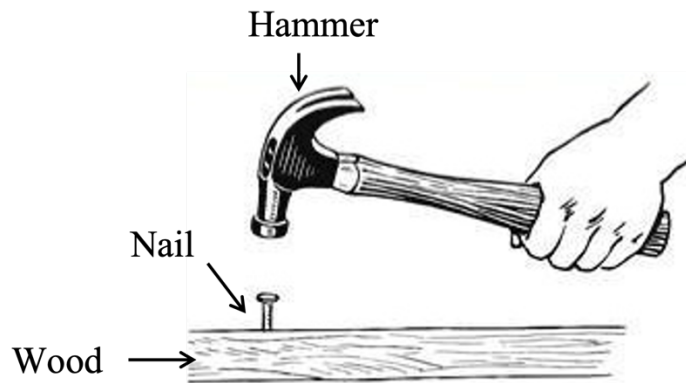
Hammer

Nail

Wood →

Diagram 7.1

(a)   Apakah maksud daya impuls?
What is the meaning of impulsive force?

Reject: Formula

Rate of change of momentum

....

[1 mark]

(b)   (i)   Jika kelajuan tukul semasa mengetuk paku adalah 20 m s^{-1} dan kemudian berhenti dalam masa 0.05 s, hitung daya impuls yang dikenakan ke atas paku tersebut.
If the velocity of the hammer while hitting and stopped in 0.05 s, calculate the impulsive force acted on the nail.

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

$$F = \frac{0.8\,(0-20)}{0.05} \quad \surd_1$$

$$F = -320\ N \quad \surd_2 \ UNIT!$$

[2 marks]

(ii)   Apakah yang berlaku kepada daya impuls jika kelajuan tukul semasa mengetuk paku bertambah?
What happen to the impulsive force it the speed of hamering increases when it hit the nail?

Increases

....

[1 mark]

(c) Rajah 7.2 menunjukkan proses pemasangan jubin lantai. Gandin digunakan untuk mengetuk permukaan jubin tanpa memecahkannya.
Diagram 7.2 shows the process of installing floor tiles. Mallet is used to knocking the tile surface without breaking it.
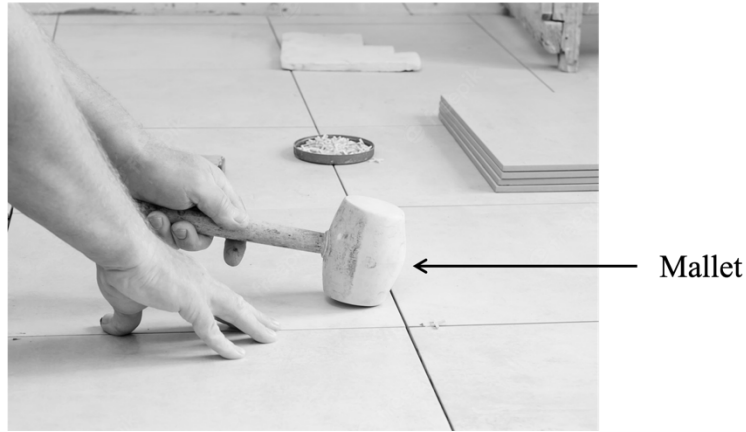

Diagram 7.2

Rajah 7.3 menunjukkan ciri-ciri tiga ganding X, Y dan Z.
Diagram 7.3 shows the characteristics of three mallet X, Y and Z.

Mallet X	Wood — Rubber — Rubber
Mallet Y	Wood — Rubber
Mallet Z	Wood — Iron — Rubber

Diagram 7.3

Berdasarkan Rajah 7.3, nyatakan ciri-ciri gandin yang sesuai untuk memasang jubin tersebut. Berikan sebab untuk kesesuaian ciri-ciri tersebut.
Based on Diagram 7.3, state the suitable characteristics of the mallet used to install the floor tiles. Give reasons for the suitability of the characteristics.

(i)   Bahan kepala gandin
      Head material of the mallet

      Rubber
      …………………………………………………………………………………..
                                                                      [1 mark]

      Sebab
      Reason

      Reduce impulsive force // high impact time
      …………………………………………………………………………………....
                                                                      [1 mark]

(ii) Jenis pemegang
      Type of handle

      wooden handle with rubber
      …………………………………………………………………………………..
                                                                      [1 mark]
      Sebab
      Reason

      increase grip // not slipping // rough
      …………………………………………………………………………………..
                                                                      [1 mark]

(iii) Berdasarkan jawapan anda di 7(c)(i) dan 7(c)(ii), pilih gandin yang paling sesuai digunakan untuk memasang jubin lantai tanpa memecahkannya.
      Based on the answer in 7(c)(i) and 7(c)(ii), choose the most suitable mallet that can be used to install the floor tiles without breaking it.

      ✗
      …………………………………………………………………………………..
                                                                      [1 mark]

                                                    TOTAL   9 marks

9 Rajah 9.1 menunjukkan seorang pemain sofbol meneruskn hayunan batang pemukul selepas bola dipukul untuk meningkatkan impuls.
Diagram 9.1 shows a softball player continuing to swing the bat after the ball is hit to increase impulse.

Diagram 9.1

(a) Apakah maksud impuls?
What is meant by impulse?

Change of momentum

[1 mark]

(b) Terangkan bagaimana teknik ikut lajak pada Rajah 9.1 dapat meningkatkan impuls.
Explain how follow through technique in Diagram 9.1 can increase the impuls.

- Time of contact long
- Final velocity increase
- Final momentum increase // momentum increase
- Change of momentum (impulse) increase

[4 marks]

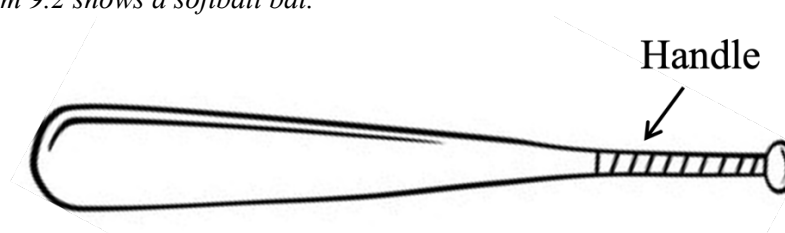(c) Rajah 9.2 menunjukkan batang pemukul sofbol.
Diagram 9.2 shows a softball bat.

Handle

Diagram 9.2

Jadual 9 menunjukkan empat jenis batang pemukul P, Q, R dan S.
Table 9 shows four types of softball bat P, Q, R and S.

Batang pemukul *Bat*	Jisim (kg) *Mass (kg)*	Bahan *Material*	Bahan tambahan pada pemegang *Additional material on the handle*	Panjang batang pemukul (cm) *Length of softball bat (cm)*
P	0.6	Kayu *Wood*	Ada grip *With Grip*	80
Q	0.8	Kayu *Wood*	Tiada grip *Whitout grip*	75
R	1.0	Logam *Metal*	Ada grip *With Grip*	85
S	1.2	Logam *Metal*	Tiada grip *Whitout grip*	70

Table 9

Anda dikehendaki menentukan jenis batang pemukul yang dapat menghasilkan pukulan bola yang paling jauh. Kaji spesifikasi keempat-empat jenis batang pemukul berdasarkan aspek yang diberi. Terangkan kesesuaian setiap spesifikasi dan seterusnya tentukan jenis batang pemukul yang paling sesuai.
Beri sebab untuk pilihan anda.
You are required to determine the type of bat that can make the farthest shot of the ball. Study the spesifications of the four types of bat based on the aspects given. Explain the suitability of each specification and then determine the most suitable type of bat.
Give reasons for your answers.

CHARACTERISTICS	REASON
Mass: High	high momentum / high impulse
Material: Metal	strong / does not break easily / durable
Additional material on the handle: With grip	increase friction / increase grip
Length of softball bat: Increase // more	increase velocity / more force
R	*Mass:* High *Material:* Metal *Additional material on the handle:* With grip *Length of softball bat:* Increase // more

[10 marks]

(d) Pemain sofbol memukul dan mengenakan daya 50 N ke atas bola berjisim 0.2 kg sedang bergerak dengan halaju 72 km j^{-1}. Masa sentuhan bola dengan batang pemukul ialah 0.2 saat.
A softball player hit and exerted 50 N force on a ball with a mass of 0.2 kg which is moving at a velocity of 72 km h^{-1}. Time contact of the ball with the bat is 0.2 second.

(i) Hitung impuls yang dialami oleh bola itu.
Calculate the impulse experienced by the ball.

$$Ft = 50 \times 0.2 \quad \sqrt{}_1$$

$$Ft = 10 \text{ Ns}$$
$$\sqrt{}_2 \textbf{ UNIT!}$$

[2 marks]

(ii) Selepas bola dipukul, bola melantun ke arah bertentangan.
Hitung halaju lantunan bola dalam unit Sistem Antarabangsa (SI).
*After the ball is hitted, the ball is **bounced** in the opposite direction.*
Calculate the bounce velocity of the ball in International System of Units (SI).

$$u = \frac{72 \text{ } km}{h} = 20 \text{ ms}^{-1}$$
$$\sqrt{}_1$$

$$Ft = mv - (-mu)$$

$$Ft = mv + mu = m(v + u)$$

$$10 = 0.2(v + 20)$$
$$\sqrt{}_2$$

$$v + 20 = \frac{10}{0.2}$$

$$v + 20 = 50$$

$$v = 30 \text{ ms}^{-1} \quad \sqrt{}_3 \textbf{ UNIT!}$$

[3 marks]

TOTAL   20 marks

9   Rajah 9.1 menunjukkan seorang pekerja pembinaan sedang mengendalikan mesin penghentak cerucuk di kawasan tapak pembinaan.
Daya dihasilkan apabila penghentak cerucuk menghentam cerucuk.
Diagram 9.1 shows a construction worker handling a pile driver machine at a construction area.
The force is produced when the pile driver hits the pile.
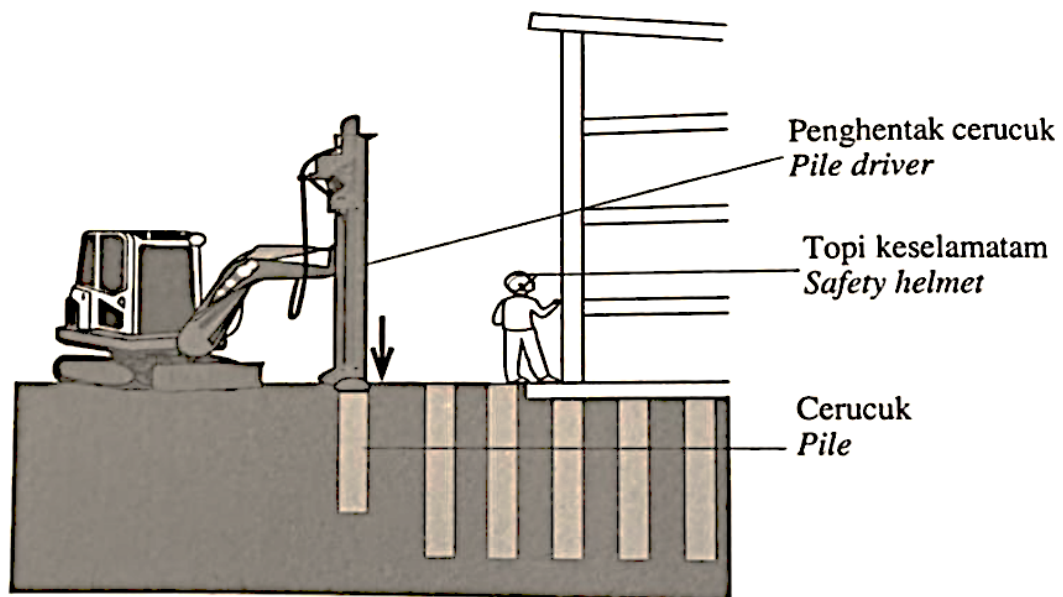
Rajah 9.1 / *Diagram* 9.1

(a)   Namakan daya yang bertindak ke atas cerucuk dalam Rajah 9.1.
Name the force acting on the pile in Diagram 9.1.

Impulsive force

[1 markah / *mark*]

(b)   Pekerja di kawasan pembinaan perlu memakai topi keselamatan.
Terangkan ciri-ciri topi keselamatan yang sesuai untuk melindungi kepala pekerja daripada kecederaan yang serius.
Workers in construction areas must wear safety helmets.
Explain what the appropriate safety helmet features are to protect the worker's head from serious injury.

[4 markah / *marks*]

Inner helmet: soft material // foam inside // span // inner cloth	Increase time impact Absorb force // shock // energy Reduce impulsive force Reduce rate of change of momentum
Outer helmet: Strong helmet // carbon fibre outside	Not break

EXTRA INFO
(IDEA FOR DECISION MAKING & MODIFICATION)

✏️Fiber glass

= strong material

= not break

= shock absorption

✏️Hard shell

= spreads out the impact force over a larger area

✏️Inner helmet cover with soft material (foam inner)

 *Thick plastic foam (firm polystyrene)

= higher time impact

= low impulsive force

✏️Chin strap

= helmet remains on the head

= helmet should feel snug and comfortable, but not slide from side-to-side or
    front-to-back

✏️Flame resistance
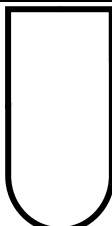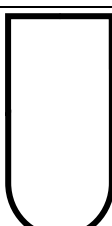
= withstand from heat

✏️Penetration resistance

= against sharp and pointed objects

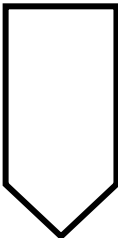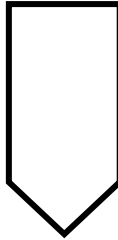
✏️Low density

= low mass

= lighter

(c) Jadual 9 menunjukkan empat sistem cerucuk, P, Q, R dan S yang digunakan di kawasan tapak pembinaan.
Table 9 *shows four pile systems,* P, Q, R *and* S *which are used in the construction site area.*

Sistem cerucuk *Piling system*	Ketinggian penghentak *Height of the pile driver*	Jisim cerucuk *Mass of the pile driver*	Bahan cerucuk *Material of pile*	Bentuk hujung cerucuk *Shape of the tip of the pile*
P	8 m	200 kg	Besi *Iron*	
Q	12 m	150 kg	Besi *Iron*	
R	12 m	200 kg	Konkrit *Concrete*	
S	8 m	100 kg	Konkrit *Concrete*	

Jadual 9 / *Table* 9

Kaji setiap ciri sistem cerucuk, P, Q, R dan S dan terangkan kesesuaian setiap ciri. Tentukan sistem cerucuk yang paling sesuai untuk digunakan dalam pembinaan. Berikan sebab untuk pilihan anda.
Study each characteristic of P, Q, R *and* S *piling systems and explain the suitability for each characteristic.*
Determine the most suitable piling system to be use in construction.
Give reasons for your choice.

[10 markah / *marks*]

Characteristic	Reason
Height of the pile driver: Higher	Gravitational potential energy higher // Kinetic energy increase // Velocity increase // Increase momentum // Impulse increase
Mass of the pile driver: Higher	Inertia increase // Higher force // Time impact decrease // Impulsive force increase
Material of pile: Concrete	Strong material // Not break
Shape of the tip of the pile:	Increase pressure at bottom // Increase force // Shorten time impact // Higher impulsive force
R	Height of the pile driver: Higher Mass of the pile driver: Higher Material of pile: Concrete Shape of the tip of the pile:

(d) Rajah 9.2 menunjukkan penghentak cerucuk berjisim 450 kg dilepaskan dari keadaan pegun.
Diagram 9.2 *shows a pile driver of mass* 450 kg *release from stationary state.*
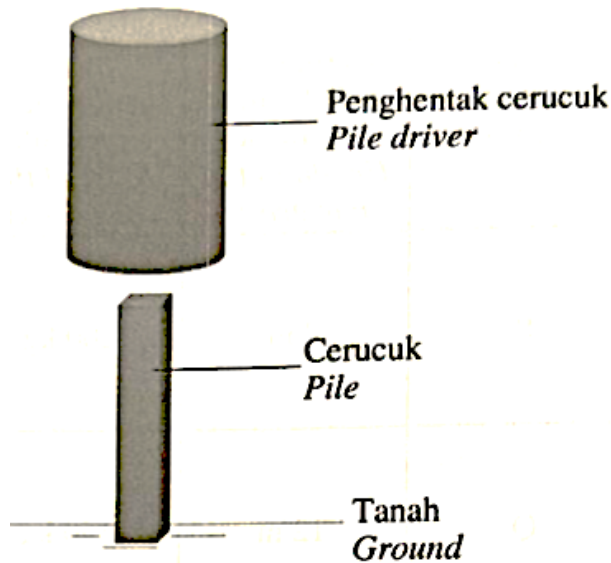
Rajah 9.2 / *Diagram* **9.2**

Masa gerakan penghentak cerucuk sejurus sebelum hentakan ialah 2 s.
The time of motion of the pile driver just before the impact is 2 s.

Hitung,
Calculate,

(i) halaju penghentak cerucuk sejurus sebelum hentaman
(nyatakan jawapan dengan unit)
the velocity of the pile drive just before the impact
(state the answer with the unit)

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

$u = 0 \text{ m s}^{-1}$

$v^2 = 2gs$ .... (1)
$s = \frac{1}{2} gt^2$ .... (2) √₁

insert (2) in (1)

$v^2 = 2g(\frac{1}{2} gt^2) = (9.81)^2(2)^2$
$v^2 = 384.94444$ √₂
$v = 19.620 \text{ m s}^{-1}$ √₃ (unit!)

[3 markah / *marks*]

(ii) Perubahan momentum penghentak cerucuk
(nyatakan jawapan dengan unit)
the change of momentum of the pile driver
(state the answer with the unit)

$Ft = mv - mu$
$Ft = 450\ (19.620)$ $\checkmark_1$
$Ft = 8\ 829\ kg\ m\ s^{-1}$
$\checkmark_2$ (unit!)

or

$Ft = 450(9.81) \times 2$ $\checkmark_1$
$Ft = 8\ 829\ N\ s$
$\checkmark_2$ (unit!)

[2 markah / *marks*]

TOTAL   20 marks

F4 BAB 3: GRAVITI

SPM 2021 (SET 1)

3   Diagram 3 shows a rubber stopper of mass 0.2 kg is tied to one end with a nylon thread and hung to a load on the other end. The rubber stopper is spinned in a circular path at a constant speed.
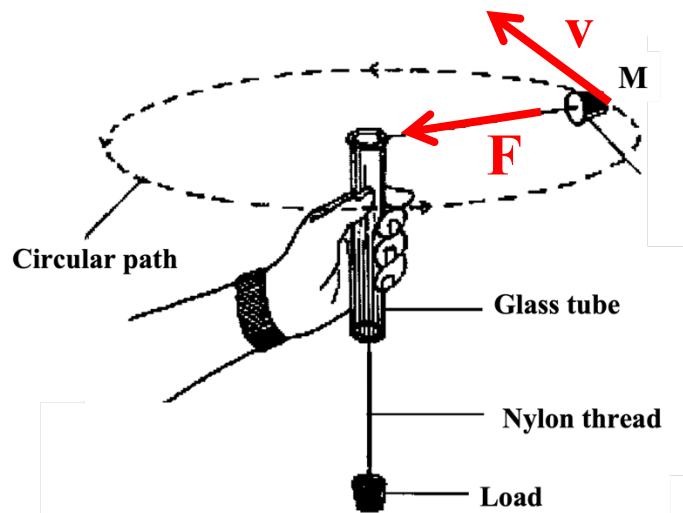

Diagram 3

(a)   Based on Diagram 3,

(i)   Name the force that remains the rubber stopper in the circular path.

Centripetal Force
....
[1 mark]

(ii)   mark the direction of force, F involved in 3(a)(i) in Diagram 3.
[1 mark]

(iii)   draw the arrow to show the direction of linear speed, v of rubber stopper at position M in Diagram 3.
[1 mark]

(b)   The rubber stopper is spinned with linear speed of 10 m s⁻¹.
Calculate the force acting on the rubber stopper when the radius of the circular path is 1.5 m.

$F = \dfrac{mv^2}{r}$

$F = \dfrac{(0.2)(10)^2}{1.5}$ √1

$F = 13.33$ N

F = ... N   √2 (min: 2 dp // max: 4dp)

13.33

Reject: 1 dp

[2 marks]

(c)   What will happen to the radius of the circular path when the rubber stopper is spinned with a higher speed?

Increase
....
[1 mark]

TOTAL   6 marks

2 Rajah 2 menunjukkan satelit J dan satelit K mengelilingi Bumi. Hukum Kepler Ketiga menjelaskan hubungan antara tempoh orbit satelit mengelilingi Bumi dan jejari orbit tersebut.
Diagram 2 shows the satellite J and satellite K orbiting the Earth. Kepler's Third Law explains the relationship between the orbital period of a satellite arround the Earth and its orbital radius.
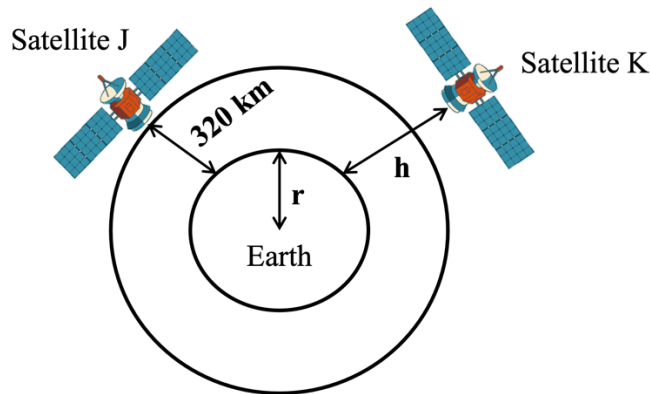

Diagram 2

(a) Nyatakan Hukum Kepler Ketiga
State Kepler's Third law.

The square of the orbital period of planet is directly proportional to the cube of its orbital radius.

[1 mark]

(b) Satelit J dan satelit K masing-masing berada pada ketinggian 320 km dan h dari permukaan Bumi. Temph orbit satelit K mengelilingi Bumi adalah lima kali ganda tempoh orbit satelit J. Kira jejari orbit satelit K. [jejari Bumi, r = 6370 km]
Satellite J and satellite K are at a height of 320 km and h respectively from the Earth's surface. The orbital period of satellite K orbiting the Earth is five times the orbiting period of satellite J. Calculate the orbital radius of satellite K.
[Radius of the Earth, r = 6370 km]

$r = h + R$
$r = 320 + 6370$
$r = 6690 \text{ km}$ √₁

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

$\dfrac{T^2}{6690^3} = \dfrac{5T^2}{r_2^3}$ √₂

$r_2 = 19561.679 \text{ km} \; // \; 1.96 \times 10^7 \text{ m}$

√₃ **UNIT!**

[3 marks]

(c) Apakah yang berlaku kepada laju linear satelit K, jika satelit itu sedang mengelilingi bumi dengan ketinggian, h yang lebih besar.
What happens to the linear speed of satellite K, if the satellite is orbiting the earth with greater height, h.

Decreases

[1 mark]

TOTAL   5 marks

4 Rajah 4 menunjukkan satelit kaji cuaca sedang mengorbit bumi pada ketinggian 850 km. Satelit tersebut merupakan sebuat satelit bukan geopegun.
Diagram 4 shows a weather forecast satellite orbiting the earth at a high of 850 km.
The satellite is a non-geostationary satellite.
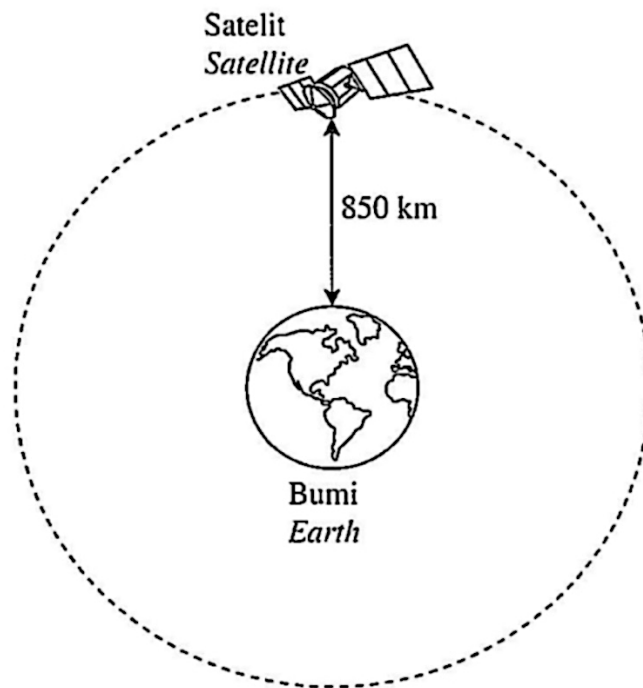
Rajah 4 / *Diagram 4*

(a) Nyatakan satu ciri satelit buka geopegun.
State one characteristic of non-geostationary satellite.

Geographical position above the earth // different orbit with earth

Orbital period different with period of rotation of earth //
Direction of rotation ≠ direction of rotation of earth //
Period ≠ 24 hours

[1 mark]

(b) Diberi,
Given,
Jisim Bumi, M *(Mass of Earth)* = 5.97 x 10²⁴ kg
Jejari Bumi, r *(Radius of Earth)* = 6.37 x 10⁶ m
Pemalar kegravitian, G *(Gravitational constant)* = 6.67 x 10⁻¹¹ N m² kg⁻²

Menggunakan rumus-rumus berikut:
Using these formulae:

$$v = \sqrt{\frac{GM}{r}} \quad \text{dan } (and) \quad T^2 = \frac{4\pi^2 r^3}{GM}$$

Hitung,
Calculate,

(i) laju linear satelit itu
the linear speed of the satellite

$$v = \sqrt{\frac{GM}{r}} = \sqrt{\frac{(6.67 \times 10^{-11})(5.97 \times 10^{24})}{6.37 \times 10^6 + 850\,000}} \quad \checkmark 2$$

$$\checkmark 1: (r = R + h)$$

v = 7426.4538 m s⁻¹

$$\checkmark 3 \text{ UNIT!}$$
$$(3 - 4 \text{ dp})$$

[3 marks]

(ii) tempoh satelit itu mengorbit bumi,
the period of the satellite orbiting the earth.

$$T^2 = \frac{4\pi^2 r^3}{GM} = \frac{4\pi^2 (6.37 \times 10^6 + 850\,000)^3}{(6.67 \times 10^{-11})(5.97 \times 10^{24})} \quad \checkmark 1$$

T = 6108.5141 s $\checkmark 2$ **UNIT!**
(3 – 4 dp)

[2 marks]

(c) Nyatakan tiga kesan kepada satelit apabila laju linear satelit berkurang daripada laju linear satelit yang sepatutnya.
State three effects on a satellite when the linear speed of a satellite decreases from the proper linear speed of a satellite.

Falls at lower altitude //
....

Falls at higher velocity (acceleration) //
....

Gravitational field strength increase //
....

Frictional (air resistance) increase //
Explode // burn // generate heat // fall to earth

[3 marks]

TOTAL   9 marks

7 Rajah 7 menunjukkan sebuah satelit komunikasi mengelilingi Bumi dan kekal pada ketinggian, h = 30 500 km dari permukaan Bumi. Jejari Bumi, R = 6 370 km.
Diagram 7 shows a communication satellite orbiting the Earth and remains at a height, h = 30 500 km *from the Earth's surface. The radius of the Earth,* R = 6 370 km.
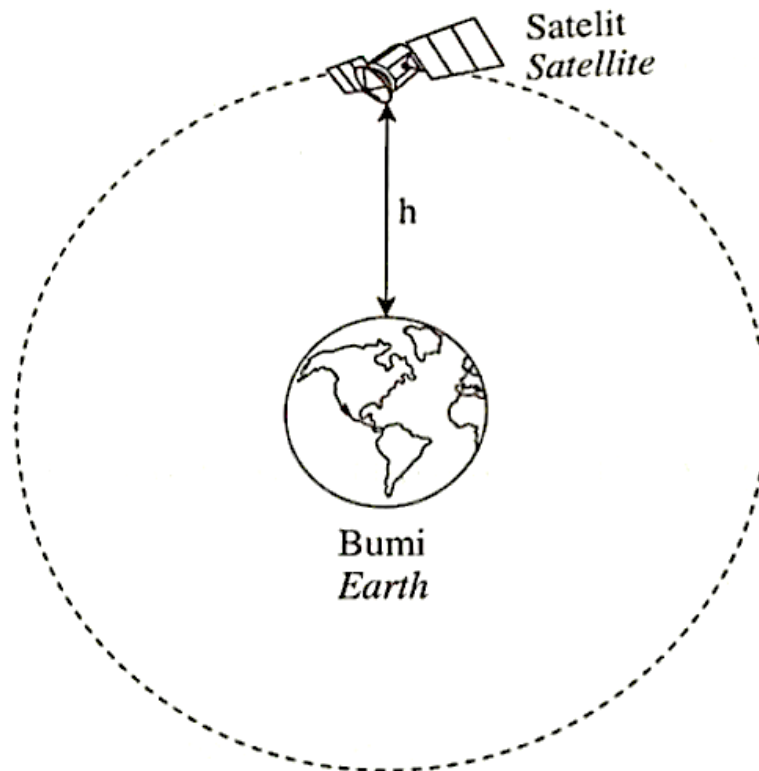
Rajah 7 / Diagram 7

(a) Namakan daya yang mengekalkan satelit pada orbitnya.
Name the force that keeps a satellite on its orbit.

Centripetal force // gravitational force
………………………………………………………………………………..............

[1 markah / *mark*]

(b) Berdasarkan Rajah 7, hitung,
Based on Diagram 7, calculate,

(i) jejari orbit, r
radius of orbit, r

r = R + h
r = 6 370 km + 30 500 km

r = …………36 870………….. km ✓₁

[1 markah / *mark*]

(ii)   laju linear satelit, v
         linear speed of satellite, v

❗ 24 h = 24 × 60 × 60 = 86 400 s

PENGIRAAN: GERAKAN MEMBULAT

$v = \dfrac{2\pi r}{T}$

$v = \dfrac{2\pi \,(36\,870 \times 1000)}{86400}$ ✓1

$v = 2681.2621 \text{ m s}^{-1}$ ✓2 (unit!)

or

$v = \dfrac{2\pi r}{T}$

$v = \dfrac{2\pi \,(36\,870)}{24}$ ✓1

$v = 9652.5434 \text{ km h}^{-1}$ ✓2 (unit!)

PENGIRAAN: GERAKAN DALAM ELIPS

$v^2 = \dfrac{GM}{r}$

$v^2 = \dfrac{(6.67 \times 10^{-11} \times 5.97 \times 10^{24})}{36870 \times 10^3}$ ✓1

$v = 3286.35 \text{ m s}^{-1}$ ✓2 (unit!)

[2 markah / *marks*]

(c)   Jadual 7 menunjukkan ciri-ciri bagi tiga buah satelit yang berbeza.
        Table 7 shows the characteristic of three different satellites.

Satelit *Satellite*	Jenis satelit *Type of satellite*	Tempoh orbit *Orbital period*
P	Geopegun *Geostationary*	24 jam 24 *hours*
Q	Bukan geopegun *Non-geostationary*	24 jam 24 *hours*
R	Geopegun *Geostationary*	12 jam 12 *hours*

Jadual 7 / *Table* **7**

Berdasarkan Jadual 7, nyatakan ciri-ciri yang sesuai bagi sebuah satelit komunikasi yang boleh digunakan oleh agensi telekomunikasi untuk siaran langsung ke seluruh dunia.
Based on Table 7, state the suitable characteristics of the communication satellite that can be used by a telecommunications agency for live broadcast around the world.

(i) Jenis satelit
Type of satellite

Geostationary

…………………………………………………………………………………...

[1 markah / *mark*]

Sebab
Reason

Direction of motion = direction of Earth rotation //
…………………………………………………………………………………...
Above the same geographical location //   [1 markah / *mark*]
Orbits the Earth // Orbital period is 24 hours
Same orbit with Earth

(ii) Tempoh orbit
Orbital period

24 hours

…………………………………………………………………………………...

[1 markah / *mark*]

Sebab
Reason

  Same orbital period with Earth
…………………………………………………………………………………...

[1 markah / *mark*]

(d) Berdasarkan jawapan anda di **7**(c)(i) dan **7**(c)(ii), tentukan satelit yang paling sesuai dipilih oleh agensi telekomunikasi tersebut.
*Based on the answer in **7**(c)(i) and **7**(c)(ii), determine the most satellite that should be chosen by the telecommunications agency.*

  P

………………………………………………………………………….................

[1 markah / *mark*]

TOTAL   9 marks

SPM 2021 (SET 1)

1 Diagram 1 shows a cooling curve for a metal in a **liquid** state.
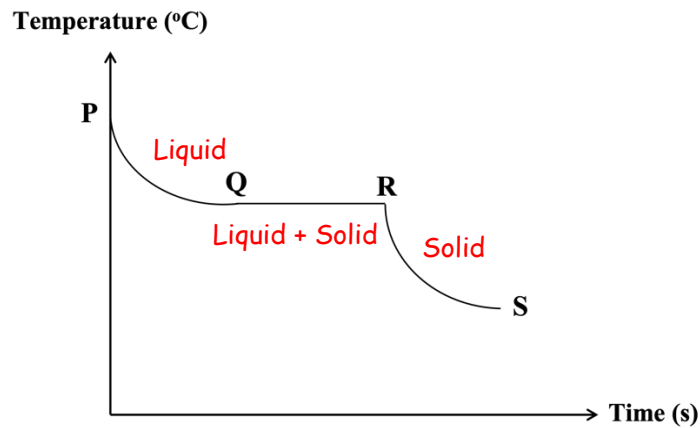
Diagram 1

(a) Temperature of the metal is constant from Q to R.

  (i) State the type of heat involved from Q to R. Tick ($\sqrt{}$) in the box for the correct answer.

  ☐ Heat capacity

  ☑ Latent heat

  [1 mark]

  (ii) Name the state of matter from Q to R.

  Liquid + Solid
  ....
  [1 mark]

  (iii) Give one reason why the temperature is constant from Q to R.

  Kinetic energy of molecules constant // Unchanged Kinetic Energy //
  ....
  heat released used to strengthen a bond between the particle [1 mark]

(c) What happened to the heat energy during the cooling process from R to S?

  Heat released
  ....
  [1 mark]

  ! *Reject:*
  Decrease

  TOTAL   4 marks

10 Rajah 10.1 menunjukkan satu pad penyejuk yang digunakan oleh seorang kanak-kanak untuk mengurangkan demam. Pad penyejuk berfungsi berdasarkan prinsip keseimbangan terma.
Diagram 10.1 shows a cooling pad that is used by a child to reduce the fever. The cooling pad works based on the principle of thermal equilbrium.

Diagram 10.1

(a) Apakah maksud keseimbangan terma?
What is meant by thermal equilibrium?

net rate of heat flow / transfer is zero //
Rate of heat transfer is same // object same temperature

[1 mark]

(b) Terangkan bagaimana penggunaan pad penyejuk boleh menurunkan suhu badan.
Explain how the usage of a cooling pad can lower the body temperature.

- gel // pad contact forehead // body // head // Put pad on forehead
- Heat transfer from forehead to the pad
- Rate net heat transfer zero / same rate heat transfer
- Achieve thermal equilibrium

[4 marks]

(c) Rajah 10.2 menunjukkan satu bantal pemanas yang digunakan untuk melegakan kesakitan otot.
Diagram 10.2 shows a heating pillow that is used to relieve the muscle pain.

Diagram 10.2

Jadual 10 menunjukkan empat jenis bantal pemanas A, B, C dan D.
Table 10 *shows four types of heating pillows A, B, C and D.*

Bantal pemanas *Heating pillow*	Bahan di dalam bantal pemanas *Substance inside the heating pillow*	Muatan haba tentu bahan *Specific heat capacity of material*	Bahan untuk sarung bantal *Material of pillow case*	Takat didih bahan *Boiling point of material*
A	Gel *Gel*	Rendah *Low*	Kanvas *Canvas*	Rendah *Low*
B	Cecair *Liquid*	Tinggi *High*	Kanvas *Canvas*	Tinggi *High*
C	Gel *Gel*	Tinggi *High*	Nilon *Nylon*	Tinggi *High*
D	Cecair *Liquid*	Rendah *Low*	Nilon *Nylon*	Rendah *Low*

Table 10

Terangkan kesesuaian setiap ciri bantal pemanas dan tentukan pemanas yang paling sesuai. Berikan sebab bagi pilihan anda.
Explain the suitability of each characteristics and determine the most suitable heating pillow. Give reason for your choice.

CHARACTERISTICS	REASON
Substance inside the heating pillow: Liquid	Heat easy to transfer through convection
Specific heat capacity of material: High	Can absorb more heat energy
Material of pillow case: Canvas	High heat resistance
Boiling point of material: High	slow to evaporate / change in form
B	*Substance inside the heating pillow*: Liquid *Specific heat capacity of material*: High *Material of pillow case*: Canvas *Boiling point of material*: High

[10 marks]

(d) Sebuah cerek elektrik berlabel 240 V, 1 kW diisikan dengan 0.8 kg air pada suhu 30 ºC.
[Muatan haba tentu air, c = 4200 J kg⁻¹ ºC⁻¹]

An electric kettle labelled 240 V, 1 kW is filled with 0.8 kg of water at temperature of 30 ºC.
[Specific heat capacity of water, c = 4200 J kg⁻¹ ºC⁻¹]

(i) Hitung tenaga haba yang diperlukan untuk menaikkan suhu air kepada 100 ºC.
Calculate the heat energy needed to raise the temperature of water to 100 ºC.

$$Q = mc\theta \quad \checkmark_1$$
$$Q = (0.8)(4200)(100 - 30) \quad \checkmark_2$$
$$Q = 235\,200 \text{ J} \,//\, 2.35 \times 10^5 \text{ J}$$
$$\checkmark_3 \text{ UNIT!}$$

[3 marks]

(ii) Hitung masa yang diperlukan untuk air itu mendidih.
Calculate the time required for the water to boil.

$$Q = Pt$$
$$t = \frac{Q}{P} = \frac{235200}{1000} \quad \checkmark_1$$
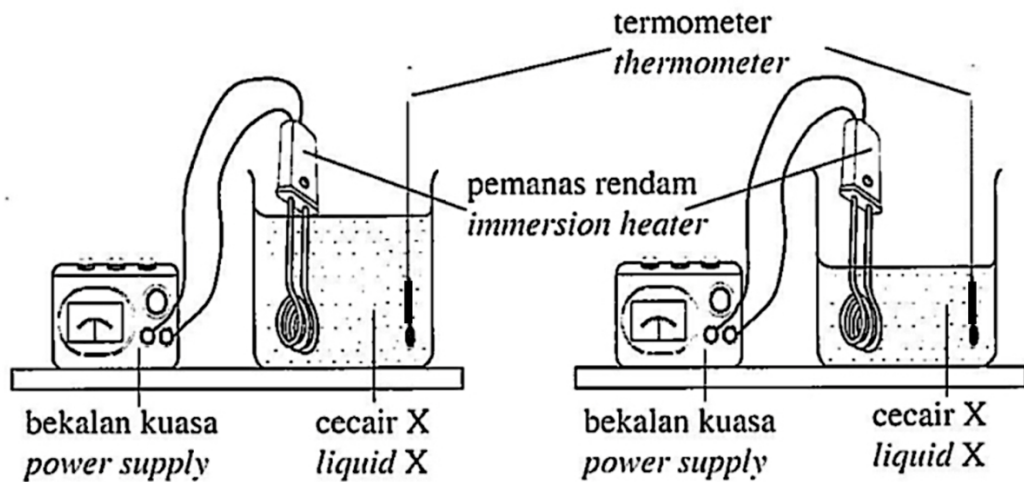
$$t = 235.2 \text{ s}$$
$$\checkmark_2 \text{ UNIT!}$$

[2 marks]

TOTAL   20 marks

11 Rajah 11.1(a) dan Rajah 11.1(b) menunjukkan suhu awal cecair X sebelum dipanaskan oleh pemanas rendam yang sama.
Diagram 11.1(a) *and Diagaram* 11.1(b) *show the initial temperatures of liquid* X *before being heated by identical immersion heater.*

Rajah 11.1(a) / *Diagram* 11.1(a)   **Rajah 11.1(b) / *Diagram* 11.1(b)**

Rajah 11.2(a) dan Rajah 11.2(b) menunjukkan suhu akhir cecair X selepas dipanaskan selama 10 minit.
Diagram 11.2(a) *and Diagaram* 11.2(b) *show the final temperatures of liquid* X *after being heated for 10 minutes.*
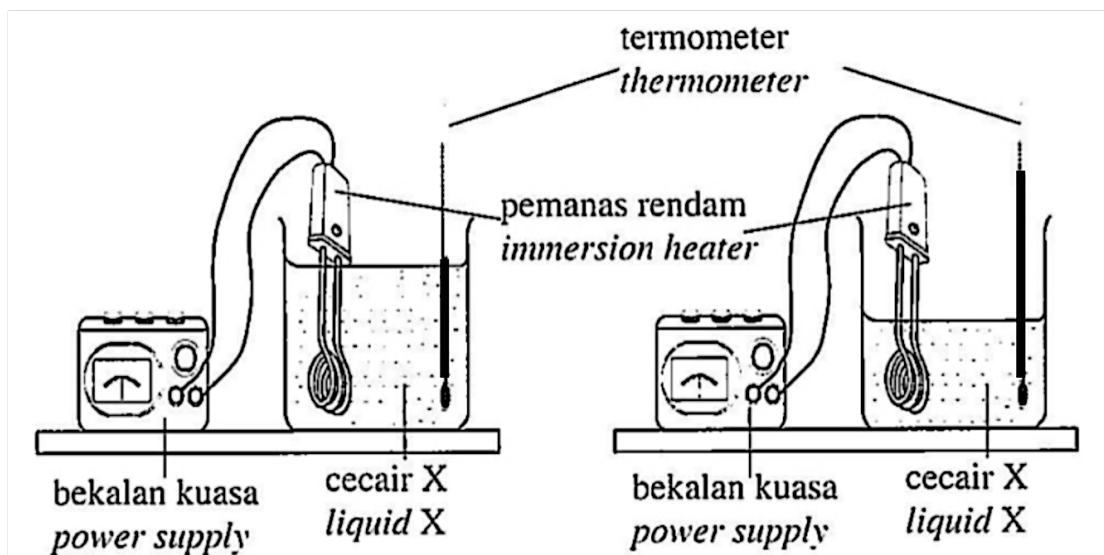
Rajah 11.2(a) / *Diagram* 11.2(a)   **Rajah 11.2(b) / *Diagram* 11.2(b)**

(a) Apakah maksud suhu?
What is the meaning of temperature?

Degree of hotness of an object

[1 mark]

(b) (i) Berdasarkan **Rajah 11.1(a) dan Rajah 11.1(b),** bandingkan suhu awal dan jisim cecair X sebelum dipanaskan.
*Based on **Diagram 11.1(a) dan Diagram 11.1(b),** compare the initial temperature and masses of liquid X before being heated.*

Initial temperature: Diagram 11.1(a) = Diagram 11.1(b) $\sqrt{}_1$
Mass of liquid X: Diagram 11.1(a) > Diagram 11.1(b) $\sqrt{}_2$

(ii) Berdasarkan **Rajah 11.2(a) dan Rajah 11.2(b),** bandingkan kenaikan suhu cecair X selepas dipanaskan.
*Based on **Diagram 11.2(a) dan Diagram 11.2(b),** compare the rise in temperature of liquid X after heating.*

Increase in temperature: Diagram 11.2(b) > Diagram 11.2(a) $\sqrt{}_3$

(iii) Hubungkaitkan jisim dengan kenaikan suhu. Nyatakan kuantiti fizik yang mesti dimalarkan bagi mendeduksikan hubungan antara jisim dengan kenaikan suhu.
Relate the mass and rise in the temperature. State the physical quantity that must be kept constant to deduce the relationship between the mass and the rise in temperature.

Mass increase, rise in temperature decrease $\sqrt{}_4$
Constant variable: specific heat capacity // heat energy // Pt $\sqrt{}_5$

[5 marks]

(c) Baca pernyataan di bawah.
Read the statement below.

> Haba daripada Matahari memanaskan pasir di pantai dan air laut dalam tempoh yang sama. Didapati pasir lebih cepat panas daripada air laut.
> *The heat from the Sun heats up the sand on the beach and sea water in same period. It is found that the sand heats up faster than the sea water.*

Menggunakan konsep fizik yang betul, jelaskan pernyataan di atas.
Using the correct physics concept, explain the above statement.

- Specific heat capacity: sand < sea water
- *Heat supply is same*
- Rise in temperature: sand > sea water
- $Q = mc\theta$
- Specific heat capacity increase, rise in temperature decrease

[4 marks]

(d) Rajah 11.3 menunjukkan sebuah rumah berkonsepkan bangunan hijau. Bangunan hijau adalah bangunan yang memberikan impak positif terhadap iklim dan persekitaran semula jadi.

Diagram 11.3 shows a house with a green building concept. A green building is a building that gives a positive impact on climate and the natural environment.

Rajah 11.3 / *Diagram* **11.3**

Menggunakan konsep fizik yang sesuai, cadangkan penggunaan bahan dan reka bentuk yang sesuai untuk meningkatkan pengudaraan dan memastikan suhu dalam rumah itu tidak tinggi. Cadangan anda mestilah merangkumi muatan haba tentu bahan dan jenis bahan yang digunakan sebagai **dinding dan bumbung rumah, bilangan tingkap** dan reka bentuk rumah.

Using appropriate physics concepts, suggest the use of appropriate materials and appropriate design to increase ventilation and ensure that the temperature in the house is not high.
*Your proposal must include the specific heat of the material and the type of material used as the **walls and roof of the house, the number of windows** and the design of the house.*

[10 marks]

TOTAL   20 Marks

	CHARACTERISTICS	REASON
Wall	High specific heat capacity	Heat up slowly // heat slow // low temperature rise // insulator // poor heat conductor
	Made of insulator (concrete, wood, bricks, cement)	High specific heat capacity // less heat absorbed // low flow of heat
Roof	High specific heat capacity	Heat up slowly // heat slow // low temperature rise // insulator // poor heat conductor // time to heat long (more)
	Made of insulator (concrete, wood, bricks, styrofoam)	High specific heat capacity // less heat absorbed // low flow of heat
	High (high ceiling)	Heat not trapped // hot air above // hot air rise
Windows	More	Heat not trapped // more heat released // more air in // more air out // increase convection // increase air flow
	Large	Heat not trapped // more heat released // more air in // more air out // increase convection // increase air flow
	Layered // thermal window // heat proof window	Less heat in // less heat conduction // not absorbed heat
Air holes		Heat not trapped // more heat released // more air in // more air out // increase air flow

1 Rajah 1 menunjukkan fenomena yang berlaku disebabkan perbezaan muatan haba tentu antara daratan dengan lautan.
*Diagram 1 shows a phenomenon that occurs due to the difference of specific heat capacity between land and ocean.*

Pokok
Tree

Matahari
Sun

Lautan
Ocean

Daratan
Land
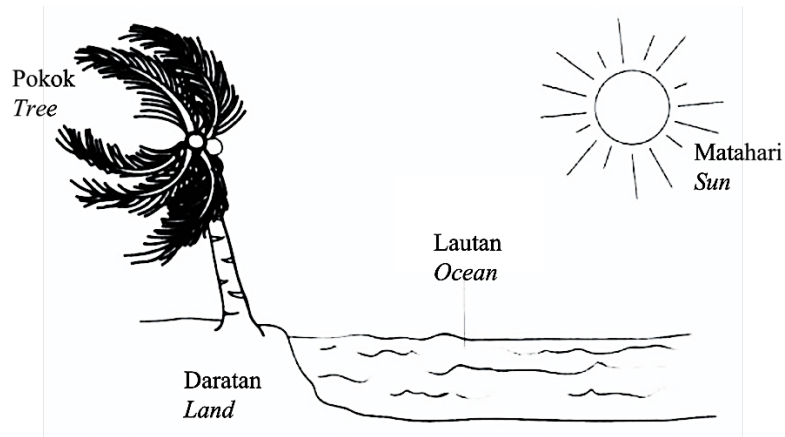
Rajah 1 / *Diagram* 1

(a) Apakah maksud muatan haba tentu?
What is meant by specific heat capacity?

Quantity of heat energy needed to raise the temperature of 1 kg mass by 1°C
....
[1 markah / *mark*]

(b) (i) Tandakan (√) pada petak untuk jawapan yang betul.
Tick (√) in the box for the correct answer.
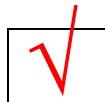
[√] Pada waktu siang, daratan lebih cepat panas
During day time, land heats up faster

[ ] Pada waktu siang, air laut lebih cepat panas
During day time, sea water heats up faster

[1 markah / *mark*]

(ii) Beri satu sebab bagi jawapan di **1**(b)(i).
*Give one reason for the answer in **1**(b)(i).*

Specific heat capacity: land < sea water
....
[1 markah / *mark*]

(c) Namakan fenomena yang berlaku dalam Rajah 1.
Name the phenomenon that occurs in Diagram 1.

See breeze
....
[1 markah / *mark*]

TOTAL   4 marks

SPM 2021 (SET 1)

5 Diagram 5.1 shows water waves are produced when the man continuously dipping his feet in the water with a constant rate.
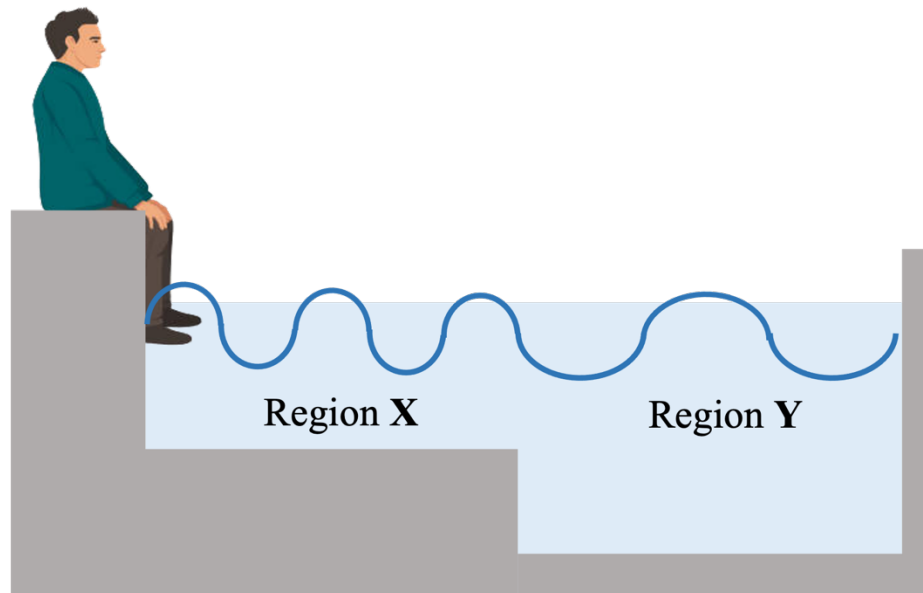
Diagram 5.1

(a) Tick (√) for the correct answer in the box provided.
Water wave is

| √ | transverse waves |

| | longitudinal waves |

[1 mark]

(b) Observe Diagram 5.1. Compare region X and region Y in terms of

　(i)　depth of water

　　Depth of water: Y > X
　　..
[1 mark]

　(ii)　wavelength

　　Wavelength: Y > X
　　..
[1 mark]

(iii) frequency

Frequency: Y = X

....

[1 mark]

(c) Relate the wavelength and depth of water.

Depth of water *increase*, wavelength *increase*

....

[1 mark]

(d) Name the wave phenomenon involved.

Refraction of water wave

....

[1 mark]

(e) Diagram 5.2 shows the propagation of waves from deep water region to shallow water region towards headland that happens in a sea area.

(i) In Diagram 5.2, draw the direction of propagation for the water wave when the waves approach the headland.
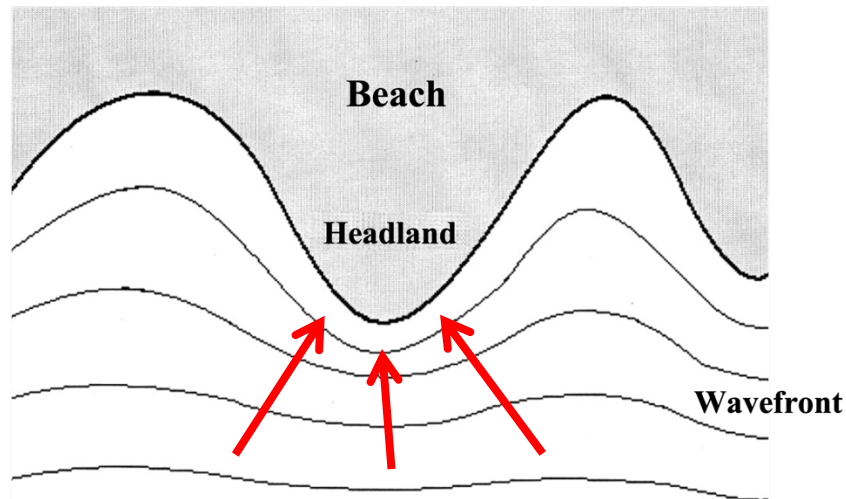
Diagram 5.2

[1 mark]

(ii) In shallow water region, the wavelength and the speed of wave is 8 m and 2.5 m s^{-1} respectively.
Calculate the speed of the water wave in deep water region when the wavelength of the wave in the region is 20 m.

$v = f\lambda$

$\dfrac{v_1}{\lambda_1} = \dfrac{v_2}{\lambda_2}$

$\dfrac{2.5}{8} = \dfrac{v_2}{20}$ $\checkmark_1$

[2 marks]

$v_2 = 6.25$ ms^{-1} $\checkmark_2$ **UNIT!**

TOTAL   9 marks

4   Rajah 4.1 menunjukkan seorang budak lelaki melompat dari sebatang dahan pokok ke dalam sebuah tasik. Dahan itu bergetar seketika sebelum berhenti.
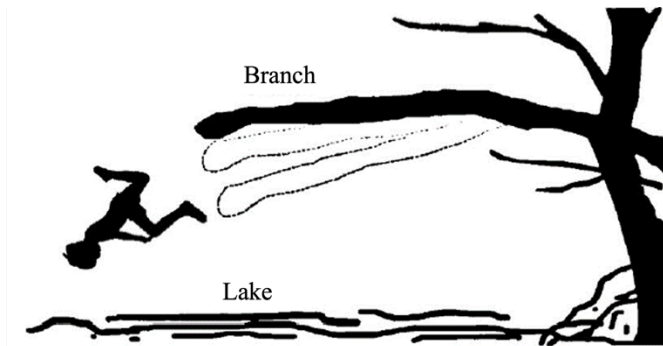   *Diagram 4.1 shows a boy jumping from a tree branch into a lake. The branch vibrates before it stopped.*

Diagram 4.1

(a)   Nyatakan fenomenon yang berlaku kepada dahan itu.
   State the phenomenon that occurs to the branch.

   Damping
   ....

   [1 mark]

(b)   (i)   Apakah yang berlaku kepada amplitud getaran dahan itu? Jelaskan jawapan anda.
      What happen to the amplitude of vibration of the branch? Explain your answer.

      amplitude decreases
      ....

      energy decreases // energy loss
      ....

      [2 marks]

   (ii)   Lakarkan graf amplitud melawan masa bagi getaran dahan tersebut dalam Rajah 4.2.
      Sketch a graph of amplitude against time for the vibration of the branch in Diagram 4.2.
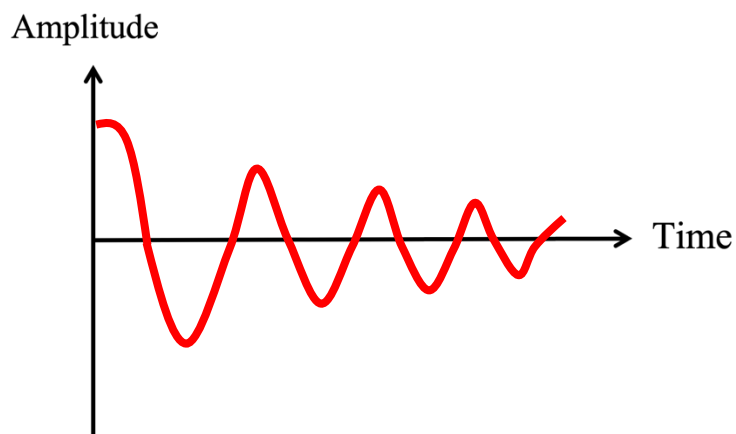

Diagram 4.2

   [1 mark]

(c) Apabila budak lelaki itu terjun ke dalam tasik, gelombang air terhasil. Rajah 4.3 menunjukkan graf sesaran melawan masa bagi gelombang air tersebut.
When the boy jumps into the lake, a water waves is produced. Diagram 4.3 shows a graph of displacement against time for the water waves.
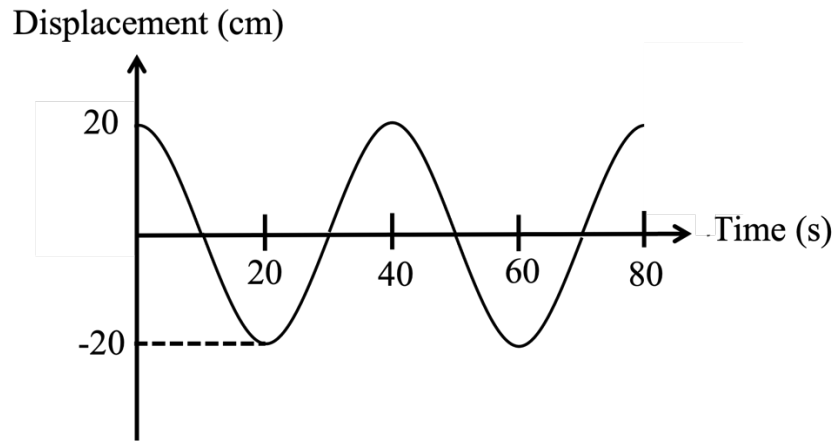
Displacement (cm)

Diagram 4.3

(i) Berdasarkan Rajah 4.3, tentukan amplitude dan panjang gelombang bagi gelombang air itu.
Based on Diagram 4.3, determine the amplitude and the wavelength of the water waves.

Amplitud : ……………… 20 …… cm
Amplitude

Panjang gelombang: ……………… 40 …… cm
Wavelength

[2 marks]

(ii) Frekuensi gelombang air itu ialah 5 Hz. Berdasarkan jawapan anda di 4(c)(i), hitung laju gelombang air itu.
The frequency of the water waves is 5 Hz. Based on your answer in 4(c)(i), calculate the speed of the water waves.

$$v = f\lambda = (5)(40) \quad \checkmark_1$$

$$v = 20 \text{ cm s}^{-1} \quad \checkmark_2 \text{ UNIT!}$$

[2 marks]

(iii) Jika kedalaman air bertambah, apakah yang berlaku kepada panjang gelombang bagi gelombang air tersebut?
If the depth of water increases, what happens to the wavelength of the water waves?
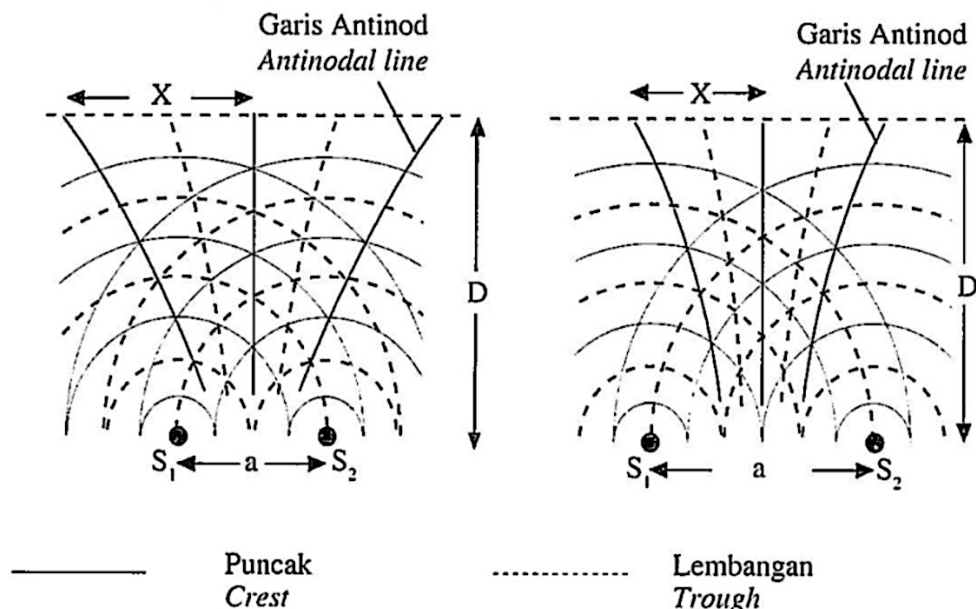
Increases

[1 mark]

TOTAL   9 marks

5 Rajah 5.1 dan Rajah 5.2 menunjukkan kesan superposisi dua sumber gelombang air S_1 dan S_2 yang koheren.
Diagram 5.1 and 5.2 show the effect of the superposition of two coherent water wave sources S_1 and S_2.

Rajah 5.1 / Diagram 5.1　　　　**Rajah 5.2 / Diagram 5.2**

(a) Apakah maksud dua sumber koheren?
What is the meaning of two coherent sources?

Same frequency *and* phase difference is constant

[1 mark]

(b) Perhatikan Rajah 5.1 dan Rajah 5.2. Bandingkan,
Observe Diagram 5.1 dan 5.2. Compare,

(i) Jarak antara dua sumber koheren, a.
The distance between two coherent sources, a.

Distance between two coherent sources, a: Diagram 5.2 > Diagram 5.1

[1 mark]

(ii) Jarak antara dua garis antinod berturutan, X.
The distance between two consecutive antinodal lines, X.

Distance between two consecutive antinodal lines, X:

Diagram 5.2 < Diagram 5.1

[1 mark]

(iii) Jarak antara dua sumber koheren ke garis pengesan, D.
The distance between two coherent sources to the detector line, D.

Distance between two coherent sources to the detector line, D:

Diagram 5.1 = Diagram 5.1

[1 mark]

(c)   Berdasarkan jawapan anda dalam 5(b).
   *Based on your answer in 5(b).*

   (i)   Hubungkaitkan antara dua sumber koheren, a dengan jarak antara dua garis
          antinod berturutan, X.
          *Relate the distance between two coherent sources, a and the distance between two
          consecutive antinodal line, X.*

   Distance between two coherent sources, a increase,
   ....
   Distance between two consecutive antinodal lines, X decrease   [1 mark]

   (ii)   Namakan fenomena gelombang yang terlibat.
          Name the wave phenomenon involved.

   Interference of wave
   ....
                                                                                        [1 mark]

(d)
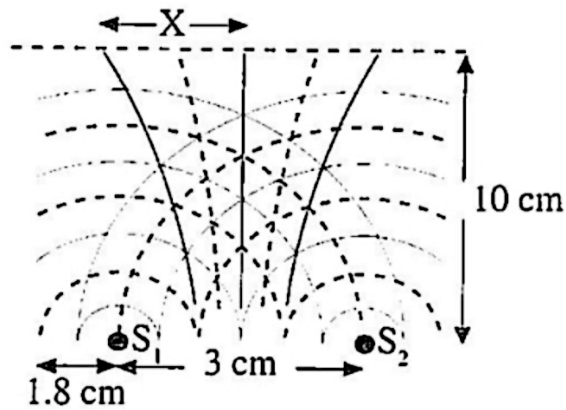
Rajah 5.3 / *Diagram 5.3*

   (i)   Berdasarkan Rajah 5.3, hitung jarak antara dua garis antinod berturutan, X.
          Based on Diagram 5.3, calculate the distance between two consecutive antinod lines, X.

   $\lambda = 1.8$ cm

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

   $x = \dfrac{\lambda D}{a} = \dfrac{(1.8)(10)}{3}$ $\checkmark_1$

   x = 6 cm = 0.06 m

   $\checkmark_2$ **UNIT!**   [2 marks]

   (ii)   Apakah yang akan berlaku kepada jarak di antara dua garis antinod berturutan, X
          jika frekuensi gelombang ditingkatkan.
          *What will happern to the distance between two consecutive antinodal lines, X if the
          frequency of waves is increased.*

   Decrease
   ....
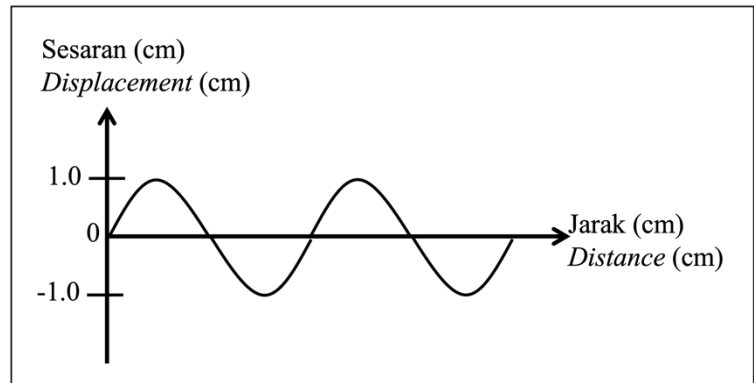   [1 mark]

   **TOTAL   9 marks**

5 Rajah 5.1 dan Rajah 5.2 menunjukkan corak gelombang air selepas melalui celah yang berlainan saiz. Panjang gelombang, λ dan frekuensi gelombang tuju, f adalah serupa.
Diagram 5.1 and Diagram 5.2 show the pattern of water wave after passing through slits with different sizes. The wavelength, λ and frequency of the incident wave, f are similar.

a = 3.0 cm

Rajah 5.1 / *Diagram* 5.1

a = 1.0 cm
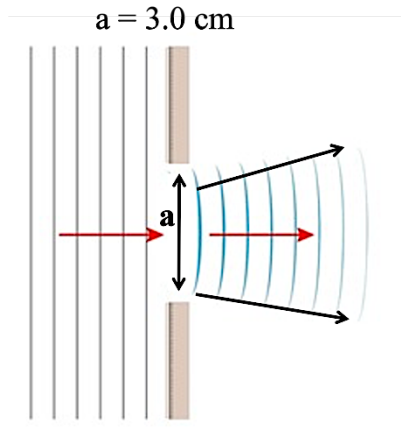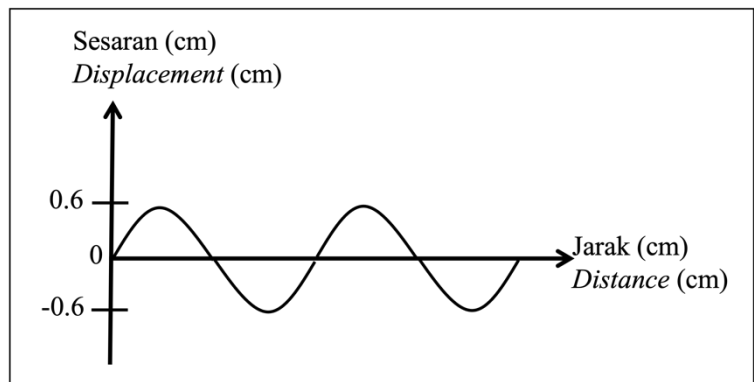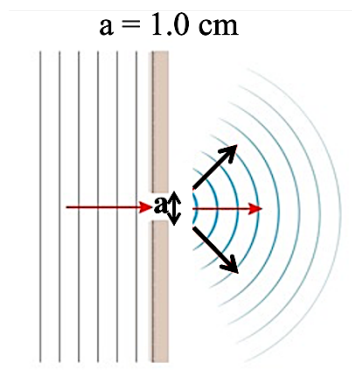
Rajah 5.2 / *Diagram* 5.2

(a) Namakan fenomena yang berlaku dalam Rajah 5.2.
Name the wave phenomenon that occurs in Diagram 5.2.

Diffraction of water wave
……………………………………………………………………….................
[1 markah / *mark*]

(b) Perhatikan Rajah 5.1 dan Rajah 5.2. Bandingkan,
Observe Diagram 5.1 and Diagram 5.2. Compare,

(i) saiz celah
size of the slit

Size of slit: Diagram 5.1 > Diagram 5.2
…………………………………………………………………………...
[1 markah / *mark*]

(ii) amplitud gelombang selepas melalui celah
the amplitude of waves after passing through the slit

Amplitude of waves: Diagram 5.1 > Diagram 5.2
....
[1 markah / *mark*]

(iii) penyebaran gelombang selepas melalui celah
spreading of waves after passing through the slit

Spreading of waves: Diagram 5.1 < Diagram 5.2
....
[1 markah / *mark*]

(c) Berdasarkan jawapan anda di **5**(b),
*Based on your answer in **5**(b),*

(i) hubungkaitkan saiz celah dengan penyebaran gelombang
relate the size of the slit with the spreading of waves

Size of slit decrease, spreading of waves increase
....
[1 markah / *mark*]

(ii) hubungkaitkan amplitud gelombang dengan penyebaran gelombang
relate the amplitude of waves with the spreading of waves

Amplitude of waves decreases, spreading of waves increase
....
[1 markah / *mark*]

(d) Mengapakah amplitud gelombang berubah selepas gelombang air melalui celah?
Why the amplitude of waves changes after the water waves pass through the slit?

Energy of waves decrease
....
[1 markah / *mark*]

(e) Rajah 5.3 menunjukkan sati sistem siren banjir yang digunakan untuk memberi amaran kepada penduduk di sebuah Kawasan perumahan.
Diagram 5.3 shows a flood siren system used to give warning to the residents in a housing area.
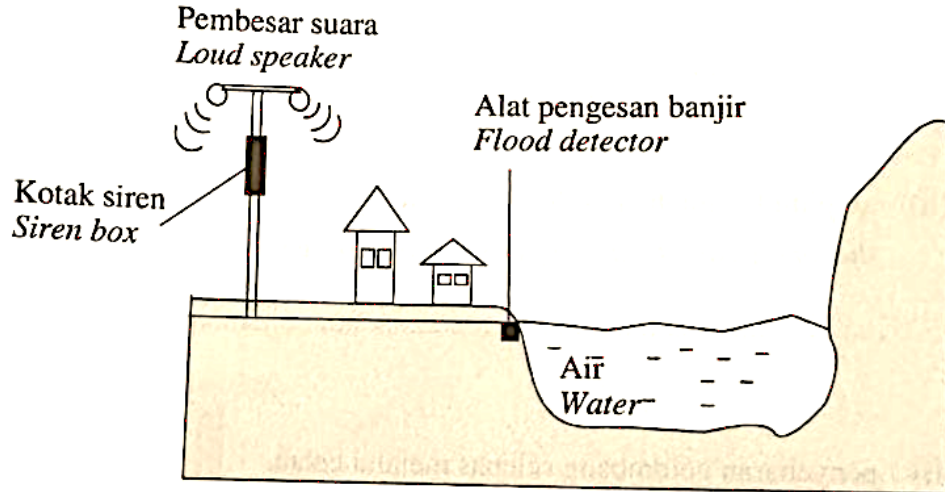
Rajah 5.3 / *Diagram* 5.3

Bunyi yang dihasilkan oleh pembesar suara tidak dapat didengari dengan jelas oleh penduduk di Kawasan perumahan tersebut.
Apakah perubahan yang perlu dilakukan terhadap frekuensi gelombang untuk mengatasi masalah tersebut?
Terangkan jawapan anda.
Sound produced by the speakers was not able to be heard clearly by the residents in the housing area.
What is the change that needs to be done on the frequency of wave to overcome the problem?
Explain your answer.

frequency of waves decreases
…………………………………………………………………………………………...
wavelength of waves increases // more diffraction
…………………………………………………………………………………………...

[2 markah / *marks*]

TOTAL   9 marks

SPM 2021 (SET 1)

8   Diagram 8 shows a ring that consist of gemstone.

Gemstone

Diagram 8

(a)   The gemstone sparkles.
State the physics phenomenon involved.

Total internal reflection
....
[1 mark]

(b)   The refractive index of the ring's gemstone is 1.5.
Calculate the critical angle of the gemstone.

$n = \dfrac{1}{\sin c}$

$1.5 = \dfrac{1}{\sin c}$ ✓**1**

$c = 41.81°$ ✓**2** **UNIT!**

[2 marks]

(c)   If the gemstone in Diagram 8 is less sparkle, state the characteristic of the following aspects to replace the gemstone in Diagram 8 to be more sparkled.

(i)   Critical angle

Decrease // small // low
....
[1 mark]

Reason

More total internal reflection
....
[1 mark]

(ii)   Optical density

High // more // increase

....

[1 mark]

Reason

more total internal reflection // high refractive index //

small critical angle

[1 mark]

(iii)   Surface of gemstone

Smooth // flat surface

....

[1 mark]

Reason

more total internal reflection // good reflector of light

....

[1 mark]

TOTAL   9 marks

11   Rajah 11.1 dan Rajah 11.2 menunjukkan sinar cahaya selari dari kedudukan yang sama. Panjang fokus kana ditentukan apabila sinar cahaya tersebut ditumpukan selepas melalui kanta.
Diagram 11.1 and Diagram 11.2 show parallel rays from the same position.
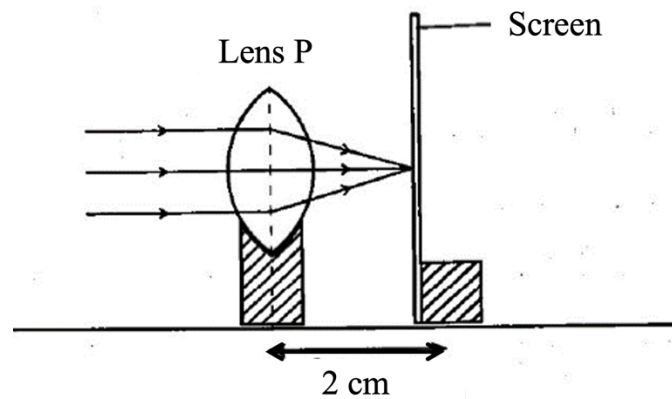*Focal length of the lens is determined when the rays converged after passing through the lens.*
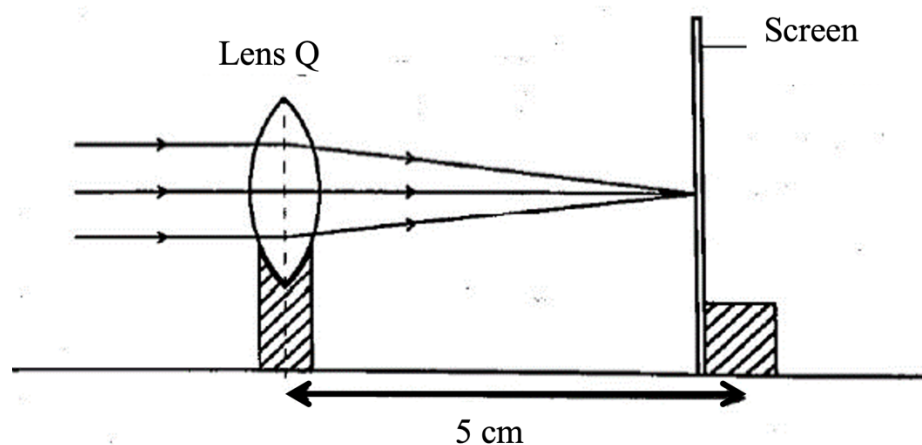

Diagram 11.1

Diagram 11.2

(a)   Apakah yang dimaksudkan dengan panjang fokus?
What is meant by focal length?

Distance between center of lens and focal point

[1 mark]

(b) Perhatikan Rajah 11.1 dan Rajah 11.2, bandingkan jarak objek, ketebalan kanta dan panjang fokus. Nyatakan hubungan antara ketebalan kanta dengan panjang fokus. Namakan fenomena fizik yang terlibat.
Observe Diagram 11.1 and Diagram 11.2, compare the object distance, the thickness of the lens and the focal point. State the relationship between the thickness of the lens and the focal length. Name the physic phenomenon involved.

- Object distance: Diagram 11.1 equal Diagram 11.2 //
   both object distances are infinity
- Thickness: Diagram 11.1 > Diagram 11.2
- Focal length: Diagram 11.2 > Diagram 11.1
- Thickness of lens increase, focal length decrease
- Phenomenon: Refraction of light

[5 marks]

(c) Rajah 11.3 menunjukkan seorang ahli gemologi menggunakan satu kanta pembesar untuk menilai batu permata.
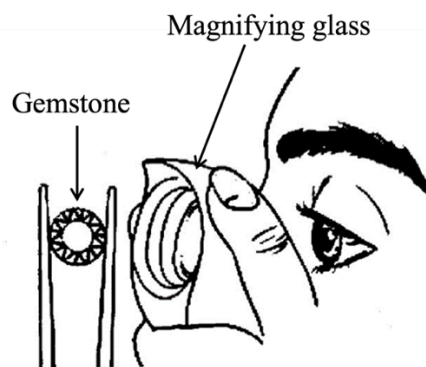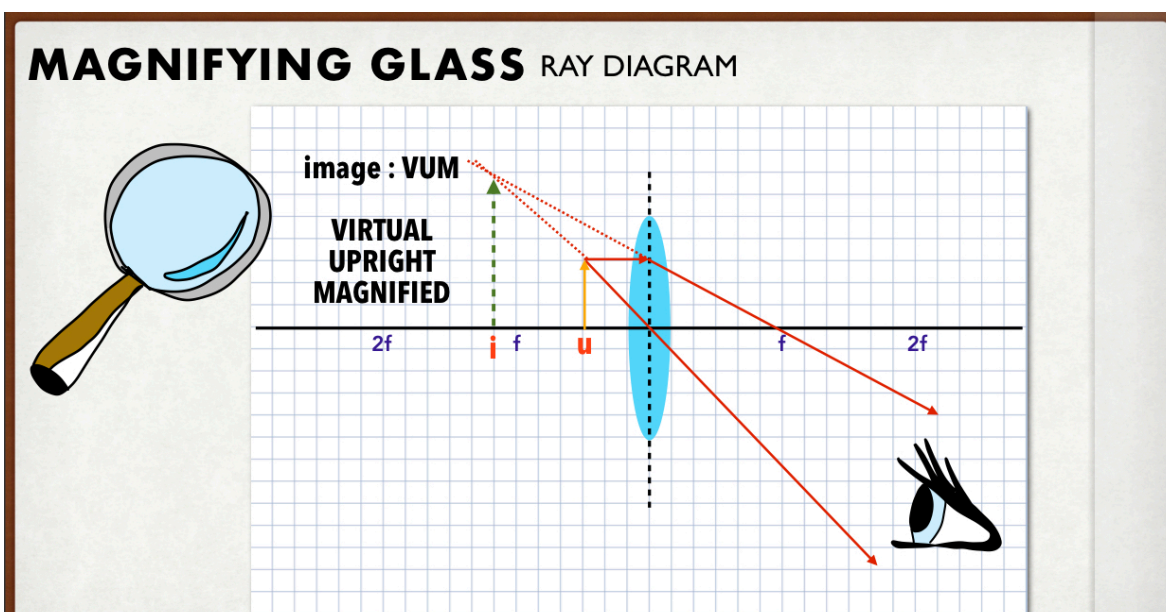*Diagram 11.3 shows a gemologist using a magnifiying lens to evaluate a gemstone.*

Diagram 11.3

Terangkan bagaimana ahli gemologi dapat memerhatikan imej yang besar dan maya.
Explain how the gemologist can observe a large and virtual image.

[4 marks]

(d) Menggunakan kanta P dan kanta Q dalam Rajah 11.1 dan Rajah 11.2 anda dikehendaki merekacipta sebuah mikroskop majmuk yang boleh menilai batu-batu permata yang lebih kecil.
Using lensP and lens Q in Diagram 11.1 and Diagram 11.2, you are required to design a compound microscope which can be used to evaluate smaller gemstones.

Nyatakan dan terangkan pengubahsuaian anda berdasarkan aspek-aspek berikut:
*State and explain your modification based on the following aspects:*

- Kanta yang akan dipilih sebagai kanta objektif dan kanta mata.
  Lens to be chosen as objective lens and eyepiece lens.
- Jarak objek bagi kanta objektif.
  The object distance of the objective lens.
- Jarak objek bagi kanta mata.
  The object distance of the eyepiece lens.
- Jarak antara kanta objektif dan kanta mata
  The distance between the objective lens and the eyepiece lens.

| Characteristic	Explanation
use convex lens	all the light ray will be focused (converge)
$f_e > f_o$	low power of lens
shorter f_o	higher power of lens
$f_o < u < 2f_o$	1st image: RIM Real, Inverted, Magnified
Normal adjustment $L > f_o + f_e$	To produce bigger image from the eyepiece // to increase the magnification

[10 marks]

TOTAL   20 marks

MICROSCOPE RAY DIAGRAM

Normal adjustment L > fo + fe

image : VIM

**VIRTUAL
INVERTED
MAGNIFIED**

amazing Physics with Teacher alinaimanarif
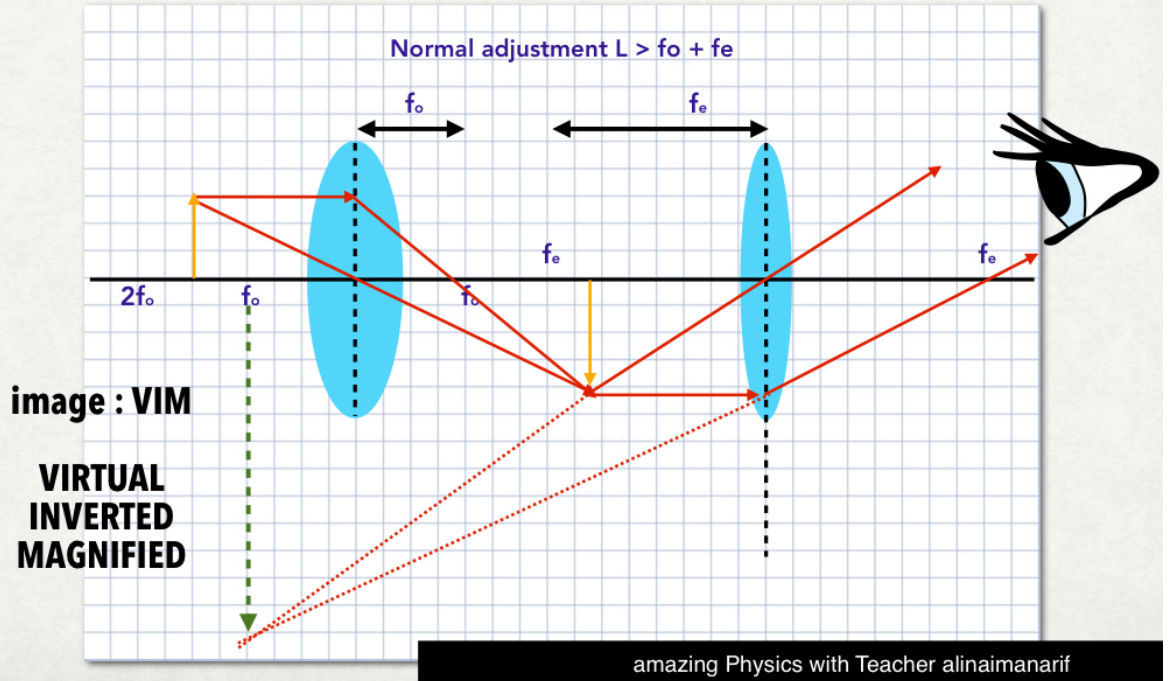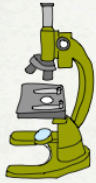
CHARACTERISTICS	REASON
P objective lens	short focal length // high power
Q eyepiece lens	long focal length
fo < u < 2fo	real and magnified image
Object distance from eyepiece < focal point	magnified image
L = fo + fe	magnified image // m > 1 // high magnification

7 Rajah 7.1 menunjukkan lintasan sinar cahaya yang merambat suatu prisma kaca.
Indeks biasan prisma kaca ialah 1.49.
Diagram 7.1 shows a ray path propogates a glass prism. The refractive index of the glass prism is 1.49.
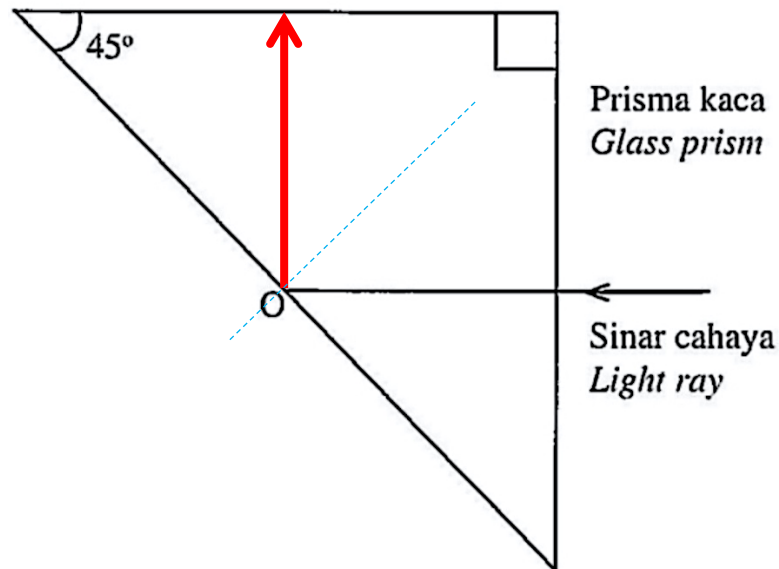
Rajah 7.1 / *Diagram 7.1*

(a) Apakah maksud indeks biasan?
What is the meaning of refractive index?

Ratio of speed of light in vacuum to the speed of light in medium //
Ratio of sin of incident angle to the sin of refracted angle   [1 mark]

(b) (i) Hitung sudut genting prisma kaca itu.
Calculate the critical angle of the glass prism.

$$\eta = \frac{1}{\sin c}$$

$$\sin c = \frac{1}{1.49} \quad \sqrt{}_1$$

$$c = \sin^{-1}\left(\frac{1}{1.49}\right)$$

$$c = 42.155° \; // \; 42.16° \quad \sqrt{}_2 \; \textbf{UNIT!}$$ [2 marks]

(ii) Pada Rajah 7.1, lukiskan lintasan sinar cahaya selepas titik O.
On Diagram 7.1, draw the path o flight ray after point O.

[1 mark]

(c) Rajah 7.2 menunjukkan imej setitis embun dihujung daun yang diambil menggunakan kanta makro untuk memfokuskan objek jarak dekat.
Diagram 7.2 shows an image of a drop of dew at the tip of the leaf taken using macro lens to focus a clos range object.
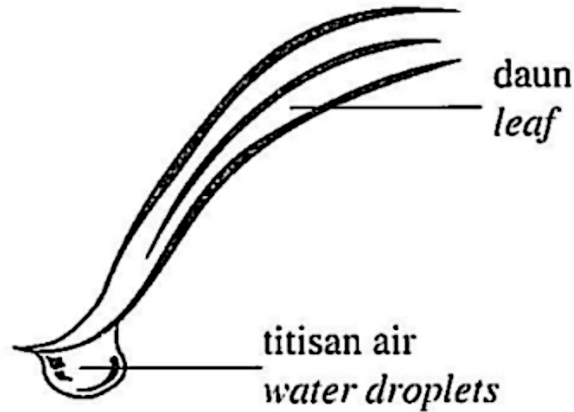
Rajah 7.2 / *Diagram 7.2*

Jadual 1 menunjukkan ciri-ciri bagi kanta P, Q dan R.
Table 1 shows the characteristics of lens P, Q and R.

Kanta *Lens*	Panjang focus *Focal length*	Diameter kanta *Diameter of lens*
P	90.0 mm	Besar *Big*
Q	35.0 mm	Besar *Big*
R	90.0 mm	Kecil *Small*

Jadual 1 / *Table 1*

Berdasarkan Jadual 1, nyatakan ciri-ciri kesesuaian kanta makro. Berikan sebab.
Based on Table 1, state the suitable characteristics of a macro lens. Give a reason.

(i) Panjang fokus kanta
Focal length of the lens

Increase // long // more // higher
....
[1 mark]

Sebab
Reason

Sharp image // clear image // increase the resolution of image //
....
Magnification is 1 // magnification is 1:1
[1 mark]

! *Reject:*
● *increase the magnification*

(ii)   Diameter kanta
        Diameter of the lens

        Increase // bigger // higher
        ……………………………………………………………………………………...
        [1 mark]

        Sebab
        Reason

        More light enters (in) // bright image // more light pass through
        ……………………………………………………………………………………...
        [1 mark]

(d)   Berdasarkan jawapan anda di 7(c)(i) dan 7(c)(ii), tentukan kanta yang paling sesuai.
        Based on the answer in 7(c)(i) and 7(c)(ii), determine the most suitable lens.
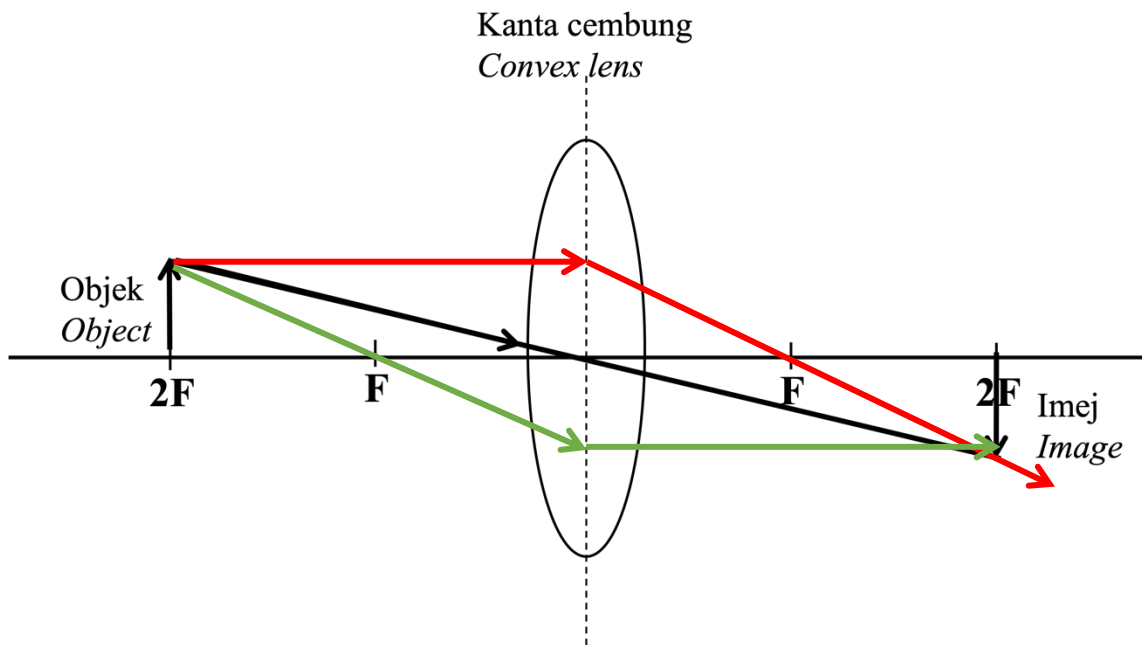
        Lens P
        ……………………………………………………………………………………...............
        [1 mark]

        TOTAL   9 marks

3 Rajah 3 menunjukkan sebahagian daripada rajah sinar bagi kanta cembung.
Diagram 3 shows part of the ray diagram for a convex lens.

Kanta cembung
Convex lens

Objek
Object

2F   **F**   **F**   **2F** Imej
Image

Rajah 3 / Diagram 3

(a) Apakah nama lain bagi kanta cembung?
What is another name for convex lens?

Converging lens
....
[1 markah / *mark*]

(b) Lengkapkan Rajah 3 dengan melukis **satu** sinar cahaya lain untuk menunjukan pembentukan imej tersebut.
*Complete Diagram 3 by drawing another **one** light ray to show the formation of the image.*

[1 markah / *mark*]

(c) Kanta dalam Rajah 3 ditukar kepada kanta yang lebih tebal.
The lens in Diagram 3 is changed to a thicker lens.

(i) Apakah yang berlaku kepada panjang fokus?
What happens to the focal length?

Decrease
....
[1 markah / *mark*]

(ii)   Nyatakan perubahan kepada saiz imej jika objek kekal berada pada kedudukan
        yang sama.
        State the change of the size of image if the object remains at the same position.

        <u>Decrease</u>..
        [1 markah / *mark*]

(d)   Satu objek berada pada jarak 12 cm dari pusat optik kanta.
       Satu imej nyata terbentuk pada jarak 9 cm.
       Hitung pembesaran linear.
       An object is placed at a distance of 12 cm *from the optical centre of the lens.*
       A real image is formed at a distance of 9 cm.
       Calculate the linear magnification.

       Linear magnification, m = $\frac{v}{u}$

       m = $\frac{9}{12}$ $\checkmark_1$

       m = 0.75 $\checkmark_2$ (no unit!)

       ! answer in fraction X
             answer in decimal √

       [2 markah / *marks*]

       TOTAL   6 marks

F5 BAB 1: DAYA & GERAKAN II

SPM 2021 (SET 1)

9   Diagram 9.1 shows a painting is hung on a wall with strings. The **weight** of the painting is
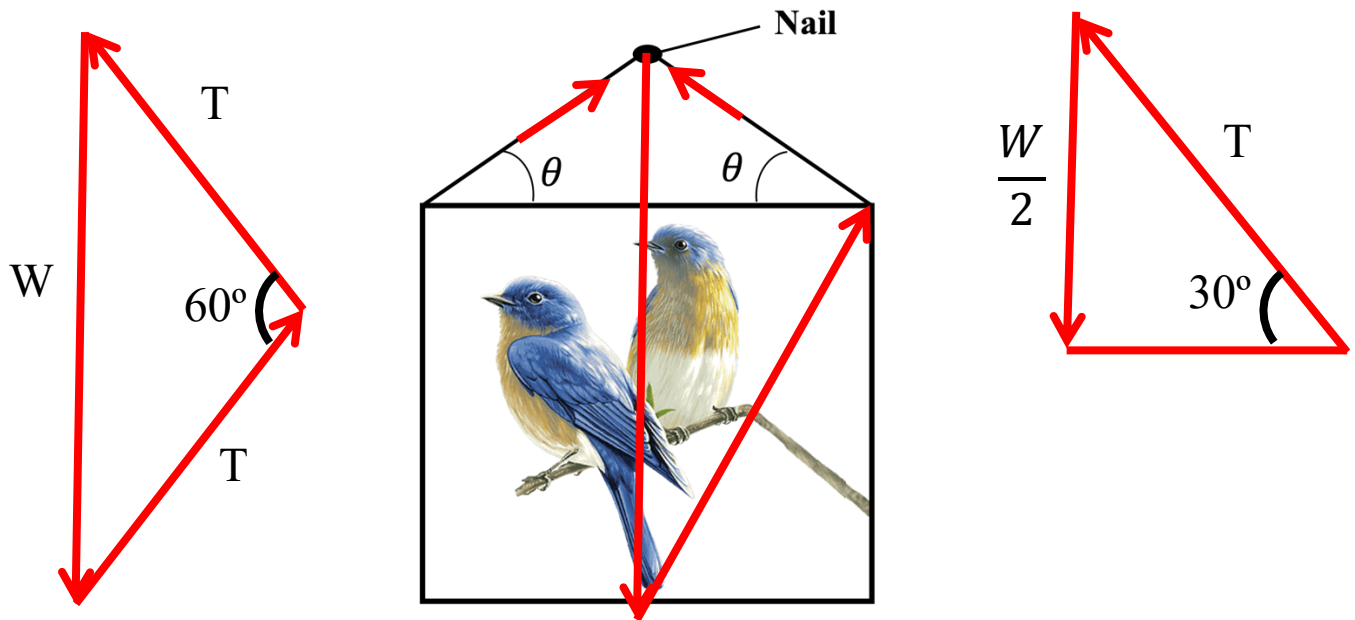   **15 N**. Each string can withstand a **maximum force of 10 N**.

Diagram 9.1

(a)   What is the meaning of weight?   **Reject: formula**

Gravitational force that acting on an objects

[1 mark]

(b)   A few second after the painting is hung, it is found that the string of the painting is
        snapped. By using the value of the angle $\theta = 30°$, calculate the **tension** of the string
        and **resultant force**. Explain why the string of the panting snaps.

√1 2T sin 30º // 2T cos 60º

√2 2T sin 30º = 15 N // 2T cos 60º = 15 N

√3 T = 15 N (tension)

√4 **T > T max // T > 10 // T > maximum force**

Resultant force = T > T max = T – 10 = 5 N

(Tension more than maximum force of the string)   [4 marks]

(c) The painting is broken when it drops from a height of 4 m. By ignoring the air resistance, calculate:

    (i) the time taken for the painting to reaches the floor

$$s = ut + \tfrac{1}{2} gt^2$$
$$4 = \tfrac{1}{2} (9.81) t^2 \quad \sqrt{}_1$$
$$t = \sqrt{\frac{(4)(2)}{9.81}}$$
$$t = 0.903 \text{ s} \; \sqrt{}_2 \; \textbf{UNIT!}$$
$$(2 - 4 \text{ dp})$$

[2 marks]

    (ii) the velocity of the painting before it reaches the floor

$$v = u + gt$$
$$v = 9.81 \times 0.903 \; \sqrt{}_1$$
$$v = 8.8584 \text{ ms}^{-1}$$
$$(2 - 4 \text{ dp}) \quad \sqrt{}_2 \; \textbf{UNIT!}$$

[2 marks]

    (iii) State **one** reason why the painting is broken.

Bigger impulsive force // shorter time impact //
Higher rate of change of momentum

[1 mark]

(d)   Table 1 shows four methods R, S, T and U to pull a lorry which is stucked in mud by two four-wheel drive vehicles.
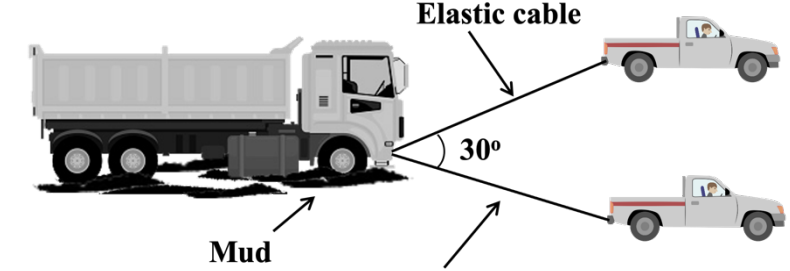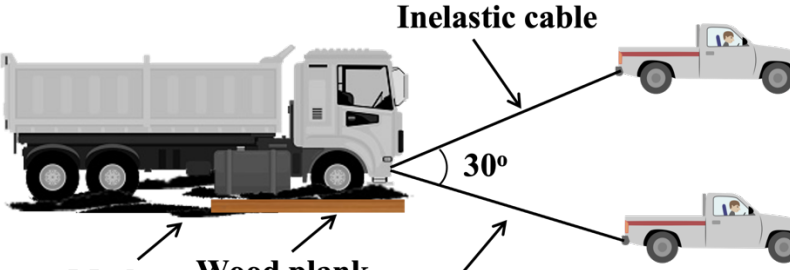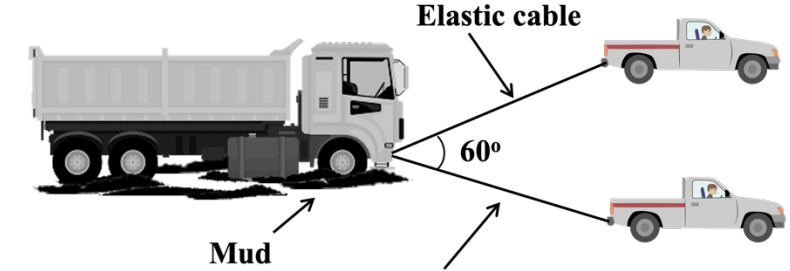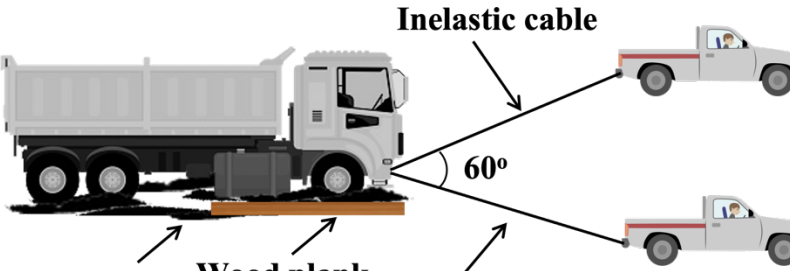

R	Elastic cable, Mud, 30°, Low maximum tension cable
S	Inelastic cable, Mud, Wood plank, 30°, High maximum tension cable
T	Elastic cable, Mud, 60°, Low maximum tension cable
U	Inelastic cable, Mud, Wood plank, 60°, High maximum tension cable

Table 1

You are required to determine the most suitable method to pull the lorry that is stucked in mud effectively from the following aspects:

- Angle between the cables
- Types of cable
- Maximum tension of the cable
- Supported material below the tyre of the lorry

Explain the suitability of the aspects and determine the most suitable method to pull the lorry effectively. Give reasons for your choice.

Characteristics	Reasons
small angle	high force // Greater (bigger // higher) resultant force
inelastic cable !(inelastic = opposite with elastic)	uniform force // constant length cable // cable not easily extend // cable does not stretch
High maximum tension	Strong // not easily break // can *withstand* bigger (high) force // not easily snap
wood plank under the tyre	Reduce pressure // increase area
S	small angle inelastic cable High maximum tension wood plank under the tyre

[10 marks]

TOTAL   20 marks

5   Rajah 5.1 menunjukkan sebuah bongkah P yang berada di atas permukaan kesat ditarik oleh pemberat Q melalui sebuah takal.
Daya paduan yang bertindak ke atas sistem itu adalah F.
Diagram 5.1 shows a block P on a rough surface is pulled by a loud Q through a pulley.
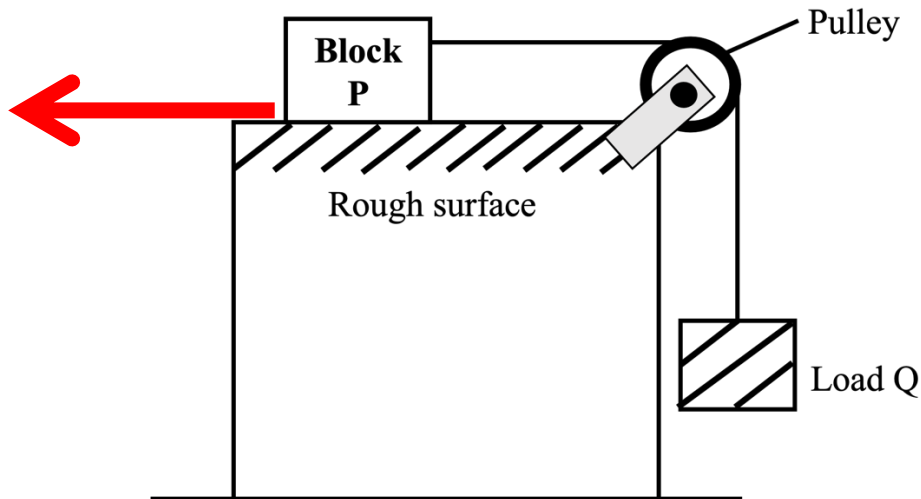*Resultant force acts on the system are F.*

Diagram 5.1

(a)   Apakah maksud daya paduan?
What is the meaning of resultant force?

A single force that represents sum of two or more forces.

[1 mark]

(b)   (i)   Pada Rajah 5.1, tanda dan label daya geseran antara bongkah P dengan permukaan kesat.
On Diagram 5.1, mark and label the friction force between block P and the rough surface.

[1 mark]

(ii)   Nyatakan keadaan gerakan bongkah P dan pemberat Q jika daya paduan adalah sifar.
State the motion of block P and load Q if the resultant force is zero.

Stationary // at rest

constant velocity // zero acceleration

[2 marks]

(c) Rajah 5.2 dan Rajah 5.3 menunjukkan sistem X dan sistem Y di atas permukaan licin dan ditarik oleh pemberat yang serupa.
Diagram 5.2 and Diagaram 5.3 shows system X and system Y on smooth surface pulled by identical load.

Diagram 5.2   **Diagram 5.3**
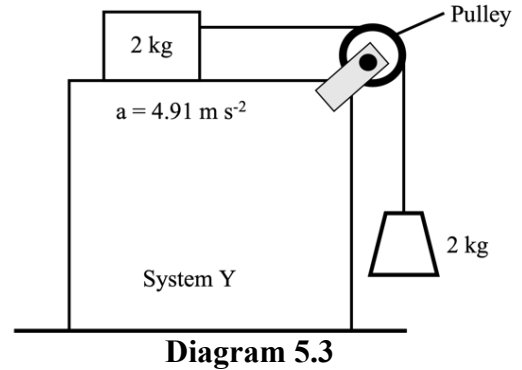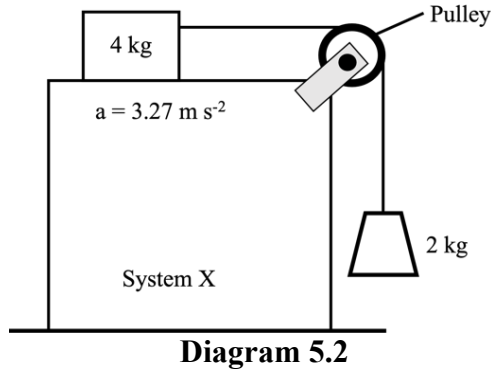
Berdasarkan Rajah 5.2 dan Rajah 5.3,
Based on Diagram 5.2 and Diagram 5.3,

(i) Bandingkan pecutan yang dihasilkan dalam sistem X dan sistem Y.
Compare the acceleration produced in system X and system Y.

Acceleration: Diagram 5.3 > Diagram 5.2
....
[1 mark]

(ii) Bandingkan jumlah jisim dalam sistem X dan sistem Y.
Compare the total mass in the system X and system Y.

Total mass: Diagram 5.2 > Diagram 5.3
....
[1 mark]

(iii) Adakah terdapat perbezaan antara daya paduan yang bertindak dalam sistem X dan sistem Y.
Is there any difference between the resultant force acting on system X and system Y.

Yes
....
[1 mark]

(d) Berdasarkan jawapan anda dalam (c)
Based on your answer in (c)

(i) Berikan satu kesimpulan yang melibatkan daya, jisim dan pecutan.
Give one conclusion involving force, mass, and acceleration.

Mass increase, acceleration decrease
....
[1 mark]

(ii) Namakan hukum fizik yang terlibat.
Name the physics law that involved.

Newton's second law

Reject:
Wrong spelling
....
[1 mark]

TOTAL   9 marks

2 Rajah 2 menunjukkan graf daya, F melawan pemanjangan spring, X bagi spring keluli.
Diagram 2 shows a graph of force, F *against the extension of spring,* X *of a steel spring.*
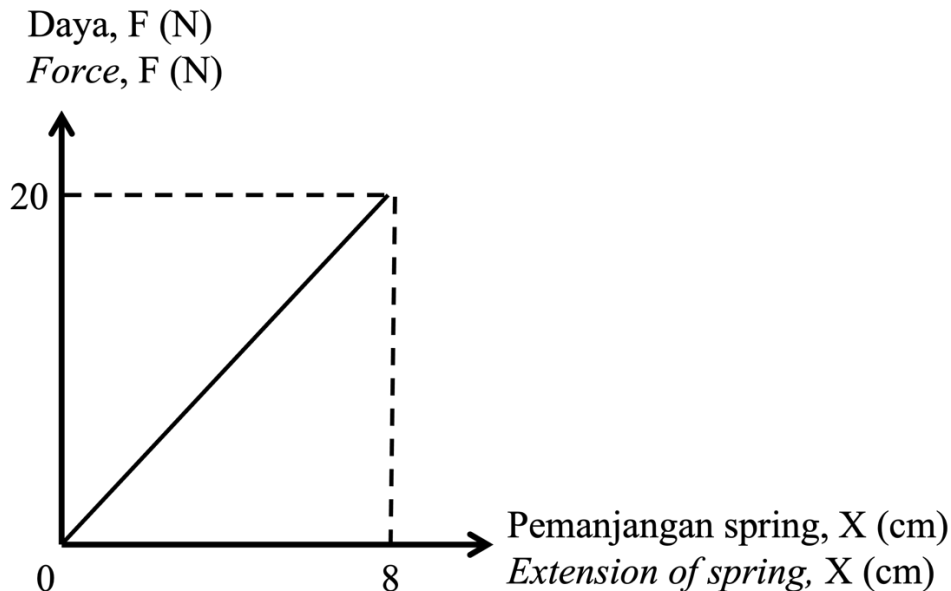
Rajah 2 / *Diagram 2*

(a) Gariskan jawapan yang betul pada pernyataan di bawah.
Underline the correct answer to the statements below.

Hubungan antara daya dengan pemanjangan spring dapat diterangkan oleh (Hukum Ohm, Hukum Hooke)

*The relationship between force and extension of spring can be explained by (Ohm's Law, **Hooke's Law**)*

[1 markah / *mark*]

(b) Berdasarkan Rajah 2, hitung pemalar spring keluli tersebut.
Based on Diagram 2, calculate the constant of the steel spring.

Spring constant = gradient of the graph
$k = \dfrac{\Delta y}{\Delta x} = \dfrac{20 \, N}{8 \, cm}$ $\checkmark_1$
$k = 2.5 \, N \, cm^{-1}$
$\checkmark_2$ (unit!)

or

Spring constant = gradient of the graph
$k = \dfrac{\Delta y}{\Delta x} = \dfrac{20 \, N}{0.08 \, m}$ $\checkmark_1$
$k = 250 \, N \, m^{-1}$

[2 markah / *marks*]

(c)　(i)　Apakah yang akan berlaku kepada kecerunan graf dalam Raajah 2, jika spring keluli diganti dengan spring kuprum yang mempunyai ciri-ciri fizikal yang serupa?
What will happen to the gradient of the graph in Diagram 2, if the steel spring is replaced with a copper spring that has the same physical properties?

Decrease

……………………………………………………………………………………...

[1 markah / *mark*]

(ii)　Beri satu sebab bagi jawapan anda di **2**(c)(i).
*Give one reason for your answer in **2**(c)(i).*

Spring constant: copper < steel

……………………………………………………………………………………...

Stiff of spring: copper < steel

Extension of the spring: copper > steel

[1 markah / *mark*]

TOTAL　　5 marks

SPM 2021 (SET 1)

11 Diagram 11.1 shows a hydrofoil board that contains a surfboard with a hydrofoil that is attaches below it. When the board moves, the shape of the hydrofoil causes the board is lifted from the surface of the water due to the Bernoulli's principle.
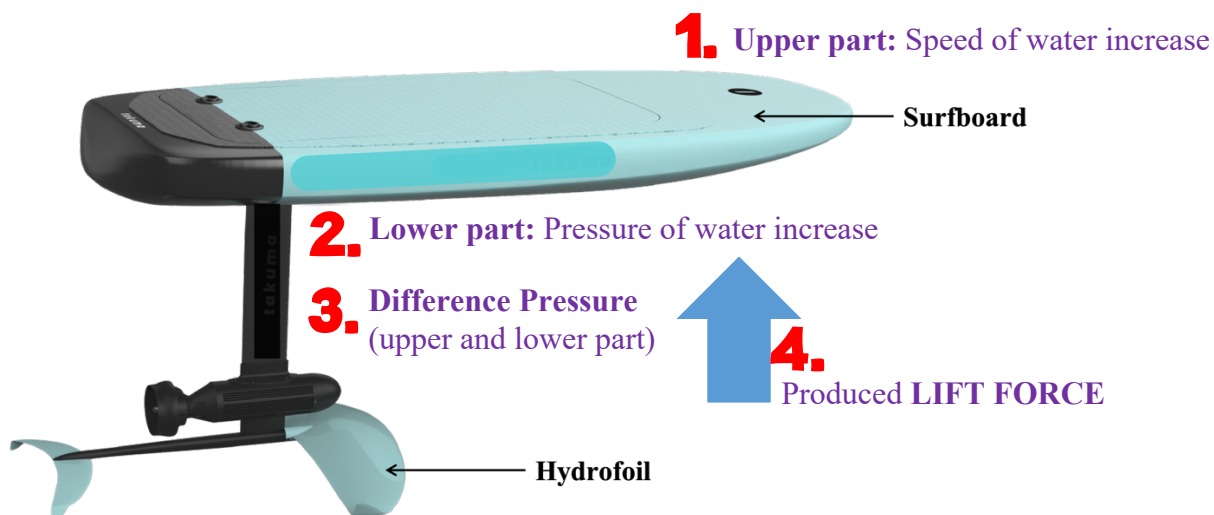
1. **Upper part:** Speed of water increase

← **Surfboard**

2. **Lower part:** Pressure of water increase

3. **Difference Pressure** (upper and lower part)

4. Produced **LIFT FORCE**

← **Hydrofoil**

Diagram 11.1

(a)   State the Bernoulli's principle.

In a moving fluid, where the speed is low, the pressure is high and where the speed is high, the pressure is low

[1 mark]

(b)   Explain how the hydrofoil can cause the board is lifted when the board moves forward.

- The speed of water at upper part of the hydrofoil increases
- The pressure of water at lower part of hydrofoil increases
- Difference in pressure
- Produced Lift force // Lift force > weight

[4 marks]

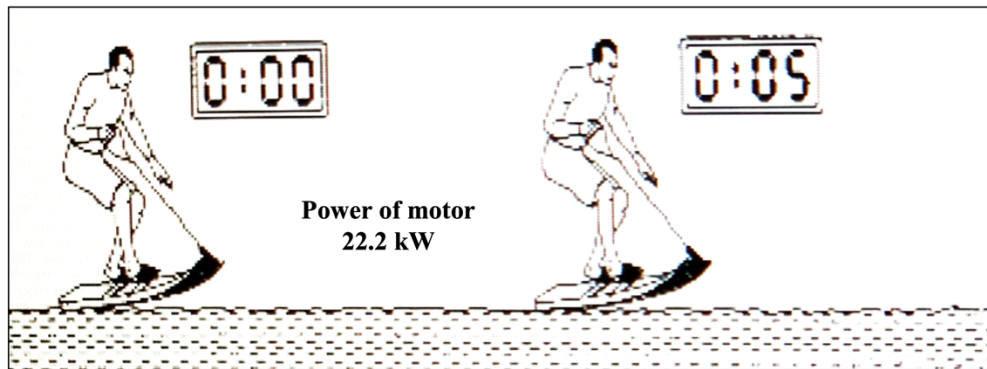(c)   Diagram 11.2 shows a motorized surfboard without hydrofoil moves in 5 s.

Diagram 11.2

Diagram 11.3 shows a motorized surfboard with hydrofoil moves in 5 s.
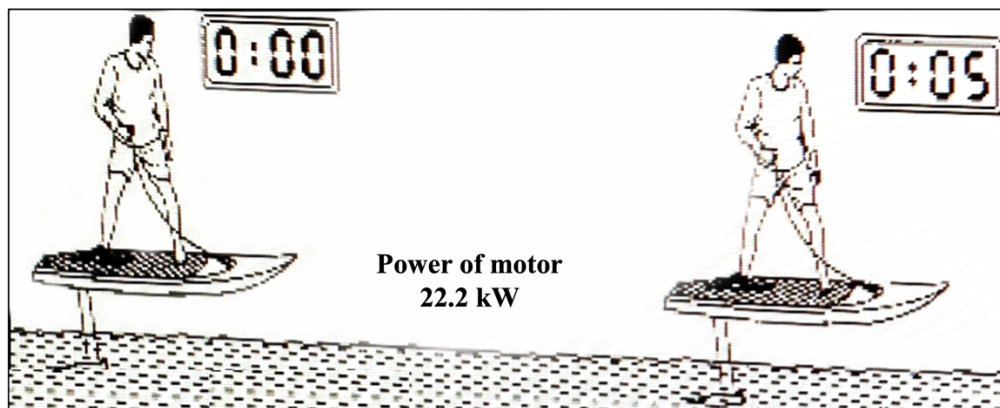

Diagram 11.3

Observe Diagram 11.2 and Diagram 11.3. Compare the height of the surfboard from the water surface, water friction acted on the surfboard and the speed of the surfboard.

Relate the height of the surfboard from the water surface and the water friction. Hence, deduce the relationship between the water friction and the speed of the surfboard.

- ***Height of the surfboard from the water surface:*** Diagram 11.3 > Diagram 11.2
- ***Water friction acted on the surfboard:*** Diagram 11.3 < Diagram 11.2
- ***Speed of the surfboard:*** Diagram 11.3 > Diagram 11.2

- Height of the surfboard from the water surface increase, water friction decrease
- Water friction decrease, speed of the surfboard increase

[5 marks]

(d) Diagram 11.4 shows a hydrofoil boat moves in the sea.
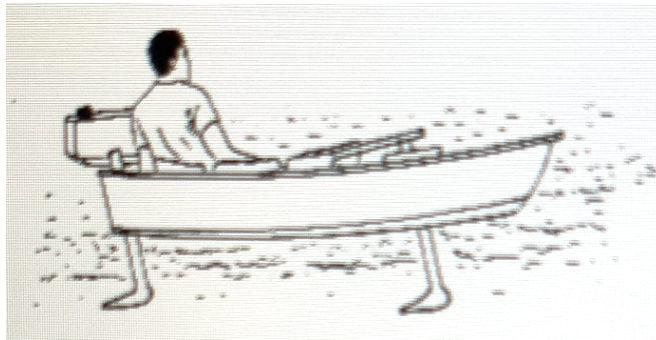

Diagram 11.4

You are required to design a hydrofoil boat that can move faster and carry more passengers at the same time and safely.

State and explain your suggestion based on the characteristics and the size of the boat, characteristics and the size of the hydrofoil, the power of engine used, and the number of the hydrofoil attached to the boat.

[10 marks]

TOTAL   20 marks

Characteristics	Reasons
BOAT	
Low density bot	Lighter // low mass // accelerate
Small mass of boat // light boat	accelerate
strong boat // aluminium boat // steel boat // Fibre plastic boat // Polyethylene boat // Carbon fibre boat	not break // not leak // Strong // not rust *Rej: not damage // not break down*
big boat // long boat // wider *Rej: higher boat*	Float // large buoyant force // displaced more water
streamline boat	low friction // low water resistance // low drag

Characteristics	Reasons
HYDROFOIL	
big hydrofoil *Rej: long hydrofoil // wide hydrofoil // tall hydrofoil*	big force // big lift force
Low density hydrofoil	Lighter // low mass // accelerate
High power engine	Big thrust // big force // accelerate // High momentum
More hydrofoil	More force // more lift force
Low mass of hydrofoil	accelerate
Steel hydrofoil // fibre plastic // polyethylene // carbon fibre	not break // Strong // Not rust *Rej: not leak*

1 Rajah 1 menunjukkan satu tiub digunakan untuk mengalirkan air dari akuarium ke dalam baldi.
Diagram 1 shows a tube used to flow out the water from an aquarium into a pail.
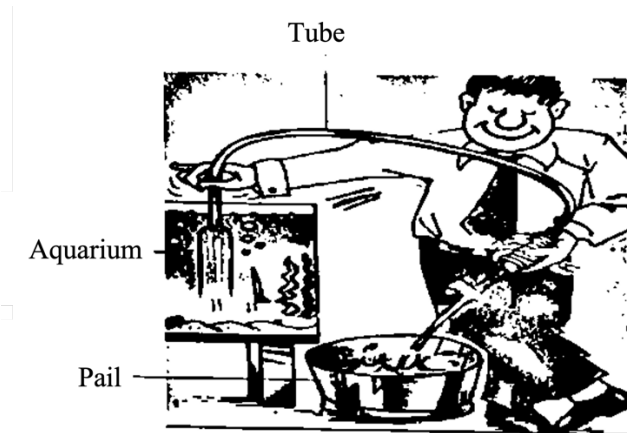

Diagram 1

! Reject:
Wrong spelling

(a) Berdasarkan Rajah 1, namakan kaedah yang digunakan.
Based on Diagram 1, name the method used.

Siphon
....

[1 mark]

(b) Apakah kuantiti fizik yang menyebabkan air mengalir keluar dari akuarium?
What is the physical quantity that causes water to flow out from the aquarium?

Pressure in liquid // Atmospheric Pressure
....

Reject: Symbol
P // P$_{atm}$

[1 mark]

Gariskan perkataan yang betul.
Underline the correct word.

Kadar pemindahan air dapat ditingkatkan dengan
Rate of water transfer can be increased by

(i) (mengurangkan, menambahkan) diameter tiub.
*(**reduce**, increase) the diameter of the tube.*

[1 mark]

(ii) (merendahkan, meninggikan) kedudukan baldi.
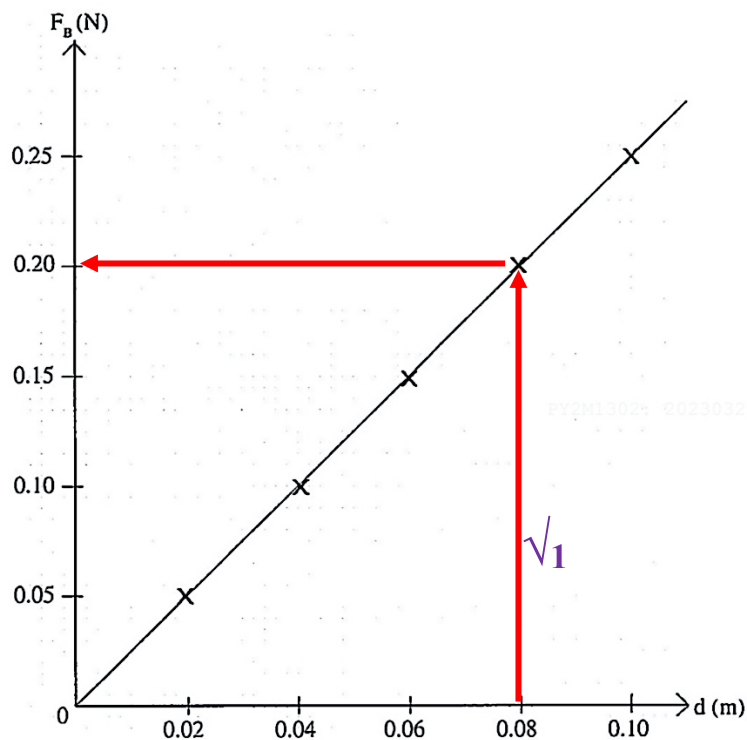*(**lower**, higher) the position of the pail.*

[1 mark]

TOTAL   4 marks

1 Rajah 1 menunjukkan keputusan eksperimen bagi menentukan hubungan antara daya apungan, F_B dan kedalaman rod tenggelam di dalam air, d.
Diagram 1 shows a result of an experiment to determine the relationship between buoyant force, F_B and depth of rod immersed in water, d.

Rajah 1 / *Diagram* **1**

(a) Nyatakan jenis kuantiti fizik bagi daya apungan, F_B.
State the type of physical quantity for buoyant force, F_B.

Derived quantity // Vector quantity

[1 mark]

(b) Berdasarkan Rajah 1,
Based on Diagram 1,

(i) Tandakan (√) bagi pembolehubah dimanupulasi dalam eksperimen tersebut.
Tick (√) the manipulated variable in the experiment.

☐ Daya apungan, F_B
Buoyant force, F_B

[√] kedalaman rod tenggelam di dalam air, d
depth of rod immersed in water, d

[1 mark]

(ii) Tentukan nilai F_B apabila d = 0.08 m.
Tunjukkan bagaimana nilai F_B ditentukan pada graf dalam Rajah 1.
Determine the value of FB when d = 0.08 m.
Show hoe the value of F_B is determined on the graph in Diagram 1.

F_B = ………0.20 N………………………...

$\sqrt{2}$ **UNIT!**

[2 marks]

TOTAL   4 marks

6 Rajah 6 menunjukkan dua orang atlet sedang mendayung kayak P dan kayak Q yang serupa dengan berat yang sama iaitu 300 N. Kedua-dua kayak tersebut terapung di air sungai. Berat atlet X dan atlet Y masing-masing adalah 800 N dan 500 N.

Diagram 6 shows two athletes are rowing kayak P and Q which are identical with the same weight of 300 N. Both kayaks are floating in the river water. The weight of athlete X and athlete Y are 800 N and 500 N respectively..
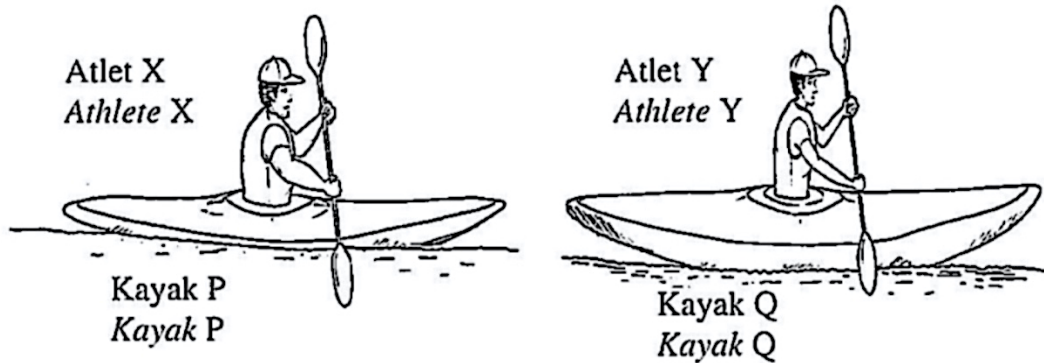
Rajah 6 / Diagram 6

(a) Apakah maksud berat?
What is the meaning of weight?

Gravitational force acting on an object
....
[1 mark]

(b) (i) Menggunakan konsep daya, nyatakan bagaimana kayak-kayak tersebut boleh terapung di permukaan air.
Using the concept of force, state how kayaks can float on the water surface

Buoyant force = weight of object //
....
Buoyant force = weight of kayak + weight of athlete   [1 mark]

(ii) Kayak P telah menyesarkan sejumlah isipadu air sungai semasa terapung. Hitung isipadu air sungai yang disesarkan, V.
[ketumpatan air sungai, $\rho = 1000$ kg m^{-3}]

Kayak P has displaced a certain volume of river water while floating.
Calculate the volume of river water displaced, V.
[*density of river water, $\rho = 1000$ kg m^{-3}*]

$$Fb = \rho V g$$
$$800 + 300 = (1000)(V)(9.81) \quad \checkmark_1$$
$$V = 0.1121 \text{ m}^3$$

V = $\underset{\checkmark_2 \ (3-4 \text{ dp})}{\overset{0.1121}{\ldots\ldots\ldots\ldots\ldots\ldots}}$ m^3

[2 marks]

(c) Berdasarkan Rajah 6,
Based on Diagram 6,

    (i) Kayak manakah menampung berat beban yang lebih besar?
Which kayak accommodate a larger load?

Kayak P

      [1 mark]

    (ii) Kayak manakah yang menyesarkan lebih banyak isipadu air sungai?
Which kayak displaces more volume of river water?

Kayak P

      [1 mark]

    (iii) Kayak manakah yang mempunyai daya apungan yang lebih besar?
Which kayak has greater buoyant force?

Kayak P

      [1 mark]

(d) Menggunakan jawapan anda di 6(c), hubungkaitkan,
Using your answer in 6(c), relate,

    (i) berat beban dengan isipadu air yang tersesar.
the weight of the load and volume of water displaced.

Weight of the load increase, volume of water displaced increase

      [1 mark]

    (ii) berat beban dengan daya apungan.
the weight of the load and the buoyant force.

Weight of the load increase, buoyant force increase

      [1 mark]

TOTAL   9 marks

10 Rajah 10.1 menunjukkan barometer Fortin untuk mengukur tekanan atmosfera.
Diagram 10.1 *shows a Fortin barometer to measure atmospheric pressure.*
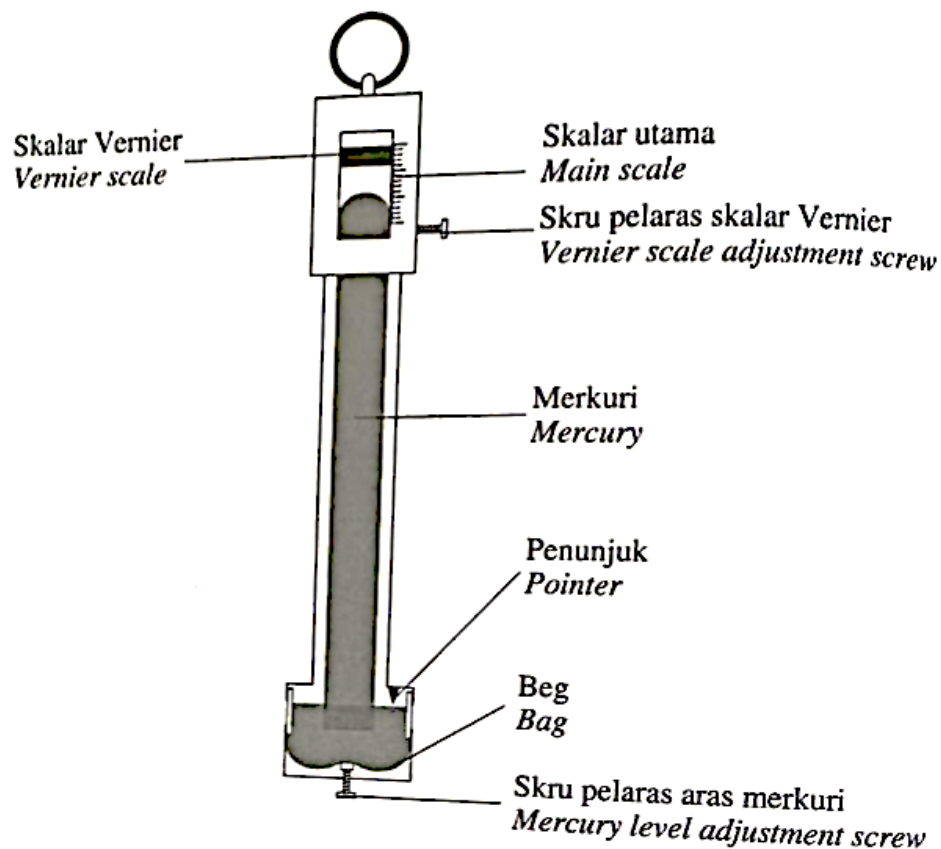
Rajah 10.1 / *Diagram* 10.1

(a) Apakah maksud tekanan atmosfera?
What is meant by atmospheric pressure?

Pressure due to the weight of the layer of air acting on the surface of the earth

[1 markah / *mark*]

(b) (i) Terangkan mengapa merkuri digunakan dalam tiub kaca barometer Fortin
Explain why mercury is used in the glass tube of Fortin barometer?

- High density
- Opaque liquid
- High boiling power
- Higher adhesive force

[3 markah / *marks*]

(ii) Mengapakah scalar vernier digunakan dalam barometer Fortin?
Why vernier scale is used in Fortin barometer?

To take greater accuracy // high accuracy instrument // $\pm$ 0.1 mm Hg

[1 markah / *mark*]

(c) Jadual 10 menunjukkan ciri-ciri komponen yang digunakan dalam barometer Fortin P, Q, R dan S.
Table 10 *shows the characteristics of the components used in the Fortin Barometer,* P, Q, R *and* S.

Barometer *Barometer*	Bahan beg *Bag material*	Bahan tiub pelindung *Protector tube material*	Bahan penunjuk *Pointer material*	Instrument tambahan *Additional instrument*
P	Plastik *Plastic*	Kaca *Glass*	Gading *Ivory*	Hidrometer *Hydrometer*
Q	Kulit *Leather*	Loyang *Brass*	Gading *Ivory*	Termometer *Thermometer*
R	Kulit *Leather*	Loyang *Brass*	Keluli *Steel*	Hidrometer *Hydrometer*
S	Plastik *Plastic*	Kaca *Glass*	Keluli *Steel*	Termometer *Thermometer*

Jadual 10 / *Table* 10

Anda dikehendaki untuk mengkaji ciri-ciri barometer Fortin dalam Jadual 10.
Jelaskan kesesuaian setiap ciri barometer Fortin tersebut.
Tentukan barometer yang paling sesuai boleh digunakan untuk mengukur tekanan atmosfera dengan berkesan.
Berikan alasan untuk pilihan anda.
You are required to study the characteristic of the Fortin barometer in Table 10.
Explain the suitability of each characteristic of the Fortin barometer.
Determine the most appropriate barometer that can be used to measure atmospheric pressure effectively.
Give reasons for your choice.

[10 markah / *marks*]

Characteristic	Reason
Bag material: Leather bag	Strong material //Able to push the mercury // Not tear // Flexible // easy to adjust the level of mercury in the glass
Protector tube material: Brass	Strong // Enables it to be carried around without breaking it// Protect glass tube from breaking
Pointer material: Ivory	Does not react with mercury // not rust // no chemical reaction // inert (lengai) // chemically inactive
Additional instrument: Thermometer	Allow the reading correction to be made when the temperature change // to measure temperature
Q	Bag material: Leather bag Protector tube material: Brass Pointer material: Ivory Additional instrument: Thermometer

(d) Tekanan atmosphere di permukaan laut ialah 76 cm Hg, manakala tekanan atmosfera di puncak sebuah gunung ialah 30 cm Hg.
Ketumpatan merkuri ialah 1.36×10^4 kg m^{-3} dan ketumpatan purata udara ialah 1.3 kg m^{-3}.
The atmospheric pressure at the surface of sea level is 76 cm Hg, *while the atmospheric pressure at the top of a mountain is* 30 cm Hg.
The density of mercury is 1.36×10^4 kg m^{-3} *and the average density of air is* 1.3 kg m^{-3}.

(i) Hitung tekanan atmosfera di permukaan laut dalam unit milibar (mbar).
(1 milibar = 1 hPa)
Calculate the atmospheric pressure at sea level in units of millibars (mbar).
(1 millibar = 1 hPa)

Atmospheric pressure at sea level = 76 cm Hg
P_{atm} = 76 cm Hg = 0.76 m Hg
P_{atm} = (0.76)(13600)(9.81)
P_{atm} = 101396.16 Pa $\checkmark_1$

100 Pa = 1 mbar $\checkmark_2$
$P_{atm} = \frac{101396.16 \times 1}{100}$
P_{atm} = 1013.9616 mbar $\checkmark_3$ (unit!)

[3 markah / *marks*]

(ii) Hitung ketinggian gunung tersebut dalam unit meter.
Calculate the height of the mountain in the unit of meter.

Atmospheric pressure at top mountain = 30 cm Hg
pgh (**air**) = Pressure at **top** mountain
$\checkmark_2$ (1.3)gh = (0.76 – 0.30)g (13600)
1.3h = 6256 $\checkmark_1$
h = 4812.3077 m $\checkmark_3$ (unit!)

[2 markah / *marks*]

TOTAL   20 marks

Top of mountain: 30 cm Hg

P(top)+p(udara)gh=P(bottom)
P(top) = 30 cm Hg (Puncak gunung)
P(bottom) = 76 cm Hg (P_{atm})

0.30 + P(udara) = 0.76
P(udara) = 0.76 -0.30
1.3(g)(h) = 0.46g(13600)
h = 4812.3077 m

height of mountain (h): (76 – 30) cm Hg

Atmosphere Pressure (sea level): 76 cm Hg
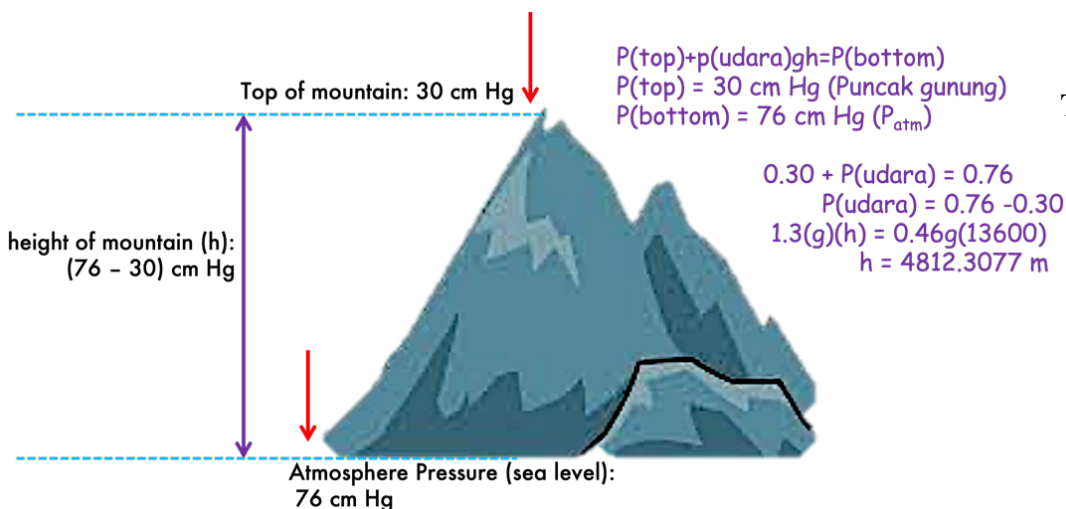
F5 BAB 3: KEELEKTRIKAN

SPM 2021 (SET 1)

10   Diagram 10.1 shows an electric cooker labelled as **1000 W 240 V**.

Diagram 10.1

(a)   What is the meaning of electric current?

Rate of flow of charge ❗ Reject: formula

[1 mark]

(b)   Diagram 10.2 shows the cross-section of the heating element in the electric cooker.
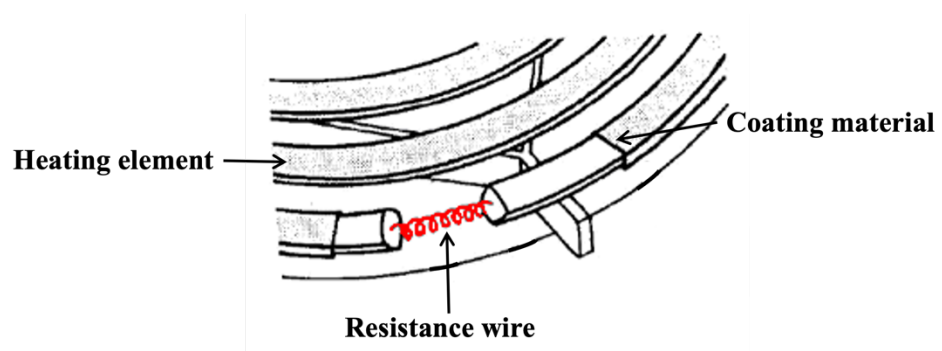
Diagram 10.2

(i)   Calculate the resistance of the resistance wire.

$$P = \frac{V^2}{R} \quad \sqrt{}_1$$

$$1000 = \frac{(240)^2}{R} \quad \sqrt{}_2$$

R = 57.6 ohm // 57.6 Ω $\sqrt{}_3$ **UNIT!**

[3 marks]

(ii) The electric current flow through the resistance wire is 4.2 A.
Calculate the power produced by the resistance wire.

$P = I^2R$
$P = (4.2)^2 \times 57.6$ √1
$P = 1016.06$ W
√2 **UNIT!**
(2 dp – 4 dp)   [2 marks]

(c) Diagram 10.3 shows a pot is placed on top of the electric cooker.

Diagram 10.3

Explain how the heating element of the electric cooker can be used to heat up the food in the pot.

- Electrical energy change to heat energy // Electrical energy → heat energy
- coil heating element
- long heating element (length increase)
- high resistance
- Resistance produce heat
- More heat energy (P = I²R)
- Heat energy transferred to the pot

Max. 4 marks

[4 marks]

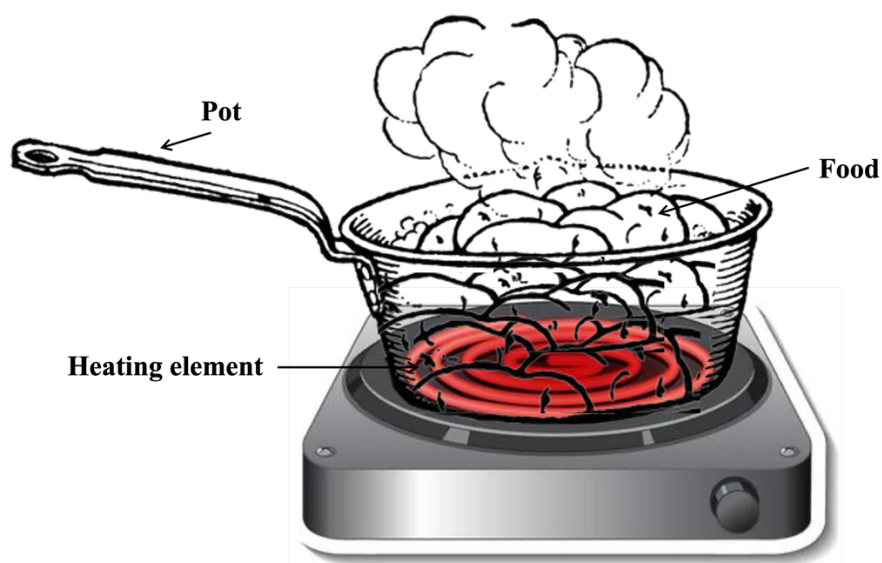(d) The heating element in Diagram 10.2 does not last and needs longer time to heat up the food. Table 2 shows the characteristics of the four heating elements K, L, M and N.

Heating element	Shape of resistance wire	The resistivity of resistance wire	Material of resistance wire	Coating material
K	Straight	High	Aluminium	Steel
L	Coiled	High	Nichrome	Steel
M	Straight	Low	Nichrome	Copper
N	Coiled	Low	Aluminium	Copper

Table 2

Study each characteristic of the heating element and explain the suitability of each characteristic.

Determine the heating element that is lasting and can be heat up the food faster. Give the reason for your choice.

Characteristics	Reasons
Shape of resistance wire: Coiled	more heat energy// high resistance
The resistivity of resistance wire: High	Produced more heat energy // resistance increase
Material of resistance wire: Nichrome	High melting point // not melt (easily) // more resistance // higher resistivity
Coating material: Steel	non oxidizing // can withstand high temperature // not rust // good heat conductor // Transfer heat easily Transfer heat faster
L	**Shape of resistance wire:** Coiled **The resistivity of resistance wire:** High **Material of resistance wire:** Nichrome **Coating material:** Steel

[10 marks]

TOTAL   20 marks

Extra!

FILAMENT BULB

HEATING ELEMENT

FILAMENT BULB	HEATING ELEMENT
coiled wire - longer (length increase) - resistance increase **diameter: thin** - more resistance / more heat energy **material: higher melting point** - can withstand higher temperature / not easy melt **material: higher resistivity** - produced more heat energy / more resistance **material: tungsten** - higher resistivity	**Higher number of turns of coil** - resistance increases - length or coil increases **low density** - lighter - low mass - easy to handle **diameter decreases** - more heat energy - higher resistance **strong material** - not easy break - long lasting - durable - not easy corrode **good conductor of heat** - absorb more heat at faster rate - good thermal conductor **higher melting point** - not easy melt - can withstand higher temperature **higher resistivity** - produced more heat - higher resistance

EXAMPLE 1:
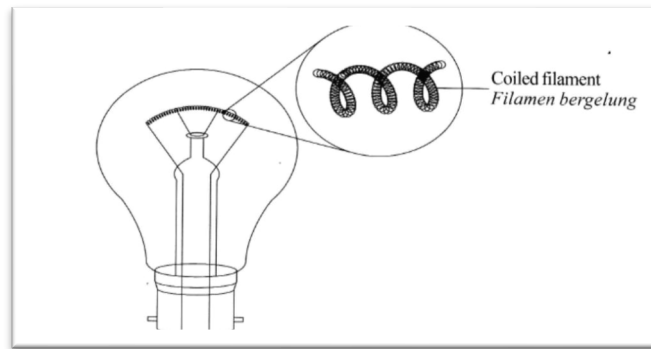
Diagram 1

Explain why the filament in coiled shape produces more light.

ANSWER:
• coil shape, length increases
• resistance increases
• heat produced increases
• heat energy converts to light energy

EXAMPLE 2:
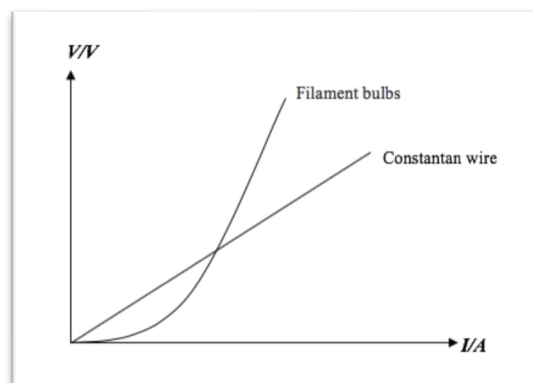
Diagram 2

Diagram 2 shows the graph of the relationship between the potential difference and the current of a constantan wire and a filament bulb.

Describe the graph of the potential difference graph against current for constantan wire and filament bulb. In your description, explain in terms of resistance and temperature.

ANSWER:
• **Filament bulbs**
    - Gradient graph increases
    - resistance increases when temperature increases

• **Constantans wire:**
    - Gradient constant
    - temperatures increase, resistance constant

10 Rajah 10.1 menunjukkan satu litar elektrik.
Diagram 10.1 shows an electrical circuit.
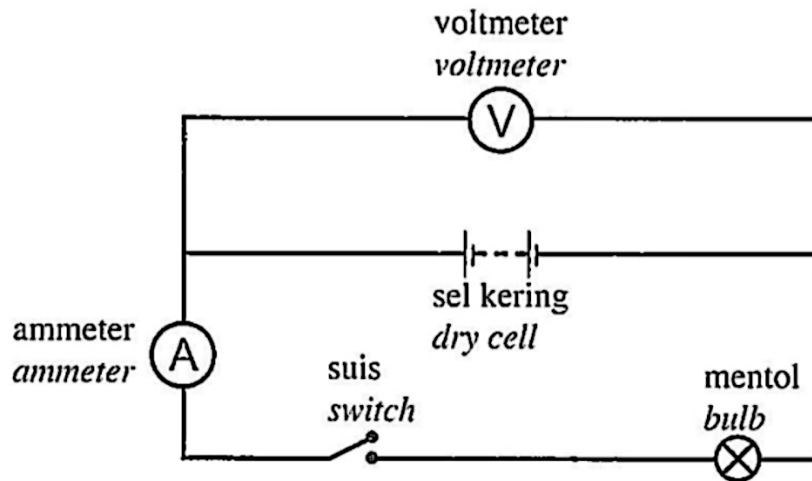
Rajah 10. 1 / *Diagram 10.1*

(a) Nyatakan fungsi voltmeter.
State the function of voltmeter.

To measure voltage // potential difference // electromotive force

[1 mark]

(b) Berdasarkan Rajah 10.1,
Based on Diagram 10.1,

(i) apakah yang berlaku kepada bacaan ammeter dan bacaan voltmeter apabila suis dihidupkan.
what happened to the ammeter reading and voltmeter reading when the switch in turned on.

- Ammeter shows a reading // ammeter reading increase
- Voltmeter reading decrease

[2 marks]

(ii) Jelaskan jawapan anda di **10(**b)(i).
*Explain your answer in **10(b)(i).***

- Current flow // electron flow // charge flow
- To overcome the internal resistance of cell // energy loss // voltage drop when circuit complete

[2 marks]

(c) Rajah 10.2 menunjukkan empat jenis litar elektrik, P, Q, R dan S. Litar elektrik itu terdiri daripada empat biji sel kering yang serupa dan dua jenis sumber cahaya iaitu tiga mentol berfilamen dan tiga Diod Pemancar Cahaya (LED). Daya gerak elektrik (d.g.e) bagi setiap sel kering dan kadar kuasa setiap sumber cahaya adalah sama.

Diagram 10.2 shows four types of electric circuits, P, Q, R and S. The electric circuits consist of four identical dry cells and two types of light sources which are three filament bulbs and three Light Emitting Diodes (LED). The electromotive force (e.m.f) for each dry cell and the power of each light source is the same.
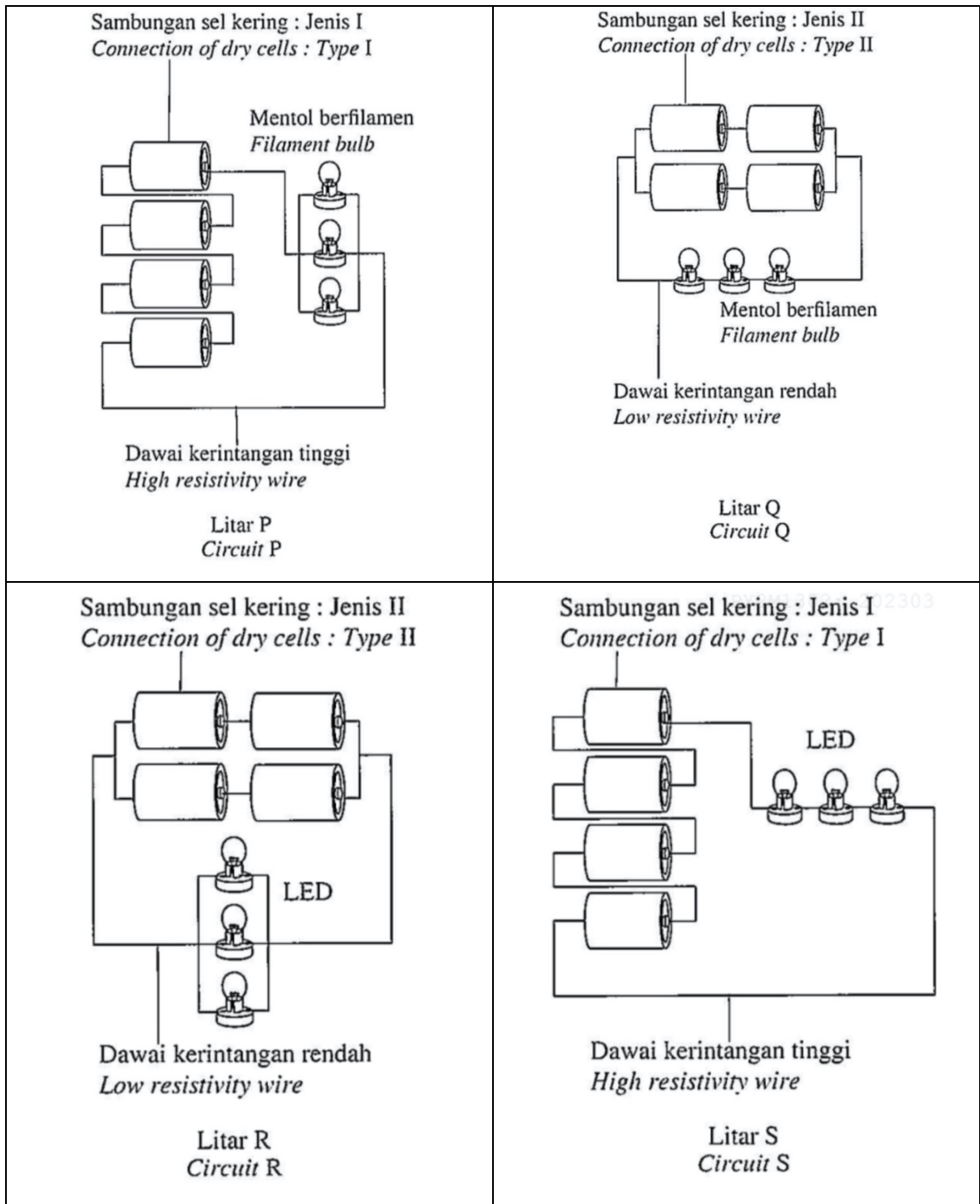
Rajah 10. 2 / *Diagram 10.2*

Kaji dan tentukan litar elektrik yang paling sesuai untuk menghasilkan cahaya yang lebih cerah dan sumber cahaya yang tidak mudah terbakar.
Study and determine the most suitable electric circuit that produce brighter light and is not easily flammable light source.

(i) Terangkan kesesuaian bagi setiap spesifikasi.
Explain the suitability for each specification.

[8 marks]

CHARACTERISTICS	REASON
Light source: LED	Less heat // low energy // low power loss // consume less power // high efficiency
Arrangement of light source: parallel	Small effective resistance // high current // high voltage (potential difference) //one bulb broken another bulb still function
Resistivity of wire: Low	Low resistance // low resistivity // more current flow // high efficiency // less energy loss // less heat loss
Type of dry cell connection: Type I	High voltage // high emf // high power // high intensity
Type II	Small effective resistance // high current // high intensity // high energy // high power

(ii) Pilih litar yang paling sesuai. Berikan sebab untuk pilihan anda.
Choose the most suitable circuit. Give reasons for your choice.

R
Light source: LED
Arrangement of light source: parallel
Resistivity of wire: Low
Type of dry cell connection: Type I or Type II

! can answer in the table //
● can also continue the answer to (c)(i)

[2 marks]

(d) Rajah 10.3 menunjukkan satu litar elektrik yang mengandungi dua sel kering 9 V setiap satu, ammeter dan satu kipas mini. Rintangan dalam sel kering ialah 0.5 Ohm dan rintangan kipas mini ialah 60 Ohm.

Diagram 10.3 shows an electric circuit containing two 9 V dry cell each, an ammeter and a mini fan. The internal resistance of each dry cell is 0.5 Ohm and the resistance of the mini fan is 60 Ohm.
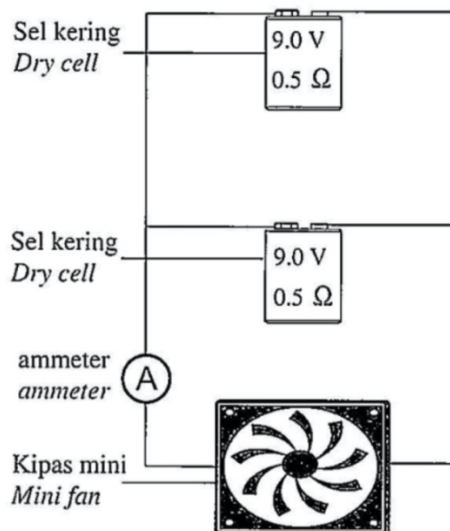
Rajah 10. 3 / *Diagram* **10.3**

Berdasarkan Rajah 10.3, hitung
Based on Diagram 10.3, calculate

(i) rintangan dalam berkesan bagi sel-sel kering.
the effective internal resistance for dry cells.

$$\frac{1}{r} = \frac{1}{r_1} + \frac{1}{r_2}$$

$$\frac{1}{r} = \frac{1}{0.5} + \frac{1}{0.5} \quad \sqrt{}_1$$

$$r = 0.25 \ \Omega \quad \sqrt{}_2 \ \textbf{UNIT!}$$

(ii) bacaan ammeter.
the reading of the ammeter.

$$E = V + Ir$$
$$E = I (R + r) \quad \sqrt{}_1 \ \textbf{(formula or correct sustituiton)}$$
$$9 = I (60 + 0.25) \quad \sqrt{}_2 \ \textbf{(60 + 0.25)}$$
$$I = 0.149 \ A$$
$$\sqrt{}_3 \ \textbf{UNIT!}$$
$$\textbf{(3 – 4 dp)}$$

[5 marks]

TOTAL   20 marks

8   Rajah 8.1 menunjukkan satu litar elektrik yang mengandungi beberapa sel kering dengan daya gerak elektrik, $\varepsilon = 6$ V dan rintangan dalam, r = 2 Ω.
Diagram 8.1 shows an electric circuit containing several dry cells with electromotive force, $\varepsilon = 6$ V and internal resistance, r = 2 Ω.

ε = 6V   r = 2Ω

A

R
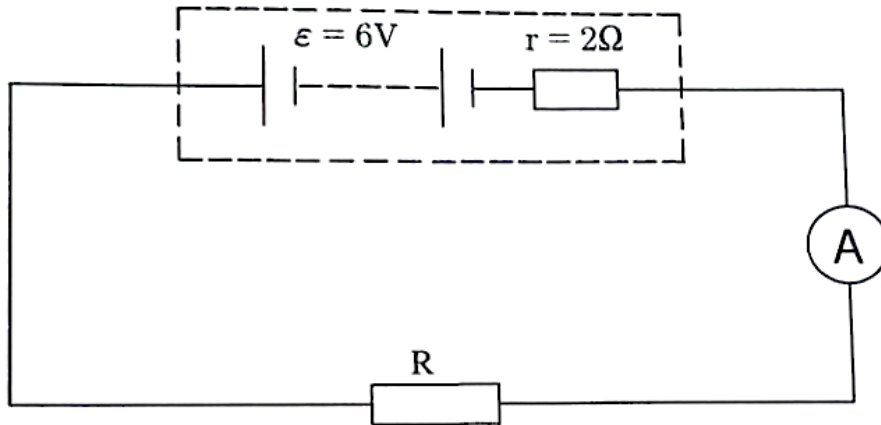
Rajah 8.1 / *Diagram* 8.1

(a) Apakah maksud daya gerak elektrik?
What is meant by electromotive force?

The energy transferred or work done by an electrical source to move one coulomb of charge in a complete circuit.

[1 markah / *mark*]

(b) Hitung bacaan ammeter dalam Rajah 8.1.
Calculate the ammeter reading in Diagram 8.1.

No value of R
∴ resistance R = R Ω

$E = V + Ir$

$E = I(R + r)$

$I = \dfrac{E}{R+r}$ √1

$I = \left(\dfrac{6}{R+2}\right)$ A √2 (unit!)

[2 markah / *marks*]

(c) Rajah 8.2 menunjukkan sebuah lampu suluh yang menggunakan sebiji bateri.
Diagram 8.2 *shows a torch light that uses a battery.*
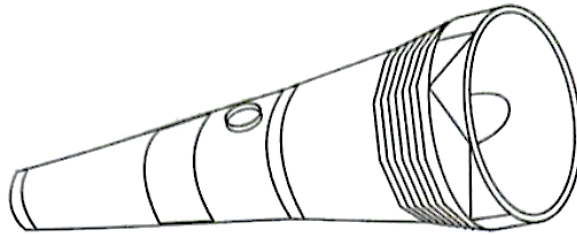
Rajah 8.2 / *Diagram* **8.2**

Cahaya yang terhasil daripada lampu suluh dalam Rajah 8.2 malap.
Nyatakan pengubahsuaian yang boleh dilakukan terhadap lampu suluh tersebut supaya dapat menghasilkan cahaya lebih terang berdasarkan aspek-aspek berikut:
The light produced by the torch light in Diagram 8.2 *is dim.*
State the modifications that can be made to the torch light so that it can produce brighter *light based on the following aspects:*

(i) bilangan bateri
the number of the batteries

More // increase // higher

……………………………………………………………………………………...
[1 markah / *mark*]

Sebab
Reason

More electrical energy // emf increase // higher potential difference
……………………………………………………………………………………
[1 markah / *mark*]

(ii) susunan bateri
the arrangement of the batteries

Series

……………………………………………………………………………………...
[1 markah / *mark*]

Sebab
Reason

Higher voltage // emf increase // higher electrical power (energy)
……………………………………………………………………………………...
[1 markah / *mark*]

(iii) jenis mentol
the type of bulb

LED

……………………………………………………………………………………...
[1 markah / *mark*]

Sebab
Reason

Less heat produce // low energy loss // low power loss //
……………………………………………………………………………………...
High efficiency // high intensity of light //   [1 markah / *mark*]
High output power

TOTAL   9 marks

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6 Diagram 6.1(a) and Diagram 6.1(b) show the copper wire in the magnetic field swings when the current flows through it.
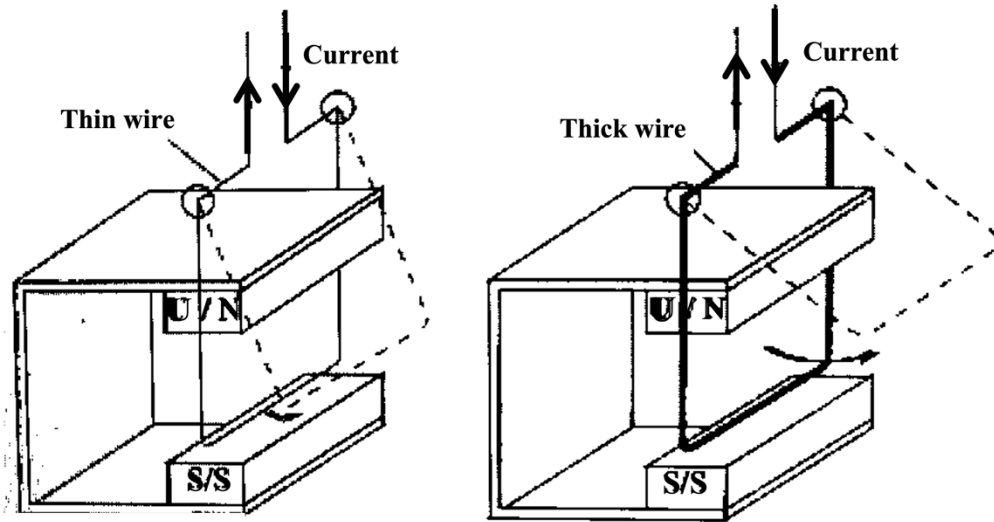
| Diagram 6.1(a) | Diagram 6.1(b) |

(a) Name the rule that is used to determine the direction of the copper wire swing.

Fleming's left-hand rule ....

! Reject: Wrong spelling

[1 mark]

(b) Observe Diagram 6.1(a) and Diagram 6.1(b). Compare

(i) the thickness of the copper wire

Thickness of the copper wire: Diagram 6.1(b) > Diagram 6.1(a)
....

[1 mark]

(ii) the size of swing angle of the copper wire

Size of swing of the copper wire:
....

Diagram 6.1(b) > Diagram 6.1(a)

[1 mark]

(iii) the force that acted on the copper wire

Force that acted on the copper wire:
....

Diagram 6.1(b) > Diagram 6.1(a)

[1 mark]

(c)   Based on the answer in 6(b), state the relationship between the force acted on the copper wire and

      (i)   the thickness of the copper wire

         Thickness of the copper wire increase,

                                                                                             [1 mark]

      (ii) size of the swing angle of copper wire

         Force acted on the copper wire increase,

         Size of the swing angle of the copper wire increase   [1 mark]

(d)   The pole of the magnet bar in Diagram 6.1(b) is reversed.
       What happens to the swing of the copper wire?

       Swing at opposite direction // swing to the left

                                                                                   [1 mark]

(e)   The copper wire in Diagram 6.1(b) is then replaced with a coil as shown in Diagram 6.2. When the switch in on, the coil rotates in one direction.
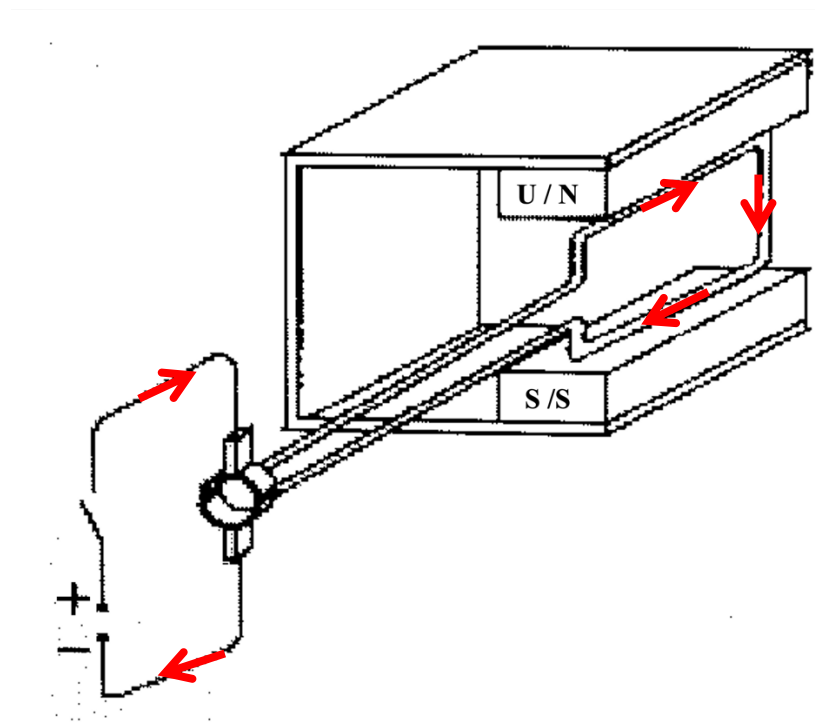
      (i)   In Diagram 6.2, mark the direction of electric current in the coil.

                                                                           [1 mark]

      (ii) State the direction of rotation of the coil.

         Anti-clockwise

                                                                             [1 mark]

                                                     TOTAL   **9 marks**

9   Rajah 9.1 menunjukkan sebatang magnet bar digerakkan mendekati satu solenoid.
Pesongan galvanometer dapat diterangkan berdasarkan konsep aruhan electromagnet.
*Diagram 9.1 shows a bar magnet is moved closer to a solenoid. The deflection of galvanometer can be
explained based on concept of electromagnet induction.*
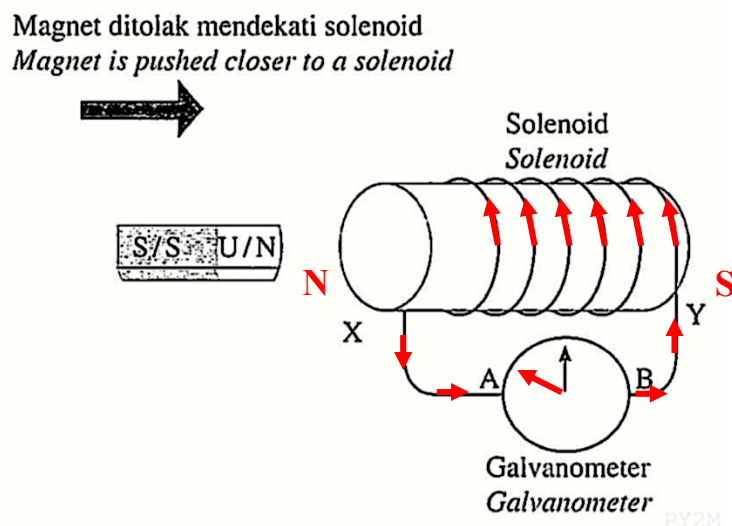
Rajah 9.1 / *Diagram 9.1*

(a)   Apakah maksud aruhan electromagnet?
What is meant by electromagnetic induction?

> Production of *induced emf* when there is a change of magnetic flux due to
> the *relative motion* between the conductor and the magnetic field.

[1 mark]

(b)   Berdasarkan Rajah 9.1,
Based on Diagram 9.1,
  (i)   Nyatakan kekutuban di X dan Y.
State the polarity at X and Y.

> X = North (N // U)
> Y = South (S)

[2 marks]

  (ii)   Tentukan arah arus yang mengalir melalui galvanometer dan nyatakan
pesongan galvanometer.
*Determine the direction of current that flows through galvanometer and state the
deflection of the galvanometer.*

- Direction of current flow: A to B (to the right)
- Deflection of pointer of the galvanometer: deflect to A   [2 marks]
  (to the left)

(iii) Terangkan jawapan anda untuk **9**(b)(ii).
*Explain your answer for **9**(b)(ii).*

- Change in magnetic flux occur (cutting of magnetic flux)
- Relative motion between the conductor and magnetic field
- Current flow

[1 mark]

(c) Berdasarkan konsep aruhan elektromagnet, terangkan bagaimana **arus aruhan** boleh terhasil dalam solenoid.
*Based on the concept of electromagnetic induction, explain ho wan **induced current** can be produced in a solenoid.*

- Motion: magnet closer (moves towards) to the conductor (solenoid)
- Change in magnetic flux occur
- ***Induced emf*** produced
- Obey Lenz's law
- Induced current always in a direction that oppose change in magnetic flux that produces it

[4 marks]

(d) Rajah 9.2 menunjukkan sebuah periuk dan dapur aruahn.
Diagram 9.2, shows a pot and an induction cooker.
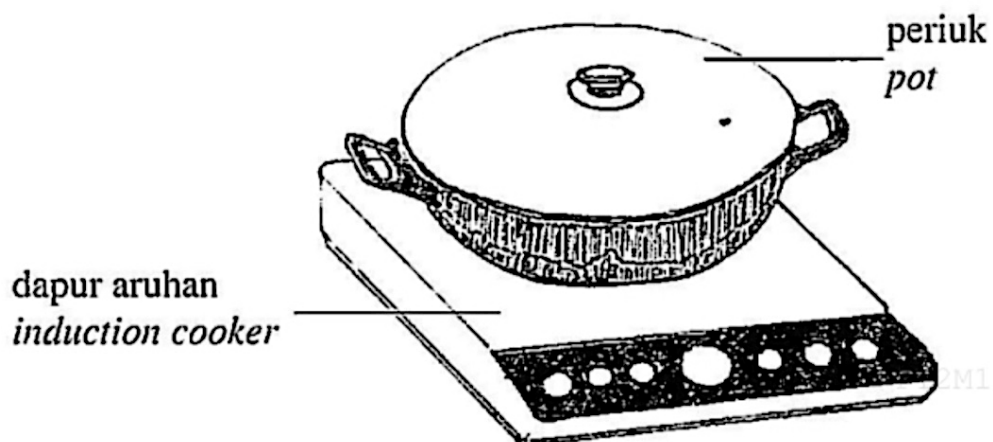
Rajah 9.2 / *Diagram 9.2*

Anda dikehendaki menyiasat ciri-ciri bagi sebuah dapur aruhan seperti yang ditunjukkan dalam Jadual 2.
You are required to investigate the characteristics of an induction cooker as shown in Table 2.

Dapur aruhan *Induction cooker*	Jenis bekalan kuasa *Type of power supply*	Bahan untuk permukaan dapur *Material for the surface of cooker*	Bahan untuk dasar periuk *Material for the base of the pot*	Jenis gegelung elektromagnet *Type of electromagnetic coil*
J	arus terus *direct current*	Keluli *Steel*	Besi *Iron*	Kuprum *Cooper*
K	arus terus *direct current*	Seramik *Ceramic*	Tanah liat *Clay*	Nikrom *Nichrome*
L	arus ulang alik *alternating current*	Seramik *Ceramic*	Besi *Iron*	Kuprum *Cooper*
M	arus ulang alik *alternating current*	Keluli *Steel*	Tanah liat *Clay*	Nikrom *Nichrome*

Jadual 2 / *Table 2*

Terangkan kesesuaian setiap ciri dapur aruhan. Tentukan dapur aruhan yang paling berkesan untuk digunakan bagi memasak makanan dengan lebih cekap dan menjimatkan.
Explain the suitability of each characteristic of induction cooker. Determine the most effective induction cooker to be used to cook food more effectively and economically.

[10 marks]

TOTAL   20 marks

CHARACTERISTICS	REASON
Type of power supply: Alternating current	Change in magnetic flux occur // cutting in magnetic flux
Surface of cooker: Ceramic	Poor heat conductor // Heat insulator // not hot // heat slow // higher specific heat capacity
Material for base of pot: Iron	Form eddy current // produced induced emf (induced current)
Electromagnetic coil: Copper	Low resistance // low resistivity // more current flow // stronger magnetic field
L	**Type of power supply:** Alternating current **Surface of cooker:** Ceramic **Material for base of pot:** Iron **Electromagnetic coil:** Copper

6 Rajah 6.1 menunjukkan satu konduktor pembawa arus yang diletakkan antara dua magnet bar. Satu medan lastik terhasil.
Diagram 6.1 shows a current carrying conductor which is placed between two bar magnets. A catapult field is produced.
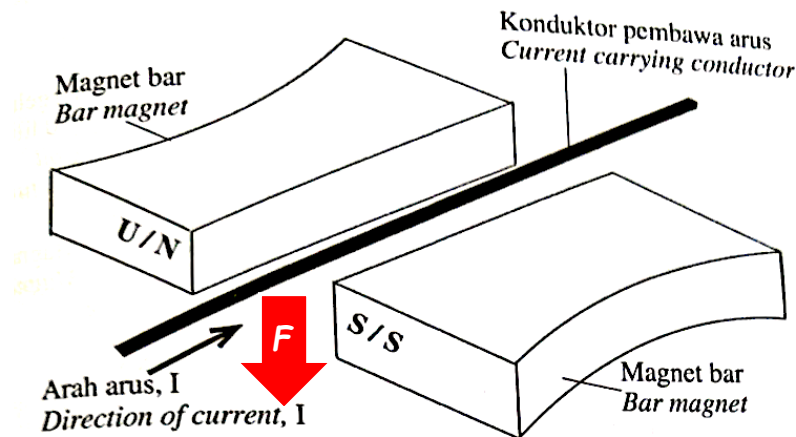
Rajah 6.1 / *Diagram* 6.1

(a) (i) Tandakan arah daya pada konduktor pembawa arus dalam Rajah 6.1.
Mark the direction of force on the current carrying conductor in Diagram 6.1.

[1 markah / *mark*]

(ii) Takrifkan medan lastik.
*Define **catapult field**.*

Resultant magnetic field produced from the interaction between the magnetic field from a current-carrying conductor and the magnetic field from a permanent magnet [1 markah / *mark*]

(b) Rajah 6.2(a) dan Rajah 6.2(b) menunjukkan suatu eksperimen ringkas electromagnet.
Diagram 6.2(a) and Diagram 6.2(b) show a simple experiment of electromagnet.
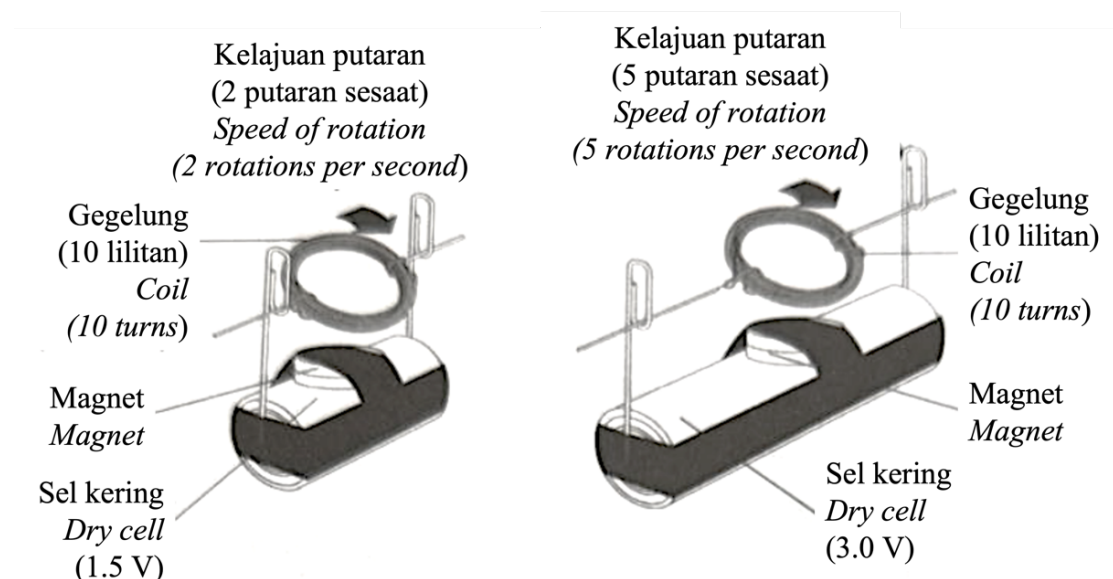
Rajah 6.2(a) / *Diagram* 6.2(a)   **Rajah 6.2(b) / *Diagram* 6.2(b)**

Perhatikan Rajah 6.2(a) dan Rajah 6.2(b). Bandingkan,
Observe Diagram 6.2(a) and Diagram 6.2(b). Compare,

    (i)   bilangan lilitan gegelung
          the number of turns of coils

          Number of turns of coils: Diagram 6.2(a) = Diagram 6.2(b)
          ....

[1 markah / *mark*]

    (ii)   beza keupayaan
           the potential difference

          Potential difference: Diagram 6.2(b) > Diagram 6.2(a)
          ....

[1 markah / *mark*]

    (iii)   kelajuan putaran gegelung
            the speed of rotation of coil

          Speed of rotation of coil: Diagram 6.2(b) > Diagram 6.2(a)
          ....

[1 markah / *mark*]

(c)   Berdasarkan jawapan anda di **6**(b)(i), **6**(b)(ii) dan **6**(b)(iii), nyatakan hubungan antara
        *Based on your answer in **6**(b)(i), **6**(b)(ii) and **6**(b)(iii), state the relationship between*

    (i)   beza keupayaan dengan kelajuan putaran gegelung
          the potential difference and the speed of rotation of coil

          Potential difference increase, speed of rotation of coil increase
          ....

[1 markah / *mark*]

    (ii)   beza keupayaan dengan daya
           the potential difference and the force

          Potential difference increase, force increase
          ....

[1 markah / *mark*]

(d)   Sel kering dalam Rajah 6.2(a) digantikan dengan bekalan kuasa arus ulang alik
        dengan frekuensi 50 Hz.
        Apakah yang akan berlaku kepada putaran gegelung?
        Beri **satu** sebab bagi jawapan anda.
        The dry cell in Diagram 6.2(a) is replaced with an alternating current power supply
        with the frequency of 50 Hz.
        What will happen to the rotation of the coil?
        *Give **one** reason for your answer.*

     Vibrate // stationary
     ....

  Direction of force changed //...
  the direction of the force changes continuously //   [2 markah / *marks*]
  the direction of the force is always changing

TOTAL   9 marks

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4   Diagram 4 shows a transistor circuit that consist of light dependent resistor (LDR).
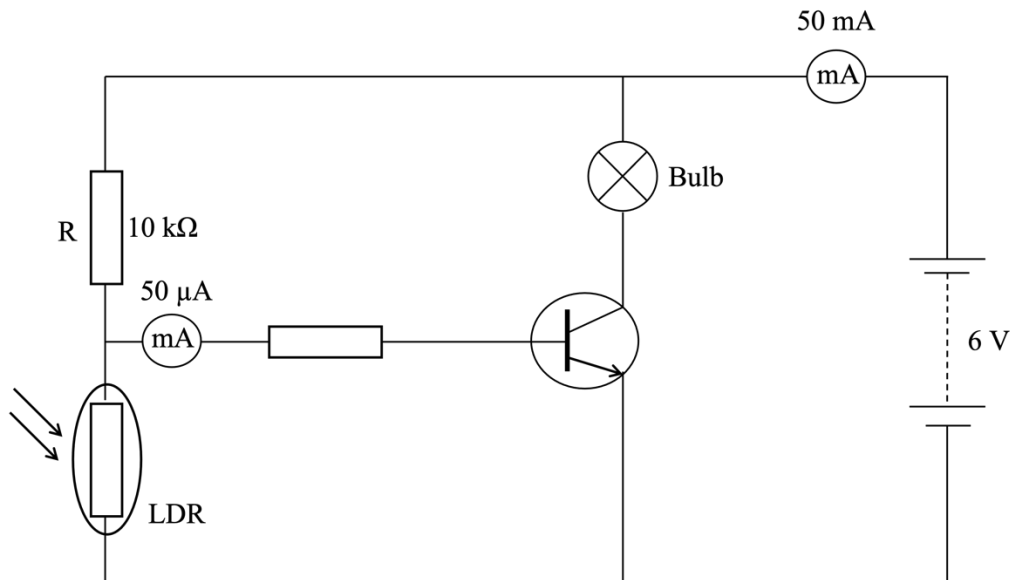   When the LDR detects light, potential difference of LDR is 1.2 V.

Diagram 4

(a)   Based on Diagram 4,

(i)   State the function of the transistor.

Automatic switch

Reject: to amplify the current
refer the DIAGRAM given!

[1 mark]

(ii)   Calculate the resistance of LDR.

$$V_{LDR} = \left(\frac{R_{LDR}}{R_{LDR} + R} \right) V$$

$$1.2 = \left(\frac{R_{LDR}}{R_{LDR} + 10k} \right) 6 \quad \sqrt{}_1$$

$$1.2\, R_{LDR} + 12k = 6\, R_{LDR}$$
$$4.8\, R_{LDR} = 12k \quad \sqrt{}_2$$
$$R_{LDR} = 2.5\ k\Omega \ // \ 2500\ \Omega$$

$\sqrt{}_3$ **UNIT!**

Reject: answer in fraction

[3 marks]

(iii) Calculate the amplification factor, ß.

$$ß = \frac{I_C}{B}$$

$$ß = \frac{50 \ mA}{50 \mu A} \quad \sqrt{1}$$

$$ß = 1000 \quad \sqrt{2}$$

[2 marks]

(b) Explain how the bulb in Diagram 4 lights up when the surrounding is dark?

$\sqrt{1}$ R_{LDR} increase when surrounding is dark
....

$\sqrt{2}$ V_{base} increase
....

$\sqrt{3}$ I_B flow to switch on the transistor
....

$\sqrt{4}$ I_C flow to switch on the bulb

[3 marks]

Max. 3 marks

TOTAL   9 marks

3   Rajah 3.1 menunjukkan rektifier tetimbang yang terdiri daripada empat diod K, L, M dan N dan satu perintang R.
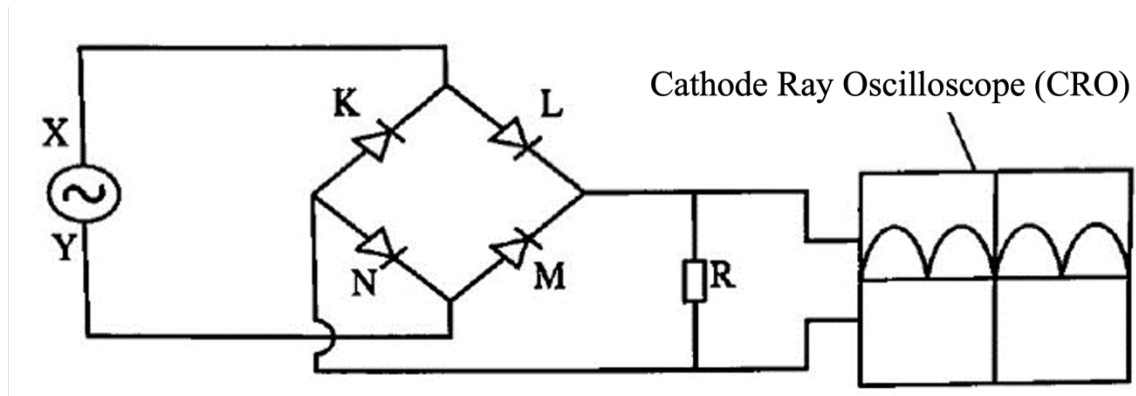*Diagram 3.1 shows a bridge rectifer consit of four diodes K, L, M and N and a resistor, R.*

Diagram 3.1

(a)   Berdasarkan Rajah 3,
Based on Diagram 3,

(i)   Namakan jenis rektifikasi.
Name the type of rectification.

Full wave rectification
....

[1 mark]

(ii)   Lengkapkan arah pengaliran arus yang melalui diod-diod K, L, M dan N dan perintang, R.
Complete the direction of current flow passing through diodes K, L, M and the resistor, R.

X   →   **L**   →   R   →   **N**   →   Y

Y   →   **M**   →   R   →   **K**   →   X

[2 marks]

(b)   Diode K dalam Rajah 3 telah rosak.
      The K diode in Diagram 3 is faulty.

(i)   Lakarkan surihan output pada skrin OSK pada Rajah 3.2.
      Sketch the output trace on the CRO screen on Diagram 3.2.
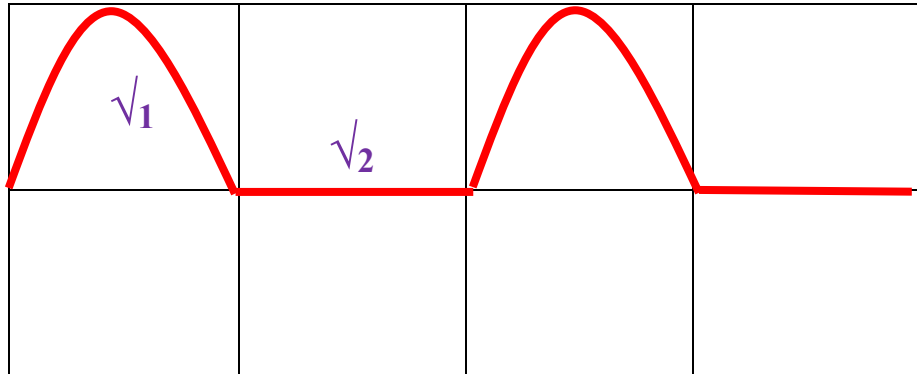

Diagram 3.2

[2 marks]

(ii) Terangkan jawapan anda dalam 3(b)(i).
      Explain your answer in 3(b)(i).

First half cycle, circuit forward biased,
second half cycle, circuit reverse biased.

[1 mark]

TOTAL   6 marks

6 Rajah 6.1 dan Rajah 6.2 menunjukkan dua litar elektrik yang mengandungi diod semikonduktor.
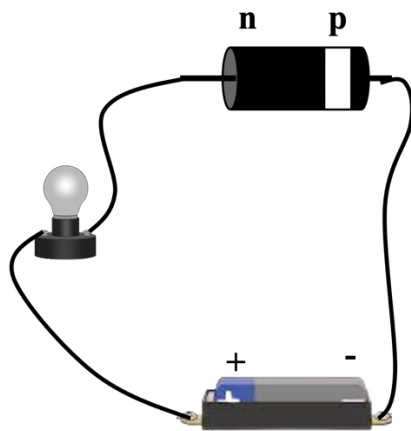*Diagram 6.1 and Diagram 6.2 show two electrical circuits consist of semiconductor diode.*
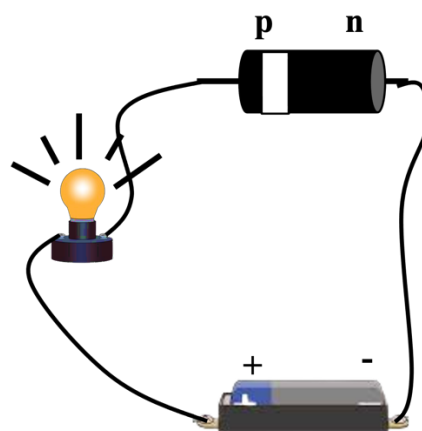
Diagram 6.1   **Diagram 6.2**

(a) Apakah yang dimaksudkan dengan semikonduktor?
What is the meaning of semiconductor?

conductivity // resistance between insulator and conductor
....
[1 mark]

(b) Menggunakan Rajah 6.1 dan Rajah 6.2, bandingkan
Using Diagram 6.1 and Diagram 6.2, compare

(i) Nyalaan mentol
The bulb lighting

Diagram 6.1: bulb does not light up

Diagram 6.2: bulb light up
[1 mark]

(ii) Pengaliran arus dalam litar
Current flows in the circuit

Diagram 6.1: no current flow

Diagram 6.2: current flow
[1 mark]

(iii) Cara sambungan diod semikonduktor ke terminal sel kering.
Way of connection of semiconductor diode to dry cell terminals.

Diagram 6.1: reverse biased // p-type semiconductor
connected to negative dry cell
[1 mark]

Diagram 6.2: forward biased // p-type semiconductor
connected to positive dry cell

(c) (i) Hubungkaitkan pengaliran arus dengan cara sambungan diod semikonduktor ke terminal sel kering.
Relate the current flows with the way of connection of semiconductor diode to dry cell terminals.

Reversed biased, no current flows

……………………… ………………………………………………………………...
[1 mark]

(ii) Berdasarkan jawapan anda dalam 6(c)(i), nyatakan satu fungsi diod semikonduktor.
Based on your answer in 6(c)(i), state one function of semiconductor diode.

Allowed current flows in one direction only

……… ………………………………………………………………………...
[1 mark]

(d) Rajah 6.3 menunjukkan sebuah litar rektifikasi gelombang dan surihan pada skrin osiloskop sinar katod bagi arus input dan arus output selepas melalui diod semikonduktor.
Diagram 6.3 shows a wave rectification circuit and the tracing of cathode ray oscilloscope screen of input current and output current after passing through the semiconductor diode.
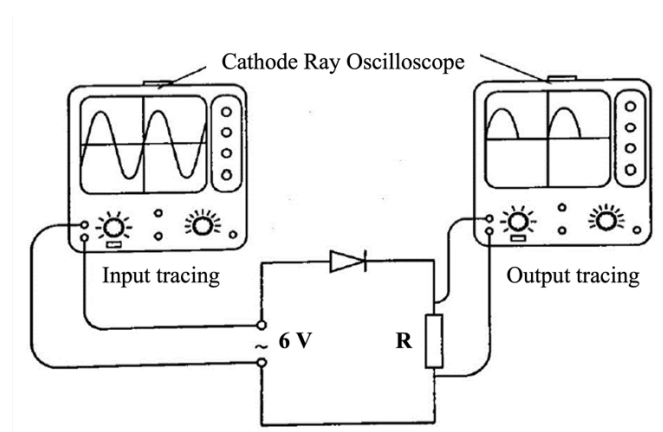

Diagram 6.3

(i) Berdasarkan Rajah 6.3, mengapakah bentuk gelombang surihan output pada skrin osiloskop sinar katod berubah selepas melalui diod?
Based on Diagram 6.3, why the shape of tracing output wave on the cathode ray oscilloscope screen changes after passing through the diode?

Half wave rectification occurred //

………………………………………………………………………………...
ac signal passing through diode changed to dc.   [1 mark]

(ii) Jelaskan bagaimana untuk menghasilkan arus mantap pada perintang R dalam Rajah 6.3.
Explain how to produce steady current at resistor R in diagram 6.3.

Connect a capacitor parallel to the resistor R.

………………………………………………………………………………...
The capacitor is smoothing wave // current //   [2 marks]

smooth wave // smooth current   **TOTAL   9 marks**
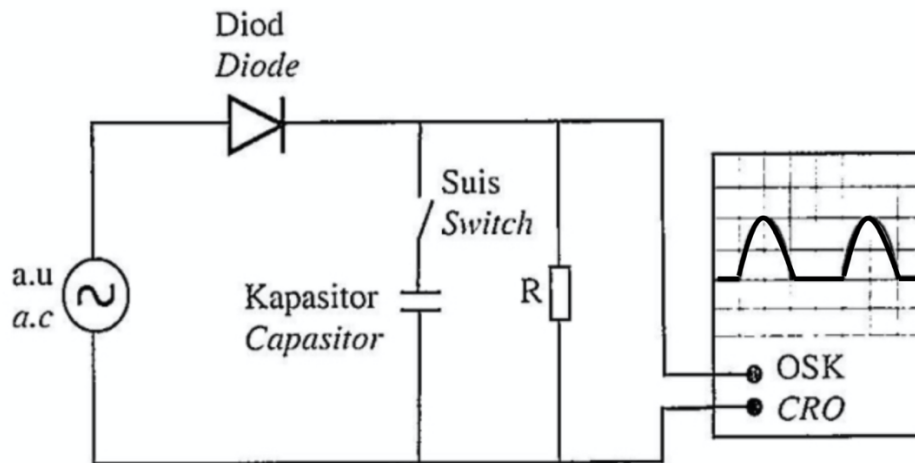
8 Rajah 8.1 menunjukkan satu litar rektifikasi. Osiloskop Sinar Katod (OSK) memaparkan surihan arus yang melalui perintang R.
Diagram 8.1 shows a rectification circuit. The Cathode Ray Oscilloscope (CRO) displays the tracing of current flow through resistor, R.

Rajah 8.1 / *Diagram 8.1*

(a) Namakan jenis rektifikasi yang ditunjukkan dalam Rajah 8.1.
Name the type of rectification shown in Diagram 8.1.

Half-wave rectification

....

[1 mark]

(b) Suis dalam litar rektifikasi dihidupkan. Jelaskan bagaimana kapasitor dapat mengubah surihan arus.
The switch in the circuit is turned on. Explain how the capacitor can change the tracing of current.

√1 When current flow, capacitor is charge
....

√2 When no current flow, capacitor is discharge
....

[2 marks]

√3 Smoothed the current

(c) Rajah 8.2 menunjukkan litar elektronik bagi unit pengadaptasi arus ulang-alik (a.u).
Diagram 8.2 shows the electronic circuit of an adapter unit of alternating current (a.c).
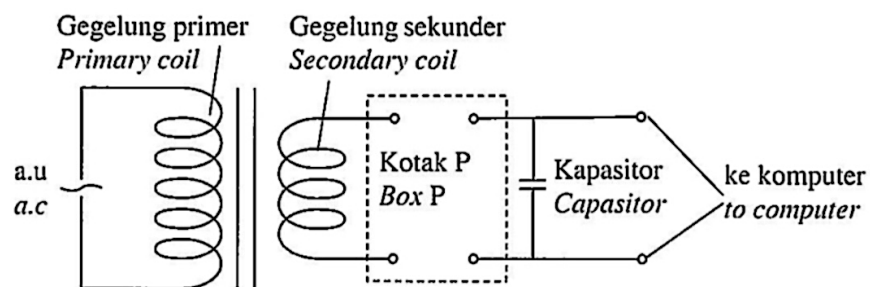
Rajah 8.2 / *Diagram 8.2*

Cadangkan bagaimana unit pengadaptasi arus ulang-alik (a.u) yang digunakan untuk mengecas computer dapat mengekalkan arus yang seragam berdasarkan aspek-aspek yang berikut:

Suggest how an adapter unit of alternating current (a.c) that is used to charge a computer can maintain uniform current based on the following aspects:

(i) Bilangan diod yang digunakan dalam Kotak P.
Number of diodes used in the Box P.

4 diodes
…………………………………………………………………………………………...

[1 mark]

Sebab
Reason

Full-wave rectification //
……………………………………………………………………………………….....
convert alternating current (a.c) to direct current (d.c)   [1 mark]

(ii) Magnitud bagi kapasitans kapasitor.
The magnitude of capacitance of capasitor.

High // more // greater // increase
…………………………………………………………………………………………...

[1 mark]

Sebab
Reason

Produce smoother current // smooth output voltage //
……………………………………………………………………………………….....
store more charge // store more energy   [1 mark]

(d) Berdasarkan Rajah 8.2, transformer dalam unit pengadaptasi arus ulang-alik (a.u) menukar 240 V arus ulang-alik kepada 12 V arus terus (a.t).
Hitung nisbah gegelung primer kepada gegelung sekunder.
Based on Diagram 8.2, the transformer in a adapter unit of alternating current (a.c) converts 240 V alternating current to 12 V direct current (dc).
Calculate the ratio of primary coil to secondary coil.

$$\frac{N_p}{N_s} = \frac{V_p}{V_s} = \frac{240}{12} \checkmark_1$$
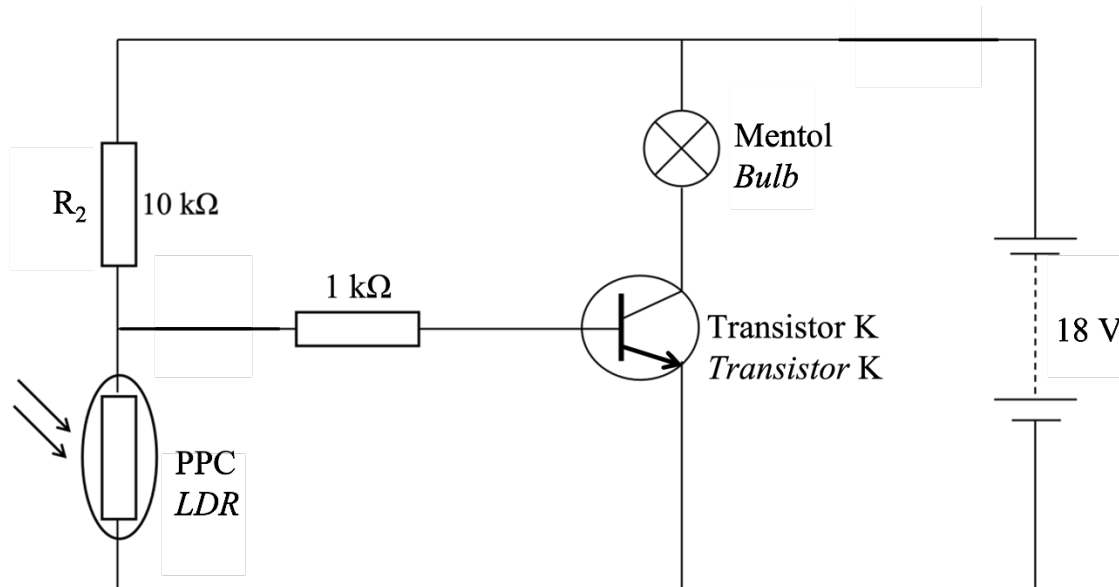
$$N_p : N_s$$

$$20 : 1 \checkmark_2$$

[2 marks]

TOTAL   9 marks

4 Rajah 4 menunjukkan suatu litar bertransistor yang berfungsi sebagai suis automatic.
Diagram 4 *shows a transistor circuit that functions as an automatic switch.*

R₂ 10 kΩ

1 kΩ

Mentol
Bulb

Transistor K
Transistor K

18 V

PPC
LDR

Rajah 4 / *Diagram* 4

(a) Namakan jenis transistor K.
Name the type of transistor K.

Transistor n-p-n
………………………………………………………………………………..............
[1 markah / *mark*]

(b) Terangkan bagaimana mentol dalam Rajah 4 boleh menyala dalam keadaan gelap.
Explain how the bulb in Diagram 4 *lights up in the dark.*

√1 R_LDR increase when surrounding is dark
……………………………………………………………………………………...

√2 V_base increase
……………………………………………………………………………………...

√3 I_B flow to switch on the transistor
……………………………………………………………………………………...

√4 I_C flow to switch on the bulb
[3 markah / *marks*]

Max. 3 marks

(c) Rintangan bagi perintang peka cahaya (PPC) dalam keadaan gelap ialah 50 kΩ.
The resistance of light dependant resistor (LDR) in the dark is 50 kΩ.

Berdasarkan Rajah 4, hitung,
Based on Diagram 4, calculate,

    (i) voltan merentasi PPC
       the voltage across the LDR

$$V_{LDR} = \left(\frac{R_{LDR}}{R_{LDR} + R_2} \right) V \qquad \checkmark_1$$

$$V_{LDR} = \left(\frac{50\,k}{50\,k + 10\,k} \right) 18$$
$$\checkmark_2$$

$$V_{LDR} = 15\ V$$
$$\checkmark_3\ (\text{unit!})$$

[3 markah / *marks*]

    (ii) arus yang mengalir melalui PPC.
       the current flowing through the LDR.

$$V_{LDR} = I\ R_{LDR}$$
$$I = \frac{V_{LDR}}{R_{LDR}}$$
$$I = \frac{15}{50\ K} \qquad \checkmark_1$$
$$I = 0.0003\ A \text{ or } 3.0 \times 10^{-4}\ A$$
$$\checkmark_2\ (\text{unit!})$$

[2 markah / *marks*]

TOTAL   9 marks

SPM 2021 (SET 1)

7 Diagram 7 shows a nuclear reactor that generates electrical energy through nuclear fission reaction.
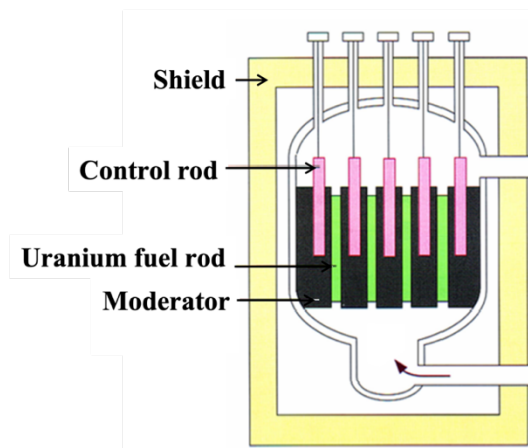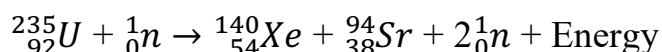

Diagram 7

(a) What is the meaning of nuclear fission?

The process of **splitting a heavy nucleus into two** lighter nuclei which releases emormous amount of energy
[1 mark]

(b) The nuclear fission reaction occurs in the nuclear reactor in Diagram 7 is represented by the following equation:

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{140}_{54}Xe + {}^{94}_{38}Sr + 2{}^{1}_{0}n + \text{Energy}$$

The mass defect produced from the nuclear fission reaction of the Uranium fuel is 0.198264 u.
Calculate

(i) mass defect in the unit of kilogram

m = 0.198264 x 1.66 x 10^{-27}

m = 3.2912 x 10^{-28} kg $\sqrt{_1}$ **UNIT!**
(2 – 4 dp)
[1 mark]

(ii) Nuclear energy that produced in the nuclear fission reaction.

E = mc^2
E = 3.2912 x 10^{-28} x (3 x 10^8)^2 $\sqrt{_1}$
E = 2.9621 x 10^{-11} J
(2 – 4 dp) $\sqrt{_2}$ **UNIT!**

[2 marks]

(c) Table 1 show the different characteristics of a few reactor models that will built for generating electrical energy in an industrial area.

Reactor nuclear model	Control rod	Moderator
J	Boron	Cadmium
K	Boron	Graphite
L	Graphite	Boron

Table 1

Based on Table 1, state the suitable characteristics to produce electrical energy with high efficiency.

(i) Control rod

Boron // Cadmium

…………………………………………………………………………………...

[1 mark]

Reason

Absorb excessed neutron

…………………………………………………………………………………...

[1 mark]

(ii) Moderator

Graphite

…………………………………………………………………………………...

[1 mark]

Reason

Slow down the motion of the neutrons

…………………………………………………………………………………...

[1 mark]

(d) Based on the answer in 7(c)(i) and 7(c)(ii), choose the most suitable nuclear reactor model to generate electrical energy at the industrial area.

K

……………………………………………………………………………….................

[1 mark]

TOTAL   9 marks

8 Rajah 8 menunjukkan struktur loji janakuasa nuklear. Loji ini menghasilkan tenaga nuklear melalui tindak balas pembelahan nukleus.
Diagram 8 shows a structure of nuclear power plant. The plant produce nuclear energy through nuclear fission reaction.
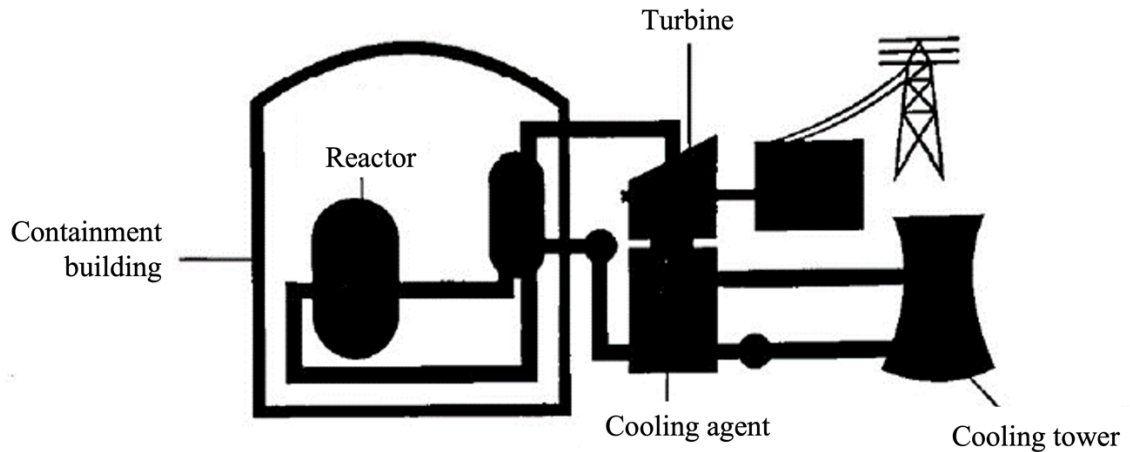

Diagram 8

(a) Apakah yang dimaksudkan dengan pembelahan nukleus?
What is meant by nuclear fission?

A process of splitting heavy nucleus into two // more lighter nucleus

[1 mark]

(b) Hitung tenaga yang terhasil dari tindak balas pembelahan nukleus jika cacat jisim ialah 3.088 x 10⁻²⁸ kg.
Calculate the nuclear energy produced from nuclear fission reaction if the mass defect is 3.088 x 10⁻²⁸ kg.

$$E = 3.088 \times 10^{-28} \times (3 \times 10^8)^2 \quad \surd_1$$

$$E = 2.779 \times 10^{-11} \text{ J}$$
$$\surd_2 \text{ UNIT!}$$

[2 marks]

(c) Loji janakuasa nuklear dalam Rajah 8 dicadangkan untuk dibina di Malaysia.
Berikan cadangan berdasarkan aspek-aspek berikut supaya loji dapat beroperasi dengan selamat.
Nuclear power plant in Diagram 8 is proposed to built in Malaysia.
Give suggestions based on the following aspects so that the plant can be operate safely.

(i) Lokasi loji janakuasa nuklear
Location of the nuclear power plant.

near to sea // river // lake
………………………………………………………………………………...

[1 mark]

Sebab
Reason

easy access to water // cooling continuously
………………………………………………………………………………...

[1 mark]

(ii) Ketebalan dinding bangunan pembendungan.
Thickness of the wall of containment building

thick
………………………………………………………………………………...

[1 mark]

Sebab
Reason

prevent radiation ray escape // prevent leakage of radiation
………………………………………………………………………………...

[1 mark]

(iii) Bahan agen penyejuk
Material of the cooling agent

water // heavy water // carbon dioxide
………………………………………………………………………………...

[1 mark]

Sebab
Reason

High specific heat capacity // absorb more heat
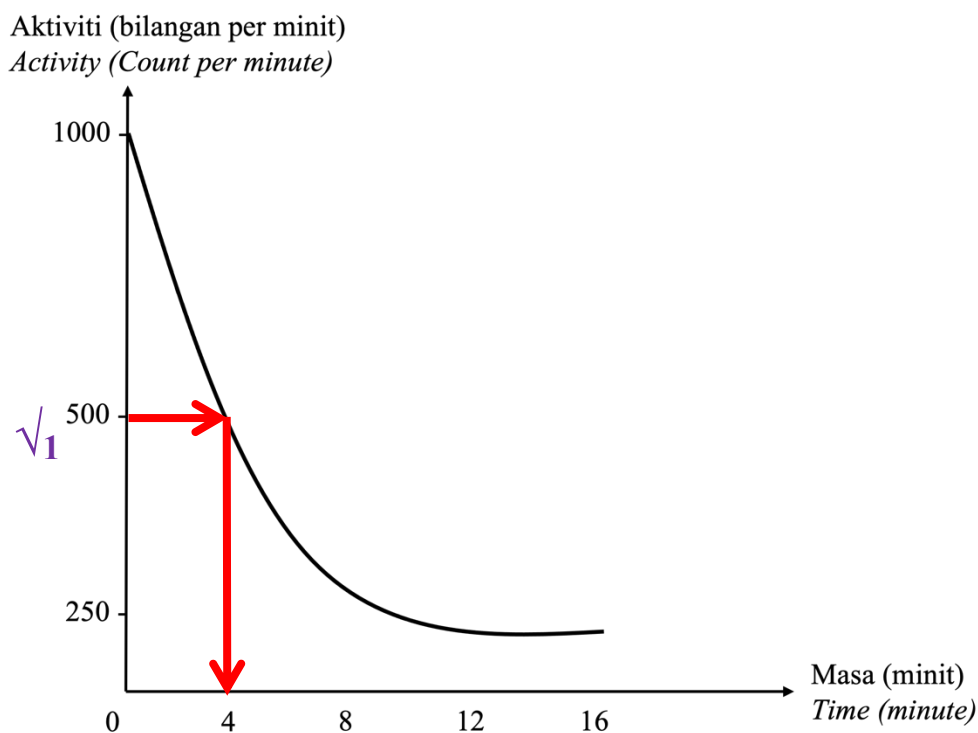………………………………………………………………………………...

[1 mark]

TOTAL   9 marks

3   Rajah 3 menunjukkan graf aktiviti melawan masa bagi reputan radioisotope Iodin-131 dengan separuh hayat tertentu.
Diagram 3 shows a graph of activity against time for radioisotope decay of Iodine-131 with a certain half-life.

Aktiviti (bilangan per minit)
Activity (Count per minute)

$\sqrt{1}$

Rajah 3 / Diagram 3

(a)   Apakah maksud separuh hayat?
What is meant by half-life?

The time taken for a sample of radioactive nuclei to decay to half of
....
its initial number (mass // activity // number of nucleus)   [1 mark]

(b)   Berdasarkan Rajah 3, tentukan nilai separuh hayat Iodin-131.
Tunjukkan pada graf bagaimana anda menentukan separuh hayat itu.
Based on Diagram 3, determine the value of half-life of Iodine-131.
Show on the graph how you determine the half-life.

Separuh hayat Iodin-131: ....4 minutes................
Half-life of Iodine-131 $\sqrt{2}$ **UNIT!**

[2 marks]

(c) Tentukan aktiviti selepas empat separuh hayat?
*Determine the activity **after four half-life**?*

$$1000 \rightarrow 500 \rightarrow 250 \rightarrow 125 \rightarrow 62.5 \quad \checkmark_1$$
$$1T_{\frac{1}{2}} \quad 2T_{\frac{1}{2}} \quad 3T_{\frac{1}{2}} \quad 4T_{\frac{1}{2}}$$

$$4T_{\frac{1}{2}} = 62.5 \text{ count per minute}$$
$$\checkmark_2 \text{ UNIT!}$$

[2 marks]

(d) Mengapakah reputan radioisotop tersebut terus berlaku?
Why does the radioisotope decay continues to occur?

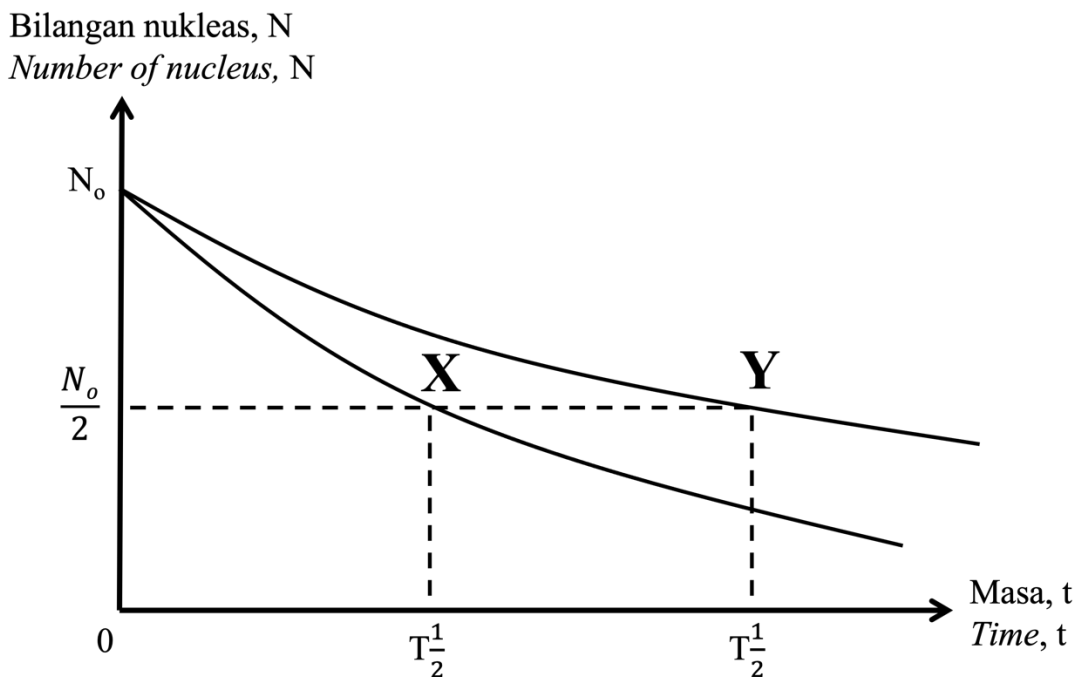To become more stable // radioisotope not stable // unstable nucleus

[1 mark]

TOTAL   6 marks

11 Rajah 11 menunjukkan graf separuh hayat bagi Radioisotop X dan Radioisitop Y.
Diagram 11 *shows the half-life graph for Radioisotope* X *and Radioisotope* Y.

Bilangan nukleas, N
Number of nucleus, N

Rajah 11 / *Diagram* 11

(a) Apakah yang dimaksudkan dengan separuh hayat?
What is meant by half-life?

The time taken for a sample of radioactive nuclei to decay to half of its initial number (initial activity // initial mass)

[1 markah / *mark*]

(b) Perhatikan Rajah 11, bandingkan bilangan nukleus asal, separuh hayat dan kadar reputan antara Radioisotop X dan Radioisotop Y.
Hubungkaitkan antara bilangan nukleus asal dengan separuh hayat dan seterusnya deduksikan hubungan antara separuh hayat dengan kadar reputan.
Observe Diagram 11, *compare the number of original nuclei, half-life and decay rate between Radioisotope* X *and Radioisotope* Y.
Relate the number of original nuclei with the half-life and then deduce the relationship between the half-life and the decay rate.

- Number of original nuclei: X = Y
- Half-life: Y > X
- Decay rate: X > Y
- Number of original nuclei not affected the by the half-life
- Half-life increase, decay rate decrease

[5 markah / *marks*]

(c) Radioisotop Y mengalami pembelahan nukleus dan menghasilkan tenaga nuklear. Terangkan mengapa tenaga nuklear boleh dihasilkan semasa proses pembelahan nucleus.
Radioisotope Y *experience nuclear fission and produces nuclear energy.*
Explain why nuclear energy can be produced during the of nuclear fission process.

- Total mass before decay > total mass after decay
- There is a mass defect during the reaction (mass loss)
- The mass defect changes to nuclear energy
- The total energy produced is given by $E = mc^2$

[4 markah / *marks*]

(d) Kerajaan bercadang supaya tenaga nuklear digunakan untuk menjana tenaga elektrik bagi menyelesaikan masalah krisis tenaga di kawasan perindustrian.
Anda sebagai ahli sains perlu menjalankan kajian dan membuat cadangan berkaitan aspek struktur rekator nuklear dan penjana arus elektrik yang sesuai digunakan supaya tenaga nuklear dan tenaga elektrik yang dihasilkan adalah mencukupi dan selamat digunakan.

Nyatakan dan terangkan cadangan anda melibatkan aspek ketebalan dinding reaktor nuklear, jenis radioisotop yang digunakan, keselamatan reaktor nuclear, turbin dan solenoid dalam penjana arus elektrik.

The government proposed that nuclear energy is used to generate electricity to solve the energy crisis problem in industrial areas.
You as a scientist need to conduct a research and make recommendations related to the structural aspects of nuclear reactors and electric current generators that are suitable for use so that the nuclear energy and electricity produced are sufficient and safe to use.

State and explain your proposal involving aspects of nuclear reactor wall thickness, types of radioisotopes used, nuclear reactor safety, turbines and solenoids in electric current generators.

[10 markah / *marks*]

TOTAL   20 marks

Ciri-ciri / Characteristic	Sebab / Reason
Ketebalan dinding: tebal *Wall thickness: increase*	Mengelakkan sinaran terbebas ke persekitaran *To prevent radiation leakage to surroundings*
Separuh hayat: panjang *Half-life: longer*	Tidak perlu diganti dengan kerap *No need to replace often (frequently)*
Keadaan jirim: pepejal *State of matter: solid*	Tidak tumpah *No spillage*
Jenis radioisotop: Uranium-238 *Type of radioisotope: Uranium-238*	pembelahan nuklear berlaku // Separuh hayat yang panjang *Undergoes nuclear fission // Long half-life*
Menggunakan rod Boron (Kadmium) *Using Boron rods (Cadmium)*	Menyerap neutron berlebihan *Absorbs excess neutrons*
Menggunakan Grafit *Using Graphite*	Memperlahankan pergerakan neutron // Tenaga kinetik neutron berkurang // *Slow down the motion of the neutrons //* *Kinetic energy of neutron decrease*
Air sebagai agen penyejuk *Water as a cooling agent*	Menyerap tenaga haba daripada tindak balas nuklear // muatan haba tentu yang tinggi *Absorbs heat energy from nuclear reactions // high specific heat load*
Turbin yang ringan *Light turbine*	Inersia kecil // jisim rendah // ringan *Small inertia // low mass // lighter*
Diameter dawai solenoid yang besar *Larger diameter of solenoid wire*	Rintangan rendah *Low resistance*
Dawai solenoid: kuprum *Solenoid wire: copper*	Rintangan rendah // kerintangan rendah *Low resistance // low resistivity*
Turbin besar *Bigger turbine*	Potong banyak fluks magnet // arus aruhan bertambah // voltan bertambah *Cut more magnetic flux // induced current increases // the voltage increases*
Solenoid: lebih banyak bilangan lilitan *Solenoid: more number of turns*	Lebih banyak arus teraruh // meningkatkan kekuatan medan magnet *More induced current // increase strength of magnetic field*

EXTRA INFO

Nuclear reactor safety	
Use forceps // robot Wear a mask // goggle	The distance between the source and the body is far. The radiation does not penetrate our eyes
Use a lead box // container with thick concrete	To prevent radiation leakage to surroundings
Keep the exposure time as short as possible	The body is not exposed to the radiation for a long time.
Wear protective clothing // shoes // Wear coat lined with lead	To minimize from the exposure to the radiations To protect the body from the radiation
Wear a radiation badge // film badge	To monitor the exposure to radiations
Attach the detector to a longer rod	To minimize the technician from the exposure to the radiations
Put radiation symbol on the storage box	To inform users of dangerous contents of the box.

SPM 2021 (SET 1)

2 Diagram 2 shows an apparatus to study the effect of photoelectric for zinc metal.
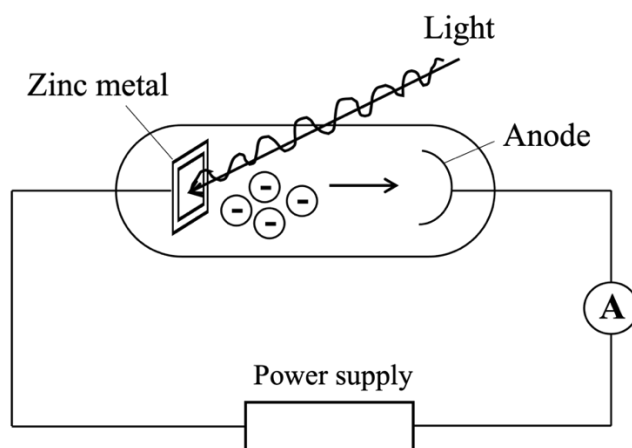The electrons are emitted from the surface of the zinc metal and move towards anode.

Diagram 2

The light frequency used is 9×10^{14} Hz that exceeds the threshold frequency, f_o of zinc.

(a) What is the meaning of threshold frequency, f_o?

Minimum frequency that can produce photoelectric effect at the metal // free electron
....
// Minimum frequency that can emit the photoelectron   [1 mark]

(b) Calculate the work function of metal zinc.
Given work function, $W = hf_o$
[Planck's constant, $h = 6.63 \times 10^{-34}$ J s]

Option 1: $W = hf_o = 6.63 \times 10^{-34} \times f_o = 6.63 \times 10^{-34} f_o$ J

Option 2: the threshold frequency of the metal zinc is 9×10^{14} Hz

Change the statement of the question

$W = hf_o = 6.63 \times 10^{-34} \times 9 \times 10^{14} = 5.94 \times 10^{-19}$ J
$\sqrt{1}$ $\sqrt{2}$ **UNIT!** [2 marks]

(c) The intensity of light that strikes the surface of zinc metal does not affect the kinetic
energy of electron.
Explain why.

Light intensity affected number of electrons released
....
Kinetic energy affected by light frequency //
....
frequency increases, kinetic energy increases   [2 marks]

TOTAL   5 marks

2 Rajah 2 menunjukkan satu litar sel foto. Katod berbentuk semisilinder disaluti dengan logam peka cahaya. Apabila katod disinari oleh alur cahaya, electron **terpancar** keluar dari permukaan logam tersebut. Penunjuk milliammeter terpesong.
*Diagram 2 shows a photocell circuit. The semi-cylinder cathode is coated with light sensitive metal. When the cathode is illuminated by beam of light, electrons **emitted** from the metal surface. The milliammeter pointer deflects.*
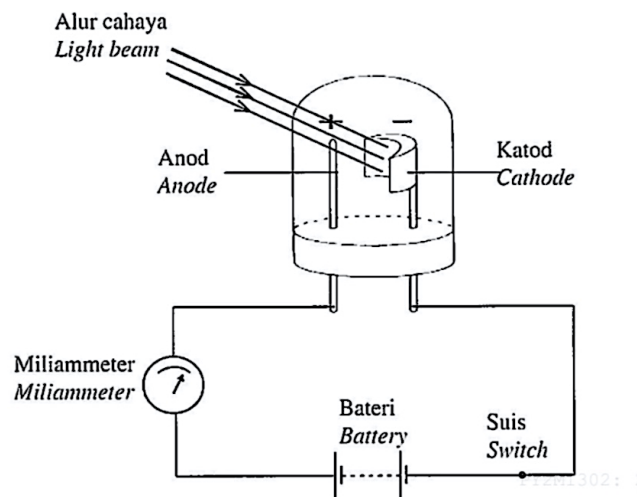
Rajah 2 / *Diagram 2*

(a) Namakan fenomena yang menyebabkan electron terpancar keluar dari permukaan logam peka cahaya itu.
Name the phenomenon that cause the electrons to emit from the surface of light sensitive metal..

Photoelectric effect
....

[1 mark]

(b) Terangkan bagaimana penunjuk milliammeter terpesong.
Explain how the milliammeter pointer deflects.

Electron attracted to the anode
....
produced current: current flow (photocurrent flow)
....

[2 marks]

(c) Frekuensi ambang bagi logam peka cahaya dalam sel foto itu ialah 5.2×10^{14} Hz. Hitung fungsi kerja bagi loga peka cahaya dalam sel foto itu.
The threshold frequency fir the light sensitive metal in the photocell is 5.2×10^{14} Hz.
Calculate the work function of the light sensitive metal in the photocell.
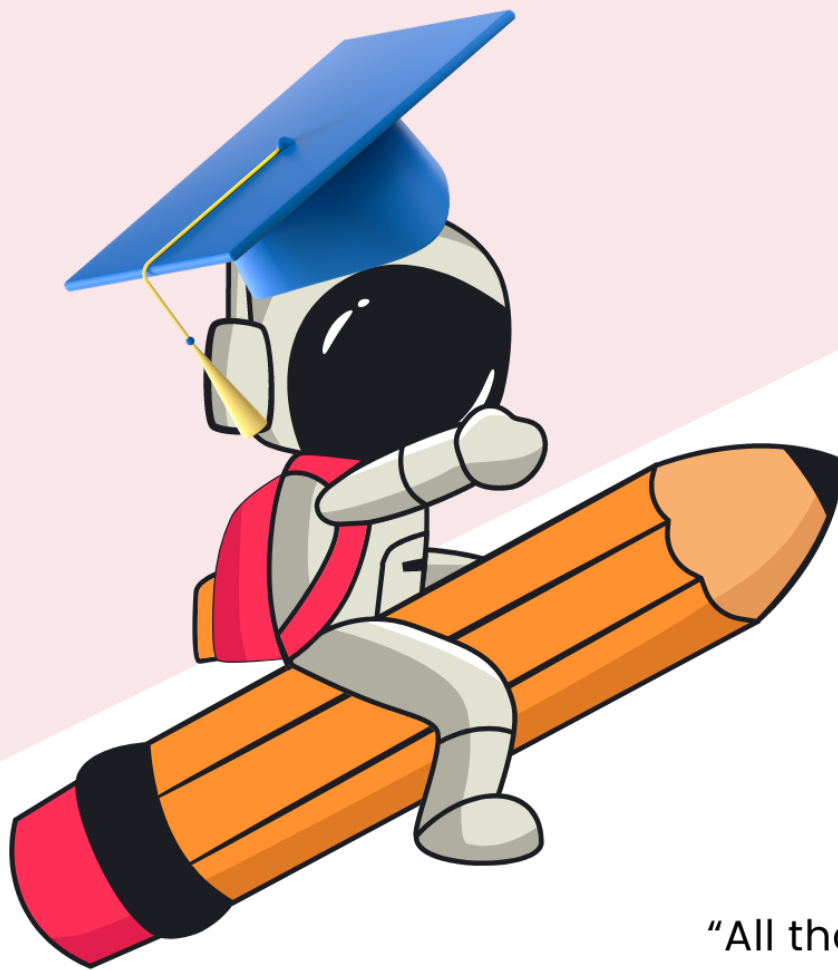
$W = hf_o$
$W = 6.63 \times 10^{-34} (5.2 \times 10^{14})$ √₁
$W = 3.4476 \times 10^{-19}$ J   [2 marks]
√₂ **UNIT!**

TOTAL   5 marks

"All that glitters may not
be gold,
but at least it contains
free electrons."
-John Desmond Bernal-

ALINA IMAN ARIF