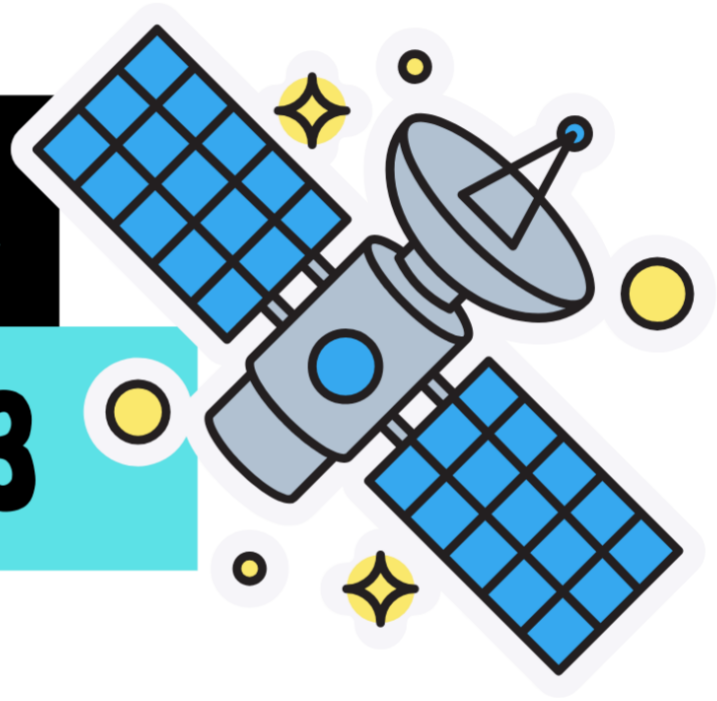
SET PECUTAN FIZIK

F4 BAB 3



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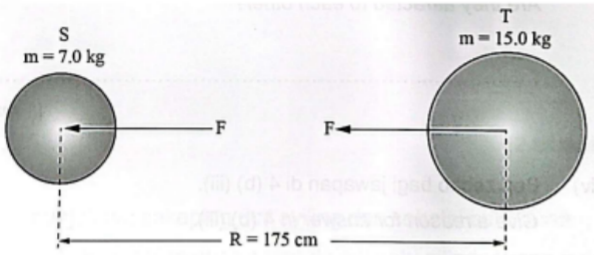
Rajah 4.1 menunjukkan dua jasad S dan T yang berbeza jisim pada jarak R antara satu sama lain. Daya graviti, F boleh dijelaskan dengan Hukum Kegravitian Semesta Newton.

Diagram 4.1 *shows two bodies S and T of different masses at a distance R between each other. The gravitational force, F can be explained by Newton's Universal Law of Gravitation.*



Rajah 4.1
Diagram 4.1

(a) Nyatakan Hukum Kegravitian Semesta Newton.
State Newton's Universal Law of Gravitation.

.....
.....
.....

[1 markah / 1 *mark*]

(a)	Hukum Kegravitian Semesta Newton menyatakan bahawa daya graviti antara dua jasad adalah berkadar terus dengan hasil darab jisim kedua-dua jasad dan berkadar songsang dengan kuasa dua jarak di antara pusat dua jasad tersebut. *Newton's Universal Law of Gravitation states that the gravitational force between two bodies is directly proportional to the product of the masses of both bodies and inversely proportional to the square of the distance between the centres of the two bodies.*	1

(b) Berdasarkan Rajah 4.1,
Based on Diagram 4.1,

(i) Hitung berat S dan T.
Calculate the weight of S *and* T.

S : .....

T : .....

[2 markah / 2 *marks*]

(ii) Hitung daya, F antara S dan T.
Calculate the force, F *between* S *and* T.

[2 markah / 2 *marks*]

(iii) Adakah kedua-dua jasad tertarik antara satu sama lain?
Are they attracted to each other?

.....

[1 markah / 1 *mark*]

(iv) Beri sebab bagi jawapan di 4 (b) (iii).
Give a reason for answer in 4 (b) (iii).

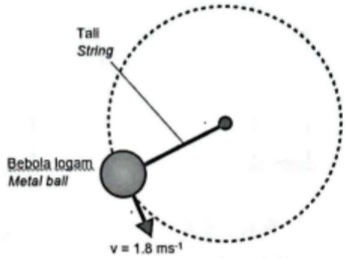
.....

[1 markah / 1 *mark*]

(b)(i)	Weight of S W = 7 x 9.81 = 68.67 N (Jawapan dengan unit betul / *Answer with correct unit*) Weight of T W = 15 x 9.81 = 147.15 N (Jawapan dengan unit betul / *Answer with correct unit*)	1 1
(b)(ii)	$F = \frac{Gm_1m_2}{r^2}$ $F = \frac{(6.67\ x\ 10^{-11})(7)(15)}{(1.75)^2}$ $= 2.2869\ x\ 10^{-9}$N (Jawapan dengan unit betul / *Answer with correct unit*)	1 1
(b)(iii)	Tidak / *No*	1
(b)(iv)	Kerana daya tarikan graviti antara dua jasad sangat kecil *Because the gravitational force between the two bodies is too small.*	1

(c) Rajah 4.2 menunjukkan sebuah bebola logam berjisim 75 g diikat pada hujung satu tali yang panjangnya 0.8 m dipusingkan dalam bulatan mengufuk dengan kelajuan 1.8 m s^{-1}.

Diagram 4.2 *shows a metal ball of mass* 75 g *is tied to the end of a string* 0.8 m *long which is rotated in a horizontal circle with a speed of* 1.8 m s^{-1}.



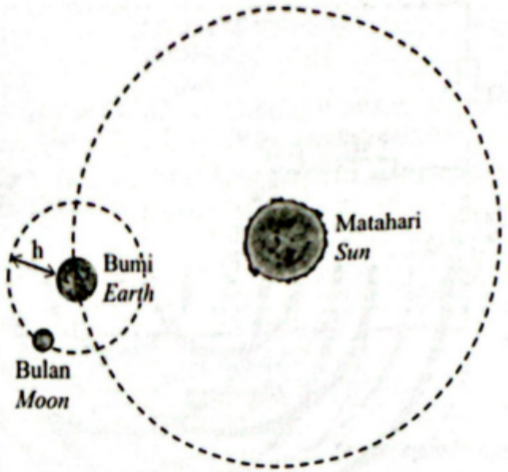
Rajah 4.2
Diagram 4.2

Hitung tegangan tali.
Calculate the tension of the string.

[2 markah / 2 *marks*]

(c)	$F = \frac{mv^2}{r}$ $F = \frac{(0.075)(1.8)^2}{0.8}$ $= 0.3038$ N (Jawapan dengan unit betul / *Answer with correct unit*)	 1 1

Rajah 3 menunjukkan Bulan mengorbit Bumi, manakala Bumi mengorbit Matahari.
Diagram 3 shows the Moon orbiting the Earth, while the Earth orbits the Sun.



Rajah 3
Diagram 3

Daya graviti antara Matahari, Bumi dan Bulan dapat ditentukan menggunakan Hukum Kegravitian Semesta Newton.
The gravitational force between the Sun, Earth and Moon can be determined using Newton's Universal Law of Gravitation.

(*a*) Apakah Hukum Kegravitian Semesta Newton?
What is Newton's Universal Law of Gravitation?

.....

.....

.....

[1 *markah*]
[1 *mark*]

(*b*) Berdasarkan Rajah 3, bandingkan daya graviti antara Bumi dan Bulan, dengan Bumi dan Matahari.
Berikan sebab.
Based on Diagram 3, compare the gravitational force between the Earth and the Moon, with the Earth and the Sun.
Give a reason.

.....

.....

[2 *markah*]
[2 *marks*]

(*c*) Diberi; Jisim Bulan $= 7.35 \times 10^{22}$ kg
Jisim Bumi $= 5.97 \times 10^{24}$ kg
Jejari Bumi $= 6.37 \times 10^{6}$ m
Daya graviti antara Bumi dan Bulan $= 2.00 \times 10^{20}$ N
Pemalar kegravitian semesta, $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}

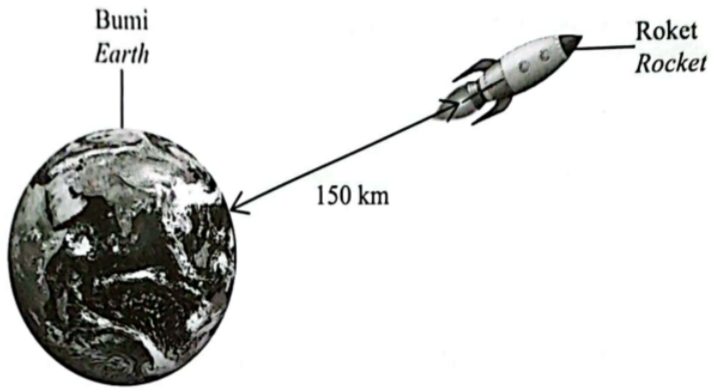
Hitung ketinggian Bulan dari permukaan Bumi, h.

Given; *Mass of Moon* $= 7.35 \times 10^{22}$ kg
Mass of the Earth $= 5.97 \times 10^{24}$ kg
Radius of the Earth $= 6.37 \times 10^{6}$ m
Gravitational force between the Earth and the Moon $= 2.00 \times 10^{20}$ N
Universal gravitational constant, $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}

Calculate the height of the Moon from the Earth's surface, h.

3(*a*)	Daya graviti antara dua jasad adalah berkadar terus dengan hasil darab jisim kedua-dua jasad dan berkadar songsang dengan kuasa dua jarak antara pusat dua jasad tersebut *Gravitational force between two bodies is directly proportional to the product of the masses of both bodies and inversely proportional to the square of the distance between the centres of the two bodies*	1
3(*b*)	**M1** daya graviti antara bumi dan bulan < daya graviti antara bumi dan matahari *gravitational force between earth and moon < gravitational force between earth and sun* **M2** Jisim bulan < jisim matahari *The mass of the moon < the mass of the sun*	2
3(*c*)	**M1** **nilai r betul** $r = (6.37 \times 10^6) + h$ **M2** **gantian yang betul** $[(6.37 \times 10^6) + h]^2 = \frac{(6.67\times10^{-11})(7.35\times10^{22})(5.97\times10^{24})}{(2\times10^{20})}$ **M3** **jawapan dan unit betul** $h = 376171674.2$ m	3

Rajah 3 menunjukkan kedudukan Bumi dan sebuah roket.
Diagram 3 shows the position of the Earth and a rocket.



Rajah 3
Diagram 3

Daya graviti yang bertindak antara Bumi dan roket diterangkan oleh Hukum Kegravitian Semesta Newton.
The gravitational force acting between the Earth and the rocket is described by Newton's Universal Law of Gravitation.

(*a*) Nyatakan Hukum Kegravitian Semesta Newton.
State the Newton's Universal Law of Gravitation.

.....

.....

.....

[1 *markah*]
[1 *mark*]

(*b*) Diberi; Pemalar kegravitian, $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}
Jejari Bumi = 6.37×10^6 m
Jisim Bumi = 5.97×10^{24} kg
Jisim roket = 5.0×10^4 kg

Given; *Gravitational constant*, $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}
Radius of the Earth = 6.37×10^6 m
Mass of the Earth = 5.97×10^{24} kg
Mass of the rocket = 5.0×10^4 kg

Berdasarkan Rajah 3, hitung daya graviti antara Bumi dan roket pada ketinggian tersebut.

Based on Diagram 3, calculate the gravitational force between the Earth and the rocket at that height.

Daya graviti : ..... N
Gravitational force

[3 *markah*]
[3 *marks*]

(*c*) Apakah perubahan yang berlaku kepada daya graviti dalam **3**(*b*) jika:
What are the changes occuring to the gravitational force in **3**(*b*) *if* :

(i) ketinggian roket berkurang
the height of the rocket decrease

(c) Apakah perubahan yang berlaku kepada daya graviti dalam **3**(*b*) jika:
What are the changes occuring to the gravitational force in **3**(*b*) *if* :

(i) ketinggian roket berkurang
the height of the rocket decrease

.....

[1 *markah*]
[1 *mark*]

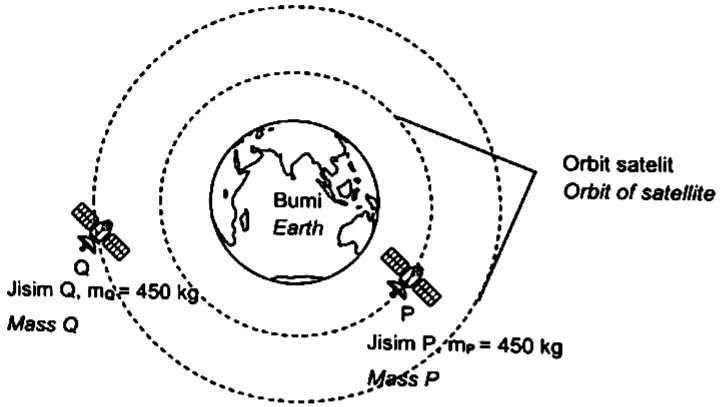
(ii) jisim roket berkurang
the mass of the rocket decrease

.....

[1 *markah*]
[1 *mark*]

(*a*)	Daya graviti berkadar terus dengan hasil darab jisim-jisim jasad dan berkadar songsang dengan kuasa dua jarak antara pusat dua jasad tersebut *The force of gravity is directly proportional to the product of the masses of the bodies and inversely proportional to the square of the distance between the centers of the two bodies*	1
(*b*)	M1 $r = 6.37 \times 10^6 + 150\,000$ M2 $F = \frac{(6.67\times10^{-11})(5.97\times10^{24})(5\times10^4)}{(6.37\times10^6+150\,000)^2}$ M3 $F = 468354.8026$	3
(*c*)(i)	bertambah // *increase*	1
(*c*)(ii)	berkurang // *decrease*	1

Rajah 5 menunjukkan dua satelit P dan Q mengelilingi Bumi.
Diagram 5 shows two satellites P and Q evolve around the Earth.



Rajah 5
Diagram 5

(a) Apakah maksud jisim?
What is the meaning of mass?

.....

[1 markah]
[1 *mark*]

(b) Berdasarkan Rajah 5,
Based on Diagram 5,

(i) Bandingkan jisim satelit P dan Q.
Compare the mass of satellite P and Q.

.....

[1 markah]
[1 *mark*]

(ii) Bandingkan jejari orbit bagi satelit P dan Q.
Compare the orbital radius of satellite P and Q.

.....

[1 markah]
[1 *mark*]

(iii) Bandingkan tempoh orbit bagi satelit P dan Q.
Compare the orbital period of satellite P and Q.

.....

[1 markah]
[1 *mark*]

(a)		Kuantiti jirim yang terkandung dalam sesuatu objek. *The quantity of matter contained in an object.*	1
(b)	(i)	$m_P = m_Q$	1
	(ii)	$r_P < r_Q$	1
	(iii)	$T_P < T_Q$	1

(c) Nyatakan hubungan antara jejari orbit dan tempoh orbit.
State the relationship between orbital radius and orbital period.

.....

.....

[1 markah]
[1 *mark*]

(d) (i) Apakah yang akan terjadi kepada tempoh orbit jika jisim satelit P ditambah?
What will happen to the orbital period if the mass of satellite P *increased?*

.....

[1 markah]
[1 *mark*]

(ii) Terangkan jawapan anda di **5**(d)(i).
Explain your answer in **5**(d)(i).

.....

.....

[1 markah]
[1 *mark*]

(e) Jika satelit Q berada pada jarak 17 000 000 m dari pusat Bumi, tentukan tempoh orbit bagi satelit tersebut.
If the satellite Q *is at a distance* 17 000 000 m *from the centre of the Earth, determine the orbital period of the satellite.*

Diberi, / *Given,* $T^2 = \frac{4\pi^2 r^3}{GM}$

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

(c)		Semakin bertambah jejari orbit, semakin bertambah tempoh orbit. Tolak: $T^2 \propto r^3$ *The greater the orbital radius, the greater the orbital period* *Reject:*: $T^2 \propto r^3$	1
(d)	(i)	Tidak berubah *Unchanged*	1
	(ii)	Tempoh orbit tidak bergantung kepada jisim *Period independent of mass of satellite*	1

(e)		$T^2 = \frac{4\pi^2 r^3}{GM}$	
	M1	$T = \sqrt{\frac{4\pi^2(17\,000\,000)^3}{(6.67\times10^{-11})(5.97\times10^{24})}}$	1
	M2	T = 22070.04 s	
		Julat: *Range*: (22070.04 s – 22078.92 s)	1

Set Pecutan Kimia 2024
Semoga dapat membantu pelajar-pelajar mengulangkaji,
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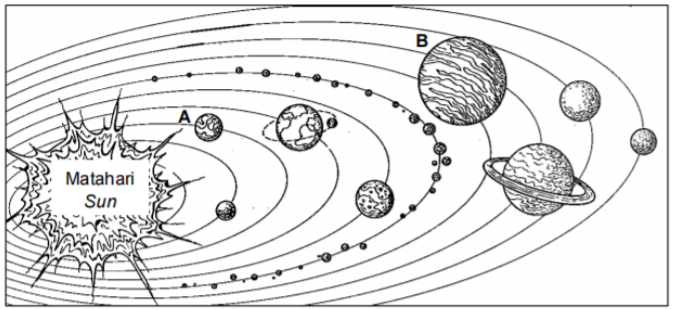
Rajah 6 menunjukkan sistem suria.
Diagram 6 shows the solar system.



Rajah 6
Diagram 6

(a) Tandakan (√) pada petak jawapan yang betul.
Tick (√) in the box for the correct answer.

Nyatakan bentuk orbit planet-planet.
State the shape of orbits of the planets.

☐ Bulat *Circle* ☐ Sfera *Sphere* ☐ Elips *Ellipse*

[1 *markah*]
[1 *mark*]

(b) Perhatikan Rajah 6, bandingkan planet A dan planet B dari segi
Observe Diagram 6, compare planet A and planet B in term of

(i) jisim.
mass.

.....
[1 *markah*]
[1 *mark*]

(ii) jejari orbit.
radius of orbit.

.....
[1 *markah*]
[1 *mark*]

(iii) tempoh orbit.
orbital period.

.....
[1 *markah*]
[1 *mark*]

(c) Hubungkaitkan jejari orbit dengan tempoh orbit
Relate between radius of orbit with orbital period.

.....
[1 *markah*]
[1 *mark*]

(d) Namakan hukum yang terlibat dalam 6(c).
Name the law involves in 6(c).

.....
[1 *markah*]
[1 *mark*]

(a)		√ Elips *Ellipse*	1
(b)	(i)	Jisim : A < B , A< , B > , B besar, A kecil, A lebih kecil daripada B *Mass A < B , A< , B > , B more, A less, A smaller than B*	1
	(ii)	Jejari orbit : A < B , A< , B > , B besar, A kecil, A lebih kecil daripada B *Radius of orbit :* *A < B , A< , B > , B more, A less, A smaller than B*	1
	(iii)	Tempoh orbit : A < B , A< , B > , B besar, A kecil, A lebih kecil daripada B *Orbital period :* *A < B , A< , B > , B more, A less, A smaller than B* *Reject :* A lebih kurang daripada B (bagi jawapan (b))	1
(c)		Jejari orbit bertambah, tempoh orbit bertambah // Jejari orbit berkadar terus dengan tempoh orbit *Radius of orbit increases, orbital period increases.* *Radius of orbit directly propoertional to orbital period.*	1

(e) Diberi
Given

Jejari orbit Bumi, R = 150 Gm.
Tempoh orbit planet B, T = 11.9 tahun

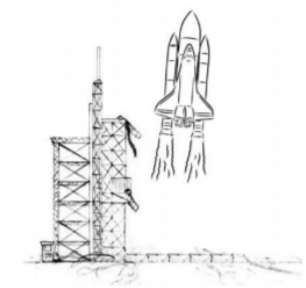
Radius of orbit Earth, R = 150 Gm
Orbital period of planet B, T = 11.9 *years*

Hitungkan jejari orbit planet B.
Calculate the radius of orbit planet B.

[3 *markah*]
[3 *marks*]

(d)	Hukum Kepler Ketiga (Ejaan nama mesti betul) *Kepler's Third Law (Spelling of name must be correct)*	1
(e)	T_{Bumi} = 1 tahun T_{Earth} = 1 *year* $\frac{T_E^2}{r_E^3} = \frac{T_P^2}{r_P^3}$ $\frac{1^2}{150^3} = \frac{11.9^2}{r_P^3}$ r_P^3 = 781.848 Gm // 781.848 x 10^9 m // 7.81848 x 10^{11} m	1 1 1

Rajah 2 menunjukkan sebuah kapal angkasa dilancarkan ke angkasa dari permukaan Bumi dengan halaju lepas.
Diagram 2 shows a spacecraft launched into space from the surface of the Earth with the escape velocity.



Rajah 2
Diagram 2

(a) Nyatakan maksud halaju lepas.
State the meaning of escape velocity.

.....

[1 markah/*mark*]

(b) Hitungkan halaju lepas yang diperlukan oleh kapal angkasa tersebut untuk terlepas ke angkasa lepas.
Calculate the escape velocity required by the spacecraft to escape to the outer space.
[Jisim Bumi = 5.97×10^{24} kg, Jejari Bumi = 6.37×10^{6} m]
[*Mass of Earth* = 5.97×10^{24} kg, *Radius of Earth* = 6.37×10^{6} m]

[2 markah/*marks*]

(c) Jika halaju kapal angkasa itu ialah 8000 ms^{-1}, bolehkah ia terlepas ke angkasa lepas? Jelaskan.
If the velocity of the spacecraft is 8000 ms^{-1}, *will it be able to escape to the outer space? Explain.*

[2 markah/*marks*]

(a)		**Menyatakan maksud halaju lepas dengan betul** Halaju minimum yang diperlukan oleh objek di permukaan bumi utk mengatasi daya graviti dan terlepas ke angkasa lepas. *The minimum velocity required by an object on the Earth surface to overcome the force of gravity and escape into space.*	1
(b)		**Menghitung halaju lepas dengan betul** M1 Penggantian yang betul *Correct substitution* $v = \sqrt{\frac{2GM}{r}}$ $v = \sqrt{\frac{2(6.67 \times 10^{-11})(5.97 \times 10^{24})}{(6.37 \times 10^{6})}}$ M2 Jawapan dengan unit yang betul. *Correct answer with correct unit.* 11181.3789 ms^{-1}	1 1
(c)		**Membuat penjelasan dengan betul.** **M1** tidak **M2** Kerana halaju kapal angkasa < halaju lepas bumi	1 1

Rajah 9.1 menunjukkan satu satelit yang sedang mengelilingi Bumi dengan laju linear, *v*.
Diagram 9.1 *shows a satellite orbiting the Earth with a linear speed, v.*

Rajah 9.1
Diagram 9.1

(a) Nyatakan maksud laju linear.
State the meaning of linear speed.

[1 markah / *mark*]

(b) Jelaskan mengapa satelit itu mengalami pecutan walaupun satelit itu bergerak mengelilingi Bumi dengan laju linear yang malar.
Explain why the satellite experiences acceleration even though the satellite is moving around the Earth at a constant linear speed.

[3 markah / *marks*]

(a)		**Menyatakan maksud laju linear** Laju bagi sebuah objek yang kekal mengorbit pada satu ketinggian tertentu. *The speed of an object that remains in orbit at a certain altitude.*	1
(b)		**Menjelaskan mengapa satelit itu mengalami pecutan walaupun satelit itu bergerak mengelilingi bumi dengan laju linear yang malar.** M1 Arah gerakan satelit berubah *The direction of the satellite's motion changes* M2 Maka halaju satelit berubah (walaupun magnitud halaju malar) *Then the velocity of the satellite changes (even though the magnitude of the velocity is constant)* M3 Satelit mengalami pecutan kerana pecutan adalah kadar perubahan halaju *Satellite experiences acceleration because acceleration is rate of change of velocity*	1 1 1

(c) Jadual 9 menunjukkan ciri-ciri bagi empat satelit J, K, L dan M yang direka oleh satu syarikat telekomunikasi.
Table 9 shows the characteristics four satellites J, K, L *and* M *designed by a communication company.*

Satelit ***Satellite***	**Jenis orbit satelit** ***Type of satellite orbit***	**Sumber tenaga bagi satelit** ***Source of satellite energy***	**Jenis gelombang untuk komunikasi** ***Type of wave for communication***	**Jangka hayat satelit** ***Lifetime satellite***
J	Geopegun *Geostationary*	Tenaga nuklear *Nuclear energy*	Gelombang radio *Radio wave*	1 - 3 tahun 1 - 3 *years*
K	Bukan Geopegun *Non-geostationary*	Tenaga nuklear *Nuclear energy*	Gelombang mikro *Microwave*	1 - 3 tahun 1 - 3 *years*
L	Geopegun *Geostationary*	Tenaga solar *Solar energy*	Gelombang mikro *Microwave*	5 - 10 tahun 5 - 10 *years*
M	Bukan Geopegun *Non-geostationary*	Tenaga solar *Solar energy*	Gelombang radio *Radio wave*	5 - 10 tahun 5 - 10 *years*

Jadual 9
Table 9

Tentukan satelit paling sesuai yang boleh berfungsi dengan berkesan sebagai satu satelit komunikasi. Justifikasikan jawapan anda.
Determine the most suitable satellite that can function efficiently as a communications satellite. Justify your answer.

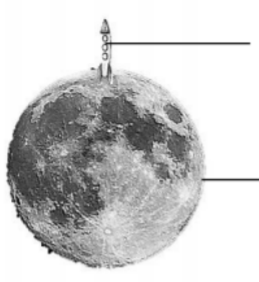
[10 markah / *marks*]

(c)		**Menyatakan jenis satelit yang betul** M1 Satelit geopegun / *Geostationary satellite*	1

		Menyatakan sebab dengan betul
		M2 Sentiasa berada dikedudukan geografi yang sama dipermukaan bumi.
		Always in the same geographical position on the surface of the earth
		// Bergerak / mengelilingi bumi dalam arah yang sama dengan arah putaran Bumi.
		Move / around the earth in the same direction as the Earth's rotation.
		// Kedudukan yang sama dari permukaan bumi.
		Same position from the surface of the earth.
		// Tempoh orbit 24 jam. /*Orbital period 24 hours*
		// Tempoh orbit = Tempoh putaran Bumi
		/ *Orbital period = Earth's rotation period.*
			1

		Menyatakan sumber tenaga satelit yang betul M3 Tenaga solar / *Solar energy*	1
		Menyatakan sebab dengan betul M4 Tenaga dibekalkan berterusan kerana tenaga diperbaharui *Energy is supplied continuously because renewable energy*	1
		Menyatakan jenis gelombang komunikasi yang betul M5 Gelombang mikro / *Microwave*	1
		Menyatakan sebab dengan betul M6 Frekuensi tinggi / tenaga tinggi / kuasa penembusan tinggi *High frequency / High energy / High penetrating power*	1
		Menyatakan jangka hayat satelit yang betul M7 Lama / *Longer*	1
		Menyatakan sebab dengan betul M8 Tahan lama *Long lasting*	1
		Membuat pilihan yang betul M9 Satelit L / *Satellite* L	1

(d) Rajah 9.2 menunjukkan sebuah roket berada di permukaan Bulan.
Diagram 9.2 shows a rocket is on a surface of Moon.



Hitung;
Calculate;

(i) pecutan graviti pada permukaan Bulan.
the acceleration of gravity on the surface of the Moon.

[2 markah / *marks*]

(ii) halaju lepas bagi roket tersebut dari permukaan Bulan.
the escape velocity of the rocket from the surface of the Moon.

[2 markah / *marks*]

(iii) daya tarikan graviti antara roket dan Bulan.
the gravitational force between the rocket and the Moon.

[2 markah / *marks*]

(d)	(i)	**Menghitung pecutan graviti pada permukaan bulan dengan betul** M1 Penggantian yang betul $g = \frac{GM}{r^2}$ $g = \frac{(6.67\times10^{-11})(7.35\times10^{22})}{(1.75\times10^{6})^2}$	1
		M2 Jawapan dengan unit yang betul. 1.6008 ms^{-2}	1
	(ii)	**Menghitung halaju lepas bagi roket dari permukaan bulan dengan betul** M1 Penggantian yang betul $v = \sqrt{\frac{2GM}{r}}$	1
		$v = \sqrt{\frac{2(6.67\times10^{-11})(7.35\times10^{22})}{1.75\times10^{6}}}$ M2 Jawapan dengan unit yang betul. 2367.023447 ms^{-1}	1
	(iii)	**Menghitung daya tarikan graviti antara roket dan bulan dengan betul** M1 Penggantian yang betul $F = \frac{GM_1M_2}{R^2}$ $F = \frac{(6.67\times10^{-11})(7.35\times10^{22})(51000)}{(1.75\times10^{6})^2}$	1
		M2 Jawapan dengan unit yang betul. 81640.8 N	1