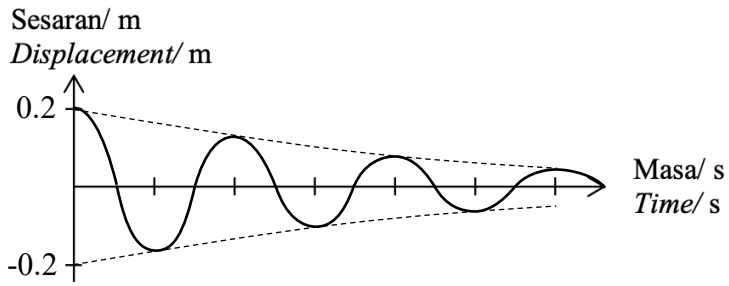
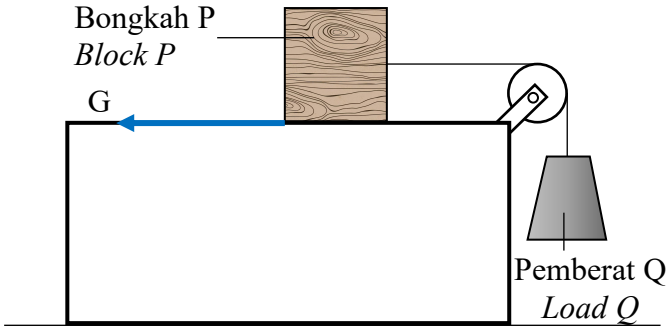
No. Soalan	Peraturan Pemarkahan	Sub Markah	Jumlah Markah
1(a)	X = 9.81 m s^{-2}	1	1
1(b)	0 m s^{-2}	1	1
1(c)(i)	g berkadar songsang dengan r *g is inversely proportional to r*	1	1
1(c)(ii)	Graf lengkung tidak menyentuh paksi-paksi graf. *A curve graph that does not touch the axes of the graph.*	1	1

No. Soalan	Peraturan Pemarkahan	Sub Markah	Jumlah Markah
2(a)	Amplitud *Amplitude*	1	1
2(b)	 M1 – Amplitud berkurang *Amplitude decreases* M2 – Tempoh tidak berubah *The period unchanged*	1 1	2
2(c)	M1 – Bandul dikenakan daya luar secara berkala. *Pendulum is applied with periodic external force.* M2 – Daya luar membekalkan tenaga kepada sistem bandul *The external force transfers energy to the pendulum system.*	1 1	2

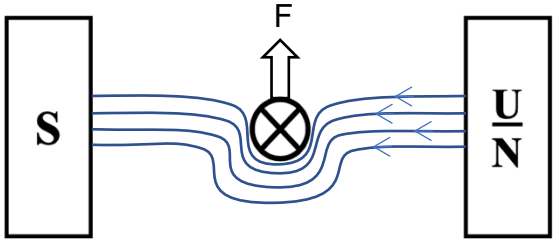
No. Soalan	Peraturan Pemarkahan	Sub Markah	Jumlah Markah
3(a)	Haba pendam tentu pelakuran ialah kuantiti haba yang diserap semasa peleburan atau kuantiti haba yang dibebaskan semasa pembekuan bagi 1 kg bahan tanpa perubahan suhu. *Specific latent heat of fusion is the quantity of heat that is absorbed during melting, or the quantity of heat released during freezing of 1 kg of the substance without any change in temperature.*	1	1
3(b)(i)	Q = $Pt = ml_f$ 500 x $t = 1.25 \times 3.34 \times 10^5$ $t = 835$ s T = 13.92 minit	1 1 1	3

3(b)(ii)	Masa yang diambil = 17.5 – 13.92 = 3.58 minit. *Time taken = 17.5 – 13.92 = 3.58 minutes.*	1	1
3(c)	Tenaga yang diserap digunakan untuk melemahkan/ melonggarkan ikatan antara molekul-molekul ais. *The absorbed energy is used to weaken/loosen the bonds between the ice molecules*	1	1

No. Soalan	Peraturan Pemarkahan	Sub Markah	Jumlah Markah
4(a)	Daya paduan ialah saya tunggal yang mewakili jumlah secara vektor dua atau lebih daya yang bertindak ke atas sesuatu objek. *Resultant force is the single force that represents the vector sum of two or more forces acting on an object.*	1	1
4(b)(i)		1	1
4(b)(ii)	Pegun *Stationary* Bergerak dengan halaju seragam. *Moving with uniform velocity.*	1 1	2
4 (c)(i)	Daya paduan, F = W_Q = mg = (0.25 x 9.81) = 2.4525 N	1 1	2
4(c)(ii)	Pecutan, a = $\frac{F}{m_p + m_Q}$ a = $\frac{2.4525}{(1 + 0.25)}$ a = 1.962 m s^{-2}	 1 1 1	3

No. Soalan	**Peraturan Pemarkahan**	**Sub Markah**	**Jumlah Markah**
5(a)	di satu titik fokus elips. *at one of focus point of the ellipse.*	1	1
5(b)(i)	$F_P > F_A$	1	1
5(b)(ii)	Jejari orbit Bumi pada kedudukan Aphelion > Perihelion *Orbital radius of the Earth at Aphelion > Perihelion position*	1	1
5(b)(iii)	Laju linear Bumi pada kedudukan Aphelion < Perihelion *Linear speed of the Earth at Aphelion < Perihelion*	1	1

5(c)(i)	Semakin bertambah jejari orbit, semakin berkurang daya graviti antara Bumi dan Matahari. *The greater the radius of the orbit, the less the gravitational force between the Earth and the Sun.*	1	1
5(c)(ii)	Semakin berkurang jejari orbit Bumi, semakin bertambah laju linear Bumi. *The smaller the orbital radius of the Earth, the greater the linear speed of the Earth.*	1	1
5(d)(i)	$F = G\frac{m_1 m_2}{r^2}$ $F = 6.67 \times 10^{-11} \left(\frac{80 \times 40}{15^2}\right)$ $F = 9.4862 \times 10^{-10}$ J	1 1	2
5(d)(ii)	Daya tarikan di antara dua objek tersebut sangat kecil. *The attraction force between the two objects is very small.*	1	1

No. Soalan	Peraturan Pemarkahan	Sub Markah	Jumlah Markah
6(a)	Petua tangan kiri Fleming *Fleming's left-hand rule*	1	1
6(b)(i)	Arus dalam Rajah 6.1(b) > Rajah 6.1(a) *Current in Diagram 6.1(b) > Diagram 6.1(a)*	1	1
6(b)(ii)	Bacaan neraca elektronik dalam Rajah 6.1(b) > Rajah 6.1(a) *The reading of electronic balance in Diagram 6.1(b) > Diagram 6.1(a)*	1	1
6(b)(iii)	Daya yang dihasilkan dalam Rajah 6.1(b) > Rajah 6.1(a) *The force produced in Diagram 6.1(b) > Diagram 6.1(a)*	1	1
6(c)(i)	Semakin bertambah arus, semakin bertambah bacaan neraca elektronik. *The higher the current increases, the higher the reading of the electronic balance increases.*	1	1
6(c)(ii)	Semakin bertambah arus, semakin bertambah daya yang dihasilkan. *The greater the current, the greater the force produced.*	1	1
6(d)	Bertambah *Increases*	1	1
6(e)		1 1	2

No. Soalan	Peraturan Pemarkahan	Sub Markah	Jumlah Markah
7(a)	Pembiasan gelombang *Refraction of wave*	1	1
7(b)	$\frac{V_1}{\lambda_1} = \frac{V_2}{\lambda_2}$ $V_2 = \frac{V_1}{\lambda_1} \times \lambda_2$ $V_2 = \frac{12}{2} \times 1$ $V_2 = 6\ cm\ s^{-1}$ $V_2 = 6.0 \times 10^{-2}\ m\ s^{-1}$	 1 1 1	3
7(c)(i)	Dalam *Deep* *Panjang gelombang bertambah* *Increase the wavelength*	1 1	2
7(c)(ii)	Kecil *Small* Mengurangkan amplitud gelombang terbelau *Reduce the amplitude of diffracted wave*	1 1	2
7(d)	R		

No. Soalan	Peraturan Pemarkahan	Sub Markah	Jumlah Markah
8(a)	Princip Pascal *Pascal principle*	1	1
8(b)	M1 – Daya yang dikenakan per unit luas menghasilkan tekanan. *Force exerted per unit area produces pressure.* M2 – Tekanan dipindahkan secara seragam dan ke semua arah oleh ubat gigi. *The pressure is transferred uniformly and in all directions by the toothpaste.*	1 1	2
8(c)(i)	Minyak *Oil* Tidak boleh dimampatkan. *Cannot be compressed.* Kurang geseran *Less friction* Tekanan dipindahkan secara seragam *Pressure is transferred uniformly*	1 1	2

8(c)(ii)	Besar Large Menghasilkan daya output yang tinggi *Produces high output force.*	1 1	2
8(d)	Faktor pengganda $= \frac{A2}{A1}$ $= \frac{75}{15}$ $= 5$	 1 1	2

No. Soalan	Peraturan Pemarkahan	Sub Markah	Jumlah Markah
9(a)	Panjang fokus ialah jarak di antara pusat optik dan titik fokus. *Focal length is the distance between optical center and the focal point.*	1	1
11(b)(i)	M1 – Sensor terletak di titik fokus kanta cembung. *Sensor located at the focal point of the convex lens.* M2 – Alur cahaya daripada objek yang selari dengan paksi utama akan terbias dan menumpu pada titik fokus. *Light rays from an object parallel to the main axis will be refracted and converge at the focal point.* M3 – Alur cahaya yang melalui titik optik bergerak pada garis yang sama selepas melalui kanta. *The light rays that pass through the optical point moves in the same line after passing through the lens.* M4 – di hadapan kanta cembung akan terbias selari dengan paksi utama Alur cahaya daripada objek yang melalui titik fokus *Light rays from the object passing through the focal point in front of a convex lens will be refracted parallel to the principal axis.* M5 – Alur-alur cahaya yang terbias oleh kanta cembung menumpu pada titik fokus/ pada sensor. *The light rays refracted by the convex lens converge at the focal point/ on the sensor.*	1 1 1 1 1	Maks 3
9(b)(ii)	Nyata, lebih kecil daripada objek dan terbalik. *Real, diminished and inverted.*	1	1
9(c)(i)	$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ $\frac{1}{f} = \frac{1}{25} + \frac{1}{2.5}$ $f = 2.2727\ cm$	1 1	2

<table>
<tr><td>9(c)(ii)</td><td>$Pembesaran, M = \frac{v}{u}$
$Pembesaran, M = \frac{2.5}{25}$
$Pembesaran, M = 0.1$</td><td>1
1</td><td>2</td></tr>
<tr><td>9(c)(iii)</td><td>Imej kelihatan kabur
The image looks blurry</td><td>1</td><td>1</td></tr>
<tr><td>9(d)</td><td>
<table>
<tr><th>Ciri-ciri
Characteristics</th><th>Penerangan
Explanation</th></tr>
<tr><td>Ketebalan kanta
Thickness of lens

- Tebal
Thick</td><td>Panjang fokus pendek
Short focal length
Objek boleh ditempatkan dekat dengan kanta
Object can be placed near to the lens.</td></tr>
<tr><td>Diameter kanta
Diameter of lens
- Besar
Large</td><td>Lebih banyak cahaya melalui kanta
More light rays passing through the lens.
Membesarkan medan penglihatan.
Enlarges the field of vision.</td></tr>
<tr><td>Kedudukan imej terbentuk
The position of image formed.

- imej terbentuk pada jarak 25 cm dari mata
- the image is formed at 25 cm from the eye</td><td>Imej akhir paling tajam dilihat oleh mata.
The final image is the sharpest seen by the eye.

Alur-alur cahaya daripada objek difokuskan ke atas retina.
Light rays from the object are focused on the retina.</td></tr>
<tr><td>Jarak antara mata dan kanta pembesar
The distance between eye and magnifying glass

- dekat
Close</td><td>Lebih banyak imej dapat diperhatikan.
More images can be seen.

Medan penglihatan bertambah
The field of vision increases</td></tr>
</table>
Kanta pembesar X. Kerana mempunyai ketebalan kanta yang tebal, diameter kanta besar, imej terbentuk pada 25 cm dari mata dan kedudukan mata dan kanta adalah dekat.

Magnifying lens X. Because it has a thick lens thickness, a large lens diameter, the image is formed at 25 cm from the eye and the position of the eye and lens is close.
</td><td>1
1
1
1
1
1
1
1
1
1</td><td>10</td></tr>
</table>

No. Soalan	Peraturan Pemarkahan	Sub Markah	Jumlah Markah
10(a)	Fungsi kerja ialah tenaga minimum yang diperlukan oleh satu fotoelektron untuk terlepas dari suatu permukaan logam. *Work function is the minimum energy required for a photoelectron to be emitted from a metal surface.*	1	1
10(b)	M1 – Frekuensi cahaya yang dipancarkan melebihi frekuensi ambang. Tenaga foton melebihi fungsi kerja logam *The frequency of light emitted exceeds the threshold frequency.* *The photon energy exceeds the work function of the metal* M2 – Kesan fotoelektrik berlaku Fotoelektron dipancar keluar dari permukaan katod. *The photoelectric effect occurs* *Photoelectrons are emitted from the cathode surface.* M3 – Fotoelektron bercas negatif Photoelectrons are negatively charged M4 – Fotoelektron ditarik oleh anod Elektron mengalir dari katod ke anod *Photoelectrons are attracted by the anode* *Electrons flow from the cathode to the anode.* M5 – Arus dihasilkan apabila cas mengalir dalam suatu litar lengkap. *Current is produced when charge flows in a complete circuit.*	1 1 1 1 1	Maks: 4
10(c)(i)	Frekuensi ambang = pintasan – x $= 10 \times 10^{14}$ Hz *Threshold frequency* = *X – intercept* $= 10 \times 10^{14}$ Hz	1	1
10(c)(ii)	Fungsi kerja, W = |pintasan – y| *Work function, W* = |*y – intercept*| = 4 eV $= 4 \times 1.6 \times 10^{-19}$ J $= 6.4 \times 10^{-19}$ J	1 1	2
10(c)(iii)	Pemalar planck, h = $\frac{fungsi\ kerja, W}{frekuensi\ ambang, f_0}$ *Planck constant, h* = $\frac{work\ function, W}{threshold\ frequency, f_o}$ = $\frac{6.4 \times 10^{-19}}{10 \times 10^{14}}$ $= 6.4 \times 10^{-34}$ J s	 1 1	2

10(d)			

Ciri-ciri ***Characteristics***	**Penerangan** ***Explanation***	
Jenis cahaya: *Type of light:* - Cahaya UV *UV light*	Tenaga foton tinggi *Hight photon energy* *Frekuensi tinggi* *High frequency*	1 1
Keamatan cahaya: *Intensity of light:* - Tinggi *High*	Kuasa foton tinggi *High photon power* *Kadar bilangan foton dipancarkan tinggi.* *The rate of the number of photons emitted is high.* Meningkatkan bilangan fotoelektron yang dikeluarkan. *Increase the number of photoelectrons emitted.*	 1 1
Jenis logam: *Type of metal:* - Cesium *Caesium*	Fungsi kerja yang rendah Low work function Fotoelektron memerlukan tenaga yang kecil untuk terbebas dari permukaan logam *Photoelectron requires a small amount of energy to be released from the metal surface.*	1 1
Sambungan terminal bateri: *Connection of battery terminal:* - Terminal bateri (+v) disambung kepada anod manakala terminal bateri (-ve) disambung kepada katod. *- The battery terminal (+v) is connected to the anode while the battery terminal (-ve) is connected to the cathode.*	Fotoelektron akan tertarik ke arah anod. *Photoelectrons will be attracted towards the anode.* Menghasilkan medan elektrik di antara anod dan katod bagi menggerakkan fotoelektron ke arah anod. *Produces an electric field between the anode and cathode to move photoelectrons toward the anode.* Menghasilkan beza keupayaan antara anod dan katod bagi menggerakkan fotoelektron ke arah anod.	1 1

Maks:

10

		Produces a potential difference between the anode and cathode to move photoelectrons towards the anode.		
	Litar sel foto P dipilih. Kerana menggunakan cahaya UV berkeamatan tinggi, logam Cesium dan terminal bateri positif disambung kepada anod dan terminal bateri negative disambung kepada katod. *The P photocell circuit is chosen. Because of using high intensity UV light, Cesium metal and the positive battery terminal is connected to the anode and the negative battery terminal is connected to the cathode.*		1 1	

No. Soalan	Peraturan Pemarkahan	Sub Markah	Jumlah Markah
11(a)	(Sambungan) sesiri/ Bersiri *In series circuit*	1	1
11(b)(i)	Rintangan, R2 dalam Rajah 11.1 lebih besar daripada Rajah 11.2 *The resistance, R2 in Diagram 11.1 is greater than Diagram 11.2*	1	1
11(b)(ii)	Beza keupayaan, V2 dalam Rajah 11.1 lebih besar daripada Rajah 11.2 *The potential difference, V2 in Diagram 11.1 is greater than Diagram 11.2*	1	1
11(b)(iii)	Arus pengumpul, I_C dalam Rajah 11.1 lebih besar daripada Rajah 11.2 *The collector current, I_C in Diagram 11.1 is greater than Diagram 11.2*	1	1
11(b)(iv)	Semakin besar rintangan, R2, semakin besar beza keupayaan, V2. *The greater the resistance, R2, the greater the potential difference, V2.*	1	1
11(b)(v)	Semakin besar beza keupayaan, V2, semakin besar arus pengumpul, I_C. *The greater the potential difference, V2, the greater the collector current, I_C.*	1	1
11(c)	M1 – Apabila thermistor mengesan haba, rintangan thermistor berkurang. *When the thermistor detects heat, the resistance of the thermistor decreases.* M2 – Rintangan thermistor < R *Thermistor resistance < R* Rintangan thermistor < 1 kΩ *Thermistor resistance < 1 kΩ* M3 – Beza keupayaan merentasi R, V_R > beza keupayaan minimum merentasi tapak, B dan pengeluar, E (V_{BE}) *Potential difference across R, VR > minimum potential difference across Base, B and Emitter, E (V_{BE})* Beza keupayaan merentasi R > Beza keupayaan merentasi termistor. *Potential difference across R > Potential difference across the thermistor.* Beza keupayaan merentasi R lebih tinggi *The potential difference across R is higher* M4 – Arus tapak, I_B *Base current, I_B* Transistor dihidupkan *The transistor is turned on* M5 – Arus pengumpul, I_C yang besar dihasilkan *A large Collector current, I_C is produced*	1 1 1 1	Maks: 5

<table>
<tr><td></td><td>Arus pengumpul, IC yang besar mengalir melalui buzzer.
A large collector current flows through the buzzer.</td><td>1</td><td></td></tr>
<tr><td>11(d)</td><td>
<table>
<tr><th>Rekabentuk
Design</th><th>Penerangan
Explanation</th></tr>
<tr><td>K – Perintang tetap 100 kΩ
Fix resistor 100 kΩ</td><td>Rintangan perintang tetap lebih kecil daripada Rintangan PPC apabila dalam keadaan gelap
The resistance of a fixed resistor is smaller than the resistance of LDR when in the dark
Dalam keadaan gelap:
$R < R_{PPC}$ atau $R_{PPC} > R$
In the dark surrounding:
$R < R_{LDR}$ or $R_{LDR} > R$</td></tr>
<tr><td>L – Perintang Peka Cahaya (PPC)
Light dependent resistor (LDR)</td><td>Rintangan PPC bertambah sehingga 1 MΩ dalam keadaan gelap dan berkurang kepada 100 Ω dalam keadaan cerah.
Resistance of LDR increases up to 1 MΩ in the dark and decreases to 100 Ω in the light.

Dalam keadaan gelap:
Voltan merentasi PPC > Voltan merentasi R
$V_{PPC} > V_R$
In the dark surrounding:
Voltage across LDR > Voltage across R
$V_{LDR} > V_R$</td></tr>
<tr><td>M – Geganti
Relay</td><td>Mengawal litar sekunder yang menggunakan voltan yang lebih tinggi.
Controls secondary circuit that uses higher voltages.</td></tr>
<tr><td>N – Terminal positif bateri disambung kepada pengumpul, C manakala terminal negative bateri disambung kepada pengeluar, E.
The positive terminal of the battery is connected to the collector, C while the negative terminal of the</td><td>Simpang BE dalam keadaan pincang ke depan.
The BE junction is in a state of forward bias.

Arus pengumpul dibenarkan mengalir
Collector current is allowed to flow</td></tr>
</table>
</td><td>1
1
1
1
1
1
1
1</td><td>Maks: 10</td></tr>
</table>

	battery is connected to the producer, E.			
	Sambungan lampu-lampu: *Connection of lamps:* secara selari *in parallel circuit*	Semua lampu menerima voltan yang sama. *All lamps receive the same voltage.* Satu lampu rosak, yang lain masih boleh berfungsi. *One lamp is broken, the other still works.*	1 1	