سلطنة عمان
وزارة التربية والتعليم

امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)
للعام الدراسي ١٤٣٧/١٤٣٦ هـ - ٢٠١٥ / ٢٠١٦ م
الدور الثاني - الفصل الدراسي الثاني

تنبيه:
- المادة: الفيزياء.
- الأسئلة في (١٢) صفحة.
- زمن الإجابة: ثلاث ساعات.
- الإجابة في الورقة نفسها.

تعليمات وضوابط التقدم للامتحـان:

- الحضور إلى اللجنة قبل عشر دقائق من بدء الامتحان للأهمية.
- إبراز البطاقة الشخصية لمراقب اللجنـة.
- يمنع كتابة رقم الجلوس أو الاسم أو أي بيانات أخرى تدل على شخصية الممتحن في دفتر الامتحان، وإلا ألغي امتحانه.
- يحظر على الممتحنين أن يصطحبوا معهم بمركز الامتحان كتبا دراسية أو كراسات أو مذكرات أو هواتف محمولة أو أجهزة النداء الآلي أو أي شيء له علاقة بالامتحان كما لا يجوز إدخال آلات حادة أو أسلحة من أي نوع كانت أو حقائب يدوية أو آلات حاسبة ذات صفة تخزينية.
- يجب أن يتقيد المتقدمون بالزي الرسمي (الدشداشة البيضاء والمصر أو الكمة للطلاب والدارسين والزي المدرسي للطالبات واللباس العماني للدارسات) ويمنع النقاب داخل المركز ولجان الامتحان.
- لا يسمح للمتقدم المتأخر عن موعد بداية الامتحان بالدخول إلا إذا كان التأخير بعذر قاهر يقبله رئيس المركز وفي حدود عشر دقائق فقط.
- يتم الالتزام بالإجراءات الواردة في دليل الطالب لأداء امتحان دبلوم التعليم العام.
- يقوم المتقدم بالإجابة عن أسئلة الامتحان المقالية بقلم الحبر (الأزرق أو الأسود).
- يقوم المتقدم بالإجابة عن أسئلة الاختيار من متعدد بتظليل الشكل (◯) وفق النموذج الآتي:

س - عاصمـة سلطنة عمـــان هي:
◯ القاهرة ◯ الدوحة
● مسقط ◯ أبوظبي

ملاحظة: يتم تظليل الشكل (●) باستخدام القلم الرصاص وعند الخطأ، امسح بعناية لإجراء التغيير.

صحيح ● **غير صحيح** ⊖ ◉ ◒ ⊗ ⊘

مُسَوَّدَة، لا يتم تصحيحها

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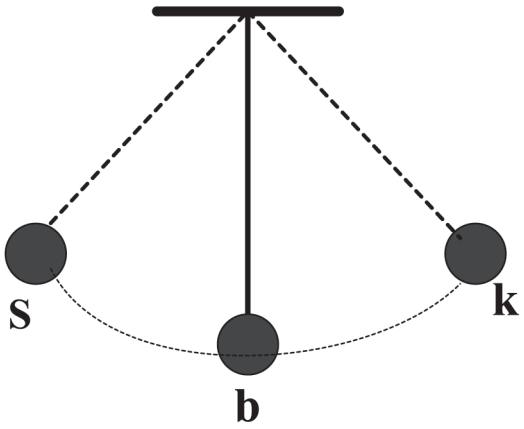
Multiple Choice Questions (28 marks)

There are 14 multiple choice items worth two marks each.
Shade in the bubble next to the best answer for each item.

1) A pendulum of mass (m) oscillates back and forth around point (b) as shown in the figure opposite. When the pendulum reaches point (k), which of the following combinations describes its potential energy (PE) and kinetic energy (KE) at this point?



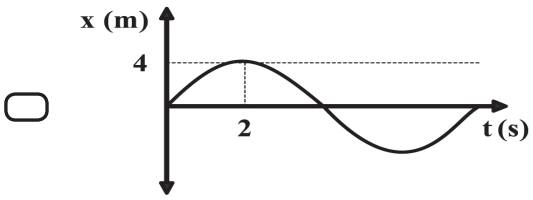
	KE	PE
○	$\frac{1}{2}KE_{max}$	$\frac{1}{2}PE_{max}$
○	KE_{max}	PE_{max}
○	Zero	PE_{max}
○	KE_{max}	Zero

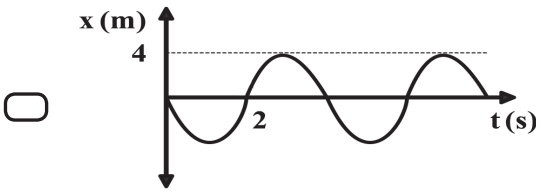
2) The displacement in (mm) of an object oscillating in (SHM) is described by the equation ($x = 15\cos 10\pi t$). What is the time period (T) and the maximum acceleration (a) of the motion?

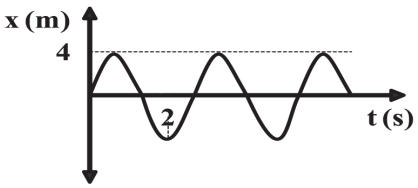
	Time period (T) in (s)	Maximum acceleration (a) in (m/s^2)
○	0.2	14.80
○	5.0	14.80
○	0.2	0.47
○	5.0	0.47

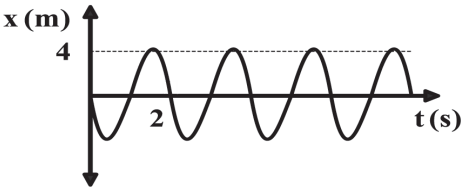
Multiple Choice continued

3) Which of the following graphs represents the motion of an object in (SHM) with the greatest maximum velocity?

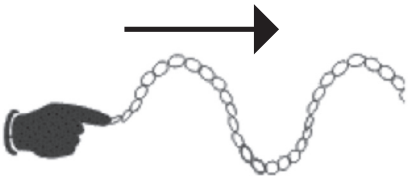








4) Which of the following waves can be both longitudinal and transverse wave?



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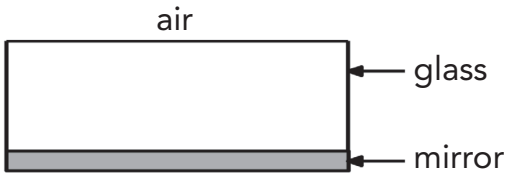
Multiple Choice continued

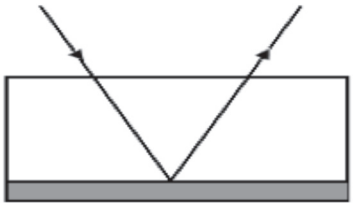
5) What will happen to the energy of a wave if the amplitude of the wave is doubled?

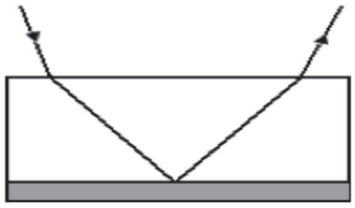
- ☐ Decrease to $\frac{1}{4}$.
- ☐ Decrease to $\frac{1}{16}$.
- ☐ Increase by 4 times.
- ☐ Increase by 16 times.

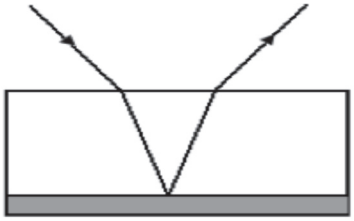
6) The diagram below shows a block consisting of two layers of mirror and glass.

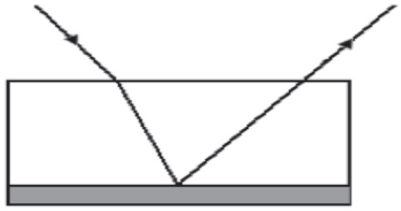


Which diagram shows the path of a ray of light passing through the block?

☐ 

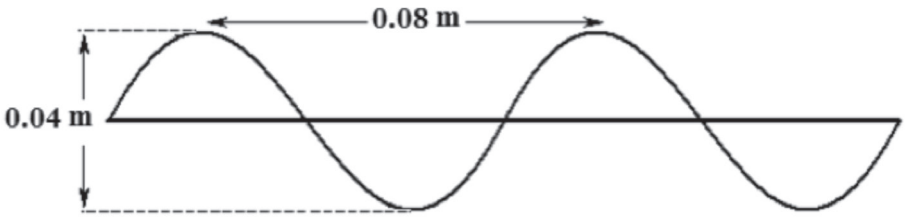
☐ 

☐ 

☐ 

Multiple Choice continued

7) What is the amplitude of the wave shown below?



- ☐ 0.02 m
- ☐ 0.04 m
- ☐ 0.08 m
- ☐ 0.16 m

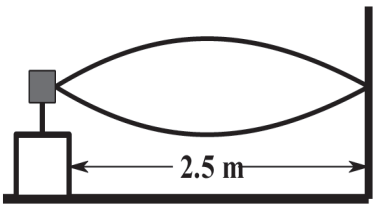
8) Which phenomenon occurs when a wave passes through a gap or curve round edges?

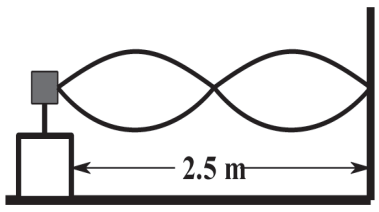
- ☐ Reflection.
- ☐ Diffraction.
- ☐ Refraction.
- ☐ Polarization.

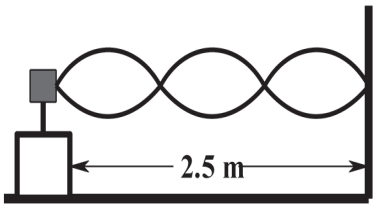
9) Microwaves are incident on a narrow metal slit of width (5 mm). The first diffraction minimum is observed at (37°). What is the wavelength of the microwaves?

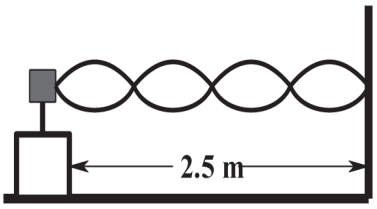
- ☐ 0.03 mm
- ☐ 0.12 mm
- ☐ 3.01 mm
- ☐ 12.04 mm

10) Which of the following figures represents standing waves with a wavelength of (1.67 m)?

☐ 

☐ 

☐ 

☐ 

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Multiple Choice continued

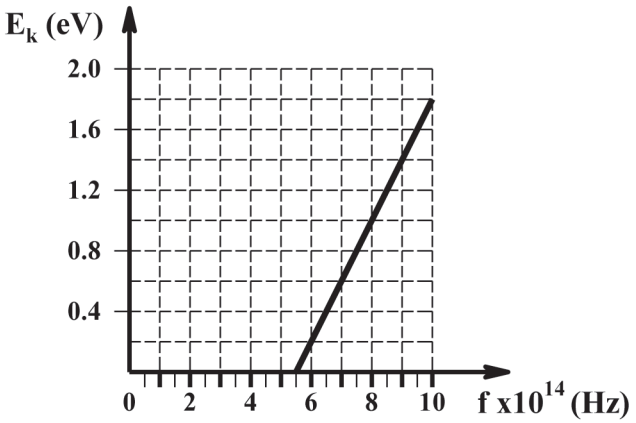
11) A plane is moving away from you. If the relation between the original frequency of the engine noise heard by the pilot (f_p) and the frequency of the noise heard by you (f_Y) is $\left(\frac{f_p}{f_y} = \frac{2}{1}\right)$, what is the speed of the plane?

- ☐ 85 m/s
- ☐ 170 m/s
- ☐ 340 m/s
- ☐ 680 m/s

12) Which scientist suggested that electromagnetic energy comes only in "lumps", which he called quanta?

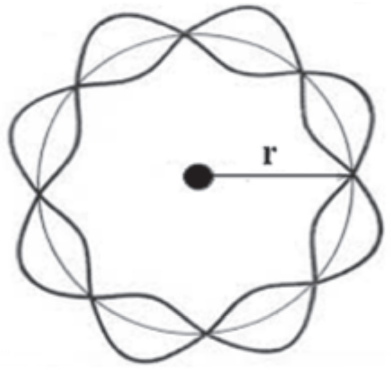
- ☐ Bohr
- ☐ Rutherford
- ☐ Einstein
- ☐ Planck

13) The graph opposite shows the kinetic energy of the photo-electrons that are emitted from lithium metal for different frequencies of light. What is the work function (Φ)?



- ☐ 3.98×10^{-33} J
- ☐ 3.65×10^{-19} J
- ☐ 5.50×10^{14} J
- ☐ 8.29×10^{47} J

14) The figure opposite shows a wavelength associated with the movement of an electron. If the diameter of the orbit is (1.27×10^{-9} m), what is the wavelength of the wave?

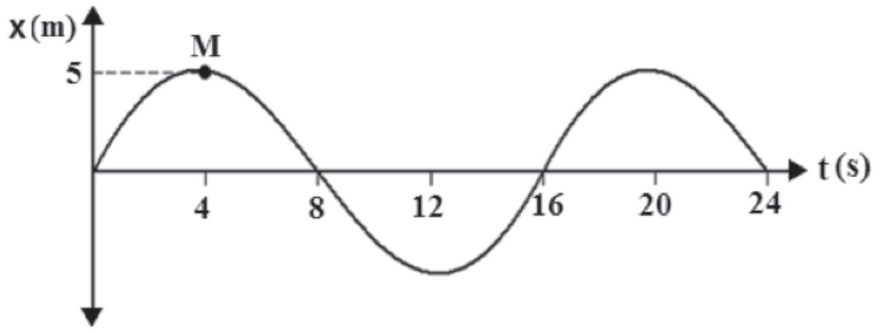


- ☐ 9.97×10^{-10} m
- ☐ 4.99×10^{-10} m
- ☐ 1.99×10^{-9} m
- ☐ 2.66×10^{-9} m

Extended Questions (42 marks)

Write your answer for each of the following questions in the space provided.
Be sure to show all your work, including the correct units where applicable.

15) A mass of (10 Kg) attached to a spring with spring constant (k) undergoes (SHM) as shown in the graph below.



a. What is meant by (T = 16 s)? (1 mark)

b. State two factors affecting the frequency of oscillations in the mass-spring system? (2 marks)

c. Calculate the spring constant (k). (2 marks)

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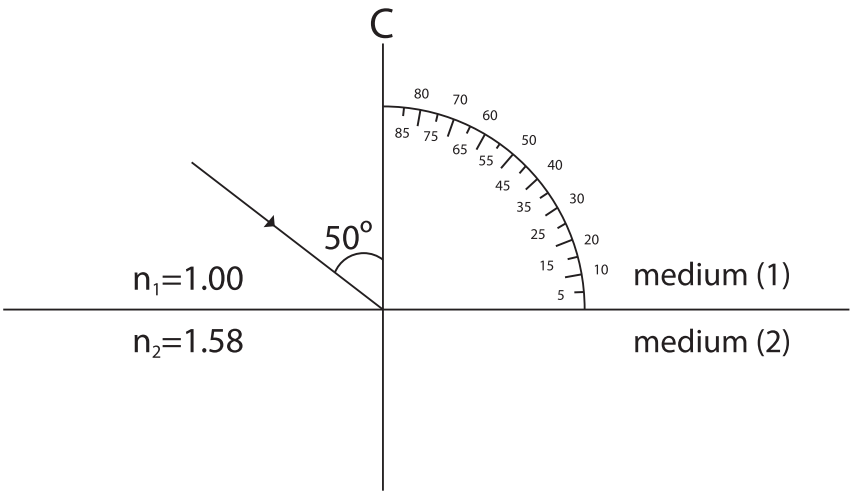
Extended Questions continued

d. Find the velocity of the motion at point (**M**) shown on the graph?. (2 marks)

e. Prove that when we increase the mass by (4 times), the relation of the time period will be: ($T_2 = 2T_1$)
(T_1: the time period of m_1, T_2: the time period of m_2). (3 marks)

16) The figure below shows a light beam incident on the boundary between two mediums.



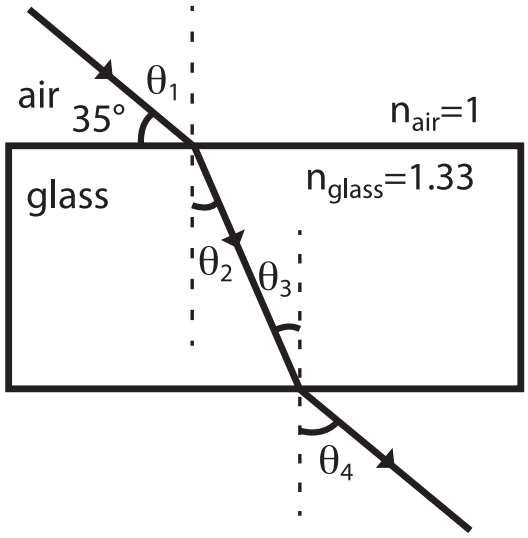
a. What is line (C) called? _____ (1 mark)

b. Draw the reflection ray on the diagram shown above. (1 mark)

Extended Questions continued

c. Calculate the angle of refraction when the light beam moves from medium (1) to medium (2). (3 marks)

17) The figure below shows a red light incident on one side of a glass block.



a. What is meant by the angle of incidence? (1 mark)

b. What is the value of the incident angle (θ_1)? (1 mark)

Extended Questions continued

c. If the refractive angle (θ_2) in glass is (38°) and the speed of light in air is (3×10^8 m/s), calculate the speed of light in glass. (3 marks)

d. Prove that ($\theta_1 = \theta_4$) by using Snell's Law. (2 marks)

18) A diffraction grating has rulings of (500 lines/ mm). Red light of wavelength (3.33×10^{-7} m) is incident normally on the grating.

a. Find which order of diffraction (n) will be seen at an angle of (30°) (1.5 marks)

Extended Questions continued

b. Calculate the angle of the second-order maximum in the diffraction pattern with red light. (1.5 marks)

19) According to the Doppler Effect, what will happen to the source wavelength (λ) and frequency (f) (**Increase** or **Decrease**) in the following cases: (3 marks)

	wavelength (λ)	**frequency (f)**
Observer moving towards source.	_____	_____
Source moving towards observer.	_____	_____
Observer moving away from source.	_____	_____

Extended Questions continued

20) In Young's double-slit experiment, a light is used to pass through the slits of separation (0.10 mm) .The separation between (20) successive bright fringes is (10 cm) and the distance between the screen and the slits is (2.2 m)

a. Calculate the light's wavelength (λ). (2 marks)

b. What will happen to the separation of maxima (or minima), if we double the separation of the two slits (s), and all the other variables remain the same. Explain your answer mathematically. (2 marks)

21) A beam of light of wavelength (5×10^{-7} m) falls on a photo electric cell cathode made of sodium with a work function of (2.3 eV)

a. What is meant by work function? (2 marks)

Extended Questions continued

b. Calculate the maximum velocity of the photon. (3 marks)

22) Find the linear momentum of photons of wavelength (350 nm). (2 marks)

23) Prove: $(\lambda) = \frac{h}{\sqrt{2\mathrm{KE}m}}$ (3 marks)

[End of Examination]

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FORMULA AND CONSTANTS

Periodic Motion

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

$$\omega = 2\pi f = \frac{2\pi}{T}$$

$$a = -(2\pi f)^2 x$$

$$x = A\sin(2\pi f t)$$

$$\upsilon = \pm 2\pi f\sqrt{A^2 - x^2}$$

$$\upsilon_{max} = \pm 2\pi f A$$

$$T = 2\pi\sqrt{\frac{l}{g}} = 2\pi\sqrt{\frac{m}{k}}$$

$$E = \frac{1}{2}m\omega^2 A^2$$

$$KE = \frac{1}{2}m\omega^2(A^2 - X^2)$$

Mechanical Waves

$$\upsilon = f\lambda$$

$$\upsilon = \frac{\Delta x}{\Delta t}$$

$$c = f\lambda$$

$$_1n_2 = \frac{\sin i}{\sin r} = \frac{\upsilon_1}{\upsilon_2} = \frac{n_2}{n_1}$$

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

Superposition of waves

$$\sin\theta = \frac{\lambda}{b}$$

$$n\lambda = d\sin\theta$$

$$Young's\ equation\ \frac{\lambda}{s} = \frac{x}{D}$$

$$Doppler\ effect\ \frac{\Delta\lambda}{\lambda} = \frac{\Delta f}{f} = \frac{\upsilon}{\upsilon_{air}}$$

Atomic Physics

$$E = hf = h\frac{c}{\lambda}$$

$$KE_{max} = hf - hf_t$$

$$E_k = hf - \phi$$

$$De\ Broglie\ wavelength = \frac{h}{m\upsilon}$$

$$2\pi r_n = n\lambda$$

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

Constants

$c = 3\times10^8\ m/s$

$m_{proton} = 1.673\times10^{-27}\ kg$

$e = 1.6\times10^{-19}\ C$

$g = 9.8\ m/s^2$

$\upsilon_{air} = 340\ m/s$

$m_{electron} = 9.11\times10^{-31}\ kg$

$h = 6.63\times10^{-34}\ J.s$

$n_{air} = 1$

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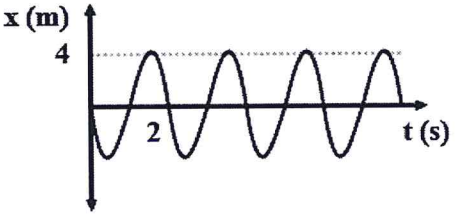
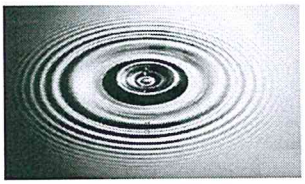
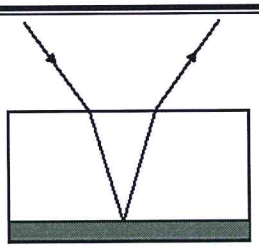
مُسَوَّدَة

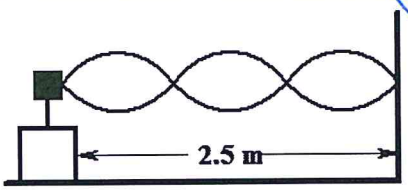
Physics 2015/2016 Bilingual Exams

2nd Semester, 2nd Session

Marking Guide

ANSWERS TO MULTIPLE CHOICE QUESTIONS: (28 marks)

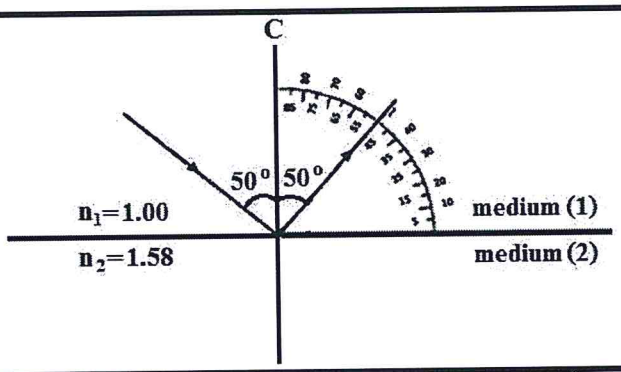
Item	Answer	Answer	Mark	OB
1	c	zero | PE_{max}	2	1.7
2	a	0.2 | 14.80	2	1.5ii
3	d		2	1.4
4	b		2	2.7
5	c	Increase by 4 times.	2	2.6
6	c		2	2.11
7	a	0.02	2	2.2
8	b	Diffraction.	2	3.5
9	c	3.01 mm	2	3.8

Item	Answer	Answer	Mark	OB
10	c		2	3.3
11	b	170 m/s	2	3.12
12	d	Planck	2	4.1
13	b	3.65×10^{-19} J	2	4.8
14	a	9.97×10^{-10} m	2	4.9

ANSWER OF EXTENDED RESPONSES: (42 marks)

Item	Part	Answer		Mark	OB
15	a	The time required for one complete oscillation equals (16 s).		1	1.3
	b	1- The mass (m) 2- The spring constant (k)	1 1	2	1.2 1.3
	c	$T = 2\pi\sqrt{\frac{m}{k}}$ $16 = 2\pi\sqrt{\frac{10}{k}}$ $\left(\frac{16}{2\pi}\right)^2 = \frac{10}{k}$ $6.485 = \frac{10}{k}$ $k = 1.542\ kg/s^2$	 1 $\frac{1}{2}$ $\frac{1}{2}$	2	1.6.ii
	d	$v = \mp 2\pi\sqrt{A^2 - x^2}$ $v = \mp 2\pi\sqrt{5^2 - 5^2}$ $v = 0$	 $1\frac{1}{2}$ $\frac{1}{2}$	2	1.5.ii

Item	Part	Answer		Mark	OB
15	e	$T_1 = 2\pi\sqrt{\frac{m_1}{k}}$	1	3	1.6.ii
		$T_2 = 2\pi\sqrt{\frac{m_2}{k}}$	1		
		$m_2 = 4\, m_1$			
		$\frac{T_1}{T_2} = \frac{\sqrt{\frac{m_1}{k}}}{\sqrt{\frac{4\, m_1}{k}}}$	1		
		$\frac{T_1}{T_2} = \frac{\sqrt{\frac{m_1}{k}}}{2\sqrt{\frac{m_1}{k}}}$			
		$T_2 = 2\ T_1$			
		Another possible answer:			
		$T_1 = 16$ s	$\frac{1}{2}$		
		$T_2 = 2\pi\sqrt{\frac{m_2}{k}}$			
		$m_2 = 4\, m_1$	$\frac{1}{2}$		
		$m_2 = 40\ kg$	$\frac{1}{2}$		
		$T_2 = 2\pi\sqrt{\frac{40}{1.542}}$	1		
		$T_2 = 31.985 \cong 32$	$\frac{1}{2}$		
		$T_2 = 2\ T_1$			

Item	Part	Answer		Mark	OB
16	a	Normal line		1	2.10
	b			1	2.10
	c	$\frac{n_2}{n_1} = \frac{\sin\theta_i}{\sin\theta_r}$ $1.58 = \frac{\sin 50}{\sin\theta_r}$ $\sin\theta_r = \frac{\sin 50}{1.58}$ $\theta_r = 29.0^\circ$	1 1 1	3	2.12
17	a	The angle between the incident ray and the normal line.		1	2.12i
	b	55°		1	2.12i
	c	$\frac{\sin\phi_1}{\sin\phi_2} = \frac{v_1}{v_2}$ $\frac{\sin 55}{\sin 38} = \frac{3\times10^8}{v_2}$ 2.25×10^8 m/s	2 1	3	2.12i
	d	$\phi_2 = 38^\circ$ $\phi_2 = \phi_3 \rightarrow \phi_3 = 38^\circ$ $\frac{\sin 38}{\sin\phi_4} = \frac{1}{1.33}$ $\phi_4 = \sin^{-1}(0.6159)$ $\phi_4 = 55^\circ \rightarrow \phi_1 = \phi_4$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2	2.12

Item	Part	Answer		Mark	OB
18	a	$n\lambda = d \sin\theta$ $n = \frac{d \sin}{\lambda}$ $n = \frac{(2x10^{-6}\ x\ \sin 30)}{3.33\ x10^{-7}}$ $n = 3$	1 $\frac{1}{2}$	$1\frac{1}{2}$	3.11
	b	$n\lambda = d \sin\theta$ $2x3.33x10^{-7} = (2x10^{-6}) \sin\theta$ $\sin\theta = \frac{2x3.33x10^{-7}}{(2x10^{-6})}$ $\theta = \sin^{-1}(0.333)$ $\theta = 19.5°$	1 $\frac{1}{2}$	$1\frac{1}{2}$	3.11
19				3	3.14

	wavelength (λ)	Frequency (f)
Observer moving towards source	increase	decrease
Source moving towards observer	increase	decrease
Observer moving away from source	decrease	increase

$\frac{1}{2}$ mark for each item.

Item	Part	Answer		Mark	OB
20	a	$s = \frac{10}{20} = 0.5\ cm$ $\frac{\lambda}{s} = \frac{x}{D}$ $\frac{\lambda}{0.005} = \frac{0.10x10^{-3}}{2.2}$ $\lambda = 2.27272x10^{-7} \approx 2.73 \times 10^{-7}\ m$	$\frac{1}{2}$ 1 $\frac{1}{2}$	2	3.10
	b	Will decrease because of: $\frac{x_2}{x_1} = \frac{s_2}{s_1}$ $\frac{x_2}{0.005} = \frac{4.4}{2.2}$ $x_2 = 0.001$	1 $\frac{1}{2}$ $\frac{1}{2}$	2	3.10
21	a	The work function is the smallest amount of energy that an electron must have to escape from the surface of a metal.		2	4.8
	b	$hf = W + E$ $\therefore h\frac{c}{\lambda} = W + \frac{1}{2}mv^2$ $\frac{1}{2}mv^2 = \frac{6.63\times10^{-34}\times3\times10^{8}}{5\times10^{-7}} - (2.3 \times 1.6 \times 10^{-19})$ $= 3.978 \times 10^{-19} - 3.68 \times 10^{-19}$ $= 2.98 \times 10^{-2}$ $\therefore v = \sqrt{\frac{2\times2.98\times10^{-20}}{9.11\times10^{-31}}}$ $v = 2.55 \times 10^{5}\ m/s$	 1 $\frac{1}{2}$ 1 $\frac{1}{2}$	3	4.8

Item	Part	Answer		Mark	OB
22		$P = \frac{h}{\lambda} = \frac{6.63\times10^{-34}}{350\times10^{-9}}$	1	2	4.9
		$\therefore P = 1.89 \times 10^{-27}\ kg.m/s$	1		
23		$KE = \frac{1}{2}mv^2$		3	4.9
		$v = \sqrt{\frac{2\ KE}{m}}$	1		
		$\lambda = \frac{h}{mv}$			
		$= \frac{h}{m\sqrt{\frac{2KE}{m}}}$	1		
		$= \frac{h}{\sqrt{\frac{2K\ \ m^2}{m}}}$	1		
		$\lambda = \frac{h}{\sqrt{2K\ \ m}}$			

End of Marking Guide