سلطنة عمان
وزارة التربية والتعليم

امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)

للعام الدراسي ١٤٣٧/١٤٣٦ هـ - ٢٠١٥ / ٢٠١٦ م

الدور الأول - الفصل الدراسي الثاني

تنبيه:
- المادة: الفيزياء.
- الأسئلة في (١١) 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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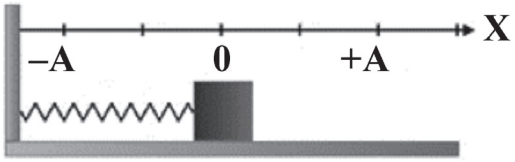
Multiple Choice Questions (28 marks)

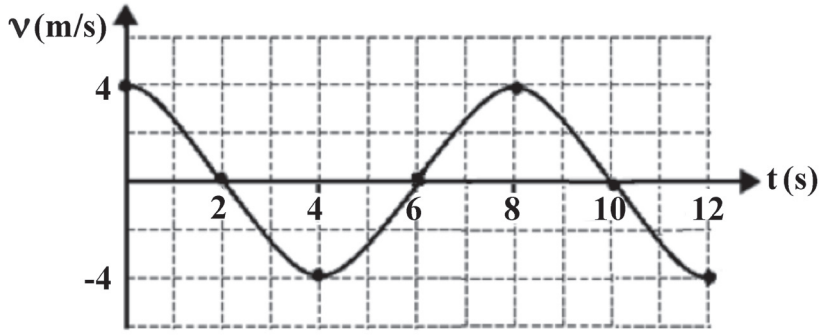
There are 14 multiple choice items worth two marks each.
Shade in the bubble next to the best answer for each item.

1) A block is moving with simple harmonic motion (SHM) as shown in the figure opposite.
When the block reaches point (+A), which of the following quantities will be at its maximum value?



- ○ Velocity.
- ○ Potential energy.
- ○ Kinetic energy.
- ○ Angular frequency.

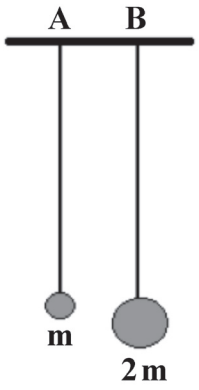
2) The graph below shows the velocity (v) versus time (t) of an oscillating object.



Assuming the motion is (SHM), what is the amplitude of this oscillation?

- ○ 0.2 m
- ○ 4.0 m
- ○ 5.1 m
- ○ 8.0 m

3) Two simple pendulums **(A)** and **(B)** have the same length as shown in the figure opposite. Pendulum **(B)** is two times heavier than pendulum **(A)**. If both of the pendulums start to move in (SHM), what will be the ratio of their frequencies (f_A: f_B)?



- ○ 1:1
- ○ 1:2
- ○ 2:1
- ○ $1:\sqrt{2}$

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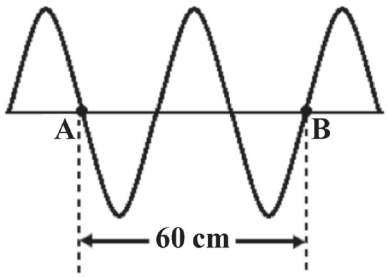
Multiple Choice continued

4) What is meant when we say that a body is making (800) oscillations in (2) seconds?

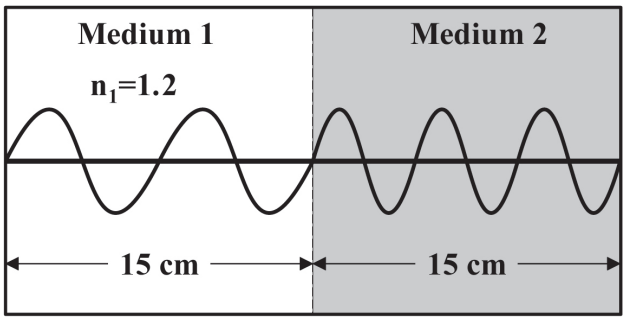
- ☐ The time period of oscillation is (800 s).
- ☐ The time period of oscillation is (400 s).
- ☐ The frequency of oscillation is (800 Hz).
- ☐ The frequency of oscillation is (400 Hz).

5) The figure opposite shows a wave pulse sent along a rope. What is the wavelength (λ) of the wave?



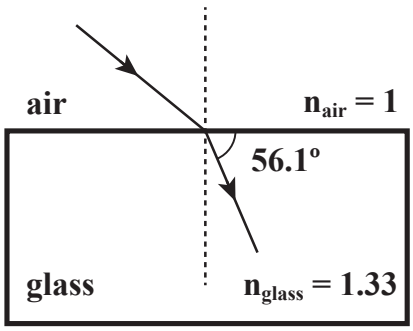
- ☐ 20 cm
- ☐ 30 cm
- ☐ 40 cm
- ☐ 60 cm

6) A Wave is travelling from medium (1) to medium (2) as shown in the figure opposite. What is the refractive index (n_2) in medium (2)?



- ☐ 0.80
- ☐ 1.00
- ☐ 1.44
- ☐ 1.80

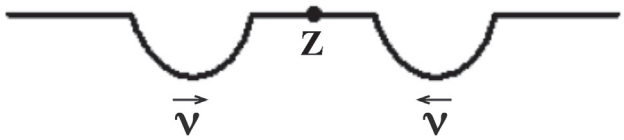
7) A light ray travels from air into a glass block as shown in the figure opposite.
What is the angle of incidence of the ray?



- ☐ 30.2°
- ☐ 33.9°
- ☐ 47.9°
- ☐ 62.8°

Multiple Choice continued

8) The figure below represents two waves approaching point **(Z)**.



When the two waves move with same speed (ν) and meet at point **(Z)**, which of the following figures represents the resultant wave?

9) If violet light has a wavelength of (400 nm), and the second order maximum of this light is (13.9°), what is the grating spacing (d)?

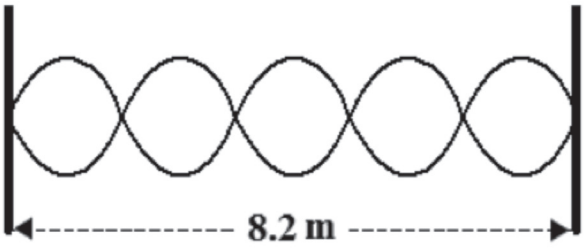
- ☐ 1.11×10^{-3} mm
- ☐ 1.67×10^{-3} mm
- ☐ 3.33×10^{-3} mm
- ☐ 3.58×10^{-3} mm

10) A man is carrying a whistle emitting continuously a note of frequency (272 Hz). He is running towards a reflecting surface at a speed of (18 Km/h). What is the frequency of the reflected sound waves that reach his ear?)

- ☐ 249.6 Hz
- ☐ 257.6 Hz
- ☐ 268.0 Hz
- ☐ 276.0 Hz

Multiple Choice continued

11) The figure below shows standing waves formed by a string vibrating up and down with (21) complete vibration cycles in (5 seconds).What is the speed of the wave?



- ☐ 6.89 m/s
- ☐ 13.78 m/s
- ☐ 34.77 m/s
- ☐ 71.41 m/s

12) Which of the following electromagnetic spectrum can be used to detect the Compton shift?

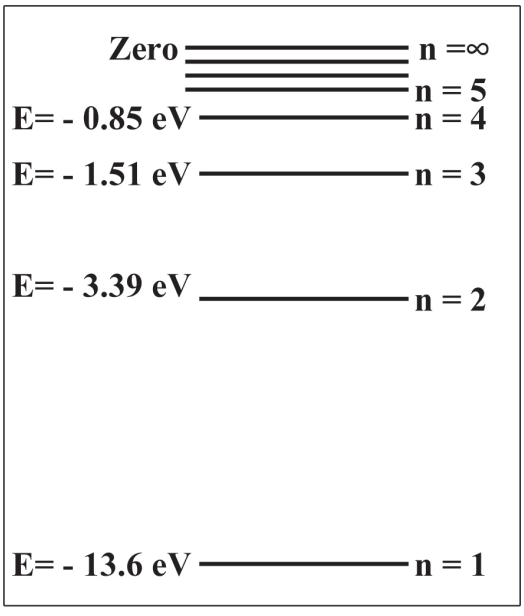
- ☐ X- Ray
- ☐ Visible light
- ☐ Microwaves
- ☐ Radio waves

13) . What is the cut-off wavelength (λ_o) for potassium if the work function is (2.5 eV)?

- ☐ 410 nm
- ☐ 434 nm
- ☐ 486 nm
- ☐ 497 nm

14) What is the wavelength of the radiation emitted by a hydrogen atom upon electron transition from (n= 4) to (n= 2) as shown in the figure opposite?

- ☐ 7.83×10^{-26} m
- ☐ 4.89×10^{-7} m
- ☐ 2.04×10^{6} m
- ☐ 6.16×10^{14} m



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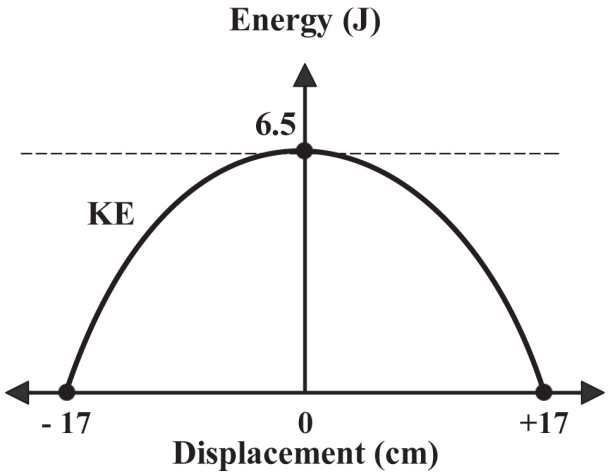
Extended Questions (42 marks)

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) The figure below shows the kinetic-energy **(KE)** diagram of an object of mass (7.6 kg) oscillating on a spring.

a. Draw on the diagram opposite the graph of potential energy **(PE)** against the same displacement. [1 mark]



b. What is the value of each of the following : [2 marks]

i. Total energy :

_____

ii. The amplitude:

_____

c. Calculate the angular frequency (ω). [2 marks]

_____

_____

_____

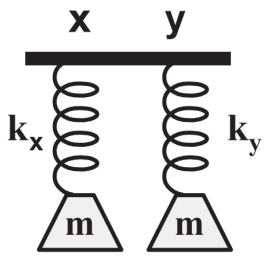
_____

_____

Extended Questions continued

d. Find the spring constant (k). [2 marks]

16) The figure opposite shows two bodies (x) and (y) of equal mass (m), suspended from two separate massless springs of constants (k_x) and (k_y), respectively.If both of them oscillate vertically such that their maximum velocities are equal, prove that the ratio of their amplitudes (A_x/A_y) is equal to $\sqrt{(k_y / k_x)}$ [3 marks]



17) Compare between longitudinal and transverse waves in the table below. [2 marks]

Types of waves	Longitudinal	Transverse
Draw the shape of the wave.		
One example of the wave.		

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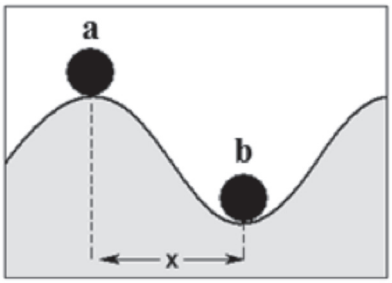
Extended Questions continued

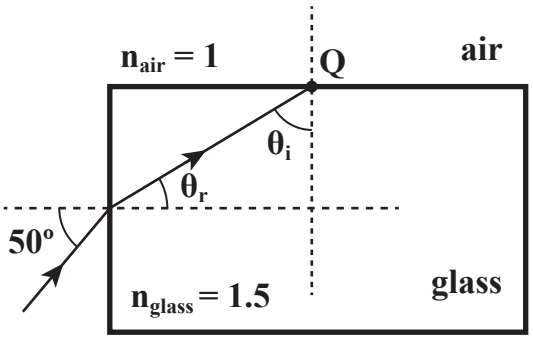


18) The figure opposite shows two balls **(a)** and **(b)** bob up and down in water and return to the same initial positions every (3s). The speed of the wave is (2.67 m/s).

a. What is the distance **(x)** between the two balls? [2 marks]

b. What will happen to the distance (x) between the two balls, if the amplitude of the wave doubled? [1 mark]

Explain your answer [1 mark]



19) The figure below shows a ray of light incident on one side of a glass block.

a. Define the phenomenon of total internal reflection. [2 marks]

Extended Questions continued

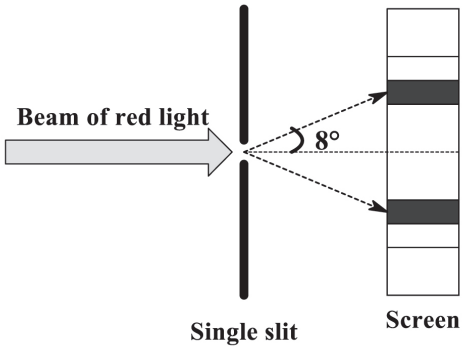
b. Calculate the following

i. The angle (θ_r). [2 marks]

ii. The angle (θ_i). [1 mark]

c. In the figure above draw the path of the ray after it strikes the surface between air and glass at point **(Q)**? [1 mark]

20) Monochromatic red light with a wavelength of (650 nm) passes through a single narrow slit and reaches a large screen as shown in the figure opposite.



a. What name is given to the pattern formed on the screen? [1 mark]

b. How is the dark fringe on the screen formed? [2 marks]

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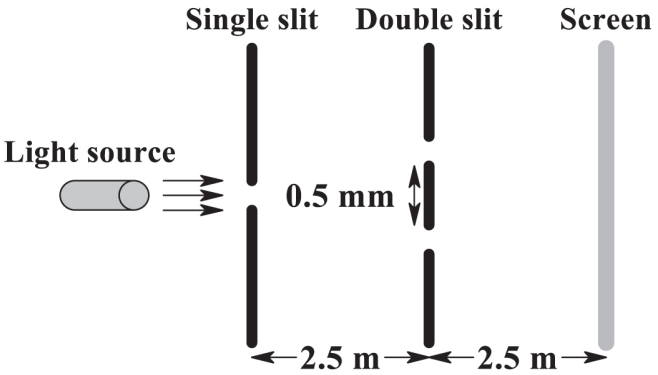
Extended Questions continued

c. Calculate the width of the slit through which the red light is passing. [2 marks]

21) The figure opposite shows Young's experiment where (10) interference fringes are formed on the screen. All the fringes appear within a length of (20 mm) along the screen.



a. Calculate the wavelength of the light. [3 marks]

b. If we move the double slit towards the single slit, what will happen to the distance between the fringes on the screen? [1 mark]

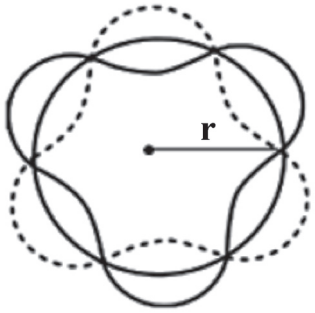
Explain your answer. [1 mark]

Extended Questions continued

22) In Compton shift for a photon after collision, write down the changes that happen to the following quantities: [3 marks]

Quantity	increase or decrease
Wavelength	_____
Frequency	_____
Energy	_____

23) The figure opposite shows a wavelength associated with the movement of an electron. If the wave length is (1.33×10^{-9} m), find the radius of the orbit. [3 marks]



_____

_____

_____

_____

_____

Extended Questions continued

24) A single beam of light of wavelength (400 nm) falls on a photo electric cell cathode which is made of potassium with a work function of (2.3 eV).
Determine if photoelectrons will be emitted. (Show your work) [2 marks]

25) Find the linear momentum of a microwave photon with wavelength (4 cm)? [2 marks]

[End of Examination]

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

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

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

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

$g = 9.8\ m/s^2$

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

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

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

$n_{air} = 1$

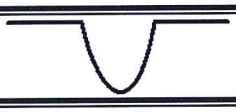
مُسَوَّدَة

Physics 2015/2016 Bilingual Exams

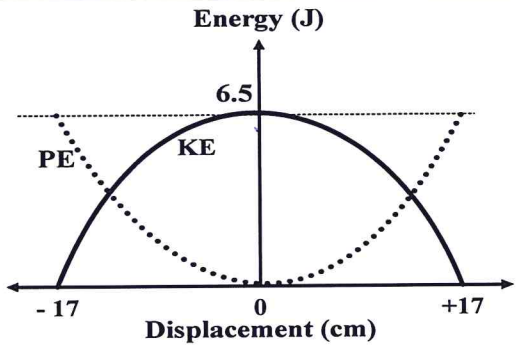
2nd Semester, 1st Session

Marking Guide

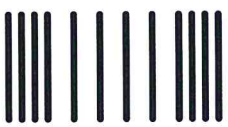
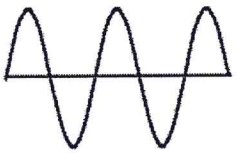
ANSWERS TO MULTIPLE CHOICE QUESTIONS: (28 marks)

Item	Answer	Answer	Mark	OB
1	b	Potential energy	2	1.3
2	c	5.1 m	2	1.4
3	a	1:1	2	1.6.i
4	d	The frequency of oscillation is (400 Hz)	2	2.2
5	c	40cm	2	2.2
6	d	1.80	2	2.12ii
7	c	47.9°	2	2.12
8	d		2	3.2
9	c	3.33×10^{-3} mm	2	3.11
10	d	276.0 Hz	2	3.12
11	b	13.78 m/s	2	3.4
12	a	X- Ray	2	4.8
13	d	497 nm	2	4.8
14	b	4.89×10^{-7} m	2	4.4

ANSWER OFEXTENDED RESPONSES:(42 marks)

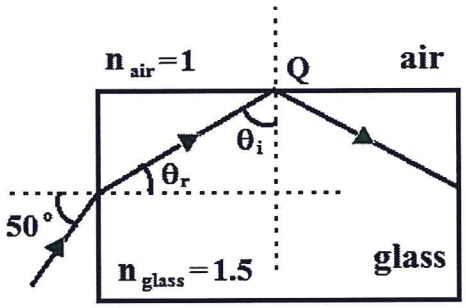
Item	Part	Answer		Mark	OB
15	a			1	1.7
	b	i. Total energy = 6.5 J ii. Amplitude = 17 cm	1 1	2	1.2 1.3 1.7
	c	$E = \frac{1}{2}m\omega^2A^2$ $\therefore \omega^2 = \frac{2E}{mA^2} = \frac{2\times6.5}{7.6\times(17\times10^{-2})^2}$ $\omega^2 = 59.2$ $\omega = 7.7\ rad/s$	 1 $\frac{1}{2}$ $\frac{1}{2}$	2	1.5
	d	$T = 2\pi\sqrt{\frac{m}{k}},\ \omega = \frac{2\pi}{T} \rightarrow T = \frac{2\pi}{\omega}$ $\frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{k}} \rightarrow \frac{1}{\omega^2} = \frac{m}{k}$ $k = m\omega^2 = 7.6 \times 59.2$ $= 449.9 \cong 450\ N/m$	 $\frac{1}{2}$ 1 $\frac{1}{2}$	2	1.6.ii

Item	Part	Answer		Mark	OB
16		$v_{x\,max} = v_{y\,max}$		3	1.6.ii
		$2\pi f_x A_x = 2\pi f_y A_y$	$\frac{1}{2}$		
		$\frac{A_x}{T_x} = \frac{A_y}{T_y}$	$\frac{1}{2}$		
		$\frac{A_x}{2\pi\sqrt{\frac{m}{k_x}}} = \frac{A_y}{2\pi\sqrt{\frac{m}{k_y}}}$	1		
		$\frac{A_x}{\sqrt{\frac{1}{k_x}}} = \frac{A_y}{\sqrt{\frac{1}{k_y}}} \rightarrow A_x\sqrt{k_x} = A_y\sqrt{k_y}$	1		
		$\therefore \frac{A_x}{A_y} = \sqrt{\frac{k_y}{k_x}}$			
17				2	2.7

Longitudinal	**Transverse**
	
Sound waves Water waves Oscillating spring	the outdoor sunlight the medical x-ray water waves Radio wave Electromagnetic waves

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

Item	Part	Answer		Mark	OB
18	a	$v = \lambda f = \frac{\lambda}{T}$		2	2.3
		$\lambda = 2.67 \times 3$	$\frac{1}{2}$		
		$= 8\ m$	$\frac{1}{2}$		
		$x = \frac{\lambda}{2} = \frac{8}{2}$	$\frac{1}{2}$		
		$= 4m$	$\frac{1}{2}$		
	b	The distance will not change.	1	2	2.2
		Because the change in amplitude will not affect the wavelength of the wave. **OR** $(E \propto A^2)$	1		
	a	The angle of incidence is greater than the critical angle, so no light is refracted out of the water, but some of the light is refracted back into the same surface.	1 1	2	2.14
19	b-i	$\frac{\sin\theta_i}{\sin\theta_r} = \frac{n_2}{n_1}$		2	2.12
		$\frac{\sin 50}{\sin\theta_r} = \frac{1.5}{1}$	$\frac{1}{2}$		
		$\sin\theta_r = 0.51016$	$\frac{1}{2}$		
		$\theta_r = \sin^{-1}(0.51016)$	$\frac{1}{2}$		
		$\theta_r = 30.7^\circ$	$\frac{1}{2}$		

Item	Part	Answer		Mark	OB
19	b.ii	$\theta_i = 180 - 90 - 30.7$ $\theta_i = 59.3^\circ$ **Or** $\theta_i = 90 - 30.7$ $\frac{1}{2}$ $\theta_i = 59.3^\circ$ $\frac{1}{2}$	$\frac{1}{2}$ $\frac{1}{2}$	1	2.12
	c			1	2.12 2.13
20	a	Diffraction Pattern		1	3.5
	b	Because of the destructive interference, when crest and trought meet.		2	3.7
	c	$sin\theta = \frac{\lambda}{b}$ $b = \frac{650\times10^{-9}}{sin8}$ $b = 4.67 \times 10^{-6}$m	1 1	2	3.11

Item	Part	Answer		Mark	OB
21	a	$x = \frac{20}{10} = 2 \times 10^{-3} m$ $\frac{\lambda}{s} = \frac{x}{D} \rightarrow \lambda = \frac{sx}{D}$ $\lambda = \frac{0.5\times10^{-3}\times2\times10^{-3}}{2.5}$ $\therefore \lambda = 4 \times 10^{-7} m$	1 1 1	3	3.10
	b	Increase. Because the distance between the double slit and screen (D) increases and the relation is ($x \propto D$)	1 1	2	3.9
22		<table><tr><th>quantity</th><th>Increase or decrease</th></tr><tr><td>Wavelength</td><td>increase</td></tr><tr><td>Frequency</td><td>decrease</td></tr><tr><td>Energy</td><td>decrease</td></tr></table> One mark for each item		3	4.8
23		$2\pi r = n\lambda$ $2\pi r = 3x1.33x10^{-9}$ $r = \frac{9.399x10^{-9}}{2\pi}$ $r = 6.35x10^{-10} m$	 1 1 1	3	4.9

Item	Part	Answer	Mark	OB
24		$E = \frac{(6.63x10^{-34})(3x10^{8})}{400x10^{-9}}$ $\frac{1}{2}$ $E = 4.97x10^{-19}$ J $\frac{1}{2}$ $E = 3.11$ eV Yes, they will be emitted because $E > \emptyset$. 1	2	4.1 4.8
25		$P = \frac{h}{\lambda}$ $= \frac{6.63\times10^{-3}}{4\times10^{-2}}$ 1 $\therefore P = 1.66 \times 10^{-32}\ kg.m/s$ 1	2	4.9

End of Marking Guid