رقم الورقة	
رقم المغلف	

حاضر ▢

غائب ▢

سلطنة عمان
وزارة التربية والتعليم

امتحان شهادة دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)

للعام الدراسي ١٤٣٣/١٤٣٤ هـ - ٢٠١٢ / ٢٠١٣ م

الدور الأول - الفصل الدراسي الثاني

تنبيه:
- المادة: الفيزياء.
- الأسئلة في (١٤) 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 شهادة 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** ▢ ◉ ◔ ⊗ ☑

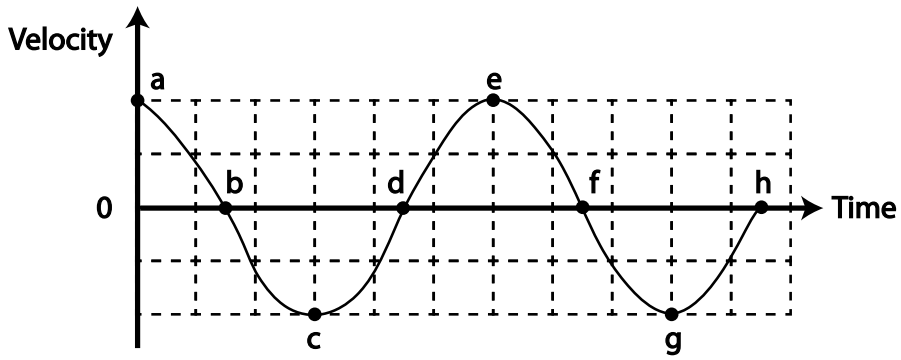
Question One:

There are 14 multiple–choice items worth two marks each.
Shade the best correct answer for each of the following items.

1. An object is moving with simple harmonic motion, at the greatest displacement from the centre. Which of the following quantities is maximum?

- ○ velocity
- ○ acceleration
- ○ kinetic energy
- ○ frequency

2. The graph below shows an object moving in (SHM). At which of the following points on the graph the displacement is maximum?



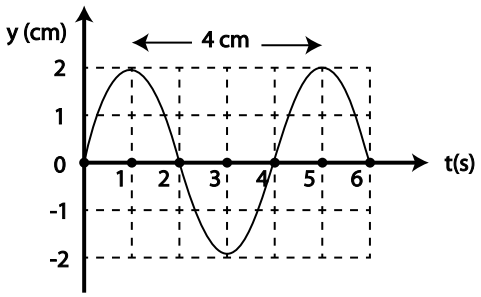
- ○ (a , c)
- ○ (b , f)
- ○ (a , e)
- ○ (c , g)

3. Assume a periodic wave passes a student who records a time of **(5 s)** between two wave crests. The frequency of the wave equals:

- ○ 0.2 Hz
- ○ 0.4 Hz
- ○ 2.0 Hz
- ○ 5.0 Hz

Question One (Cont'd)

4. The graph opposite shows a transverse wave generated at one end of a long horizontal string. The frequency, velocity and the amplitude of the wave are:



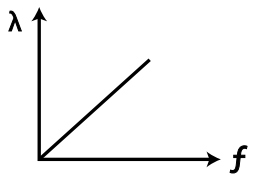
	Frequency (Hz)	Velocity (cm/s)	Amplitude(cm)
☐	0.25	1.25	1
☐	2	10	1
☐	2	1	2
☐	0.25	1	2

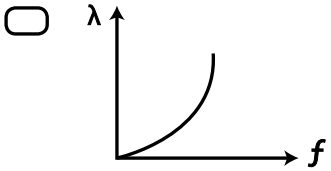
5. A ray of light passes from air into a transparent material at an angle of incidence of **(60°)**. The angle of refraction was **(45°)**. What will be the angle of incidence when the angle of refraction is **(25°)**?

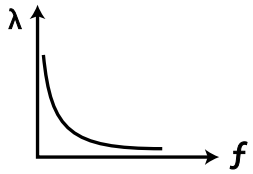
☐ 15° ☐ 20°

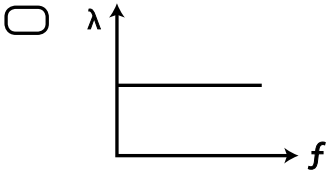
☐ 31° ☐ 45°

6. The graph which shows that the wavelength of water waves changes when the frequency is changed in a ripple tank is:

☐ 

☐ 

☐ 

☐ 

Question One (Cont'd)

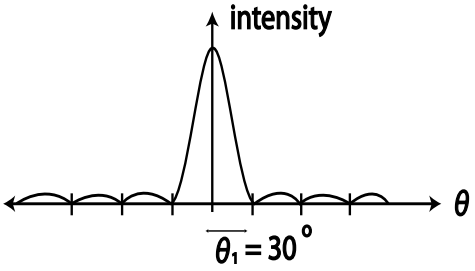
7. A ray of light of wavelength **(λ)** enters a piece of glass with ($\mathbf{n}=\frac{\mathbf{3}}{\mathbf{2}}$) ,at an incidence angle of **(θ)**. What is the wavelength of the light?

- ☐ $\frac{2}{\lambda}$
- ☐ $\frac{\lambda}{2}$
- ☐ $\frac{3}{2\lambda}$
- ☐ $\frac{2\lambda}{3}$

8. For a transverse wave, if the amplitude of the wave is doubled, then the energy will be

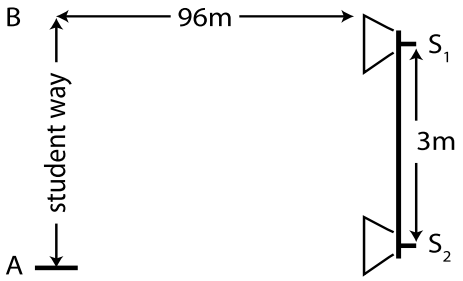
- ☐ decreased by half
- ☐ increased by 2 times
- ☐ increased by 4 times
- ☐ decreased by 4 times

9. The graph opposite represents the relationship between intensity and the angle of first minima. The gap width equals:



- ☐ 2λ
- ☐ $\frac{2\lambda}{\sqrt{3}}$
- ☐ λ
- ☐ $\frac{\sqrt{3}\,\lambda}{2}$

10. A student stands at a distance of **(96 m)** from two speakers **(S_1,S_2)**. as shown in the opposite diagram. When the student walks from point **(A)** to point **(B)** he hears loud and quite sound. If the distance between the loud and quite sound is **(4 m)**, then the wavelength emitted from the speakers is :

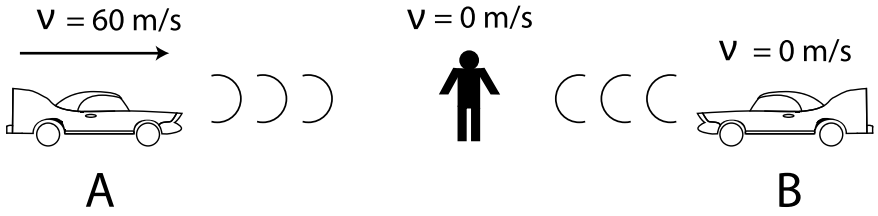


- ☐ 0.0139 m
- ☐ 0.125 m
- ☐ 72 m
- ☐ 128 m

Do not write in this space

Question One (Cont'd)

11. The diagram below shows a listener standing between two cars. The sound received by the listener from the two cars can be described as:



	Sound from car (A)		Sound from car (B)	
	λ	f	λ	f
☐	long	high	long	high
☐	short	high	constant	constant
☐	short	low	short	low
☐	long	low	constant	constant

12. Cesium metal has a work function of **(1.8 eV)**. When Cesium is illuminated with light of a certain wavelength, then electrons ejected from its surface have kinetic energies ranging from **(0 to 2.2 eV)**. What is the frequency of the light?

☐ $\frac{4}{h}$ ☐ $\frac{h}{0.4}$

☐ $\frac{0.4}{h}$ ☐ $\frac{h}{4}$

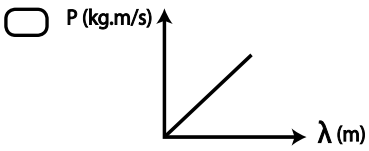
13. "The electron radiates energy only when it jumps from an outer orbit to an inner orbit", this statement is part of the atom model of:

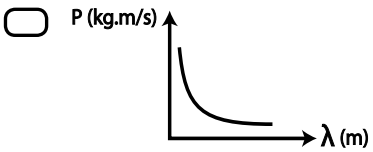
☐ Bohr ☐ Giger

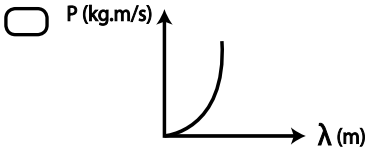
☐ Thomson ☐ Rutherford

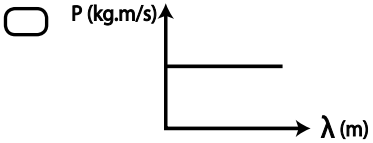
Question One (Cont'd)

14. The graph which represents the variation of particles momentum and its associated de-Broglie wavelength is:









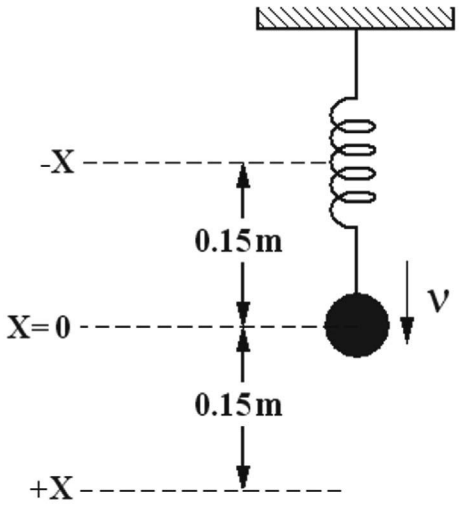
Extended Questions

Write your answer for each of the three questions in the constructed–response section in the space provided.

Be sure to show all your work, including the correct units where applicable.

Question Two:

A) A **(0.5 kg)** metal ball is attached to the end of a vertical spring with a spring constant of **(20 N/m)** as shown opposite. The ball is displaced **(0.15 m)** into the **(+x)** direction and released so that it oscillates forth and back with period **(T)**. Assume the system is moving with SHM



1. What is the velocity of the ball when it reaches position **(x = 0.15 m)**? (2 marks)

2. Calculate the position and acceleration of the ball at time $\left(t = \frac{T}{8}\ (s)\right)$.

I. The position: (2 marks)

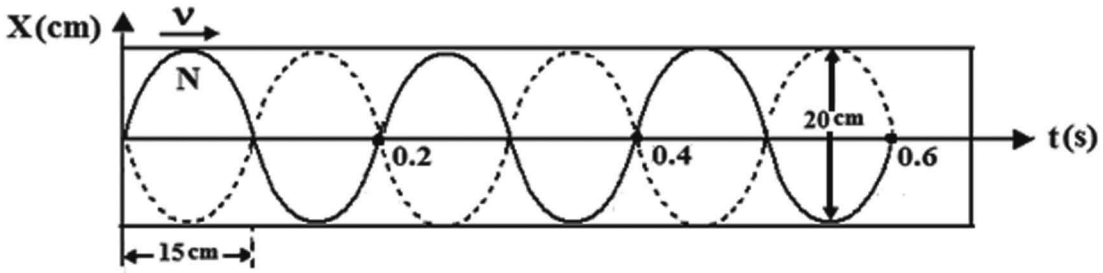
II. The acceleration: (2 marks)

Question Two (Cont'd)

B) 1. Two identical pendulums **(A)** and **(B)** have the same amplitude and time period. If the mass of **(A)** is twice the mass of **(B)**, prove that **($E_A=2E_B$).** (3 marks)

Question Two (Cont'd)

2. The graph below shows two waves (N and M) travelling to the right.



Calculate:

I. The amplitude of wave **(N)** (½ mark)

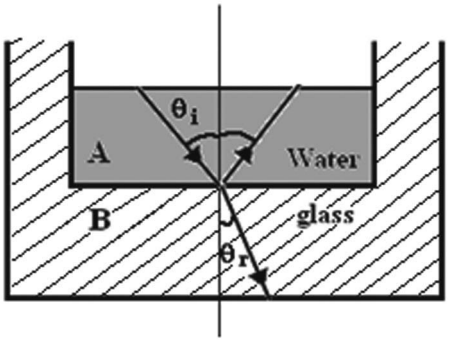
II. The frequency of wave **(N)** (½ mark)

III. The velocity of wave **(M)** (1 mark)

IV. What is the phase difference between wave **(N)** and wave **(M)**? (1 mark)

Question Two (Cont'd)

C) A light ray travelling through water is incident on a trough of glass at an angle of **(θ_i)** to the normal as shown in the opposite diagram.
Note: **(n_{water}= 1.33, and n_{glass}=1.52)**.



Calculate the speed of light in the glass if the speed of light in air is **(3×10^8 m/s)**.

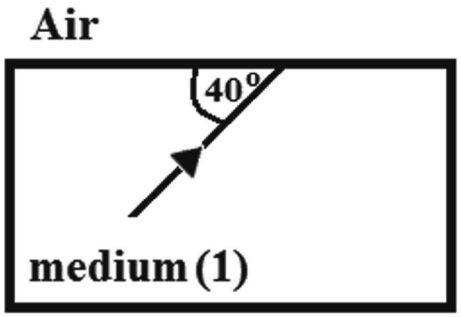
(2 marks)

Question Three:

A) The table below shows four different types of waves. Complete the table by classifying them into transverse **(T)** or longitudinal **(L)** waves by writing the letter only, also write the letter **(P)** for each wave that can be polarized. (3.5 marks)

Wave number	Wave Description	Wave Type	Polarization
1	Outdoor sunlight.	_____	_____
2	Water ripples produced by a student jumping into swimming pool.	_____	_____
3	Sound of a car horn.	_____	_____
4	The medical x-ray.	_____	_____

B) The diagram opposite shows a ray of light incident from medium **(1)** to air. The critical angle of medium **(1)** is **(45°)**.



1. Define the critical angle**.** (1.5 marks)

2. Find the angle of incidence. (½ mark)

Question Three (Cont'd)

3. What phenomenon will occur when the ray strikes the surface of the air? (½ mark)

4. On the diagram, draw the path of the ray after it strikes the surface of the air. (1 mark)

C) 1. Define Diffraction. (2 marks)

2. In Young's double-slit experiment, a light of wavelength **(4.7×10^{-7} m)** is used to pass through the slits of separation **(0.40 mm)**. If the separation between **(10)** successive bright fringes is **(2.0 cm),** answer the following questions:

I. Calculate the distance of the screen from the slits. (2 marks)

II. If the experiment is repeated using a screen placed **(1.2 m)** from the double-slit and all the other variables were the same, calculate the separation between the slits. (2 marks)

III. What will happen to the interference fringes if one of the double-slits is closed? (1 mark)

Question Four:

A) In an experiment, diffraction grating of **(400 lines per mm)** is used to find the wavelength of yellow light. The second order diffraction image is seen at an angle of **(28°)** with the incident beam.

1. Why it is important to use a diffraction grating instead of double slit in Young's experiment? (2 marks)

2. What is the wavelength of the yellow light used? (2 mark)

3. What will happen to the wavelength of the yellow light if the number of lines is doubled in the grating. (1 mark)

B) **1.** Assume an electron in a television tube has a speed of **(5×10^7 m/s)**. Determine the de Broglie wavelength that is associated with this electron. (2 marks)

Question Four (Cont'd)

2. A light of **(500 nm)** is incident on a particular surface with a work function of **(3.28×10^{-19}J)**:

I. What is meant by:"the work function of a substance is **(3.28×10^{-19}J)**". (2 marks)

II. Find the maximum Kinetic energy for this material. (2 marks)

C) 1. A photon has a de-Broglie wavelength of **(5000×10^{-10} m)**.

I. Calculate the momentum of the photon. (1 mark)

II. If the photon collides with an electron which is at rest and gives it the whole momentum. Calculate the speed of the electron after the collision. (1 mark)

Question Four (Cont'd)

2. A photon and an electron have the same wavelength. Which of them has less velocity? Why? (1 mark)

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

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

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

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

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

Atomic Physics

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

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

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

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

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

Constants

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

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

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

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

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

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

$n_{air} = 1$

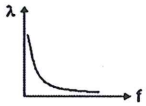
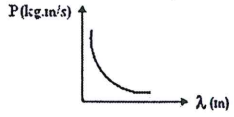
مُسوَّدَة

Physics 2012/2013 Bilingual Exams

2 nd semester, 1st session

Model Answers

Answer of Question One:(28 marks)

item	answer	answer	mark	C.L	OB
1	B	acceleration	2	K	1.3
2	B	b, f	2	A	1.2
3	A	0.2Hz	2	K	1.3
4	D	0.25 | 1 | 2	2	A	2.2,2.4
5	C	31°	2	A	2.12.i
6	C		2	R	2.3
7	D	$\frac{2\lambda}{3}$	2	A	2.12.i,ii
8	C	Increased by 4 times.	2	K	2.6
9	A	2λ	2	A	3.8
10	B	0.125m	2	A	3.10
11	B	short | high | constant | constant	2	R	3.12
12	A	$\frac{4}{h}$	2	A	4.1
13	A	Bohr	2	K	4.5
14	B		2	R	4.9

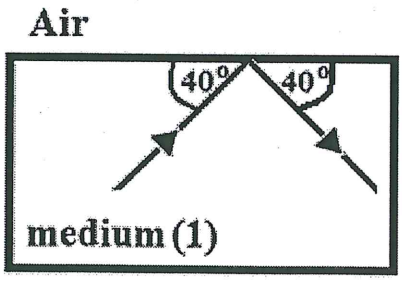
Answer of Question Two:(14 marks)

item	answer	mark	C.L	OB
(A) 1	$v = 0$ m/s	2	K	1.5.iii
(A) 2.I	$x = A\cos(2\pi ft)$ $=A\cos(\frac{2\pi}{T} \times \frac{T}{8})$ $=0.15\cos(\frac{\pi}{4})$ $= 0.106$m	$\frac{1}{2}$ 1 $\frac{1}{2}$	A	1.5.ii
(A) 2.II	$a = -A\omega^2\cos(\omega t)$ $= -A(\frac{k}{m})\cos(\omega t)$ $= 0.15(\frac{20}{0.5})\cos(\frac{\pi}{4})$ $=4.24$m/s^2	$\frac{1}{2}$ 1 $\frac{1}{2}$	A	1.5.i
(B) 1	$E_A = 1/2\, m_A (\omega^2{}_A) A_A{}^2$ $E_B = 1/2\, m_B (\omega^2{}_B) A_B{}^2$ *By dividing* E_A/E_B $\frac{E_A}{E_B} = \frac{1/2\, m_A (\omega^2{}_A) A_A{}^2}{1/2\, m_B (\omega^2{}_B) A_B{}^2}$ $\because T_A = T_B$, $\omega^2{}_A = \omega^2{}_B$, $A_A = A_B$, $m_A = 2\, m_B$, thus $\therefore \frac{E_A}{E_B} = \frac{2m_B}{m_B}$ Thus $E_A = 2E_B$	$\frac{1}{2}$ $\frac{1}{2}$ 1 1	R	1.7 1.8

Answer of Question Two:(14 marks)

item	answer	mark	C.L	OB
(B) 2.I	A= 20/2=10cm	$\frac{1}{2}$	A	2.2
(B)2. II	f =1/T = 1/0.2 = 5 Hz	 $\frac{1}{2}$	A	2.2
(B)2. III	$\because v = \lambda f$ $\therefore v = 5\times30$ = 150 cm/s = 1.5 m/s	 $\frac{1}{2}$ $\frac{1}{2}$	A	2.3
(B)2. IV	π or 180°	1	A	2.3
(C)	$\because v_{water} = \frac{v_{air}}{n_{water}}$ $\therefore v_{water} = \frac{3x10^8}{1.33}$ $= 2.26 \times 10^8$ m/s $\because \frac{n_{glass}}{n_{water}} = \frac{v_{water}}{v_{glass}}$ $\therefore v_{glass} = \frac{1.33 \times 2.26x10^8}{1.52}$ $v_{glass} = 1.98 \times 10^8$ m/s	 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	A	2.12.ii

Answer of Question Three: (14 marks)

<table>
<tr><th>item</th><th>answer</th><th>mark</th><th>C.L</th><th>OB</th></tr>
<tr><td>(A)</td><td>
<table>
<tr><th>Wave number</th><th>The wave description</th><th>The wave type</th><th>polarization</th></tr>
<tr><td>1</td><td>The outdoor sun light.</td><td>T</td><td>P</td></tr>
<tr><td>2</td><td>Water ripples produced by a student jumping in a swimming poll.</td><td>T</td><td>P</td></tr>
<tr><td>3</td><td>Sound of a car horn.</td><td>L</td><td>-</td></tr>
<tr><td>4</td><td>The medical x-ray.</td><td>T</td><td>P</td></tr>
</table>
</td><td>$\frac{1}{2}+\frac{1}{2}$
$\frac{1}{2}+\frac{1}{2}$
$\frac{1}{2}$
$\frac{1}{2}+\frac{1}{2}$</td><td>K</td><td>2.7
2.9</td></tr>
<tr><td>(B) 1</td><td>The largest angle at which refraction is just possible.</td><td>$1\frac{1}{2}$</td><td>K</td><td>2.13</td></tr>
<tr><td>(B) 2</td><td>$\theta_i = 90^\circ - 40^\circ = 50^\circ$</td><td>$\frac{1}{2}$</td><td rowspan="3">R</td><td rowspan="3">2.12.i</td></tr>
<tr><td>(B) 3</td><td>Total internal reflaction</td><td>$\frac{1}{2}$</td></tr>
<tr><td>(B) 4</td><td> 
</td><td>1</td></tr>
</table>

Answer of Question Three: (14 marks)

item	answer	mark	C.L	OB
(C) 1	The bending of waves when they go through a gap or curve round edges.	2	K	3.5
(C) 2.I	$\because \frac{\lambda}{S} = \frac{X}{D} \rightarrow D = \frac{X.S}{\lambda}$ $\therefore D = \frac{0.4\times10^{-3}\times2\times10^{-3}}{7.4\times10^{-7}}$ $= 1.7\text{m}$	$1\frac{1}{2}$ $\frac{1}{2}$	A	3.10
(C) 2.II	$\frac{S_2}{S_1} = \frac{D_2}{D_1}$ $\therefore S_2 = \frac{1.2}{1.7} \times 0.4 \times 10^{-3}$ $=0.28\times10^{-3}\ m$	$\frac{1}{2}$ 1 $\frac{1}{2}$	A	3.10
(C) 2.III	The fringes will disappear. Or No interference will occur.	1	R	3.1

Answer of Question Four: (14 marks)

item	answer	mark	C.L	OB
(A) 1	Because it is quite hard to measure the distance between maxima, or the distance between minima, accurately.	2	k	3.11
(A) 2	$d = \frac{1}{400} \times 10^{-3}$ $= 2.5 \times 10^{-6} m$ $\because n\lambda = d \sin\theta \rightarrow \lambda = \frac{d \sin\theta}{n}$ $\therefore \lambda = \frac{2.5\times10^{-6}\times sin28°}{2}$ $= 5.9 \times 10^{-7} m$	$1\frac{1}{2}$ $\frac{1}{2}$	A	3.8
(A) 3	The wavelength will stay constant.	1	R	3.11
(B) 1	$\because \lambda = \frac{h}{mv}$ $\therefore \lambda = \frac{6.63x10^{-34}}{9.11x10^{-31}x5x10^{7}}$ $= 0.145\ x\ 10^{-10} m$	$1\frac{1}{2}$ $\frac{1}{2}$	A	4.9
(B) 2.I	The minimum energy required to remove an electron from the substance atom is **(3.28×10^{-19} J)**.	2	A	4.1

Answer of Question Four: (14 marks)

item	answer	mark	C.L	OB
(B) 2.II	$hf = \frac{6.63x\ 10^{-34}\ x3x10^{8}}{500x10^{-9}}$	$\frac{1}{2}$	A	4.1
	$= 3.98x10^{-19}J$	$\frac{1}{2}$		
	$kE_{max} = hf - hf_t$	$\frac{1}{2}$		
	$\therefore kE_{max} = 3.98 \times 10^{-19}\ J - 3.28 \times 10^{-19}\ J$			
	$= 0.70 \times 10^{-19} J$	$\frac{1}{2}$		
(C) 1.I	$\because \lambda = \frac{h}{p}$		A	4.9
	$\therefore p = \frac{h}{\lambda} = \frac{6.63\times10^{-34}}{5000\times10^{-10}}$	$\frac{1}{2}$		
	$= 1.33\times10^{-27}$kg.m/s	$\frac{1}{2}$		
(C) 1.II	$\because p = mv$		A	4.8
	$\therefore v = \frac{1.33\times10^{-27}}{9.11\times10^{-31}}$	$\frac{1}{2}$		
	$= 1.46 \times 10^{3} m/s$	$\frac{1}{2}$		
(C) 2	The electron.	$\frac{1}{2}$	R	4.7
	Because it has a mass.	$\frac{1}{2}$		

End of Answer Model