رقم الورقة	
رقم المغلف	

حاضر ☐

غائب ☐

سلطنة عمان
وزارة التربية والتعليم

امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)

للعام الدراسي ١٤٣٥/١٤٣٤ هـ - ٢٠١٣ / ٢٠١٤ م

الدور الثاني - الفصل الدراسي الثاني

تنبيه:
- المادة: فيزياء.
- الأسئلة في (١٣) 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.

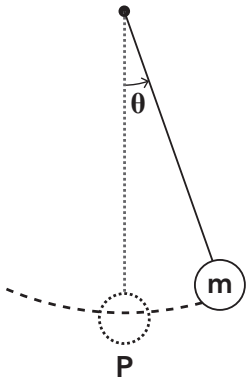
صحيح ● **غير صحيح** ⊖ ◉ ◒ ⊗ ☑

Question One — 28 Marks

Shade the best correct answer for each of the following questions.

1. A pendulum of mass **(m)** oscillates back and forth around the point **(P)** as shown in the figure below. When mass (**m**) passes through point **(P)**, which of the following combinations describes its velocity **(*v*)** and acceleration (a)?

	Velocity (*v*)	**Acceleration** (a)
☐	zero	zero
☐	maximum	zero
☐	zero	maximum
☐	maximum	maximum

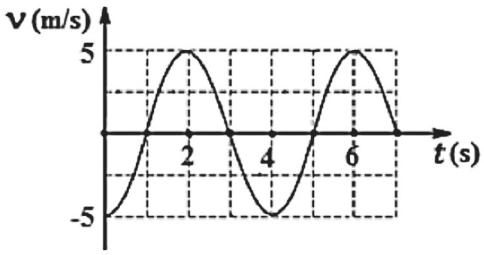


2. Object (A) is four times heavier than object (B), each object is attached to a spring with equal spring constants. If the two objects undergoes simple harmonic motion, what will be the ratio of the time periods of the two oscillators ($T_A : T_B$)?

☐ 1 : 4 ☐ 4 : 1

☐ 2 : 1 ☐ 1 : 2

3. The diagram opposite shows the velocity-time graph for a body executing simple harmonic motion. What is the maximum acceleration of the body?



☐ 1.25π ☐ 2.5π

☐ $1.25\pi^2$ ☐ $2.5\pi^2$

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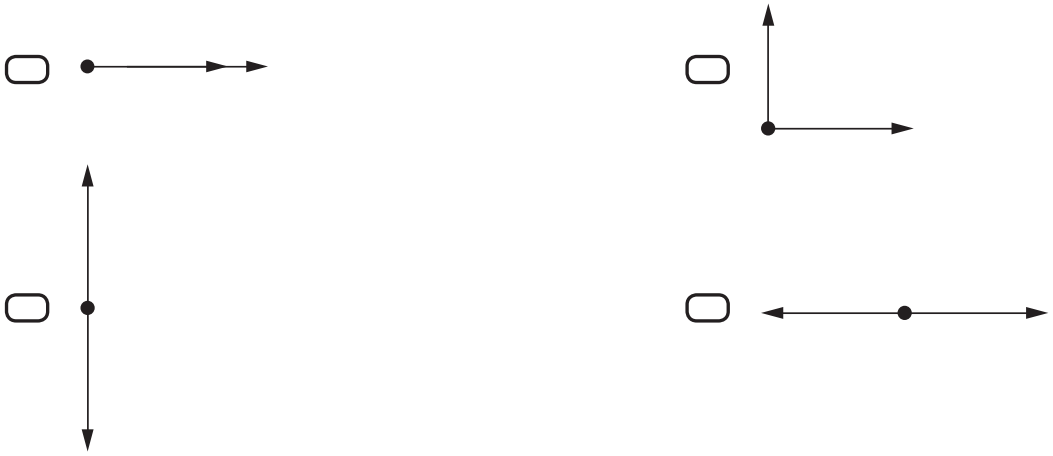
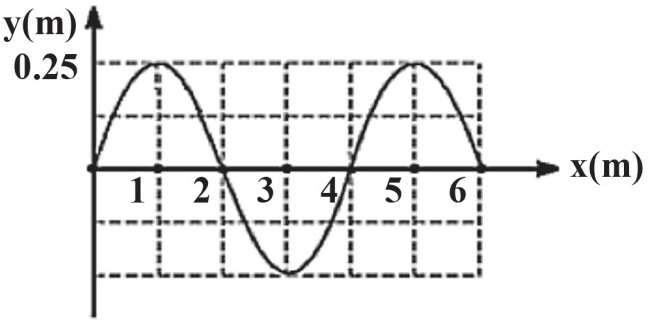
4. When a sound wave travels through air, which of the following diagrams is correct for the wave and particle direction?



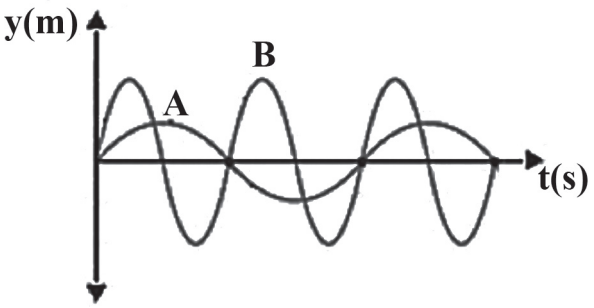
5. The graph opposite shows a wave moving with frequency of **(3 Hz)**.

What is the speed of the wave?



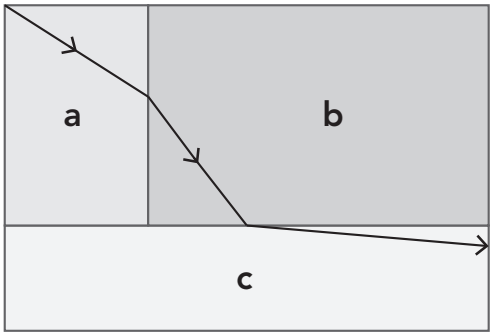
- 0.75
- 4.70
- 12.0
- 18.0

6. The diagram opposite shows two mechanical waves **(A)** and **(B)** travelling to the right. Which of the following combinations are correct regarding their energy **(E)** and angular frequency **(ω)**?



$E_A > E_B$	$\omega_A > \omega_B$
$E_A > E_B$	$\omega_A < \omega_B$
$E_A < E_B$	$\omega_A > \omega B$
$E_A < E_B$	$\omega_A < \omega_B$

7. The graph opposite shows rays of monochromatic light passing through three materials **(a)**, **(b)**, and **(c)**. Which of the following represents the relationship between the refractive indices of these materials?



- ☐ $n_a = n_b = n_c$
- ☐ $n_a > n_b > n_c$
- ☐ $n_b > n_c > n_a$
- ☐ $n_c > n_b > n_a$

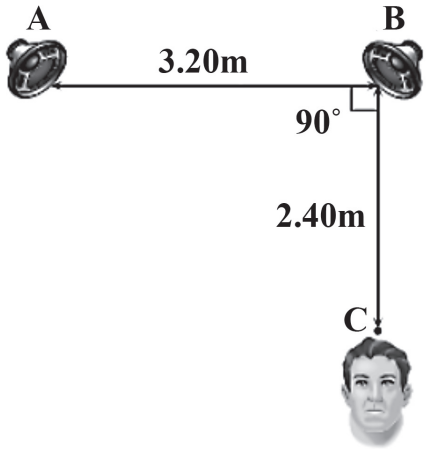
8. Standing waves are produced by the superposition of two waves. Under which of the following conditions are these waves produced?

	Amplitude	Frequency	Direction or propagation
☐	same	same	same
☐	same	same	opposite
☐	same	different	same
☐	different	different	opposite

9. A single slit of width **(996 nm)** forms a diffraction pattern, with the first maximum at an angle of **(40°)** from the central maximum. What is the wavelength of the monochromatic light used in **(nm)**?

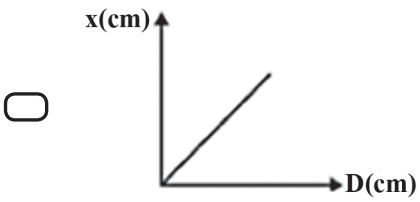
- ☐ 132.4
- ☐ 264.2
- ☐ 329.1
- ☐ 640.2

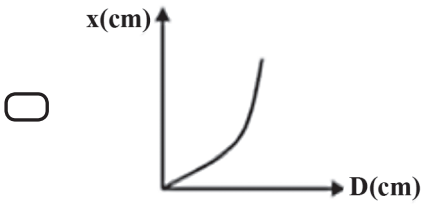
10. Two loudspeakers **(A)** and **(B)** are positioned as shown in the figure opposite. A listener is stationed at point **(C)**. Both speakers are emitting sound waves with identical frequencies **(214 Hz)**, and the speed of sound is **(343 m/s)**.What does the path difference of the two sources at the listener equals?

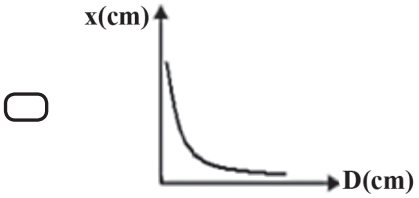


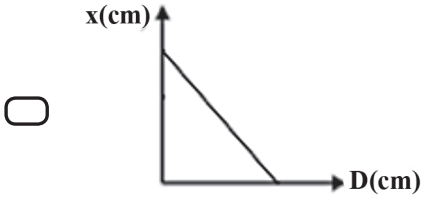
- ☐ 0.5 λ
- ☐ λ
- ☐ 1.3 λ
- ☐ 2 λ

11. In Young's experiment, which of the following graphs represents the relationship between screen-slit distance (**D**) and the separation of maxima (**x**)?

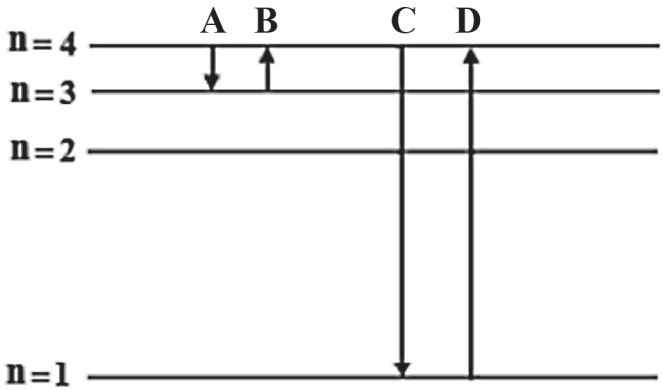








12. The diagram below shows the energy levels for an electron in Hydrogen atom.



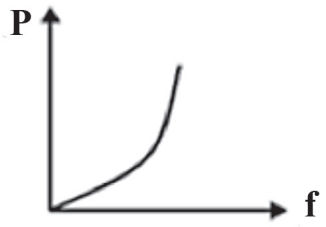
Which of the following transitions represents the lowest energy absorption?

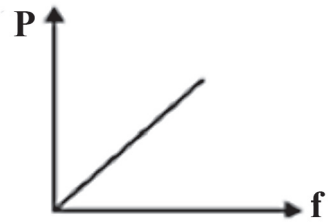
- A
- B
- C
- D

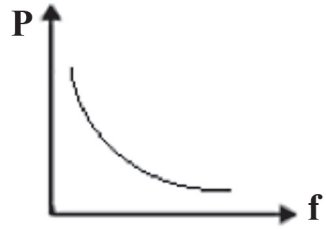
13. What is the de-Broglie wavelength in (**nm**) of an electron with kinetic energy of **(1.92×10^{-17} J)**?

- ☐ 0.112
- ☐ 1.12
- ☐ 11.2
- ☐ 112

14. Which of the following graphs represents the relationship between the momentum and the frequency of the photon?

- ☐ 

- ☐ 

- ☐ 

- ☐ 

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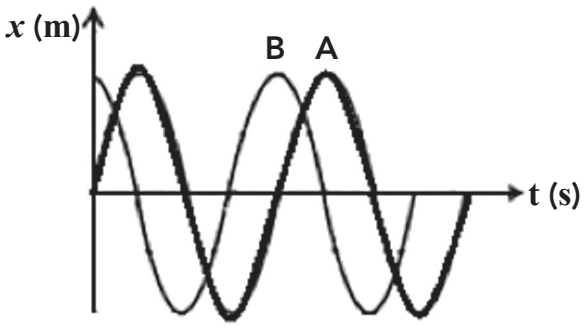
Write your answer for each of the three questions in the constructed response section in the space provided.
Be sure to show all your work, including the correct units where applicable.

Question Two — 14 Marks

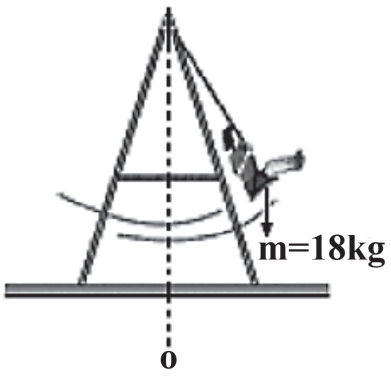
15. The graph opposite shows two waves **(A)** and **(B)**.



A. What is the phase difference between the two waves? (1 mark)

B. Write down the equation of displacement of wave **(A)** and wave **(B)** if the two waves start motion from **(t = 0)**. (2 marks)

16. The diagram opposite shows Sara swinging on a garden swing. At a certain time the swing was **(2 m)** from equilibrium position with velocity of **(4 m/s)** and acceleration of **(10 m/s^2)**. Ignoring the air resistance, calculate the following:

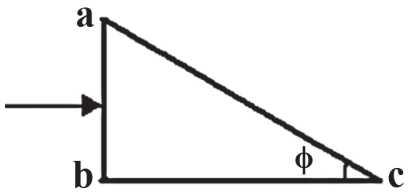


A. The time period **(T)** of this motion. (2 marks)

B. The kinetic energy at this position. (2 marks)

17. A particle is executing simple harmonic motion according to the equation $x = 5 \sin (20\ t)$. It started its motion at time ($t = 0$). Find the time at first maximum displacement? (3 marks)

18. A ray of light is perpendicular to the face **(ab)** of a glass triangle placed in air as shown in the figure opposite. ($n_{glass} = 1.52$)



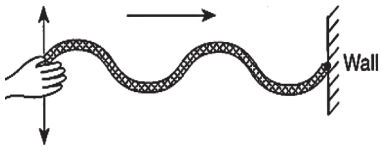
A. Find the critical angle when the ray reaches face **(ac)**. (2 marks)

B. If the triangle is then placed in water **($n_{water} = 1.33$)**, what will be the effect of that on the critical angle? Explain your answer. (2 marks)

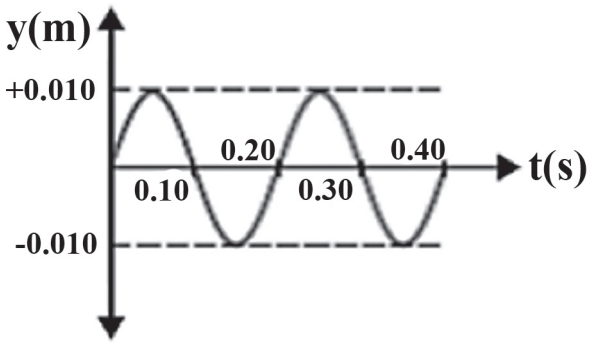
Question Three: 14 Marks

19. Compare between the waves produced by the following in the table below:

(2 marks)

		
Types of waves produced (Longitudinal **or** Transverse).		
The direction of propagation of particles on the wave compared to the wave direction.		

20. The graph opposite represents the relationship between the displacement **y (m)** and the time **(t)**.



Answer the following questions:

A. What is meant by: "The amplitude of oscillation is **(0.01 m)**"? (2 marks)

B. Calculate the angular frequency of the motion. (2 marks)

C. Find the maximum speed. (2 marks)

21. Define the (node) in a standing wave. (2 marks)

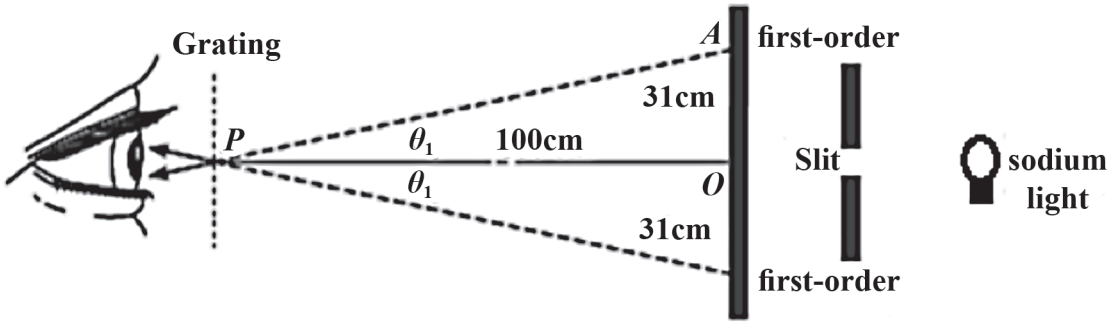
22. A bird standing on a tree branch emits a sound of wavelength **(0.1 m)**. The change in the wavelength **(Δλ)** when it flies directly towards a stationary listener is **(0.002 m)**.

A. As the bird move closer toward the listener, its sound becomes louder. Explain. (2 marks)

B. Calculate the speed of the bird. (2 marks)

Question Four: (14 Marks)

23. The figure below shows a laboratory setup for grating experiment. The grating has **5000 lines/cm** and is **(100 cm)** from the slit, which is illuminated with sodium light.



A. Determine what will happen to the distance between the fringes if the slit width was increased. (Increase or Decrease) (1 mark)

Explain your answer. (1 mark)

B. Calculate the wavelength of the light if each first- order image is **(31 cm)** from the slit. (3 marks)

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24. How did the quantum theory explain the ejection of the electron from the metal in photoelectric effect when the metal is illuminated by appropriate light.

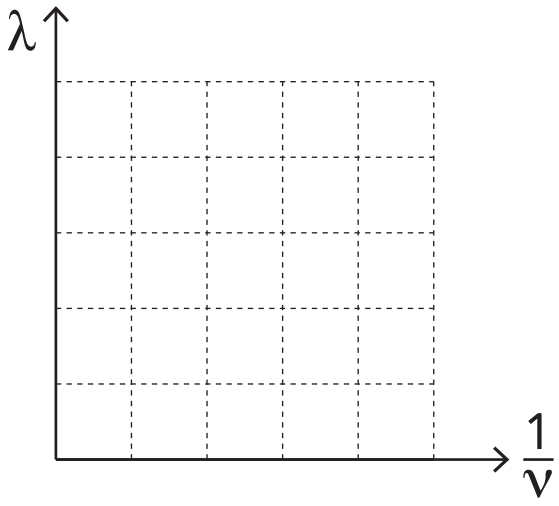
(2 marks)

25. Calculate in **(eV)** the energy of a photon of blue light of wavelength **(450 nm)**. (2 marks)

26. De Broglie assumed that "an electron orbit would be stable only if it contained a (whole) number of electron wavelengths".

Regarding De Broglie's hypothesis, answer the following questions:

A. Draw a graph representing the relationship between the wavelength **(λ)** in the (y-axis) and the inverse of the velocity $\frac{1}{v}$ in the (x-axis). (1 mark)



B. From the graph prove that the gradient equals **(7.29×10^4 m^2/s)**. (3 marks)

C. What will happen to De Broglie's wavelength if we displace the electron with a proton moving with the same speed? (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

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

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

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

$n_{air} = 1$

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

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

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

$g = 9.8\ m/s^2$

مُسَوَّدَة

Physics 2013/2014 Bilingual Exams

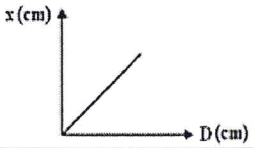
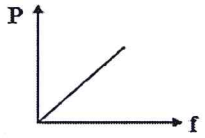
2nd Semester, 2nd Session

MarkingGuide

Answers for Question One:(28 marks)

item	answer	answer	mark	C.L	OB
1	b	velocity / acceleration maximum / zero	2	K	1.1
2	c	2:1	2	A	1.6.ii
3	c	$1.25\pi^2$	2	A	1.5
4	a		2	K	2.8
5	c	12.0	2	A	2.4
6	d	$E_A<E_B$ / $\omega_A<\omega_B$	2	A	2.2 2.6
7	b	$\mathbf{n_a>n_b>n_c}$	2	R	2.10
8	b	same / same / opposite	2	K	3.4
9	d	640.2	2	A	3.11

Answers for Question One:(28 marks)

item	answer	answer	mark	C.L	OB
10	b	λ	2	R	3.2
11	a		2	R	3.10
12	b	B	2	K	4.5
13	a	0.112	2	A	4.9
14	b		2	R	4.8

Answers for Question Two:(14 marks)

item	answer	mark	C.L	OB
(15) -a	90^o or $\frac{\pi}{2}$ or -90^o or $-\frac{\pi}{2}$	1	K	1.3
(15) -b	For wave (A) $x = A\sin(\omega t)$ For wave (B) $x = A\cos(\omega t)$ **or** $x = A\sin(\omega t + \frac{\pi}{2})$	1 1	K	1.5
(16) -a	$a = \omega^2 x \rightarrow 10 = \omega^2 \times 2$ $\omega^2 = \frac{10}{2} = 5$ $\omega = \sqrt{5}\,rad/s = 2.24\,rad/s$ $T = \frac{2\pi}{\omega} = \frac{2\pi}{2.24}$ $T = 2.8s$	 1 1	A	1.5 1.6
(16) -b	$KE = \frac{1}{2}mv^2 = \frac{1}{2}\times 18\times 4^2$ $KE = 144J$	1 1	A	1.8

Answers for Question Two:(14 marks)

item	answer	mark	C.L	OB
(17)	At point P (maximum displacement) at which occurs <u>maximum acceleration.</u> $a=-\omega^2 A\sin(\omega t)$ $-\omega^2 A=-\omega^2 A\sin(20t)$ $\sin(20t)=1$ $20t=\frac{\pi}{2}$ $t=\frac{\pi}{40}s$ **<u>Another solution;</u>** <u>At this position (v= 0)</u> $v=\omega A\cos(\omega t)$ $0=20\times5\cos(20t)$ 1 $0=\cos(20t)$ $\frac{1}{2}$ $20t=\frac{\pi}{2}$ $\frac{1}{2}$ $t=\frac{\pi}{40}s$ 1	1 $\frac{1}{2}$ $\frac{1}{2}$ 1	R	1.5
(18) -a	From Snell's law $\frac{n_2}{n_1}=\frac{\sin(\theta_1)}{\sin(\theta_2)}$ $\frac{1}{1.52}=\frac{\sin(\theta_2)}{\sin(90)}\rightarrow\sin(\theta_2)=\frac{1}{1.52}=0.65$ $\theta_2=41.1^o$	1 1	A	1.12 1.13

Answers for Question Two:(14 marks)

item	answer	mark	C.L	OB
(18) -b	In the case of water The critical angle will increase Because the relationship between (n and θ) is direct. **Or:** $\frac{1.33}{1.52}=\frac{\sin(\theta_2)}{\sin(90)} \rightarrow \sin(\theta_2)=\frac{1.33}{1.52}=0.87$ $\frac{1}{2}$ $\theta_2 = 61^o$ $\frac{1}{2}$	1 1	R	1.12 1.13

Answers for Question Three:(14 marks)

item	answer	mark	C.L	OB
(19)	<table><tr><td>Type of wave.</td><td>Longitudinal wave.</td><td>Transverse wave.</td></tr><tr><td>The direction of propagation of particles on the wave.</td><td>In same direction as the wave.</td><td>Perpendicular to the wave.</td></tr></table>	$\frac{1}{2}+\frac{1}{2}$ $\frac{1}{2}+\frac{1}{2}$	K	2.7
(20)-a	The maximum displacement from the center of the motion equals (0.01 m).	2	A	2.2
(20)-b	$\omega = \frac{2\pi}{T}$ $\omega = \frac{2\pi}{0.2}$ $\omega = 31.4 rad/s$ **Or:** $\omega = 2\pi f$ $\omega = 2\pi \times 5$ $\omega = 31.4 rad/s$	1 1 1 1	A	2.3

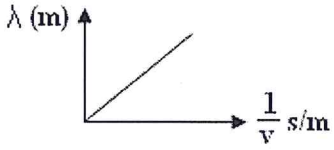
Answers for Question Three:(14 marks)

(20)-c	From the graph A= 0.01m $v = \omega A$ $v = 0.01 \times 31.4$ $v = 0.314\ m/s$	 1 1	A	2.2
(21)	The points of no oscillation. **Or**: The point where the string does not moves at all.	2	K	2.2
(22)-a	Because the apparent wavelength is shorter and hence the frequency is greater.	2	A	2.2
(22)-b	From Doppler equation $\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$ $v = \frac{340 \times 0.002}{0.1}$ $v = 6.8m$	 1 1	R	2.12 2.13

Answers for Question Four: (14 marks)

item	answer	mark	C.L	OB
(23)- a	The distance between the fringes will decrease. Because there is an inverse relationship between the slit width and the distance between the fringes.	1 1	A	3.11
(23)-b	$d = \frac{1}{5000} = 2 \times 10^{-4}$ $\therefore \lambda = \frac{0.000200 \times 0.296}{1}$ $\therefore \lambda = 592 \times 10^{-7} cm = 592\ nm$	1 1 1	A	3.11
(24)	In photo electric, an ejection of an electron from metal occurs by photon. A certain photon with a certain amount of energy can do that.	2	K	4.4
(25)	$E = \frac{hc}{\lambda}$ $\therefore E = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{450 \times 10^{-9}}$ $\therefore E = 4.42 \times 10^{-19} J$ $= 2.76\ eV$	1 1	A	4.8

Answers for Question Four: (14 marks)

item	answer	mark	C.L	OB
26-(a)		1	A	4.9
26-(b)	$the\ gradiant = \frac{h}{m}$ $\lambda v = \frac{h}{m}$ $= \frac{6.63x10^{-34}}{9.11x10^{-31}}$ $= 7.29x10^{-4} m^2/s$	1 1 1	R A	4.9
26-(C)	It will decrease	1	k	4.9

End of Marking Guide