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 الأول - الفصل الدراسي الثاني

تنبيه:
- المادة: الفيزياء.
- الأسئلة في (١٧) 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

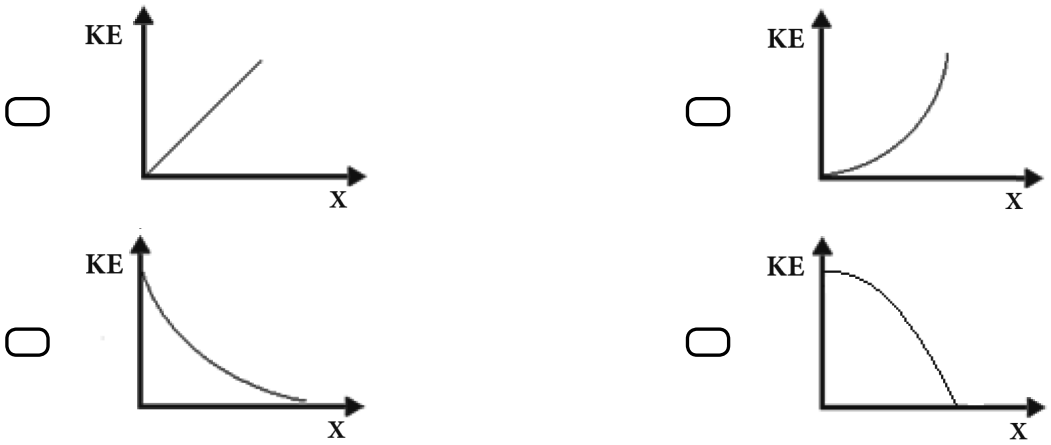
ملاحظة: يتم تظليل الشكل (●) باستخدام القلم الرصاص وعند الخطأ، امسح بعناية لإجراء التغيير.

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. A body undergoes simple harmonic motion. Which graph shows the relationship between the kinetic energy **(KE)** of this body and the displacement **(x)** when it moves from the equilibrium position to the maximum displacement?

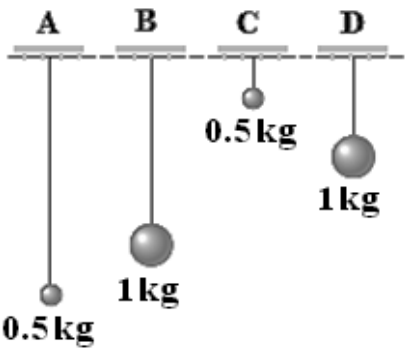


2. Two identical masses **(M)** and **(N)** are suspended from two separate massless springs of spring constant **(k_M)** and **(k_N)** respectively, both systems oscillate vertically with the same maximum velocities. What is the ratio of the amplitudes **(A_M/A_N)**?

- $\sqrt{k_M / k_N}$
- $\sqrt{k_N / k_M}$
- k_M / k_N
- k_N / k_M

3. Four simple pendulums of different lengths and masses are shown in the below figure. Which pendulum has the largest angular frequency **(ω)**?

- A
- B
- C
- D

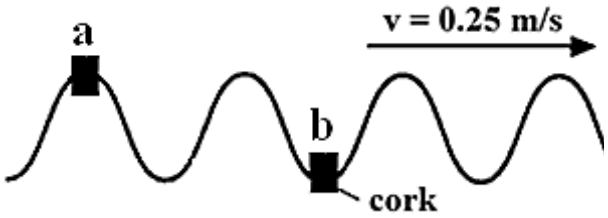


Question One (Cont'd)

4. Four wave sources each produce waves in **(1s)**. Which of these wave sources has the lowest frequency **(f)**?

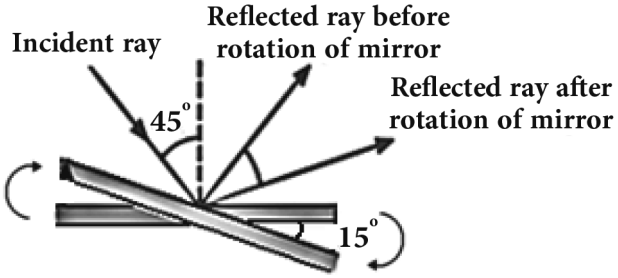
5. In the diagram below, a water wave causes a cork to move from point **(a)** to point **(b)** in 8 seconds. What is the wavelength of this water wave?

- 0.17 m
- 1.33 m
- 1.5 m
- 2.0 m



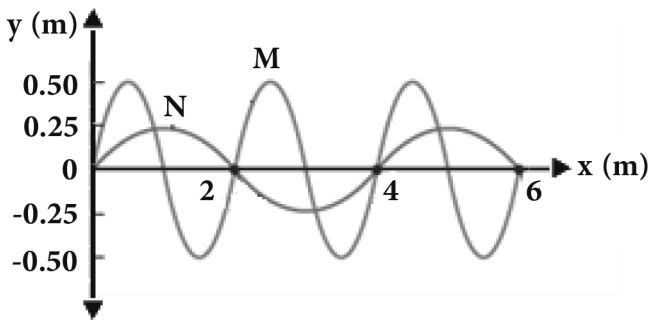
6. A ray of light strikes a plane mirror at a **(45°)** angle of incidence. The mirror is then rotated by **(15°)** into the position shown in in the figure below, while the incident ray is kept fixed, What will be the reflection angle after the rotation?

- 15°
- 30°
- 45°
- 60°



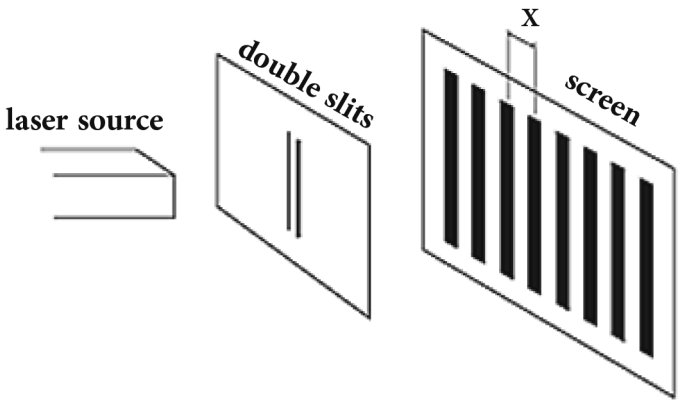
7. The graph below shows two waves **(N)** and **(M)** traveling in air to the right. Which of the following combinations is correct about their wavelength **(λ)** and speed **(ν)**?

	Wavelength (λ)	speed (ν)
☐	$\lambda_N = 2\lambda_M$	$\nu_N = 1/2\ \nu_M$
☐	$\lambda_N = \lambda_M$	$\nu_N = \nu_M$
☐	$\lambda_N = 1/2\ \lambda_M$	$\nu_N = 2\nu_M$
☐	$\lambda_N = 2\lambda_M$	$\nu_N = \nu_M$



Question One (Cont'd)

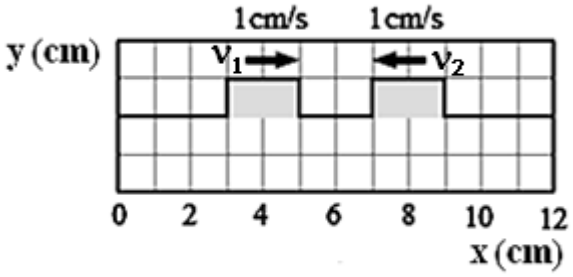
8. The figure below shows the patterns of bright and dark fringes observed in Young's double slit experiment.



Which of the following actions will increase the distance **(x)** between the dark fringes in this double slit interference pattern?

- ☐ Decrease the slit width.
- ☐ Decrease the slit separation.
- ☐ Decrease the slit-screen distance.
- ☐ Decrease the wavelength of the light.

9. The graph opposite shows two rectangular pulses **(1)** and **(2)** traveling at a constant speed of **(1cm/s)** starting from the position shown in the figure. Which of the following graphs represents the linear superposition of the two pulses after **(3s)**?



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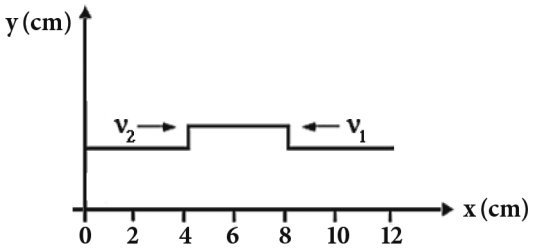

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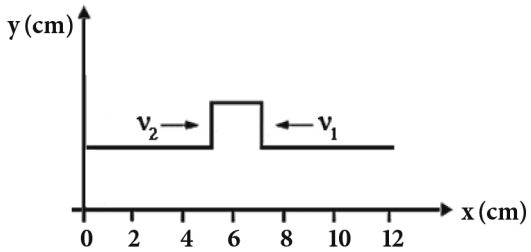

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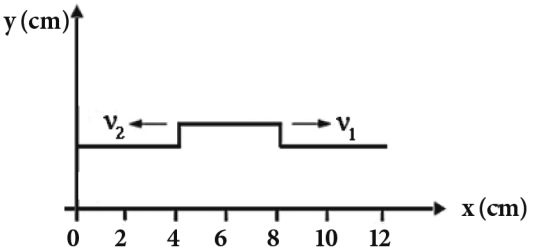

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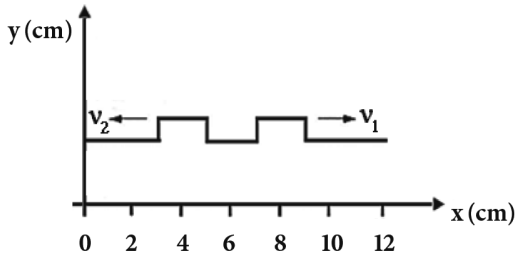
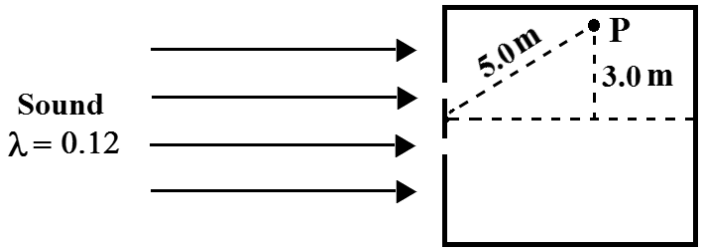


Question One (Cont'd)

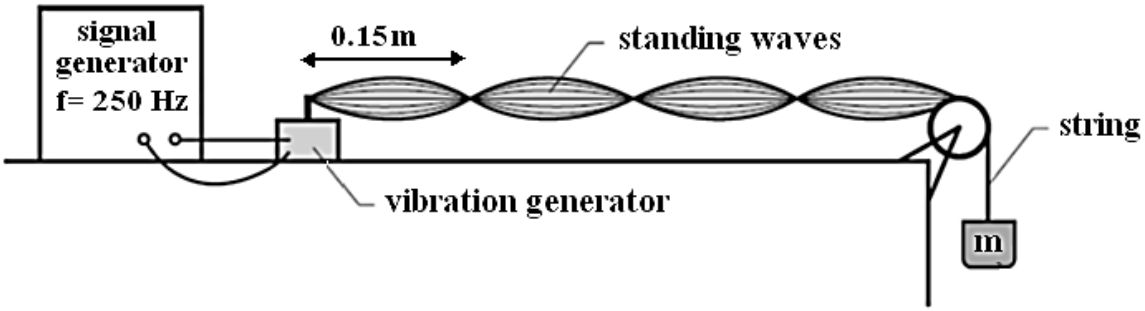
10. Plane sound waves of wavelength **(0.12 m)** are incident on two narrow slits in a box with non reflecting walls as shown in the figure below. At a distance of **(5.0 m)** from the center of the slits, a first-order maximum occurs at point **P**.



What is the distance between the slits?

- ☐ 0.09 m
- ☐ 0.16 m
- ☐ 0.20 m
- ☐ 0.24 m

11. The apparatus shown below is set to measure the speed of transverse waves.



What will be the speed of the waves if the frequency of the signal generator is doubled?

- ☐ 18.8 m/s
- ☐ 37.5 m/s
- ☐ 75 m/s
- ☐ 150 m/s

12. In the photo electric effect, which of the following would lead to an increase in the maximum kinetic energy of the emitted electrons?

- ☐ Decreasing the frequency of the incident light.
- ☐ Increasing the frequency of the incident light.
- ☐ Decreasing the number of photons per second striking the surface.
- ☐ Increasing the number of photons per second striking the surface.

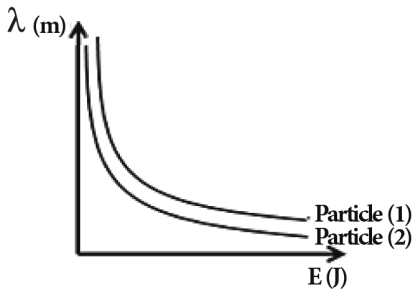
Question One (Cont'd)

13. Photon **(A)** has twice the energy of photon **(B)**, which is the correct option for their momentum **(P)** and wavelength **(λ)**?

	Momentum (*P*)	Wavelength (λ)
☐	$P_A < P_B$	$\lambda_A < \lambda_B$
☐	$P_A = P_B$	$\lambda_A < \lambda_B$
☐	$P_A = P_B$	$\lambda_A > \lambda_B$
☐	$P_A > P_B$	$\lambda_A < \lambda_B$

14. In the case if two identical particles (1) and (2), if particle (1) is moving faster than particle (2), which graph represents the relation between wavelength and energy for each particle compared to the other?

☐



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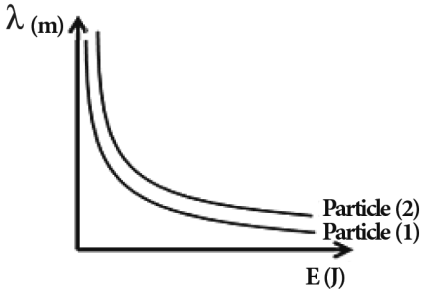

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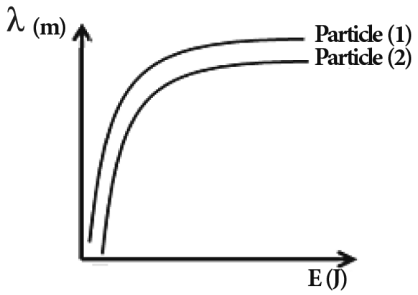

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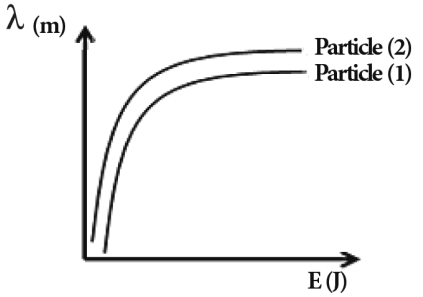

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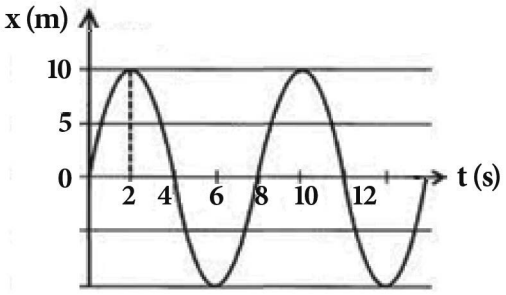
Write your answer for each of the three questions in the constructed–response section in the space provided.

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

Question Two: (14 marks)

15. The below graph shows the simple harmonic motion of a pendulum.



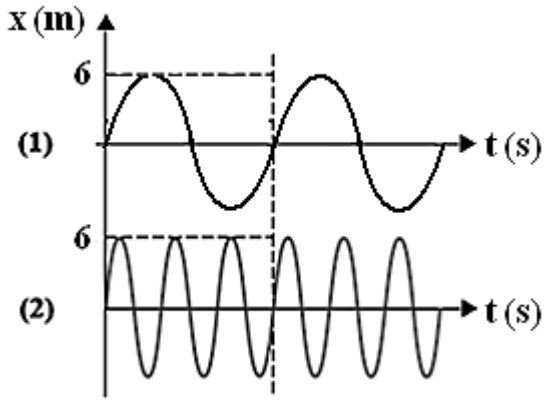
a. What is meant by: "the amplitude of the oscillation is 10 m"? (1 mark)

b. Find the angular frequency for this harmonic motion. (1 mark)

c. Calculate the value of acceleration at time **(t = 5s)**. (2 marks)

Question Two (Cont'd)

16. The below graph shows two plots of displacement **(x)** versus time **(t)** for two objects undergoing simple harmonic motion.



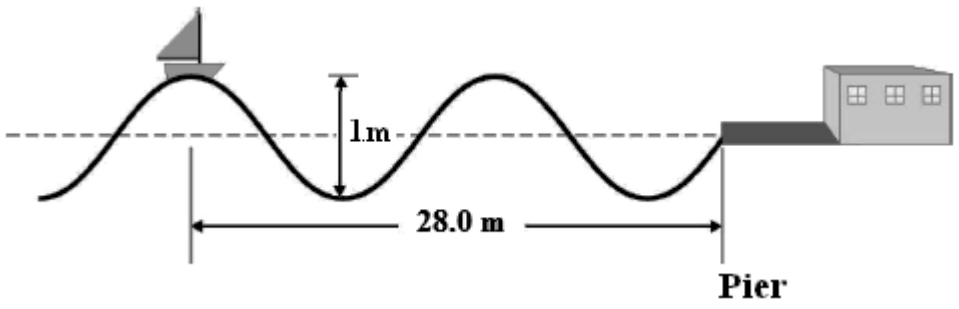
a. Which object (1) or (2), has the greatest maximum velocity? Why? (2 marks)

b. For object (1) at what distance from equilibrium position will the kinetic energy be **(KE = $\frac{3}{4}$ E)**? (1 mark)

Question Two (Cont'd)

17. A particle started moving from equilibrium position with simple harmonic motion according to the equation $\mathbf{y = A\sin(\omega t)}$. Prove that at position $\left(\frac{A}{2}\right)$ the time taken by the particle is $\left(t = \frac{T}{12}\right)$. (3 marks)

18. A fisherman notices that his boat is moving up and down in a periodic way because of waves on the surface of the water. It takes **(5.0 s)** for the boat to travel from its highest point to its lowest point. The boat is **(28.0 m)** from the end of the pier as shown in the figure below.



a. What is the amplitude of the waves? (1 mark)

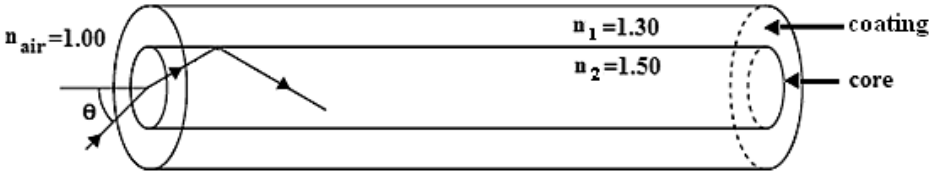
Question Two (Cont'd)

b. Find the frequency of the waves. (1 mark)

c. Calculate the speed of the waves. (2 marks)

Question Three: (14 marks)

19. The figure below shows an optical fiber cable with a coating of refractive index **(n_1= 1.30)** and a core of refractive index **(n_2= 1.50)**.



a. Define the following:

(i) The critical angle. (1 mark)

(ii) The total internal reflection. (1 mark)

b. Find the angle **(θ)**. (2 marks)

Question Three (Cont'd)

c. **i)** If the optical fiber cable is then placed in water **(n = 1.33)**, is it possible to get the critical angle when the ray transfers from water to the core of the optical fiber? (1 mark)

ii) Explain your answer. (1 mark)

20. Study figures (1) and (2), then answer the following questions:

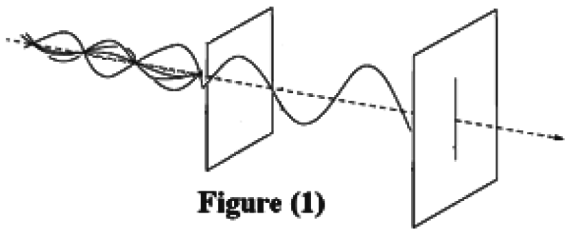


Figure (1)

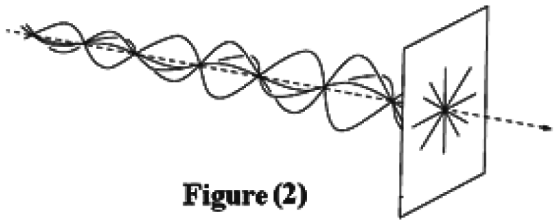


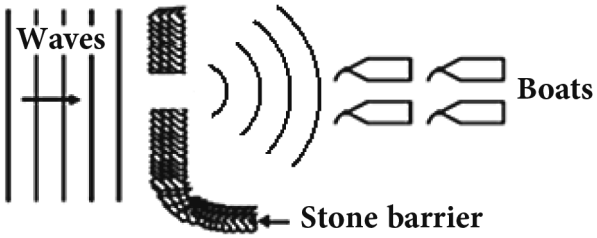
Figure (2)

a. Which of the figures represent a plane polarized wave? (1 mark)

b. Explain your answer. (1 mark)

Question Three (Cont'd)

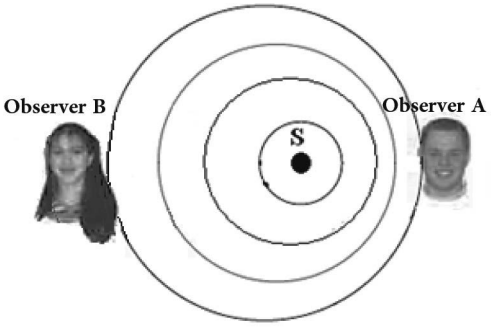
21. The below diagram shows ocean waves incident on a stone barrier protecting boats anchored behind it.



a. The boats could still be at risk of damage by waves mainly as a result of a certain phenomenon. What is this physical phenomenon? (1 mark)

b. Define this phenomenon. (1 mark)

22. A sound source **(S)** produces sound with wavelength **(0.20 m)**. The source is moving with a speed of **(2 m/s)** as shown in the figure opposite.



a. Find the change in the wavelength **($\Delta\lambda$)** (2 marks)

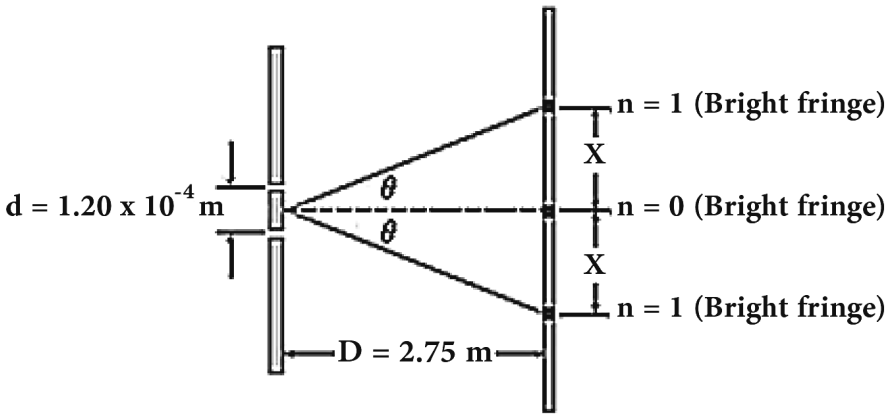
Question Three (Cont'd)

b. Towards which observer will the direction of the sound source motion be? (1 mark)

c. Explain your answer. (1 mark)

Question Four: (14 marks)

23. Red light of wavelength **(λ = 664 nm)** in vacuum is used in Young's experiment as shown in the below figure. The slits are separated by a distance of **(d= 1.2 × 10^{-4} m)** and the screen is located at a distance of **(D = 2.75 m)** from the slits.

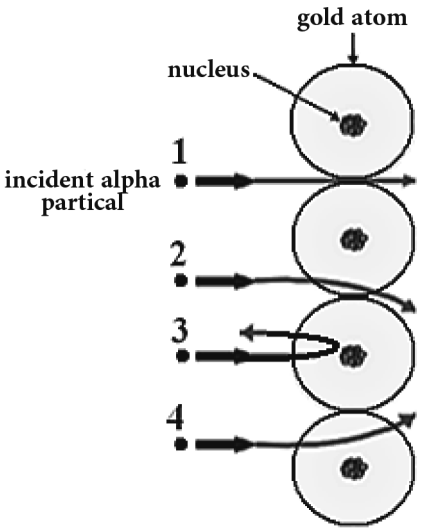


a. Find the distance **(x)** on the screen between the central bright fringe and the first order bright fringe. (2 marks)

Question Four (Cont'd)

b. If the red light is replaced by blue light of wavelength **(λ = 470 nm)**, what will happen to the distance of the third bright fringe from the central fringe. Explain. (2 marks)

24. The below figure shows the Rutherford experiment of alpha particles deflection. Rutherford noticed that alpha particles move on different paths.



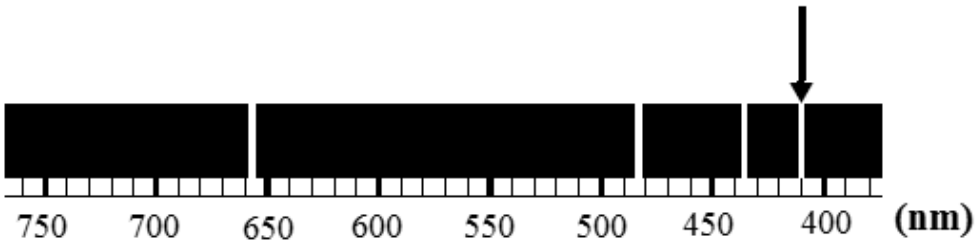
How did he explain the following:

a. Most of the alpha particles pass through the foil target. (1 mark)

Question Four (Cont'd)

b. Some of the alpha particles reflect backward. (1 mark)

25. The special line, indicated with an arrow in the figure below, is in the visible region of the spectrum.



a. Define the photon. (1 mark)

b. What is the energy in **(eV)** of a photon of this wavelength? (2 marks)

26. In a lab experiment for studying the photoelectric effect of three lights on different metals, the following data was obtained:

Color of light	Green	Blue	Ultraviolet
Wavelength of light (nm)	546	436	365

a. When Blue light falls on the metals shown in the following table:

Metals	A	B	C	D
Threshold frequency$\times 10^{14}$Hz	5.2	5.4	5.5	5.9

From which of these metals, electrons will be ejected? Explain your answer. (2 marks)

b. Calculate the energy of the photons of ultraviolet light. (2 marks)

c. If one beam of ultraviolet light can release **(8 electrons)** from metal **(C)** in **(4s)**, how many electrons will be released from this metal if three beams of ultraviolet light was used in **(4s)**. (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

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

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

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

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

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

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

$n_{air} = 1$

$g = 9.8\ m/s^2$

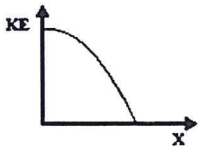
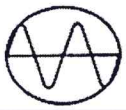
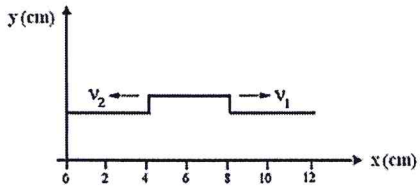
مُسوَّدَة

Physics 2013/2014 Bilingual Exams

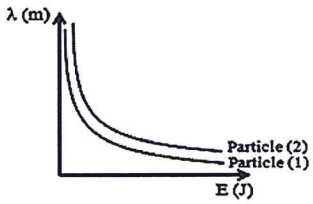
2nd Semester, 1st session

Marking Guide

Answers for Question One:(28 marks)

Item	Answer	Answer	Mark	C.L	OB
1	d		2	K	1.4
2	b	$\sqrt{k_N / k_M}$	2	A	1.3
3	c	C	2	A	1.6.i
4	a		2	K	2.2
5	b	1.33	2	A	2.4
6	d	60^o	2	A	2.10
7	d	$\lambda_N = 2\lambda_M$ | $\nu_N = \nu_M$	2	R	2.2 2.8
8	b	Decrease the slit separation	2	K	3.10
9	c		2	A	3.1

Answers for Question One:(28 marks)

Item	Answer	Answer	Mark	C.L	OB
10	b	0.16 m	2	R	3.9
11	c	75 m/s	2	R	3.3 3.4
12	b	Increasing the frequency of the incident light	2	K	4.8
13	d	$P_A > P_B$ $\lambda_A < \lambda_B$	2	A	4.8
14	b		2	R	4.9

Answers for Question Two:(14 marks)

Item	Answer	Mark	C.L	OB
(15) -a	The maximum displacement from the center of the motion is (10 m).	1	K	1.3
(15) -b	$\omega = \frac{2\pi}{T}$ $\omega = \frac{2\pi}{8}$ $\omega = \frac{\pi}{4}\text{rad/s} = 0.78\,\text{rad/s}$	1	A	1.4
(15) -c	$a = -\omega^2 A \sin(\omega t)$ $a = -(\frac{\pi}{4})^2 \times 10 \times \sin(\frac{\pi}{4}t)$ $a = -6.16 \sin(\frac{\pi}{4} \times 5)$ $a = -4.36\,m/s^2$	1 1	A	1.5
(16) -a	Wave (2). Because the frequency of wave (2) is greater than the frequency of wave (1)	1 1	A	1.2
(16) -b	$KE = \frac{3}{4}E$ $\frac{1}{2}m\omega^2(A^2 - x^2) = \frac{3}{4}(\frac{1}{2}m\omega^2 A^2)$ $A^2 - x^2 = \frac{3}{4}A^2 \rightarrow A^2 - \frac{3}{4}A^2 = x^2$ $\frac{1}{4}A^2 = x^2 \rightarrow x = \frac{1}{2}A$ $x = \frac{1}{2} \times (6) = 3m$	$\frac{1}{2}$ $\frac{1}{2}$	A	1.8

Answers for Question Two:(14 marks)

Item	Answer	Mark	C.L	OB
(17)	$y = A\sin(\omega t)$ $\frac{A}{2} = A\sin(\omega t)$ $\sin(\omega t) = \frac{1}{2}$ $\omega t = \frac{\pi}{6}$ $t = \frac{\pi}{6\omega}$ $\because \omega = \frac{2\pi}{T}$ $t = \frac{\pi T}{12\pi}$ $\therefore t = \frac{T}{12}$	1 1 $\frac{1}{2}$ $\frac{1}{2}$	R	2.13
(18)-a	From the figure: A=0.5m	1	A	2.2
(18)-b	$\because \frac{1}{2}T = 5s$ $T = 10s$ $f = \frac{1}{T} = \frac{1}{10}$ $f = 0.1Hz$	$\frac{1}{2}$ $\frac{1}{2}$	A	2.2
(18)-c	From the figure: $\frac{7}{4}\lambda = 28m \rightarrow \lambda = 16m$ $v = \lambda f = 16 \times 0.1$ $v = 1.6m/s$	1 $\frac{1}{2}$ $\frac{1}{2}$	A	2.4

Answers for Question Three: (14 marks)

Item	Answer	Mark	C.L	OB
(19)-a	- The critical angle: "The largest angle at which refraction out of a denser medium is just possible". - The total internal reflection: "a phenomenon happens when the angle of incidence is greater than the critical angle, so that all the incident rays are reflected back".	1 1	K	2.13
(19)-b	firstly calculate the critical angle $\frac{n_1}{n_2} = \frac{\sin(\theta_2)}{\sin(\theta_1)}$ $\frac{1.5}{1.3} = \frac{\sin(90)}{\sin(\theta_1)} \rightarrow \sin(\theta_1) = \frac{1.3}{1.5} = 0.86$ $\therefore \theta_1 = 60^\circ$ then, find angle θ $\frac{n_{air}}{n_1} = \frac{\sin(\theta_1)}{\sin(\theta)}$ From the figure, the refraction angle in the core is 30°, so for θ: $\frac{1}{1.5} = \frac{\sin(30)}{\sin(\theta)} \rightarrow \sin(\theta) = 0.5 \times 1.5$ $\theta = 48.6^\circ$	 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	A	2.12 2.13

Answers for Question Three: (14 marks)

Item	Answer	Mark	C.L	OB
(19) -c	No. By calculating the refraction angle in the core $\frac{1.33}{1.5}=\frac{\sin(\theta_3)}{\sin(48.6)}\rightarrow \sin(\theta_3)=\frac{1.33\times\sin(48.6)}{1.5}=0.66$ $\theta_3=41.6$ and the incidence angle between the core and coating will be=90-41.6=48.3° Hence the critical angle will not exist at this case. **Or:** Because the travels from less dense medium to more dense medium.	1 1	R	2.12 2.13
(20)-a	Figure (1).	1	K	2.9
(20)-b	Because the wave has the oscillation in one plane only.	1	K	2.9
(21)-a	Diffraction.	1	K	3.5
(21)-b	The bending of waves when they go through a gap, or curve round edges.	1	K	3.5

Answers for Question Three: (14 marks)

Item	Answer	Mark	C.L	OB
(22)-a	From Doppler equation $\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$ $\Delta\lambda = \frac{0.2\times 2}{340}$ $\Delta\lambda = 1.17\times 10^{-3} m$	 1 1	A	3.12
(22)-b	Observer (A)	1	K	3.13
(22)-c	Because the apparent wavelength is shorter and hence the frequency is greater.	1	A	3.13

Answers for Question Four: (14 marks)

Item	Answer	Mark	C.L	OB
(23)- a	From Young's equation $\frac{n\lambda}{s} = \frac{y}{D}$ $\frac{664\times10^{-9}}{1.2\times10^{-4}} = \frac{y}{2.75}$ $y = \frac{664\times10^{-9}\times2.75}{1.2\times10^{-4}}$ $y = 1.52\times10^{-2}\ m$	1 1	A	3.10
(23)-b	The wavelength of blue light is shorter than the wave length of red light. So, from Young's equation ,if we decrease the wavelength of light the separation between fringes will decrease.	2	A	3.9 3.10
(24)-a	Because most of atoms is space. **Or** The radios of the atoms is greater than the radius of the nucleus.	1	K	4.2
(24)-b	Because the alpha particles collide with a very heavy mass **Or** Because they are a large repulsive force with the same charge of Alpha particles.	1	K	4.2

Answers for Question Four: (14 marks)

Item	Answer	Mark	C.L	OB
(25)-a	A unit or quantum of light. **Or** A particle of electromagnetic radiation that has zero mass and carries a quantum of energy.	**1**	k	4.6
(25)-b	$E = hf = h\frac{c}{\lambda}$ $E = 6.63\times10^{-34} \times \frac{3\times10^{8}}{410\times10^{-9}}$ $E = 4.85\times10^{-19}\,J$ To find the energy in (eV): $E = \frac{4.85\times10^{-19}}{1.6\times10^{-19}}$ $E = 3.03eV$	**1** $\frac{1}{2}$ $\frac{1}{2}$	A	4.1
(26)-a	The green light can release electrons from metals (A and B) only. Because the frequency of green light is greater than the threshold frequency of metals (A and B) and less than metals (C and D). **Or:** $C = \lambda f$ $\therefore f = \frac{3\times10^{8}}{546\times10^{-9}}$ $\frac{1}{2}$ $f = 5.49\times10^{14}\,Hz$ $\frac{1}{2}$	**1** 1	A	4.8

Answers for Question Four: (14 marks)

Item	Answer	Mark	C.L	OB
(26)-b	$\lambda = 365\times10^{-9}\,m$ $E = h\frac{c}{\lambda} = \frac{6.63\times10^{-34}\times3\times10^{8}}{365\times10^{-9}}$ $\therefore E = 5.45\times10^{-19}\,J$	1 1	A	4.8
(26)-c	1 beam releases 8 electrons. Three beams release: 3×8= 24 electrons	1	A	4. 8

End of Marking Guide