



امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)

الفصل الدراسي الثاني - الدور الأول

للعام الدراسي ١٤٤٧/١٤٤٦ هـ - ٢٠٢٤ / ٢٠٢٥ م

تنبيه:
- المادة: الفيزياء.
- الأسئلة في (١٤) صفحة.
- زمن الإجابة: ثلاث ساعات.
- الإجابة في الورقة نفسها.

تعليمات مهمة:

- يجب الحضور إلى قاعة الامتحان قبل عشر دقائق على الأقل من بدء زمن الامتحان.
- يجب إحضار أصل ما يثبت الهوية وإبرازها للعاملين بالامتحانات.
- يجب الالتزام بالزي (الدشداشة البيضاء والمصر أو الكمة للذكور) والزي المدرسي للطالبات ، ويستثنى من ذلك الدارسون من غير العمانيين بشرط الالتزام بالذوق العام، ويمنع على جميع المتقدمات ارتداء النقاب داخل المركز وقاعات الامتحان.
- يحظر على الممتحنين اصطحاب الهواتف النقالة وأجهزة النداء الآلي وآلات التصوير والحواسيب الشخصية والساعات الرقمية الذكية والآلات الحاسبة ذات الصفة التخزينية والمجلات والصحف والكتب الدراسية والدفاتر والمذكرات والحقائب اليدوية والآلات الحادة أو الأسلحة أياً كان نوعها وأي شيء له علاقة بالامتحان.
- يجب على الممتحن الامتثال لإجراءات التفتيش داخل المركز طوال أيام الامتحان.
- يجب على الممتحن التأكد من استلام دفتر امتحانه، مغلفاً بغلاف بلاستيكي شفاف وغير ممزق ، وهو مسؤول عنه حتى يسلمه لمراقبي اللجنة بعد الانتهاء من الإجابة.
- يجب الالتزام بضوابط إدارة امتحانات دبلوم التعليم العام وما في مستواه وأية مخالفة لهذه الضوابط تعرضك للتدابير والإجراءات والعقوبات المنصوص عليها بالقرار الوزاري رقم ٥٨٨ / ٢٠١٥.
- 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 – عاصمة سلطنة عمان 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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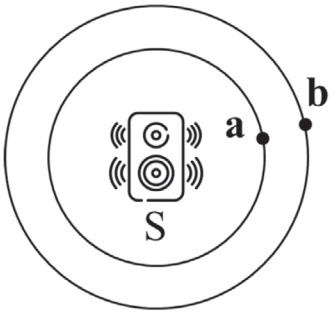
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Question 1: Multiple Choice Items (14 marks)

There are 14 multiple choice items worth one mark each.
Shade in the bubble (⬭) next to the **best** answer for each item.

1) Sound waves propagate from a source (S) as shown in the figure below.
Which row correctly describes the intensity (I) and the power (P) at two points (a) and (b)?

	Intensity	Power
⬭	$I_a > I_b$	$P_a = P_b$
⬭	$I_a = I_b$	$P_a = P_b$
⬭	$I_a > I_b$	$P_a < P_b$
⬭	$I_a < I_b$	$P_a > P_b$



2) Which of the following statements **is correct** about wave interference?

⬭ Destructive when waves meet in phase.
⬭ Constructive when waves meet in phase.
⬭ Destructive when the path difference is (2λ).
⬭ Constructive when the path difference is $(\lambda/2)$.

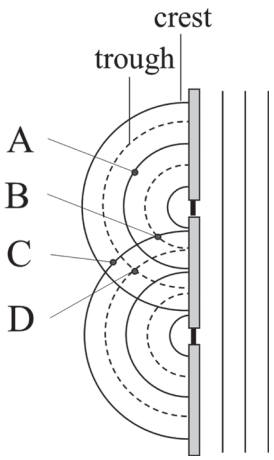
3) Which of the following waves can be polarized?

⬭ Sound waves.
⬭ Light waves.
⬭ Transverse waves on a spring.
⬭ Longitudinal waves on a spring.

4) The figure opposite shows water waves in a ripple tank produced by two coherent sources.

At which point is the displacement of the waves at the maximum?

⬭ A
⬭ B
⬭ C
⬭ D



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Question 1 continued

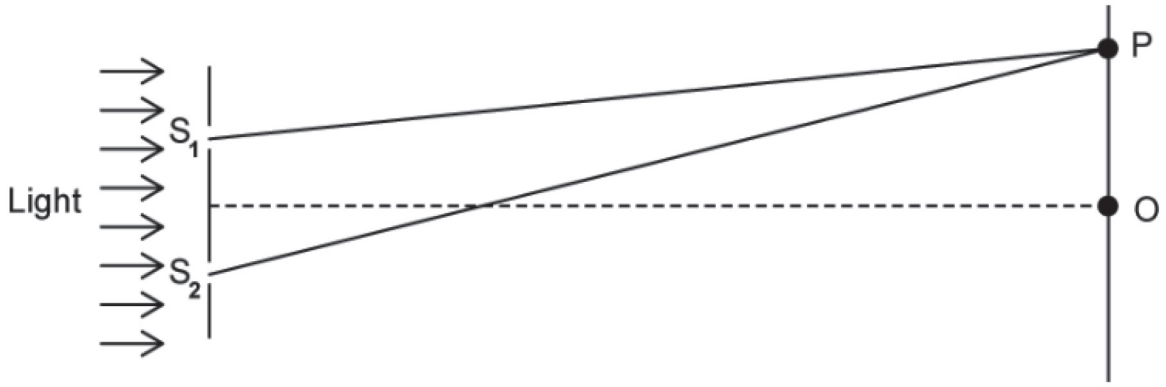
5) What is the frequency of the third harmonic in an one-end closed pipe of length (L)?

- ○ $\frac{255}{L}$
- ○ $\frac{425}{L}$
- ○ $\frac{510}{L}$
- ○ $\frac{850}{L}$

6) A diffraction grating is used to analyze white light. If the red light in the first-order spectrum appears at (30°), where will the green light in the first-order spectrum appear?

- ○ Will not appear.
- ○ At a larger angle.
- ○ At a smaller angle.
- ○ At the same angle.

7) The figure below shows Young's double- slit experiment with two light sources (S_1) and (S_2) emitting light of frequency (f). The central bright fringe appears at point (O), while the second-order bright fringe is observed at point (P).



What is the distance ($S_2P - S_1P$)?

- ○ $\frac{f}{c}$
- ○ $\frac{2c}{f}$
- ○ $\frac{c}{f}$
- ○ $\frac{2f}{c}$

8) "The release of electrons from the surface of a metal when an electromagnetic radiation is incident on its surface" is called:

- ○ Stopping potential.
- ○ Kinetic energy.
- ○ Photoelectric effect.
- ○ Threshold frequency.

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Question 1 continued

9) An electron with a maximum kinetic energy of (15.8 eV) is emitted from a metal surface of work function ($\varnothing$ = 2.4 eV).
What is the frequency of the incident light?

- ○ $3.24 \times 10^{15}\ Hz$
- ○ $3.81 \times 10^{15}\ Hz$
- ○ $4.39 \times 10^{15}\ Hz$
- ○ $5.72 \times 10^{15}\ Hz$

10) If the de Broglie wavelength of an electron (λ_e) is four times the de Broglie wavelength of a proton (λ_p), what will be the ratio of the velocity of proton to the velocity of the electron $\left(\frac{v_p}{v_e}\right)$ in term of their masses?

- ○ $\frac{4\ m_e}{m_p}$
- ○ $\frac{4\ m_p}{m_e}$
- ○ $\frac{m_e}{4\ m_p}$
- ○ $\frac{m_p}{4\ m_e}$

11) What conclusion can be drawn from the fact that most α-particles pass through undeflected in Rutherford's scattering experiment?

- ○ The atom is neutrally charged.
- ○ The nucleus is positively charged.
- ○ Electrons orbit the atomic nucleus.
- ○ The existence of and the small size of the nucleus.

12) Carbon-14 undergoes (β–) decay to form a stable isotope of Nitrogen (N).
Which option correctly gives the missing numbers in the following nuclear equation?

$$^{14}_{6}\mathrm{C} \longrightarrow {}^{X}_{Y}\mathrm{N} + {}^{Z}_{L}\beta + \bar{\nu}$$

	X	Y	Z	L
○	14	7	0	-1
○	13	7	0	-1
○	13	6	-1	0
○	14	6	-1	0

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Question 1 continued

13) Figures (1) and (2) below show the behaviors of different types of radiation rays.

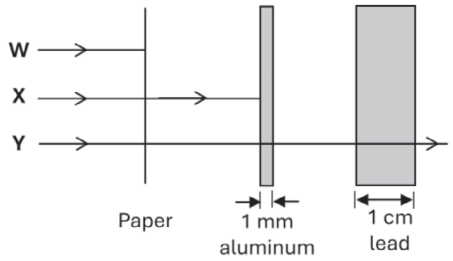


Figure (1)

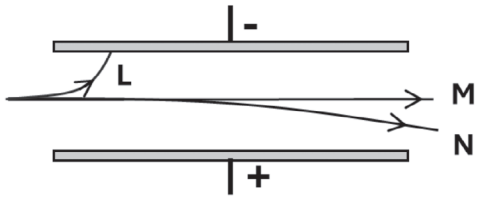
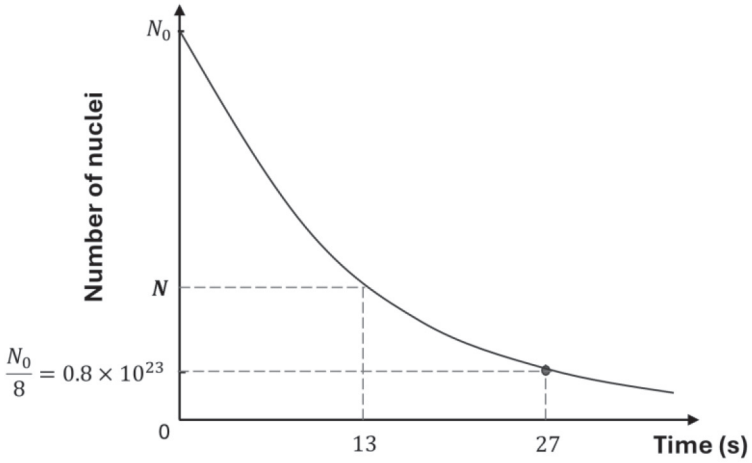


Figure (2)

Which labels in the diagrams represent α-radiation?

- ○ Y & M
- ○ W & L
- ○ W & N
- ○ X & L

14) The graph opposite shows a radioactive decay curve. What is the number of nuclei (N)?



- ○ 2.35×10^{23} nuclei.
- ○ 3.20×10^{23} nuclei.
- ○ 4.58×10^{23} nuclei.
- ○ 6.40×10^{23} nuclei.

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Question 2: Extended Questions (56 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.

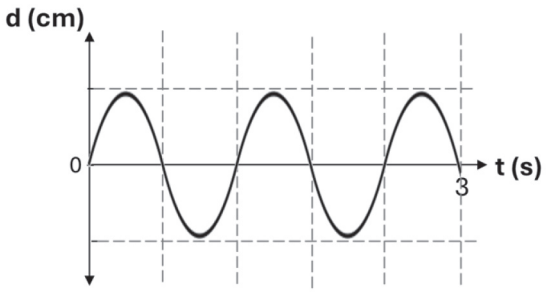
15) Name **two** factors which are directly proportional to the intensity of a progressive wave. (2 marks)

1. _____

2. _____

16) The graph opposite shows the variation of displacement (d) with time (t) for a wave. The horizontal distance between a consecutive crest and trough is (0.04 m).

Calculate the wave speed. (4 marks)



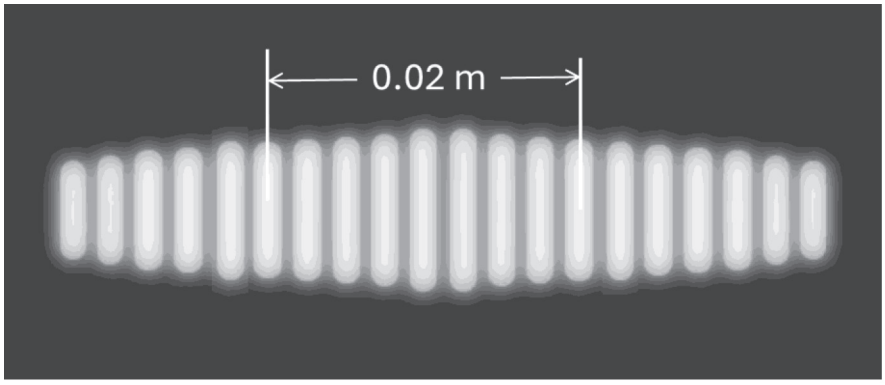
17) A fast electric train moves away from a stationary observer at a speed of $\left(v = \frac{v_{sound}}{4}\right)$. The train emits a sound with a frequency of (226.7 Hz).

Find the difference between the source frequency and the frequency heard by the observer. (2 marks)

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Question 2 continued

18) A light of (550 nm) wavelength shines normally on a double slit. The fringes appear as shown in the figure below on a screen (1.7 m) away from the slits.



a. Write **two** conditions required for observing interference fringes. (2 marks)

1. _____

2. _____

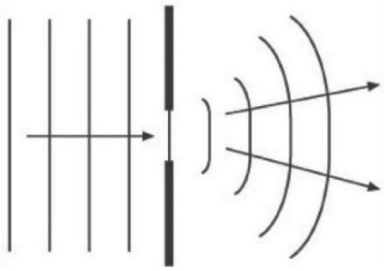
b. Calculate the slit's separation (a). (3 marks)

_____

_____

_____

19) The figure below shows a wave passing through a gap.



What will happen to the pattern if a slightly narrower gap is used? (1 mark)

_____

_____

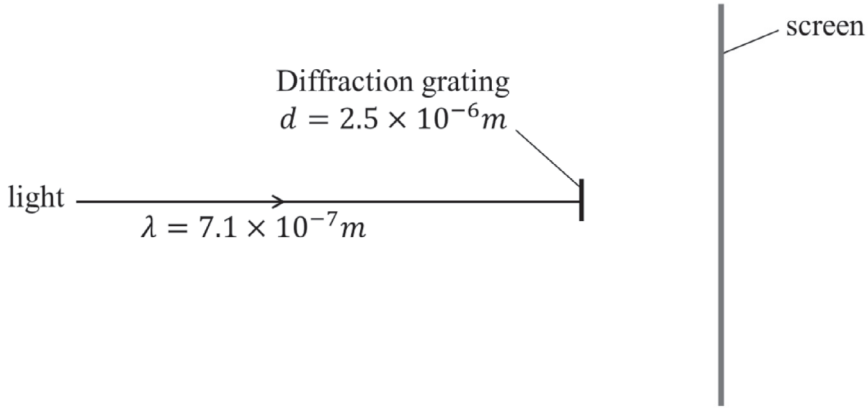
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Question 2 continued

20) The figure below shows light incident normally on a diffraction grating.



a. Calculate the angle of the second-order maximum. (2 marks)

b. Calculate the maximum number of bright spots that are formed on the screen. (2 marks)

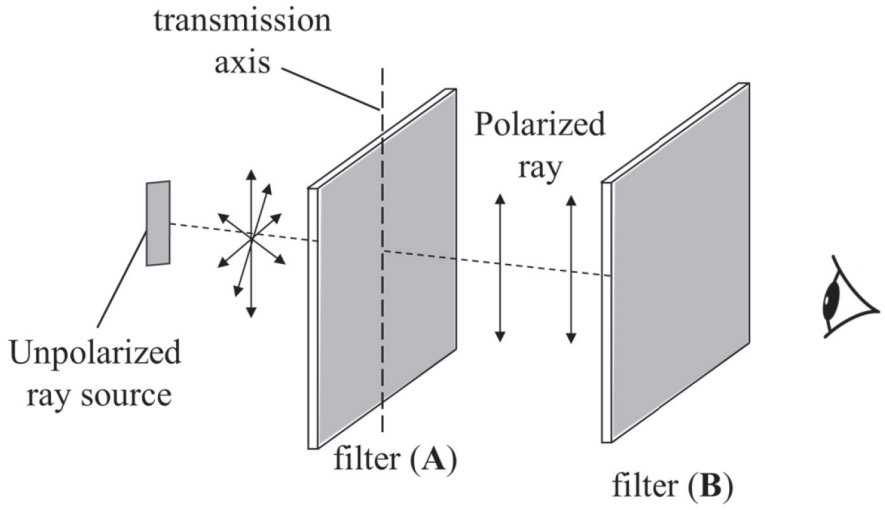
c. Define diffraction grating. (1 mark)

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Question 2 continued

21) The figure below shows unpolarized ray incidents on two polarizing filters (**A**) and (**B**). The arrows indicate the plane in which the electric field of the wave oscillates.

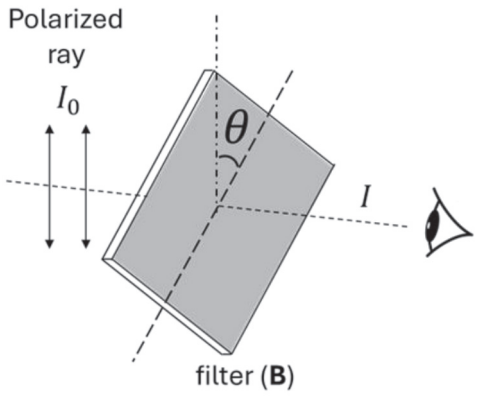


a. If no ray reaches the observer, draw the direction of the transmission axis on filter (**B**) **in the figure above**. (1 mark)

b. If filter (**B**) is rotated as shown in the figure opposite until the ratio of:

$$\frac{\text{transmitted by intensity } (I)}{\text{incident polarized ray intensity } (I_o)} = 0.75$$

Calculate the angle (θ). (2 marks)

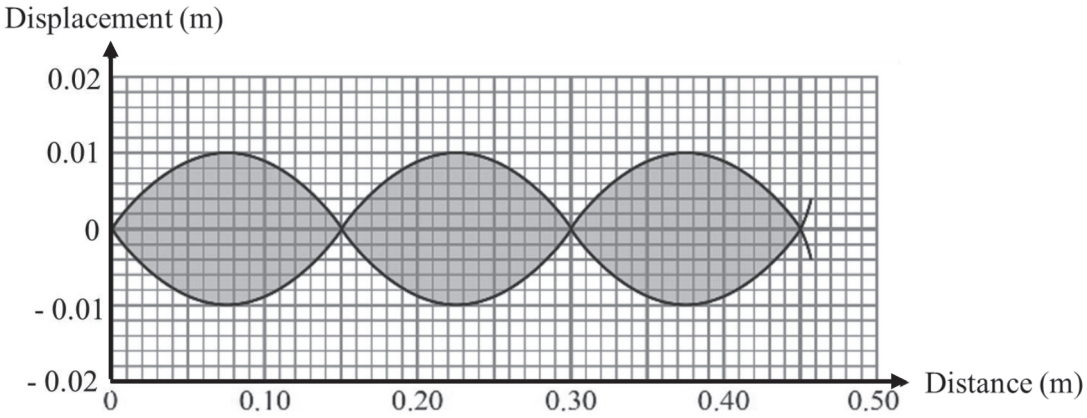


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Question 2 continued

22) The graph below shows a stationary wave produced by a vibrator on a stretched string.



a. What is the wavelength of the wave? (1 mark)

b. Label **one** node (**N**) and **one** antinode (**A**) **on the above graph**. (2 marks)

c. If the frequency of the vibrator is (36 *Hz*), calculate the speed of the wave. (2 marks)

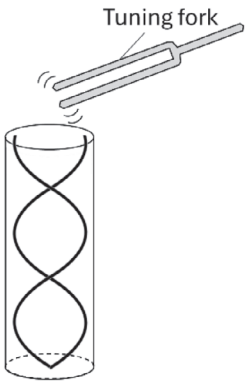
d. If the load on the rope is decreased, halving the wave speed, calculate the new fundamental frequency of the vibrator. (2 marks)

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Question 2 continued

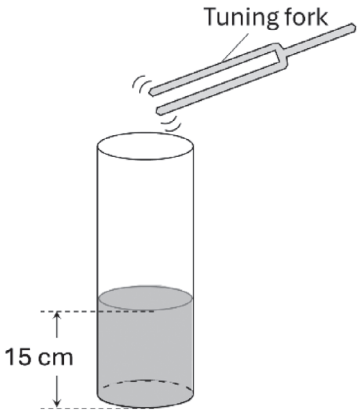
23) A tuning fork is placed above an empty one-end closed tube, producing resonance, as shown in the figure opposite.



a. Which harmonic mode is shown in the figure? (1 mark)

_____

b. The consecutive resonance is heard once again after (15 cm) of water is added to the tube, as shown in the figure opposite. What is the wavelength of the wave produced by the tuning fork? (2 marks)



_____

_____

_____

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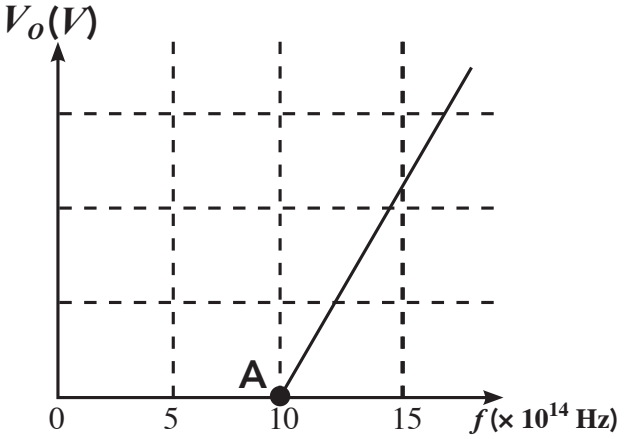
_____

24) **a.** Define Work function. (1 mark)

_____

_____

b. The graph opposite shows the variation of the stopping potential (V_O) versus the frequency (f) of the incident light on the surface of a photoelectric cell.



(i) What does point (**A**) represent? (1 mark)

_____

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Question 2 continued

(ii) What does the slope of the graph represent? (1 mark)

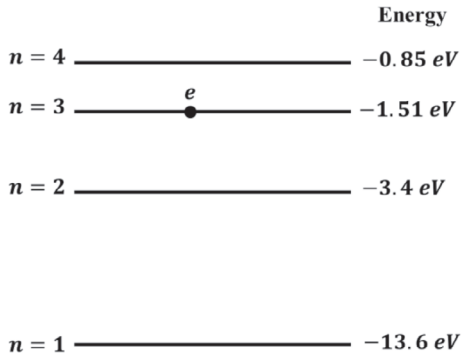
(iii) Calculate the work function (ø) of the cell in (J). (3 marks)

25) a. Name **two** phenomena that can explain the wave nature of light. (2 marks)

1. _____

2. _____

b. The figure below shows an excited electron in the hydrogen atom.



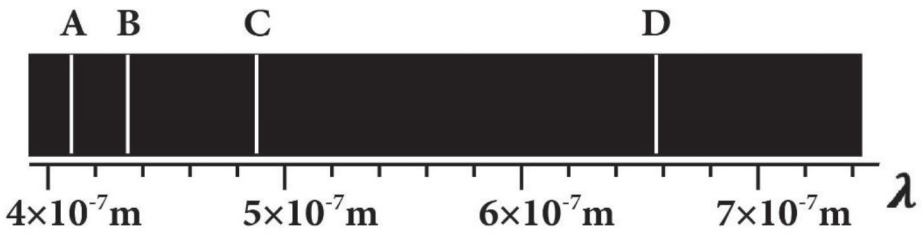
(i) If the electron falls to level (n = 2), calculate the emitted energy in (J). (2 marks)

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Question 2 continued

(ii) The figure below shows the emission spectrum for a hydrogen atom.



Which line results from the transition in **part (i)**?

Explain your answer by calculation. (2 marks)

26) a. Complete the table below. (2 marks)

Term	_____	Binding energy
Definition	The difference between the mass of the separated, nucleons and the combined mass of the nucleus.	_____ _____ _____ _____

b. A nucleus (X) decays by emitting a (β+) particle to form $\left(^{23}_{10}\mathrm{Ne}\right)$.

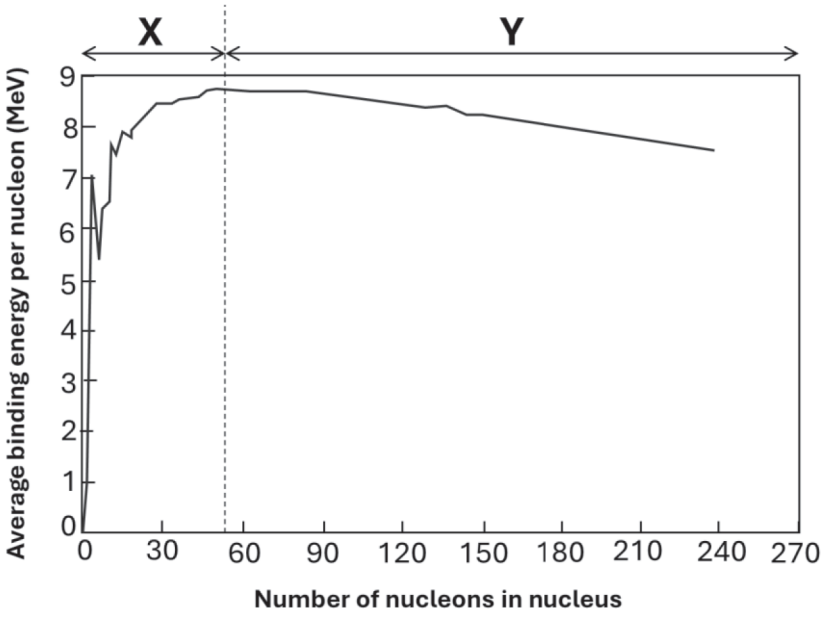
Write the nuclide (X) in the notation of ($^{A}_{Z}\mathrm{X}$). (2 marks)

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Question 2 continued

27) a. The figure below shows the binding energy per nucleon for different nuclei.



(i) Name **one quantity** that is always conserved during any nuclear process. (1 mark)

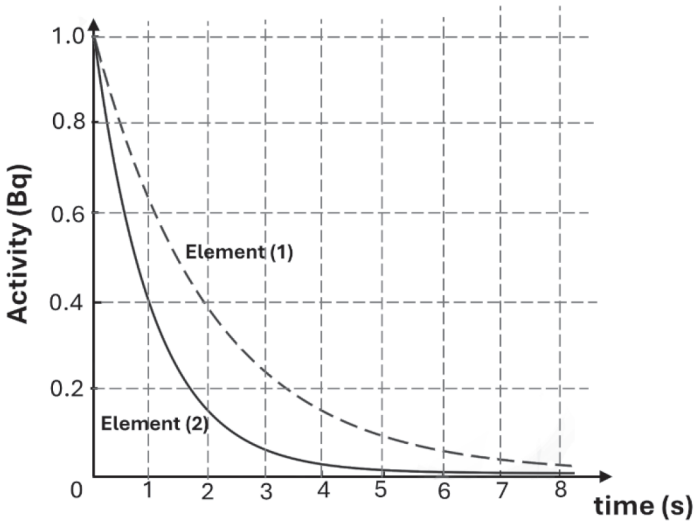
(ii) Explain why elements in region (**X**) tend to undergo fusion process? (1 mark)

b. A radioactive material decays to one-quarter of its original amount in (10 s). Find the decay constant (λ). (3 marks)

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Question 2 continued

28) The graph below shows the activity (A) versus time (t) for two radioactive elements (1) and (2).



a. Which element has the higher decay constant (λ)?

○ Element (1). ○ Element (2). (Choose the correct answer)

Explain your answer. (1 mark)

b. Calculate the decay constant (λ) of element (2). (2 marks)

[End of Examination]

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FORMULA AND CONSTANTS

CONSTANTS

$c = 3 \times 10^8 m/s$

speed of sound in air:

$V_{sound_air} = 340\ m\ s^{-1}$

$e = 1.6 \times 10^{-19} C$

$m_e = 9.11 \times 10^{-31} kg$

$m_P = 1.67 \times 10^{-27} kg$

$1eV = 1.60 \times 10^{-19} J$

$h = 6.63 \times 10^{-34} J\ s$

$1u = 1.66 \times 10^{-27} kg$

$m_p = 1.007276\ u$

$m_n = 1.008665\ u$

$m_e = 0.000549\ u$

$1Mev = 1.60 \times 10^{-13} J$

Waves

$v = \lambda f$	$T = \frac{1}{f}$	$I \propto A^2$	$f_o = \frac{f_s v}{(v \pm v_s)}$

Superposition

$\lambda = \frac{ax}{D}$	$f_n = \frac{nv}{2L}$	$d\ sin\theta = n\lambda$	$f_n = \frac{(2n-1)v}{4L}$
$v = \lambda f$	$d = \frac{1}{N}$	$I = I_0 cos^2(\theta)$	

Quantum physics

$\emptyset = hf_o$	$E = hf = \frac{hc}{\lambda}$	$\frac{1}{2}mv_{max}^2 = eV_O$
$\lambda = \frac{h}{mv}$	$hf = \emptyset + \frac{1}{2}mv_{max}^2$	
$p = mv$		
$p = \frac{E}{c}$	$\Delta E = hf = E_2 - E_1 = \frac{hc}{\lambda}$	

Particle and nuclear physics

$E = mc^2$	$A = -\frac{\Delta N}{\Delta t} = N\lambda$	$\lambda = \frac{0.693}{t_{1/2}}$	$x = x_o e^{-\lambda t}$
$\Delta m = Zm_p + (A - Z)m_n - m_{nucleus}$			

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GENERAL EDUCATION DIPLOMA EXAMINATION

Diploma, Bilingual

Physics 2nd Semester, 1st Session 2024-2025

Marking Guide

Note: the marking guide in (14) pages **Full marks: (70)**

ANSWERS TO MULTIPLE CHOICE QUESTIONS :(14 marks)

Item	Answer	Mark	C.L	OB	P.N
1	$I_a > I_b$ | $P_a = P_b$	1	A	1.1 h	O 120 H 115
2	Constructive when waves meet in phase.	1	K	2.1 d	H 136-138 O 138
3	Light waves.	1	K	2.4 c	H 122-125 O 124
4	D	1	A	2.1 e	H 135-138 O 138
5	$\frac{425}{L}$	1	A	2.6 b	H 145-146 O 132
6	At a smaller angle.	1	A	2.3 c	H 152 O 142
7	$\frac{2c}{f}$	1	R	2.1 h	H 138 O 138
8	Photoelectric effect.	1	K	3.2 a	H 351 O 296

9	$4.39 \times 10^{15} Hz.$	1	A	3.2 f	O 299 H 355
10	$\frac{4\, m_e}{m_p}$	1	R	3.3 b	O 302 H 357
11	The existence and small size of the nucleus.	1	K	4.1 a	H 206-207 O 146-147
12	<table><tr><td>14</td><td>7</td><td>0</td><td>-1</td></tr></table>	1	A	4.2 c	H 200 O 153
13	W & L	1	A	4.1 g	H 199-201 O 150
14	2.35×10^{23} nuclei.	1	R	4.3 d	H 374 O 306

ANSWERS TO EXTENDED QUESTIONS :(56 marks)

Item	Part	Answer	Mark	C.L	OB	P.N
15	-	- Amplitude OR (A)/ Square of the amplitude OR (A^2) - The power - Energy - Frequency - $\frac{1}{Area}$ - $\frac{1}{distance}$ **Any two from above**	1 1	K	1.1 h	O 120 H 115

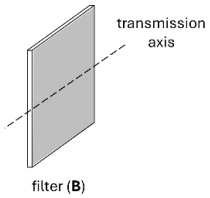
Item	Part	Answer	Mark	C.L	OB	P.N
16	-	$v = \frac{\lambda}{T}$ $T = 1.2\ s$ $\lambda = 0.08$ $v = \frac{0.08}{1.2}$ $= 6.7 \times 10^{-2} m/s$ **(OR)** When d=0.04 m, t=3/5 s (2) $v = \frac{d}{t}$ $v = \frac{0.04}{\frac{3}{5}}$ (1) $v = 6.7 \times 10^{-2} m/s$ (1) **(OR)** In t = 3s, d = 0.04 × 5 (2) $v = \frac{d}{t}$ $v = \frac{0.04 \times 5}{3}$ (1) $v = 6.7 \times 10^{-2} m/s$ (1)	1 1 1 1	A	1.1 f	O 120 H 112

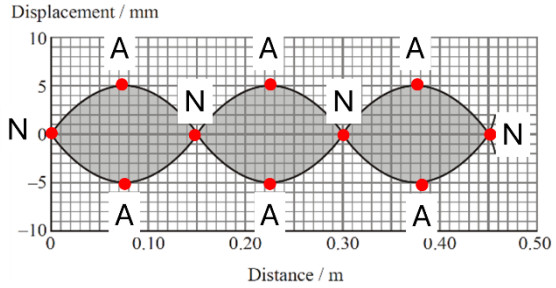
Item	Part	Answer	Mark	C.L	OB	P.N
17	-	$f_0 = \frac{f_s v}{v + v_s}$ $v_s = \frac{340}{4} = 85\ m\ s^{-1}$ $f_0 = \frac{226.7 \times 340}{340 + 85}$ $f_0 = 181.4\ \text{Hz}$ $\Delta f = f_s - f_0$ $= 226.7 - 181.4$ $= 45.3\ Hz$	1 1	R	1.2 c	O 134 H 120

Item	Part	Answer	Mark	C.L	OB	P.N
18	a	1) Coherence (OR) constant phase difference. 2) Monochromaticity (OR) single wavelength (OR) same frequency (OR) Laser. 3) Equal or comparable intensity (OR) equal amplitude. 4) Overlapping wavefronts. 5) Same polarization. 6) In the same plane. **Any two from above**	1 1	K	2.1 g	H 139 O 140
	b	$x = \frac{0.02}{8} = 0.0025\ m$ $a = \frac{\lambda D}{x} = \frac{550 \times 10^{-9} \times 1.7}{0.0025}$ $= 3.74 \times 10^{-4}\ m$	1 1 1	R	2.1 i	H 140 O 140

Item	Part	Answer	Mark	C.L	OB	P.N
19	-	The diffraction pattern will spread out more. (OR) Will increase the amount of diffraction. (1) (OR) The waves will bend more around the edges of the obstacle, resulting in a wider diffraction pattern. (1) (OR) Less visible. (1)	1	A	2.2 b	H 149 O 123

Item	Part	Answer	Mark	C.L	OB	P.N
20	a	$sin\,\theta = \frac{n\lambda}{d} = \frac{2 \times 7.1 \times 10^{-7}}{2.5 \times 10^{-6}} = 0.568$ $\theta = \sin^{-1}(0.568)$ $\theta = 34.6^{o}$	1 1	A	2.3 b	H 152 O 142
	b	$n = \frac{d}{\lambda} = \frac{2.5 \times 10^{-6}}{7.1 \times 10^{-7}}$ $= 3.5$ Number of bright fringes = $2n + 1 = (2 \times 3) + 1$ $= 7$	1 1	R	2.3 b	H 152 O 142
	c	A plane on which there is a very large number of parallel, identical, very closely spaced slits. **(OR)** A transparent plane with many closely spaced parallel slits ruled on it. (1)	1	K	2.3 a	H 152 O 142

Item	Part	Answer	Mark	C.L	OB	P.N
21	a		1	K	2.4 c	H 122-125 O 124
	b	$\cos^2\theta = 0.75$ $cos\,\theta = 0.866$ $\theta = 30^{o}$	1 1	A	2.4 d	H 125-126 O 125

Item	Part	Answer	Mark	C.L	OB	P.N
22	a	$0.30\ m$	1	A	2.5 c	H 142 O 126-128
	b	 **Accept any correct marking of the node and the antinode**	1 1	K	2.5 b	H 141 O 126-128
	c	$v = \frac{2Lf_n}{n} = \frac{2 \times 0.45 \times 36}{3}$ $= 10.8\ m/s$ **(OR)** $v = f \times \lambda = 36 \times 0.3$ (1) $= 10.8\ m/s$ (1)	1 1	A	2.5 e	H 141-143 O 130-131

	d	$f_1 = \frac{1 \times v_o / 2}{2L}$ $= \frac{10.8 / 2}{2 \times 0.45}$ $= 6\ Hz$ **(OR)** $f\ \alpha\ vn$ $f_2 = f_1 \frac{v_2 n_2}{v_1 n_1}$ (1) $= 36 \frac{\frac{v_1}{2} n_2}{v_1 \times 3n_2} = \frac{36}{2 \times 3}$ $= 6\ Hz$ (1)	1 1	A	2.5 d	H 141-143 O 130-131

Item	Part	Answer	Mark	C.L	OB	P.N
23	a	3rd harmonic **(OR)** 2nd overtone	1	K	2.6 a	H 145-148 O 132
	b	The water added gives the second harmonic The difference between 3rd and 2nd harmonics is $\frac{\lambda}{2} = \mathbf{15\ cm}$ The wavelength $\boldsymbol{\lambda = 30\ cm}$ (OR) $\boldsymbol{\lambda = 0.3\ m}$. The student gets (2 marks) if he wrote $\boldsymbol{\lambda = 30\ cm}$ (OR) $\boldsymbol{\lambda = 0.3\ m}$ only. (2) **(OR)** $L = \frac{5}{4}\lambda \qquad L - 15 = \frac{3}{4}\lambda$ $15 = \frac{5}{4}\lambda - \frac{3}{4}\lambda \quad (1)$ $15 = \frac{2}{4}\lambda$ $\lambda = 30\ cm \quad (1)$	1 1 1	A	2.6 a	H 147 O 132

Item	Part	Answer	Mark	C.L	OB	P.N
24	a	The minimum amount of energy necessary for an electron to escape from the surface. **(OR)** The minimum energy needed by a conduction electron to escape from the metal surface when the metal is at zero potential. (1)	1	K	3.2 a	O 297 H 354
	b -i	Threshold frequency. **(OR)** f_0 **(OR)** Cutoff frequency.	1	K	3.2 j	O 299 H 353
	b -ii	$\frac{Planck's\ constant}{e}$ **(OR)** $\frac{h}{e}$	1	A	3.2 j	O 302 H 354
	b -iii	$\Phi = hf_0$ $f_0 = 10 \times 10^{14}\ Hz$ $\Phi = 6.63 \times 10^{-34} \times 10 \times 10^{14}$ $\Phi = 6.63 \times 10^{-19} J$	1 1 1	A	3.2 c	O 302 H 354

Item	Part	Answer	Mark	C.L	OB	P.N
25	a	Diffraction. Interference. Reflection. Refraction. Polarization. **Any two from above**	2	K	3.2 b	O 302 H 356
	b - i	$\Delta E = [(-3.4) - (-1.51)] \times 1.6 \times 10^{-19}$ $E = -3.024 \times 10^{-19}\text{J}$ **No mark deducted for negative sign.** **If the student calculated the energy in eV, give one mark**	1 1	A	3.4 c	O 300 H 360
	b - ii	Line (D) $\boldsymbol{\lambda} = \frac{h\,c}{E}$ $\boldsymbol{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{3.024 \times 10^{-19}}$ $\boldsymbol{\lambda} = 6.58 \times 10^{-7} m$	1 1	R	3.4 c	O 300 H 360



<table>
<tr><th>Item</th><th>Part</th><th>Answer</th><th>Mark</th><th>C.L</th><th>OB</th><th>P.N</th></tr>
<tr><td rowspan="2">26</td><td>a</td><td>
<table>
<tr><td>Term</td><td>Mass defect <u>(OR)</u> mass deficiency <u>(OR)</u> Change in mass</td><td></td></tr>
<tr><td>Definition</td><td></td><td>The energy equivalent of the mass defect of a nucleus.
<u>(OR)</u>
The energy required to separate to infinity all the nucleons of a nucleus. (1)
<u>(OR)</u>
The work that must be done to separate a nucleus into its constituent neutrons and protons. (1)</td></tr>
</table>
</td><td>1
1</td><td>K</td><td>4.2 d</td><td>H 365-367
O 318-319</td></tr>
<tr><td>b</td><td>$^{23}_{11}X$
One mark for A and one mark for Z.</td><td>2</td><td>A</td><td>4.1 e</td><td>H 198
O 149+318</td></tr>
</table>

Item	Part	Answer	Mark	C.L	OB	P.N
27	a-i	- nucleon number - mass number - proton number - atomic number - mass-energy - charge - momentum - energy **Any one from above**	1	K	4.1 f	H 200-201 O 153
	a-ii	Fusion occurs in lighter nuclei (low mass numbers) where binding energy per nucleon increases as nuclei combine, releasing energy.	1	K	4.2 g	H 370-371 O 318-321
	b	$t_{1/2} = 5s$ $\lambda = \frac{\ln 2}{t_{1/2}}$ $= \frac{0.693}{5}$ $= 0.139\ s^{-1}$ **(OR)** $A = A_0 e^{-\lambda t}$ $\frac{A_0}{4} = A_0 e^{-\lambda t}$ (1) $\ln\left(\frac{1}{4}\right) = -\lambda \times 10$ (1) $\lambda = 0.139\ s^{-1}$ (1)	1 1 1 1	A	4.3 g,d	H 378 O 311

Item	Part	Answer	Mark	C.L	OB	P.N
28	a	i- [√] Element (2). Element (2) decays faster (steeper curve) than Element (1), indicating a higher decay constant $\lambda_2 > \lambda_1$ **(OR)** $\lambda \alpha \frac{1}{t_{\frac{1}{2}}}$, and element (2) has less $t_{\frac{1}{2}}$ **(OR)** Graph (2) is steeper initially (larger gradient). **(OR)** Element in graph (2) has less activity at any instant. **(OR)** Graph (2) reaches to almost zero first. **The student gets the mark only if both the choice and the explanation are correct.**	1	A	4.3 d	H 377 O 309-313
	b	Choosing the point (1,0.4) $\lambda = -\frac{ln\left(\frac{A}{A_0}\right)}{t} = -\frac{ln\left(\frac{0.4}{1.0}\right)}{1}$ $\lambda = 0.9\ s^{-1}$ **Accept the choice of any valid point to give λ between 0.75 to 1.0 s^{-1}**	1 1	R	4.3 e	H 377 O 310

End of Marking Guide





امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)

الفصل الدراسي الثاني- الدور الثاني

للعام الدراسي ١٤٤٦ - ١٤٤٧ هـ - ٢٠٢٤ / ٢٠٢٥ م

تنبيه:
- المادة: الفيزياء.
- الأسئلة في (١١) صفحة.
- زمن الإجابة: ثلاث ساعات.
- الإجابة في الورقة نفسها.

تعليمات مهمة:

- يجب الحضور إلى قاعة الامتحان قبل عشر دقائق على الأقل من بدء زمن الامتحان.
- يجب إحضار أصل ما يثبت الهوية وإبرازها للعاملين بالامتحانات.
- يجب الالتزام بالزي (الدشداشة البيضاء والمصر أو الكمة للذكور) والزي المدرسي للطالبات ، ويستثنى من ذلك الدارسون من غير العمانيين بشرط الالتزام بالذوق العام، ويمنع على جميع المتقدمات ارتداء النقاب داخل المركز وقاعات الامتحان.
- يحظر على الممتحنين اصطحاب الهواتف النقالة وأجهزة النداء الآلي وآلات التصوير والحواسيب الشخصية والساعات الرقمية الذكية والآلات الحاسبة ذات الصفة التخزينية والمجلات والصحف والكتب الدراسية والدفاتر والمذكرات والحقائب اليدوية والآلات الحادة أو الأسلحة أياً كان نوعها وأي شيء له علاقة بالامتحان.
- يجب على الممتحن الامتثال لإجراءات التفتيش داخل المركز طوال أيام الامتحان.
- يجب على الممتحن التأكد من استلام دفتر امتحانه، مغلفاً بغلاف بلاستيكي شفاف وغير ممزق ، وهو مسؤول عنه حتى يسلمه لمراقبي اللجنة بعد الانتهاء من الإجابة.
- يجب الالتزام بضوابط إدارة امتحانات دبلوم التعليم العام وما في مستواه وأية مخالفة لهذه الضوابط تعرضك للتدابير والإجراءات والعقوبات المنصوص عليها بالقرار الوزاري رقم ٥٨٨ / ٢٠١٥.
- 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 – عاصمة سلطنة عمان هي:

○ القاهرة ○ الدوحة

● مسقط ○ أبوظبي

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

صحيح ● **غير صحيح** ▭ ◉ ◒ ✗ ✓

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مُسَوَّدَة، لا يتم تصحيحها

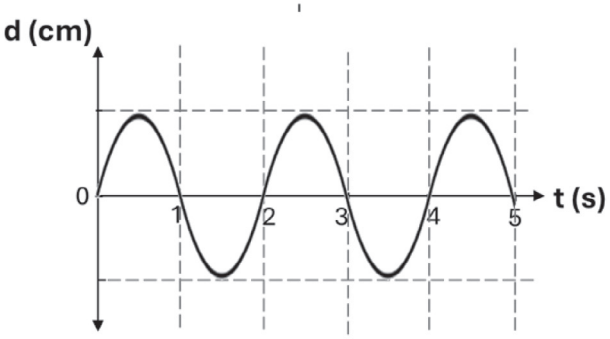
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Question 1: Multiple Choice Items (14 marks)

There are 14 multiple choice items worth one mark each.
Shade in the bubble (⬭) next to the **correct** answer for each item.

1) The opposite figure shows a displacement-time graph for a wave. If the horizontal distance between a consecutive crest and trough is (0.02 m), what is the speed of the wave?

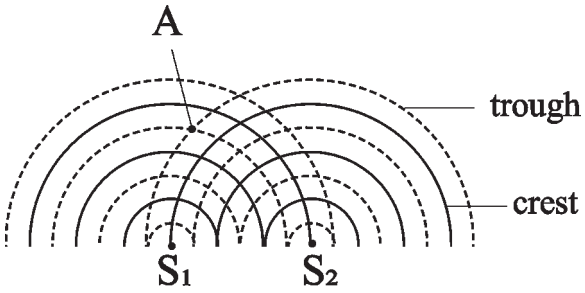


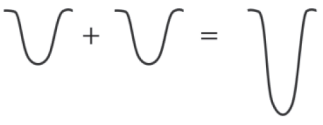
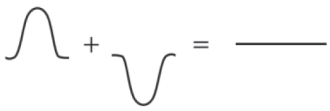
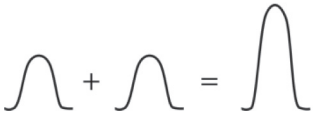
- ⬭ 0.02 m s^{-1}
- ⬭ 0.04 m s^{-1}
- ⬭ 0.08 m s^{-1}
- ⬭ 0.018 m s^{-1}

2) Which of the following causes diffraction?

- ⬭ Two coherent waves superpose.
- ⬭ Two waves travel towards each other.
- ⬭ A wave passes around the edge of an obstacle.
- ⬭ A wave source moves towards a stationary observer.

3) The figure opposite shows interference created by two identical sources (S_1 and S_2) in a water ripple. Which of the following correctly represents the wave interference at point (A)?



- ⬭ 
- ⬭ 
- ⬭ 
- ⬭ 

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4) An experiment producing a pattern of dark and bright fringes with light waves. What is this phenomenon called?

- ☐ Diffraction.
- ☐ Interference.
- ☐ Reflection.
- ☐ Refraction.

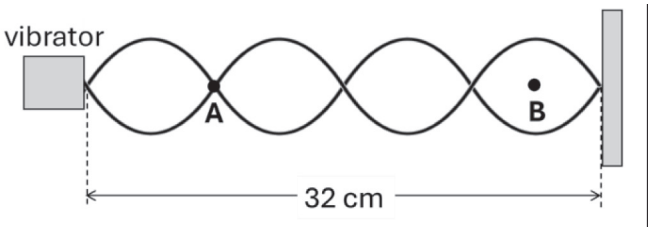
5) Fringes of separation (x) are observed on a screen at distance (D) from the double-slit that is illuminated with monochromatic light of wavelength (λ).

At what distance from the slits will fringes with separation of $\left(\frac{5}{3}x\right)$ be observed using a light of wavelength $\left(\frac{2}{3}\lambda\right)$?

- ☐ $\frac{2}{5}D$
- ☐ $\frac{9}{10}D$
- ☐ $\frac{10}{9}D$
- ☐ $\frac{5}{2}D$

6) What is the distance between points (**A**) and (**B**) in the wave shown below?

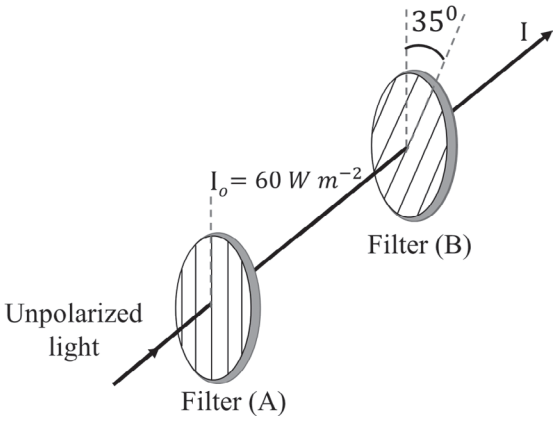
- ☐ 12 cm
- ☐ 16 cm
- ☐ 20 cm
- ☐ 24 cm



7) The figure opposite shows unpolarized light passing through two polarizing filters (A) and (B).

What is the intensity (I)?

- ☐ 40.3 Wm^{-2}
- ☐ 49.1 Wm^{-2}
- ☐ 80.5 Wm^{-2}
- ☐ 98.3 Wm^{-2}



8) "The minimum amount of energy needed by an electron to escape from the surface of the metal" is called:

- ☐ Stopping potential.
- ☐ Kinetic energy.
- ☐ Work function.
- ☐ Threshold frequency.

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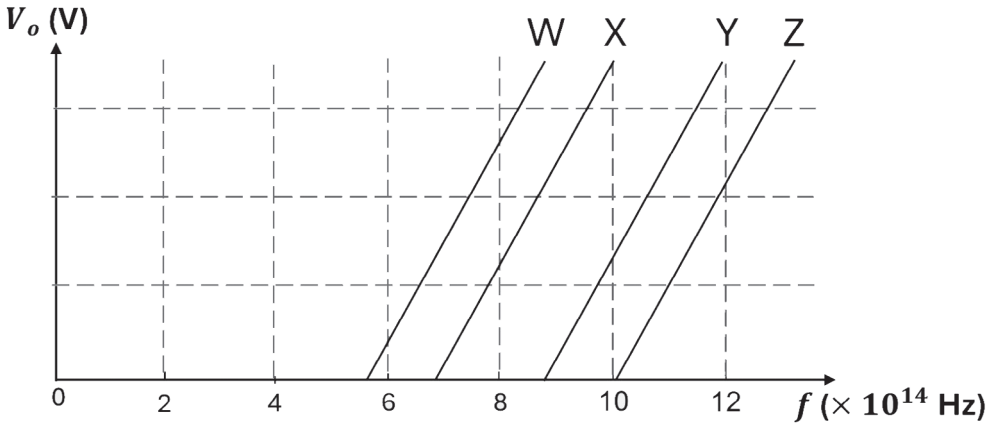
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9) The electron in a hydrogen atom makes a transition from an energy level at (–0.85 eV) to an energy level at (–3.4 eV).

What is the wavelength of the emitted photon?

- ☐ 2.9×10^{-7} m
- ☐ 3.7×10^{-7} m
- ☐ 4.9×10^{-7} m
- ☐ 14.6×10^{-7} m

10) The figure below shows the variation of stopping potential (V_0) with frequency (f) for four different metals (W, X, Y, and Z).



If the wavelength of the incident photon is (λ = 250 nm).

Which metal(s) will release electrons?

- ☐ W only.
- ☐ W and X only.
- ☐ W, X and Y only.
- ☐ W, X, Y and Z.

11) In the alpha-particle scattering experiment, some of the alpha particles deflected away from the nucleus because of the:

- ☐ Attraction between alpha particles and protons.
- ☐ Repulsion between alpha particles and protons.
- ☐ Attraction between alpha particles and neutrons.
- ☐ Repulsion between alpha particles and neutrons.

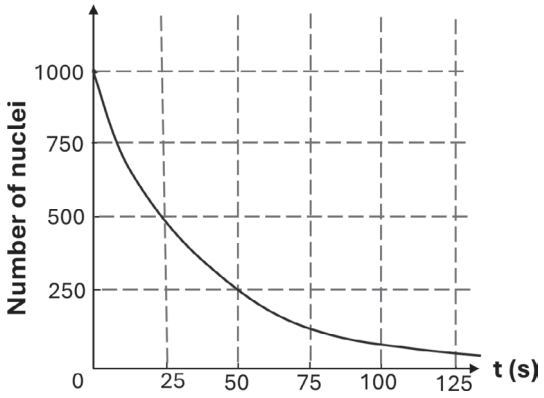
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12) Which of the following nuclear equations represents the decay of Thorium (Th) nucleus to Radium (Ra) nucleus?

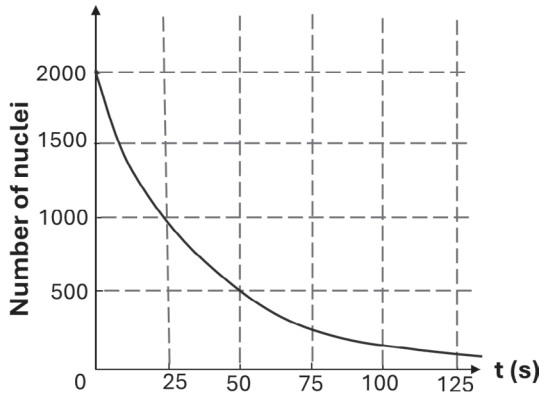
- ☐ $^{228}_{90}\text{Th} \longrightarrow {}^{224}_{88}\text{Ra} + {}^{4}_{2}\alpha$
- ☐ $^{232}_{90}\text{Th} \longrightarrow {}^{228}_{89}\text{Ra} + {}^{0}_{1}\beta$
- ☐ $^{228}_{90}\text{Th} \longrightarrow {}^{224}_{87}\text{Ra} + {}^{4}_{2}\alpha$
- ☐ $^{232}_{90}\text{Th} \longrightarrow {}^{224}_{88}\text{Ra} + {}^{0}_{-1}\beta$

13) The activity of a radioactive material (A) after the first half-life is (28 decays/s). Which of the following graphs represents the decay process?

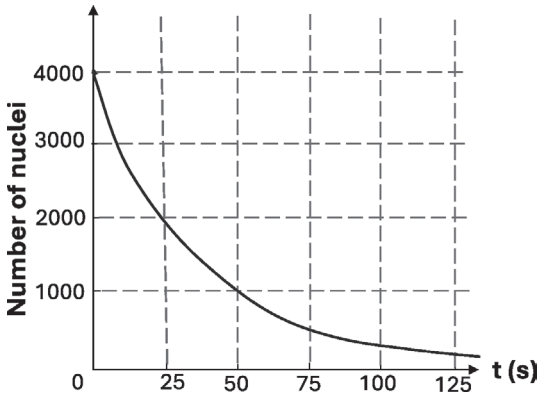
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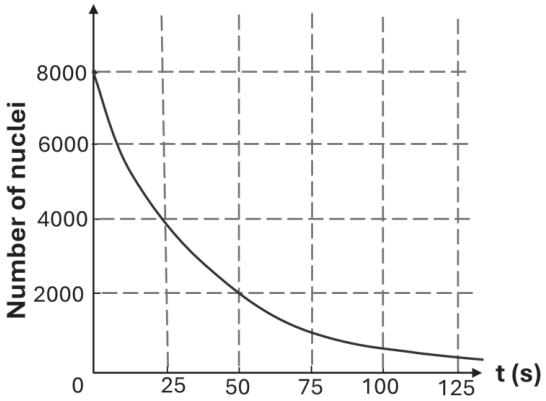
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14) Which of the following equations represents the nuclear fusion of Deuterium nuclei $\left({}^{2}_{1}\text{H}\right)$ with Tritium nuclei $\left({}^{3}_{1}\text{H}\right)$?

- ☐ $^{2}_{1}\text{H} + {}^{3}_{1}\text{H} \longrightarrow {}^{4}_{2}\text{He} + {}^{1}_{0}n +$ energy
- ☐ $^{2}_{1}\text{H} + {}^{3}_{1}\text{H} \longrightarrow {}^{4}_{2}\text{He} + {}^{0}_{-1}\beta +$ energy
- ☐ $^{2}_{1}\text{H} + {}^{3}_{1}\text{H} \longrightarrow {}^{4}_{2}\text{He} + {}^{0}_{1}\beta +$ energy
- ☐ $^{2}_{1}\text{H} + {}^{3}_{1}\text{H} \longrightarrow {}^{4}_{2}\text{He} + {}^{0}_{1}n +$ energy

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Question 2: Extended Questions (56 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) Name **two** examples of waves in which the Doppler effect can be observed. (2 marks)

1. _____

2. _____

16) A motorcycle whistle emits a sound at a frequency of (320 Hz) while moving at a constant speed. An observer records the whistle's frequency as (360 Hz).

a. What is the direction of the motion of the motorcycle? (1 mark)

☐ Towards the observer. ☐ Away from the observer.

(Choose the correct answer)

Explain your answer.

_____

_____

b. Calculate the speed of the motorcycle. (3 marks)

_____

_____

_____

c. What will happen to the wavelength recorded by the observer if the speed of the motorcycle is increased? Explain your answer. (2 marks)

_____

_____

_____

_____

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17) **a.** Write the **two** types of interference. (2 marks)

1. _____

2. _____

b. A white light of wavelengths ranging from ($\lambda_{violet} = 450$ nm) to ($\lambda_{red} = 680$ nm) is incident normally on a diffraction grating with slits spacing of ($d = 2.5 \times 10^{-6}$ m).

Calculate the difference in angles between the third-order diffraction for the red light and the violet light. (3 marks)

_____

_____

_____

_____

18) Write **three** properties of standing waves. (3 marks)

1. _____

2. _____

3. _____

19) A (0.7 m) long string is fixed at both ends to form a standing wave. If the period for the 4th harmonic mode is (2.0×10^{-2} s).

Calculate the speed of the progressive wave. (3 marks)

_____

_____

_____

_____

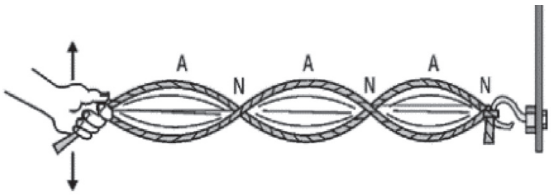
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20) A standing wave is produced in a string of length (L) with a wavelength of (1.2 m) and speed of (117 m s^{-1}) in the fundamental mode.

The frequency of the standing wave is then changed to produce the pattern shown in the figure opposite.



a. Define the terms: (2 marks)

(i) Node: _____

_____

(ii) Antinode: _____

_____

b. Calculate the following:

(i) The new frequency (f). (2 marks)

_____

_____

_____

(ii) The new wavelength (λ). (2 marks)

_____

_____

_____

(iii) How many nodes will be in the standing wave when the frequency is ($f = 487.5$ Hz). (2 marks)

_____

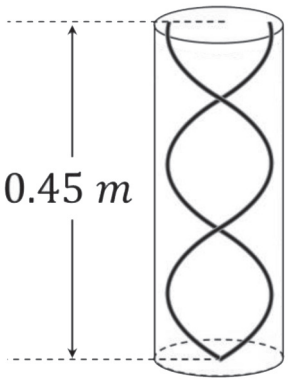
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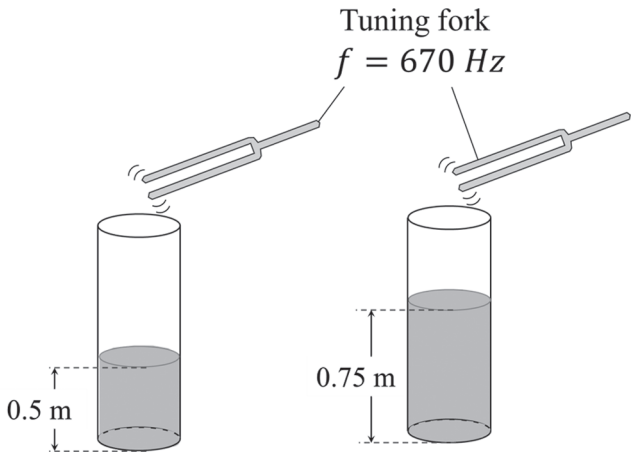
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21) Calculate the frequency of the standing sound wave shown in the figure opposite. (2 marks)



22) A tuning fork produces two consecutive resonances at two different lengths in an one-end closed tube as shown in the figure below.



Calculate the speed of sound caused by the tuning fork in the air column. (3 marks)

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23) A monochromatic light of (λ = 450 nm) is incident on a sodium photocell to produce a photoelectric current. Then, the current drops to zero when a stopping potential of (0.36 V) is applied.

a. Calculate the maximum speed of emitted electrons. (2 marks)

b. What will happen to the number of emitted electrons and their maximum kinetic energy if the intensity of the source beam is decreased? (2 marks)

- Number of emitted electrons _____

- Maximum kinetic energy _____

c. Prove mathematically that no emission will occur if a sodium plate is replaced by a zinc plate (ϕ = 3.6 eV). (4 marks)

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24) **a.** What are the **two** types of line spectra? (2 marks)

1. _____

2. _____

b. If the de Broglie wavelength (λ_e) of an electron is four times the de Broglie wavelength of a proton (λ_p).

What is the ratio of $\left(\frac{\text{electron momentum } (p_e)}{\text{proton momentum } (p_p)}\right)$? (2 marks)

_____

_____

_____

_____

_____

25) An unstable boron nucleus $\left({}^{11}_{5}B\right)$ decays to carbon nuclei $\left({}^{11}_{6}C\right)$ as represented by the following equation:

$$ {}^{11}_{5}B \longrightarrow {}^{11}_{6}C + X $$

a. Complete the following table: (2 marks)

	Particle (X)
Name	_____
Charge	_____

b. Write **three** characteristics of alpha radiation (α). (3 marks)

1. _____

2. _____

3. _____

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26) The mass of boron nucleus $\left({}^{11}_{5}\mathrm{B}\right)$ is 11.009305 u.

Calculate the mass defect in (u). (5 marks)

27) If 82% of a radioactive sample is decayed after 15 minutes.

Calculate the decay constant (λ). (2 marks)

[End of Examination]

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FORMULA AND CONSTANTS

CONSTANTS

$c = 3 \times 10^8 \text{m/s}$

speed of sound in air:

$V_{sound_air} = 340\ \text{m s}^{-1}$

$e = 1.6 \times 10^{-19}\text{C}$

$m_e = 9.11 \times 10^{-31}\text{kg}$

$m_P = 1.67 \times 10^{-27}\text{kg}$

$1\text{eV} = 1.60 \times 10^{-19}\text{J}$

$h = 6.63 \times 10^{-34}\text{J s}$

$1u = 1.66 \times 10^{-27}\text{kg}$

$m_p = 1.007276\ u$

$m_n = 1.008665\ u$

$m_e = 0.000549\ u$

$1\text{Mev} = 1.60 \times 10^{-13}\text{J}$

Waves

$v = \lambda f$	$T = \frac{1}{f}$	$I \propto A^2$	$f_o = \frac{f_s v}{(v \pm v_s)}$

Superposition

$\lambda = \frac{ax}{D}$	$f_n = \frac{nv}{2L}$	$d\ sin\theta = n\lambda$	$f_n = \frac{(2n-1)v}{4L}$
$v = \lambda f$	$d = \frac{1}{N}$	$I = I_0 cos^2(\theta)$	

Quantum physics

$\emptyset = hf_o$	$E = hf = \frac{hc}{\lambda}$	$\frac{1}{2}mv_{max}^2 = eV_O$
$\lambda = \frac{h}{mv}$	$hf = \emptyset + \frac{1}{2}mv_{max}^2$	
$p = mv$		
$p = \frac{E}{c}$	$\Delta E = hf = E_2 - E_1 = \frac{hc}{\lambda}$	

Particle and nuclear physics

$E = mc^2$	$A = -\frac{\Delta N}{\Delta t} = N\lambda$	$\lambda = \frac{0.693}{t_{1/2}}$	$x = x_o e^{-\lambda t}$

$$\Delta m = Zm_p + (A - Z)m_n - m_{nucleus}$$

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GENERAL EDUCATION DIPLOMA EXAMINATION

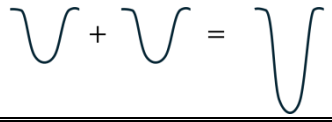
Diploma, Bilingual

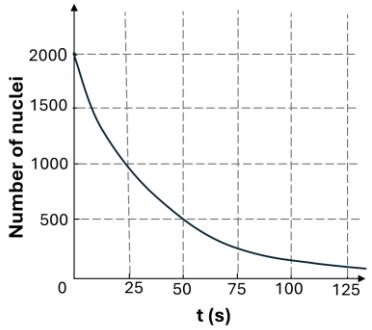
Physics 2nd Semester, 2nd Session 2024-2025

Marking Guide

Note: the marking guide in (13) pages **Full marks: (70)**

ANSWERS TO MULTIPLE CHOICE QUESTIONS :(14 marks)

Item	Answer	Mark	C.L	OB	P.N
1	0.02 m s^{-1}	1	A	1.1 f	H 114 O 121
2	A wave passes around the edge of an obstacle.	1	K	2.2 a	H 134 O 126
3		1	A	2.1e	H 134 O 126-127
4	Interference	1	K	2.1 b	H 149 O 122
5	$\frac{5}{2}\ D$	1	R	2.1 i	H 138 O 140
6	20 cm	1	A	2.5 c	H 141 O 126-128
7	40.3 Wm^{-2}	1	A	2.4 d	H 125-126 O 124-125

8	Work function.	1	K	3.2 a	H 354 O 297
9	$4.9 \times 10^{-7}\ m$	1	A	3.4c	H 360 O 300
10	W, X, Y and Z.	1	R	3.2 f	H 352 O 299
11	Repulsion between alpha particles and protons.	1	K	4.1 a	H 203-206 O 146-147
12	$^{228}_{90}Th \longrightarrow {}^{224}_{88}Ra + {}^{4}_{2}\alpha$	1	A	4.1 f	H 200-201 O 150
13		1	R	4.3 c	H 375-378 O 309-313
14	$^{2}_{1}H + {}^{3}_{1}H \longrightarrow {}^{4}_{2}He + {}^{1}_{0}n$ + energy	1	A	4.2 c	H 370 O 321

ANSWERS TO EXTENDED QUESTIONS :(56 marks)

Item	Part	Answer	Mark	C.L	OB	P.N
15	-	Sound waves. Light waves.	1 1	K	1.2 d	H 119-120 O 134-135

Item	Part	Answer	Mark	C.L	OB	P.N
16	a	✓ Towards the observer. Since the frequency is increased. **(OR)** The recorded frequency is greater than the source frequency. (1) **(OR)** $f_0 > f_S$ (1) **The student gets the mark only if both the choice and the explanation are correct.**	1	A	1.2 b	H 119 O 134-135

	b	$f_0 = \frac{f_s v}{v - v_s}$ $v_s = v\,(1 - f_s/f_0)$ $v_s = 340\,(1 - 320/360)$ $v_s = 37.78$ m/s **If the student <u>adds</u> the velocities and <u>substituted correctly based on that</u> he should get 2 marks**	1 1 1	A	1.2 c	H 120 O 134-135
	c	The wavelength will <u>decrease</u> since there is an <u>inverse relationship between the wavelength and the speed</u> of the source. **Accept if the student explained it mathematically.**	1 1	R	1.2 c	H 114 O 121

Item	Part	Answer	Mark	C.L	OB	P.N
17	a	- Constructive. - Destructive.	1 1	K	2.1 c	H 134 O 138-139
	b	$d \sin\theta = n\,\lambda$ $\theta_{red} = sin^{-1}(\frac{3 \times 680 \times 10^{-9}}{2.5 \times 10^{-6}}) = sin^{-1}(\frac{2.04 \times 10^{-6}}{2.5 \times 10^{-6}})$ $\theta_{red} = 54.7$	1	R	2.3 b	H 152-153 O 142

		$\theta_{violet} = sin^{-1}(\frac{3 \times 450 \times 10^{-9}}{2.5 \times 10^{-6}}) = sin^{-1}(\frac{1.35 \times 10^{-6}}{2.5 \times 10^{-6}})$ $\theta_{violet} = 32.7$ $\Delta\theta = 54.7 - 32.7 = 22°$	1 1			

Item	Part	Answer	Mark	C.L	OB	P.N
18	-	- Particles vibrate with different displacements. - Don't transmit energy - Produced by the superposition of two waves moved in opposite directions. - The nodes and antinode don't move along the string. - Displacment A=0 at node - Displacement A=max at antinode. **Any three of the above**	3	K	2.5 a	H 140 O 128-130

Item	Part	Answer	Mark	C.L	OB	P.N
19	-	$f_4 = \frac{1}{T} = \frac{1}{2.0 \times 10^{-2}} = 50Hz$ $f_4 = \frac{nv}{2L}$ $v = \frac{50 \times 2 \times 0.7}{4}$ $v = 17.5m/s$ (OR)	1 1 1	A	2.5 e	H 141-143 O 130-131

	$\lambda = \frac{0.7}{2} = 0.35\ m$ (1) $v = \frac{0.35}{2.0\times10^{-2}}$ (1) $v = 17.5 m/s$ (1)				

Item	Part	Answer	Mark	C.L	OB	P.N
20	a	i- Node: is a point on a standing wave with no displacement.	1	K	2.5 b	H 141 O 126-128
		ii- Antinode: is a point on a standing wave of maximum displacement.	1			
	b	i- $L = \frac{1.2}{2} = 0.6\ m$ $f_3 = \frac{3 \times 117}{2 \times 0.6} = 292.5\ Hz$ **(OR)** $f_1 = \frac{v}{\lambda} = \frac{117}{1.2}$ $f_1 = 97.5\ Hz$ (1) $f_3 = 3f_1 = 292.5\ Hz$ (1)	1 1	A	2.5d	H 141-143 O 130-131
		ii- $\frac{0.6}{3} = 0.2m$ $\lambda_3 = 2 \times 0.2 = 0.4\ m$ **(OR)** $\lambda_3 = \frac{2}{3} \times 0.6$ (1) $\lambda_3 = 0.4\ m$ (1)	1 1	A	2.5c	H 142 O 130-131

		iii- $f = \frac{nv}{2L}$ $n = \frac{2fL}{v}$ $n = \frac{2 \times 487.5 \times 0.6}{117} = 5$ Number of nodes = n +1 = 5 + 1 = 6	1 1	R	2.5d	H 141-143 O 130-131

Item	Part	Answer	Mark	C.L	OB	P.N
21	-	$f_n = \frac{(2n-1)v}{4L}$ $f_3 = \frac{(2 \times 3 - 1) \times 340}{4 \times 0.45}$ $f_3 = 944\ Hz$	1 1	A	2.6 b	H 145-146 O 132

Item	Part	Answer	Mark	C.L	OB	P.N
22	-	$0.75 - 0.50 = 0.25m$ $0.25m = \frac{\lambda}{2}$ $\lambda = 2 \times 0.25 = 0.5m$ $v = f\lambda = 670 \times 0.5 = 335\ m\ s^{-1}$	1 1 1	A	2.6 c	H 145-146 O 132

Item	Part	Answer	Mark	C.L	OB	P.N
23	a	$KE_{max} = eV_o$ $0.5\, m_e {v_{max}}^2 = eV_o$ $v_{max} = \sqrt{\frac{2eV_o}{m_e}}$ $v_{max} = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 0.36}{9.11 \times 10^{-31}}}$ $v_{max} = 3.56 \times 10^5\ m\ s^{-1}$	1 1	A	3.2 h	H 355 O 299
	b	The number of electrons will **<u>decrease</u>**. Kinetic energy will **<u>not change</u>**. **(OR)** Stay the same. (1)	1 1	K	3.2 e	H 352 O 297
	c	The energy of the photon: $E = \frac{h\,c}{\lambda}$ $E = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{450 \times 10^{-9}}$ $E = 4.42 \times 10^{-19} J$ $E = \frac{4.42 \times 10^{-19}}{1.6 \times 10^{-19}}$ $E = 2.76\ eV$ **<u>The energy of the photons is lower than the work function of zinc</u>**	1 1 1 1	A	3.2 c	H 350 O 297

Item	Part	Answer	Mark	C.L	OB	P.N
24	a	- Absorption. - Emission.	1 1	K	3.4 b	H 358 O 301
	b	$\lambda_e = 4\lambda_p$ $\frac{h}{p_e} = 4\frac{h}{p_p}$ $(\frac{p_e}{p_p}) = \frac{1}{4}$ **(OR)** $\frac{h}{p_e} = 4\frac{h}{p_p}$ (1) $p_p = 4p_e$ (1) **(OR)** $\frac{p_e}{p_p} = \frac{\lambda_p}{\lambda_e}$ $\frac{p_e}{p_p} = \frac{\lambda_p}{4\lambda_p}$ (1) $p_p = 4p_e$ (1)	1 1	R	3.3 b	H 357 O 303

Item	Part	Answer	Mark	C.L	OB	P.N
25	a	$_{-1}^{0}\beta$ **(OR)** Beta particle. Negative charge **(OR)** -1	1 1	A K	4.1 i	H 200-201 O 153
	b	- Its nature is identical to the nucleus of the helium atom; it contains two protons and two neutrons. / $_{2}^{4}He^{+2}$ - Its charge is +2e / positive - Its mass is 4u - Its speed is up to 10^7m/s (about 5% of the speed of light) - Its penetrating power is the least of the three types of emission. - It can pass through very thin paper/ in a few centimeters of air. - Is unable to penetrate thin card. - It is deflected by electric and magnetic fields. - It is attracted by negative charge/ repelled by positive charge - It has high ionizing power. - It is an efficient ionizer. **Any three from above.**	3	K	4.1 g	H 199-200 O 150

Item	Part	Answer	Mark	C.L	OB	P.N
26	-	Boron nucleus ($^{11}_{5}B$) consists of 5 protons and 6 neutrons • mass of the protons = 5×1.007276 $= 5.03638\ u$ • mass of the neutrons = 6×1.008665 $= 6.05199\ u$ • Total mass of the separated nucleus $= 5.03638 + 6.05199$ $= 11.08837u$ • Combined mass = $11.009305\ u$ • $\Delta m = Zm_p + (A-Z)m_n - m_{nucleus}$ Mass defect = Total mass of the separated nucleus − Combined mass of the nucleus Mass defect $= 11.08837 - 11.009305$ $= 0.079065\ u$	1 1 1 1 1 1	A	4.2 d	H 368-369 O 319

Item	Part	Answer	Mark	C.L	OB	P.N
27	-	Remaining N = 100 – 82 = 18 % $N = N_O e^{-\lambda t}$ $\frac{18}{100} N_O = N_O e^{-\lambda \times 15 \times 60}$ $ln(\frac{18}{100}) = -900\lambda = -1.171$ $\lambda = \frac{-0.171}{-900} = 1.9 \times 10^{-3}\ s^{-1}$	1 1	R	4.3 d	H 377 O 309-313

End of Marking Guide