Second Semester

Physics

(الفيزياء)

(Questions)

امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)

للعام الدراسي ١٤٤٤ هـ - ٢٠٢٢ / ٢٠٢٣ م

الدور الأول - الفصل الدراسي الثاني

تنبيه:
- المادة: الفيزياء.
- الأسئلة في (١٢) 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.
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- 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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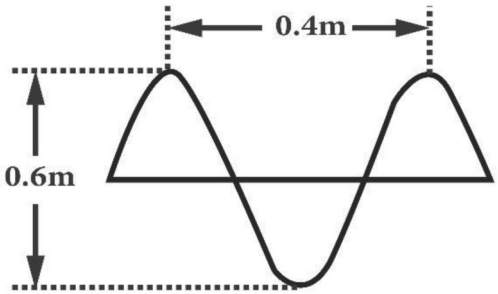
Question 1 Multiple Choice Items (14 marks)

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

1) The number of cycles of vibration per unit time is called:

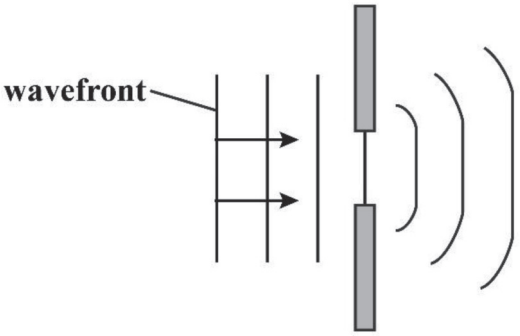
- ○ Wavelength.
- ○ Frequency.
- ○ Period.
- ○ Speed.

2) What is the wavelength of the wave shown in the figure opposite?



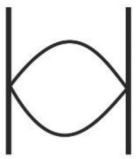
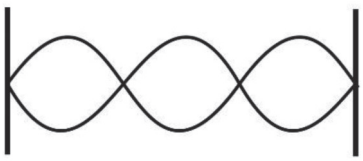
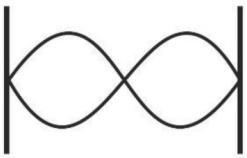
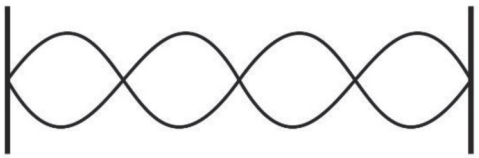
- ○ 0.2 m
- ○ 0.3 m
- ○ 0.4 m
- ○ 0.6 m

3) The figure below represents a wave passing through a gap. What is this phenomenon called?



- ○ Superposition.
- ○ Resonance.
- ○ Interference.
- ○ Diffraction.

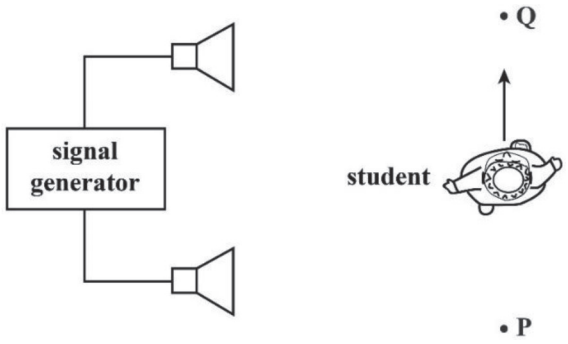
4) Which of the following represents a stationary wave (in a stretched string) at a third harmonic?

- ○ 
- ○ 
- ○ 
- ○ 

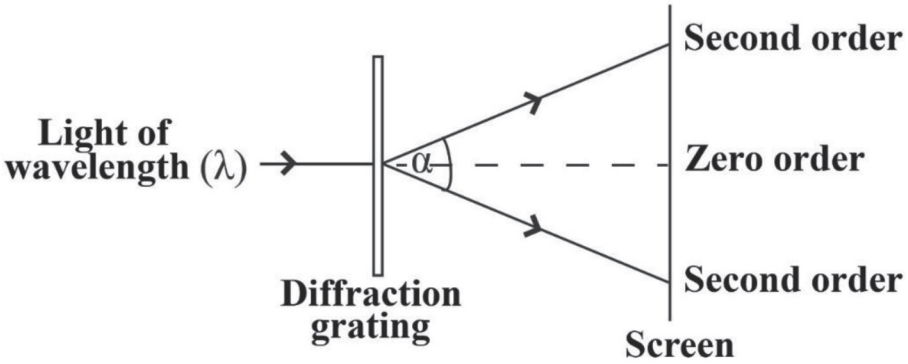
Question 1 continued

5) The figure below shows two loudspeakers connected to a signal generator. As a student walks from point (P) to point (Q) he notices that the loudness of the sound increases and then decreases repeatedly. Which phenomenon causes this?

- ☐ Diffraction.
- ☐ Interference.
- ☐ Resonance.
- ☐ Refraction.



6) The figure below shows an arrangement to obtain a fringe pattern with diffraction grating of slit spacing (d).



Which of the following gives the angle (α) between the two second order maxima?

- ☐ $2\sin^{-1}\left(\frac{\lambda}{d}\right)$
- ☐ $2\sin^{-1}\left(\frac{2\lambda}{d}\right)$
- ☐ $\sin^{-1}\left(\frac{\lambda}{d}\right)$
- ☐ $\sin^{-1}\left(\frac{2\lambda}{d}\right)$

7) When a stationary wave is formed along stretched string of length (L), its first harmonic frequency is (f). If the length of the string is halved, what will be the first harmonic frequency of the wave formed?

- ☐ $\frac{f}{4}$
- ☐ $\frac{f}{2}$
- ☐ $2f$
- ☐ $4f$

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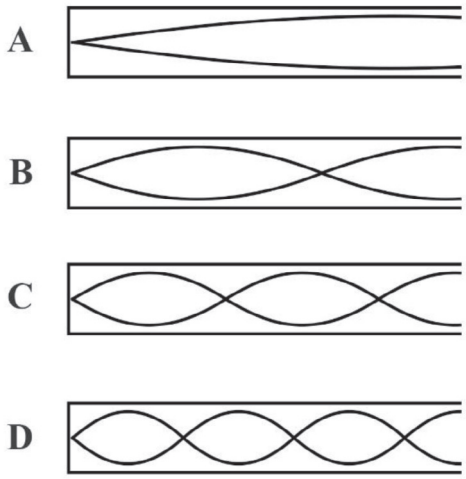
Question 1 continued

8) The figures opposite show the stationary wave patterns formed in one-end closed pipe.

Which figure shows the stationary wave with the highest frequency?



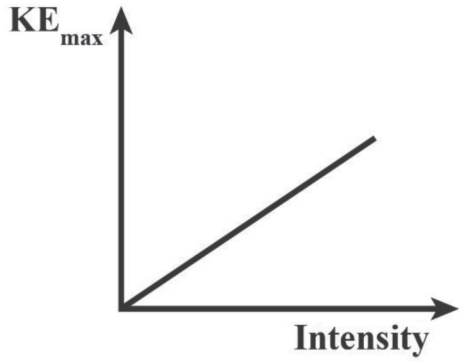
- ☐ A.
- ☐ B.
- ☐ C.
- ☐ D.

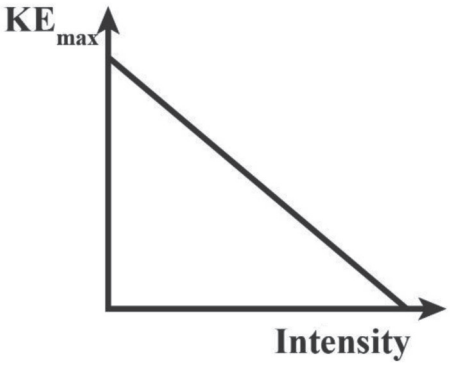
9) In photoelectric effect, electrons with a maximum kinetic energy of (15.8 eV) are emitted from a metal of work function (4.3 eV).

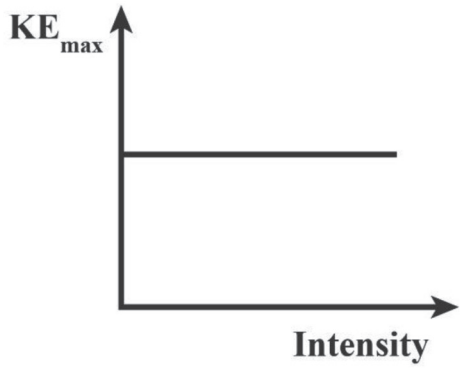
What is the energy of the incident photon?

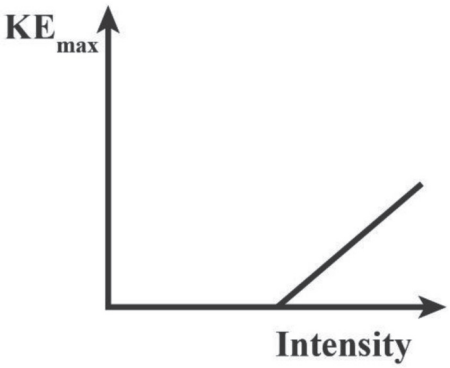
- ☐ 20.1 eV
- ☐ 15.8 eV
- ☐ 11.5 eV
- ☐ 4.3 eV

10) Which of the following graphs shows the relation between the maximum kinetic energy (KE_{max}) of the emitted electrons in the photoelectric effect and the intensity of the incident radiation?

- ☐ 

- ☐ 

- ☐ 

- ☐ 

Question 1 continued

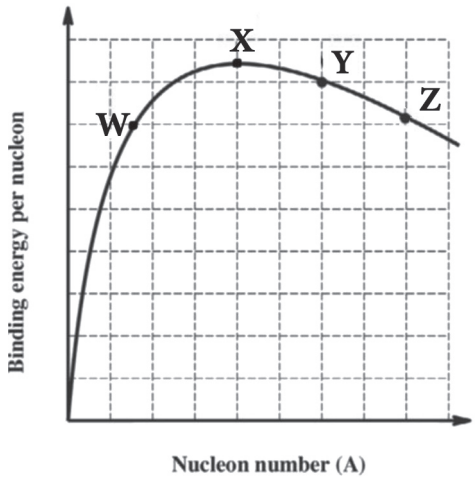
11) A proton momentum (p_p) is four times an electron momentum (p_e). If the electron has a de Broglie wavelength (λ_e), what is the de Broglie wavelength of the proton?

- ☐ $\frac{\lambda_e}{4}$
- ☐ $\frac{1}{\lambda_e}$
- ☐ λ_e
- ☐ $4\,\lambda_e$

12) The Process in which light nuclei fuse together to form a heavier nucleus is called:

- ☐ Fission.
- ☐ Mass defect.
- ☐ Fusion.
- ☐ Binding energy.

13) The graph opposite shows binding energy per nucleon versus the nucleon number (A) for four elements (W, X, Y and Z). Wich element is the most stable.



- ☐ W
- ☐ X
- ☐ Y
- ☐ Z

14) When a thorium ($^{232}_{90}Th$) nucleus emits (α and β^-) particles, which element will be produced?

- ☐ $^{222}_{86}Rn$
- ☐ $^{223}_{87}Fr$
- ☐ $^{226}_{88}Ra$
- ☐ $^{228}_{89}Ac$

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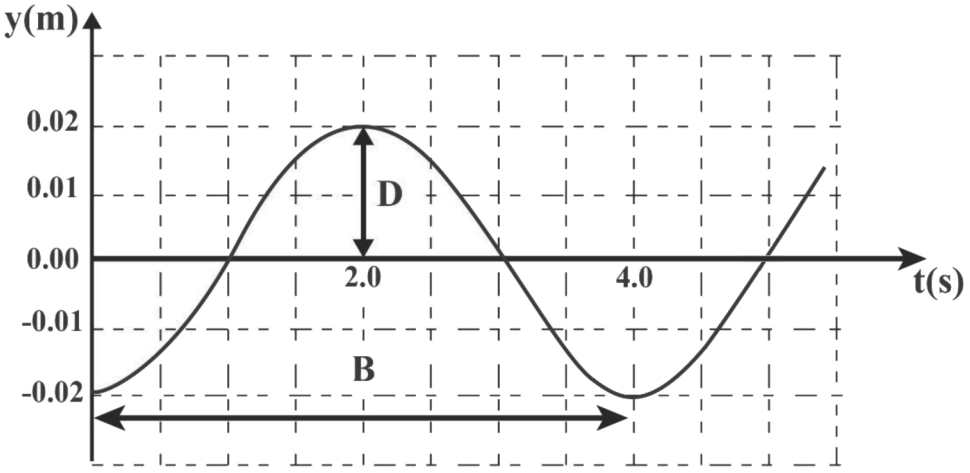
Question 2: EXTENDED QUESTIONS (56 marks)

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) a. The figure below shows a graph of displacement (y) versus time (t) for a wave.



(i) What do arrows (B and D) represent? (2 marks)

B: _____ D: _____

(ii) Calculate the frequency of the wave. (1 mark)

_____

_____

b. A bat flies with a speed of (4.40m/s) toward a stationary mouse and emits a sound of frequency (82×10^3 Hz). The speed of sound in air is (340 m/s).

(i) Calculate the frequency of the sound that heard by the mouse. (3 marks)

_____

_____

_____

_____

Question 2 continued

(ii) Calculate the wavelength of the sound heard by the mouse. (2 marks)

16) a. In the table below, compare between constructive interference (reinforcement) and destructive interference (cancellation) in terms of path difference. (2 marks)

	Constructive (reinforcement)	Destructive (cancellation)
Path difference		

b. Write two conditions required to observe the fringes of two-source interference. (2 marks)

c. In the Young's double-slit experiment, (0.125×10^{-3} m) apart slits are illuminated by a light of wavelength (4.5×10^{-7} m). The screen is (1 m) away from the slits.

(i) Calculate the fringe width. (2 marks)

(ii) What will happen to the fringe width when the slits separation is decreased? (1 mark)

Question 2 continued

17) A monochromatic light of wavelength (7×10^{-7} m) incidents on a diffraction grating containing (1×10^{6}) lines per meter. Calculate the diffraction angle of the first-order maximum. (4 marks)

18) **a.** In the table below, write the scientific terms for each definition. (2 marks)

Definition	Scientific term
(i) A point of zero amplitude on a stationary wave.	
(ii) A point of maximum amplitude on a stationary wave.	

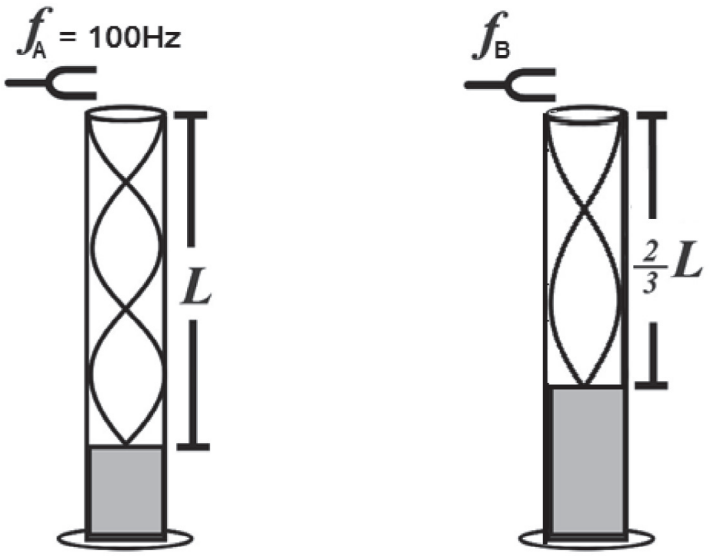
b. A string of (1.25 m) long is stretched between two fixed points. A transverse wave of speed (50 m/s) travels along the string and produces a stationary wave.

(i) State the principle of superposition of waves. (1 mark)

(ii) What is the frequency of the third harmonic vibration? (2 marks)

Question 2 continued

19) The figures below show an experiment to measure the speed of the sound in air using two identical pipes (A and B) filled with water into two different levels. Two tuning forks are making stationary waves through each pipe.



a. What is the mode of vibration in each pipe? (2 marks)

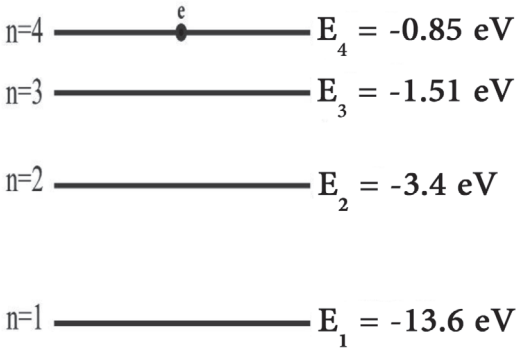
Pipe (A): _____

Pipe (B): _____

b. Calculate the frequency of the second tuning fork (f_B). (4 marks)

Question 2 continued

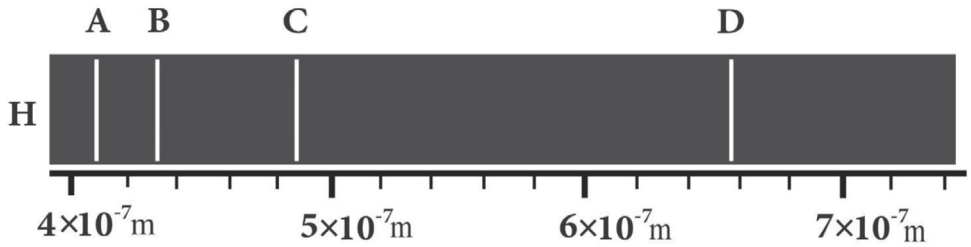
20) The figure below shows the energy levels of the hydrogen atom with an electron at energy level (n = 4).



a. If the electron falls to the energy level (n = 2), calculate the emitted energy.

(2 marks)

b. The figure below shows the emission line spectrum for a hydrogen gas.



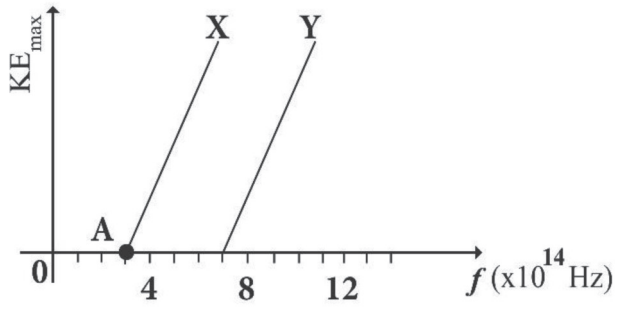
Which line results from the transition in **part (a)**? Explain your answer by calculations.

(2 marks)

Question 2 continued

21) a. Write two phenomena that provide evidence for the wave nature of particles. (2 marks)

b. The graph opposite shows the maximum kinetic energy (KE_{max}) for the emitted photoelectrons against frequency (f) for two different metals (X and Y).



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

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

(iii) If the frequency of the incident photons is (6×10^{14} Hz), which metal will emit photoelectrons? Explain your answer. (3 marks)

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Question 2 continued

22) **a.** In the table below, compare between (α) particles and (γ) radiation. (4 marks)

	alpha, (α)	Gamma, (γ)
Charge		
Ionization (weak/strong)		

b. Complete the following nuclear equation: (2 marks)

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{137}_{55}Cs + \underline{\quad}^{96}Rb + \ldots\ldots {}^{1}_{0}n + \text{energy}$$

23) A sample of a radioactive substance consists of (0.5×10^{23}) nuclei at time ($t = 4t_{\frac{1}{2}}$). Calculate its initial number of nuclei, (N_0). (3 marks)

Question 2 continued

24) The following equation shows the radioactive decay of $^{238}_{92}U$.

$$^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He + \text{energy}$$

Mass of $^{238}_{92}U$ = 3.952926 × 10^{-25} kg

Mass of $^{234}_{90}Th$ = 3.886385 × 10^{-25} kg

Mass of $^{4}_{2}He$ = 6.646478 × 10^{-27} kg

Mass of a neutron = 1.675 × 10^{-27} kg

Mass of a proton = 1.673 × 10^{-27} kg

Calculate the following:

a. The mass defect of ($^{234}_{90}Th$). (2 marks)

b. The total change in mass during the reaction (Δm). (2 marks)

c. The amount of released energy. (2 marks)

[End of Examination]

FORMULA AND CONSTANTS

CONSTANTS

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

Speed of the sound in air $(v_{air}) = 340\ m/s$

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

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

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

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

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

Waves

$v = f\lambda$	$f_o = \frac{f_s v}{(v \pm v_s)}$	$T = \frac{1}{f}$

Superposition of waves

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

Quantum physics

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

Particle and nuclear physics

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

مُسَوَّدَة

مُسَوَّدَة

مُسَوَّدَة

امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)

للعام الدراسي ١٤٤٤ هـ - ٢٠٢٢ / ٢٠٢٣ م

الدور الثاني - الفصل الدراسي الثاني

تنبيه:
- المادة: الفيزياء.
- الأسئلة في (١٣) صفحة.
- زمن الإجابة: ثلاث ساعات.
- الإجابة في الورقة نفسها.

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- 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.
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- 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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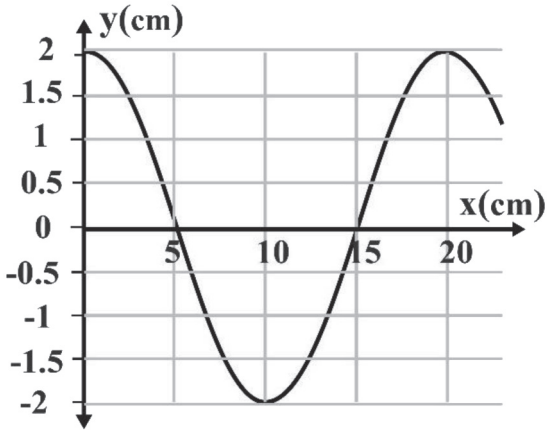
Question 1: Multiple Choice Items (14 marks)

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

1) The intensity of the wave is directly proportional to the square of:

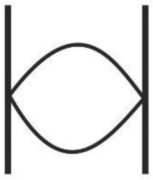
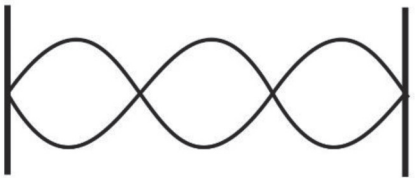
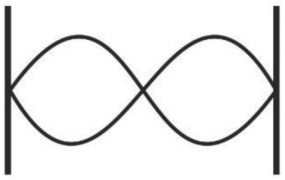
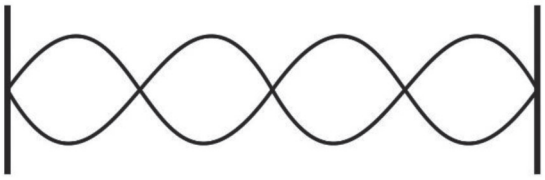
⬭ Period
⬭ Amplitude
⬭ Wavelength
⬭ Speed

2) The figure below shows displacement (y)- distance (x) graph for a wave. What is the wavelength of this wave?



⬭ 2 cm
⬭ 5 cm
⬭ 15 cm
⬭ 20 cm

3) Which of the following represents a stationary wave at a second harmonic?

⬭ 
⬭ 
⬭ 
⬭ 

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Question 1 continued

4) In a Young's double slit experiment, which of the following changes will increase the distance between the adjacent fringes?

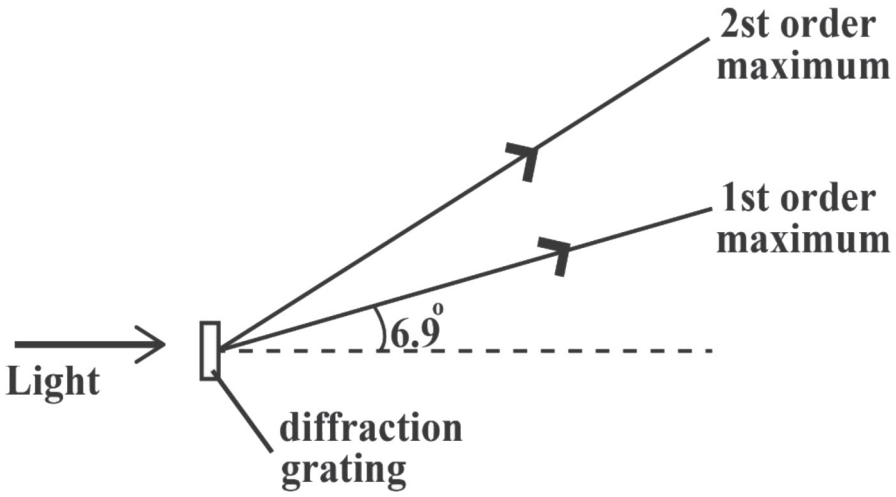
- ☐ Use light of a higher frequency.
- ☐ Use light of a shorter wavelength.
- ☐ Decrease the distance between the slits.
- ☐ Move the screen closer to the double-slit.

5) When waves pass through a narrow gap, they spread out.

What does this phenomenon called?

- ☐ Superposition.
- ☐ Interference.
- ☐ Resonance.
- ☐ Diffraction.

6) In the diffraction grating experiment a light of wavelength (400×10^{-9} m) passes through a grating of slit separation (3.33×10^{-6} m) as shown in figure below.



What is the angular separation between the first and second order maxima?

- ☐ 7.0°
- ☐ 10.3°
- ☐ 13.9°
- ☐ 20.8°

Question 1 continued

7) The fundamental frequency of one end closed pipe is (f). How many nodes are present in a standing wave of a frequency ($9f$) in the same pipe?

- ☐ 3 nodes
- ☐ 7 nodes
- ☐ 5 nodes
- ☐ 9 nodes

8) A stationary wave travel along a string of length (L). The frequency of the first harmonic is (f). If the length of the string is reduced to 15% of its original length, what will be the frequency of its first harmonic?

- ☐ $\frac{1}{0.85}f$
- ☐ $\frac{1}{0.15}f$
- ☐ $0.15f$
- ☐ $0.85f$

9) What is the frequency of a photon with energy of (66.3 eV)?

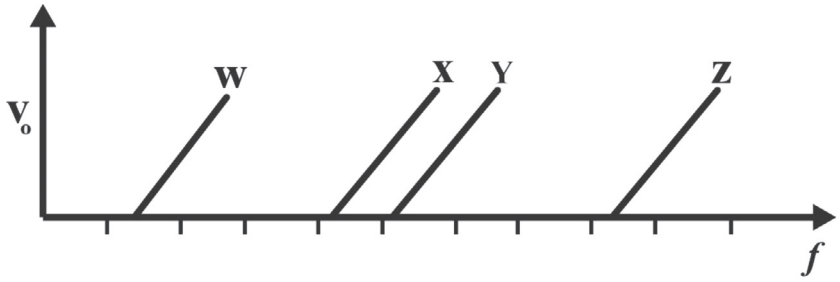
- ☐ 1.6×10^{16} Hz
- ☐ 12.6×10^{16} Hz
- ☐ 81.6×10^{16} Hz
- ☐ 91.6×10^{16} Hz

10) If the de Broglie wavelength of the electron (λ_e) is four times the de Broglie wavelength of the proton (λ_p), what will be the ratio of the electron's momentum to the proton's momentum ($\frac{p_e}{p_p}$)

- ☐ $\frac{1}{16}$
- ☐ $\frac{1}{4}$
- ☐ $\frac{4}{1}$
- ☐ $\frac{16}{1}$

Question 1 continued

11) The figure below shows the stopping potential (V_o) against frequency for four metals (W, X, Y and Z).



When the metals are illuminated with the same light of energy greater than the work function of all metals, from which metal the electrons will be emitted with the highest maximum kinetic energy (KE_{max})?

- ☐ W
- ☐ X
- ☐ Y
- ☐ Z

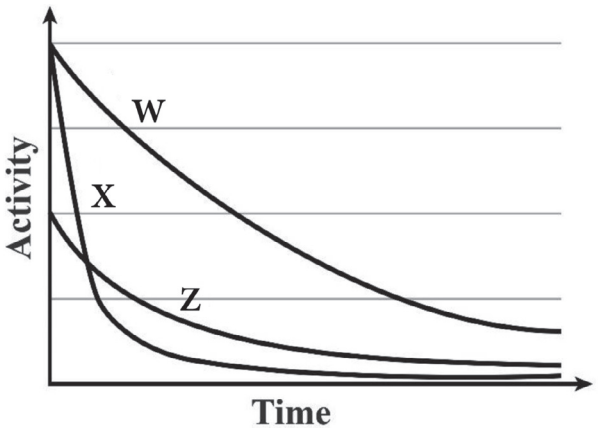
12) The process in which a large unstable nucleus splits into two fragments that are more stable than the original nucleus is called:

- ☐ Fission
- ☐ Fusion
- ☐ Mass defect
- ☐ Binding energy

13) The number of neutrons in Sodium ($^{23}_{11}Na$) is:

- ☐ 34
- ☐ 23
- ☐ 12
- ☐ 11

14) The figure below shows the activities of three radioactive samples (W, X, and Z). Which of the following shows the correct relations between their decay constants?



- ☐ $\lambda_W > \lambda_X > \lambda_Z$
- ☐ $\lambda_Z > \lambda_X > \lambda_W$
- ☐ $\lambda_X > \lambda_Z > \lambda_W$
- ☐ $\lambda_W > \lambda_Z > \lambda_X$

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) a. Name two types of waves in which the Doppler Effect can be observed. (2 marks)

b. A sound source is moving at a constant speed of (240 m/s) towards a stationary observer. The observer records a frequency of (3600 Hz).
Calculate the following:

(i) The frequency of the source. (3 marks)

(ii) The time period of the recorded sound. (1 mark)

(iii) The wavelength of the sound emitted by the source. (2 marks)

Question 2 continued

16) a. In the table below compare between the constructive interference (reinforcement) and destructive interference (cancellation) in terms of a path difference. (2 marks)

	Constructive (reinforcement)	Destructive (cancellation).
Path difference		

b. Write two conditions required to observe the fringes of two-source interference. (2 marks)

c. In a Young's double slit experiment, the slits are (0.15×10^{-3} m) apart and (1.2 m) far from a screen. The fringe width is (3×10^{-3} m).
Calculate the wavelength of the used light. (2 marks)

Question 2 continued

17) A monochromatic light of wavelength (3×10^{-7}m) is incident on a diffraction grating containing (1×10^{6}) lines per metre.

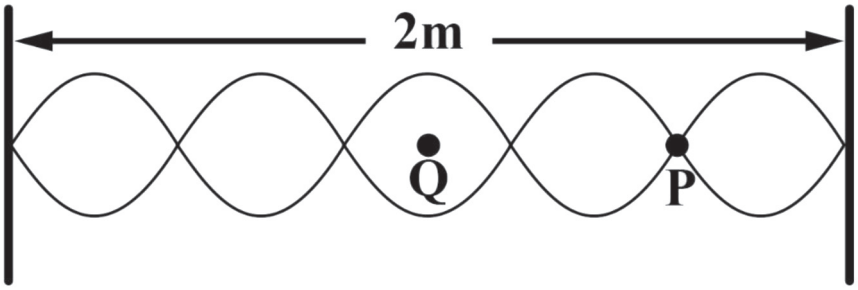
a. Calculate the diffraction angle of the first-order maximum. (4 marks)

b. Calculate the maximum number of orders produced on the screen. (1 mark)

c. If the monochromatic light is replaced by a white light, how will the fringes appear? (1 mark)

Question 2 continued

18) A stretched string of (2 m) long vibrates as shown in the below figure.



a. Which points on the figure represent the following? (2 marks)

Node: _____

Antinode: _____

b. If the speed of stationary wave in the string is (12 m/s), calculate the frequency of the stationary wave. (2 marks)

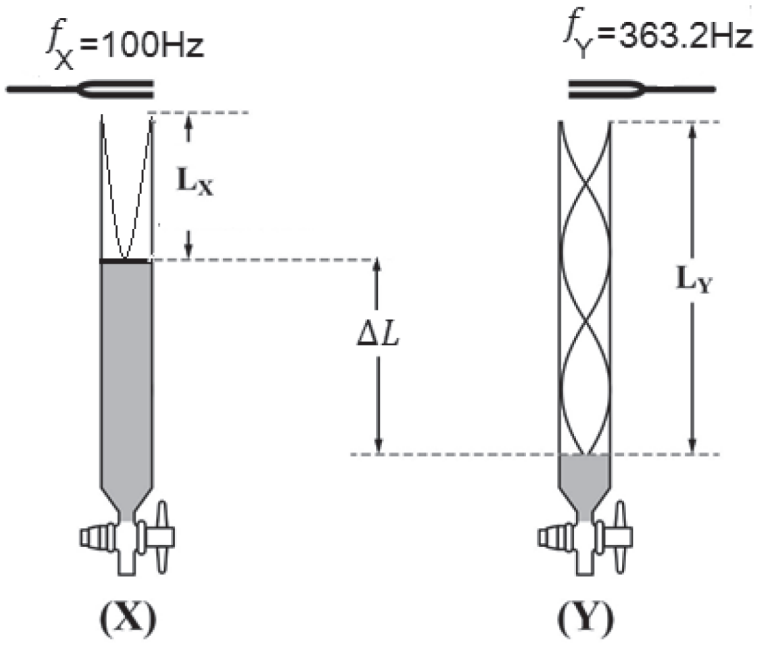
_____

_____

_____

Question 2 continued

19) The figure below shows two long identical pipes (X and Y) filled with water. Two tuning forks are making stationary waves through each pipe. The speed of the waves in each pipe is (340 m/s).



a. What is the mode of vibration in each pipe? (2 marks)

Pipe (X): _____

Pipe (Y): _____

b. Calculate (ΔL). (4 marks)

_____

_____

_____

_____

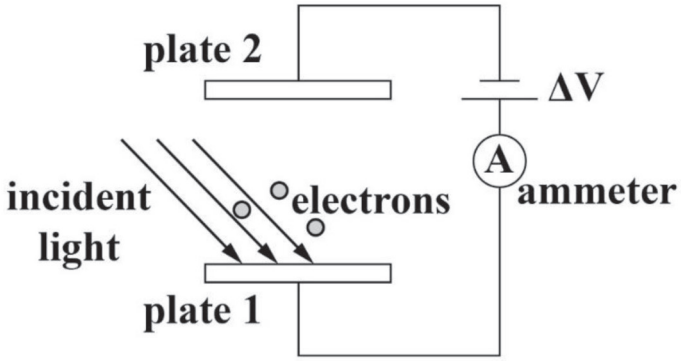
_____

_____

Question 2 continued

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

b. A student is investigating photoelectric effect by shining a monochromatic light of energy (8.29×10^{-19} J) on a metal plate as shown in figure below.



He found that the current of the ammeter drops to zero when the battery voltage is (1.40 V).

(i) Calculate the (KE_{max}) of the electrons. (2 marks)

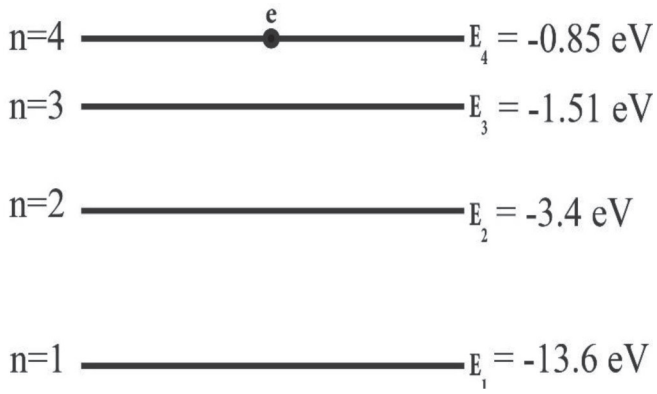
(ii) Calculate the work function of the metal. (2 marks)

(iii) When the intensity of incident light is increased, what will happen to the kinetic energy of the photoelectrons? (1 mark)

Question 2 continued

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

b. The figure bellow shows the energy levels of the hydrogen atom with an electron at energy level (n = 4). Calculate the energy emitted by an electron when it falls to the ground state? (2 marks)



22) a. In the table below, compare between (α) and (β^-) particles. (4 marks)

	Alpha, (α)	Beta, (β^-)
Charge		
Ionization (weak/strong)		

b. Complete the following nuclear equation: (2 marks)

$$^{238}_{92}U \longrightarrow \text{.....}Th + {}^{4}_{2}He$$

Question 2 continued

23) Half lives of two radioactive substances (A and B) are (20 min and 40 min), respectively. Initially, the samples have an equal number of nuclei.

Calculate the following:

a. The decay constant for sample (B). (2 marks)

b. At (t = 80 min), calculate the ratio of the remaining nuclei of sample (A) to sample (B) $\left(\frac{N_A}{N_B}\right)$. (3 marks)

Question 2 continued

24) For the reaction: ${}^{2}_{1}\mathrm{H} + {}^{3}_{1}\mathrm{H} \longrightarrow {}^{4}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n}$ + energy

Mass of ${}^{2}_{1}\mathrm{H}$ = 3.344495×10^{-27} kg

Mass of ${}^{3}_{1}\mathrm{H}$ = 5.008267×10^{-27} kg

Mass of ${}^{4}_{2}\mathrm{He}$ = 6.646478×10^{-27} kg

Mass of a neutron = 1.675×10^{-27} kg

Calculate the following:

a. Mass defect of the reaction. (2 marks)

b. The energy released during the reaction. (2 marks)

[End of Examination]

FORMULA AND CONSTANTS

CONSTANTS

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

Speed of the sound in air $(v_{air}) = 340\ m/s$

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

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

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

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

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

Waves

$v = f\lambda$	$f_o = \frac{f_s v}{(v \pm v_s)}$	$T = \frac{1}{f}$

Superposition of waves

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

Quantum physics

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

Particle and nuclear physics

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

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مُسَوَّدَة

مُسَوَّدَة

امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)

للعام الدراسي ١٤٤٣ هـ - ٢٠٢١ / ٢٠٢٢ م

الدور الأول - الفصل الدراسي الثاني

تنبيه:
- المادة: الفيزياء.
- الأسئلة في (١٣) 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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Question 1 Multiple Choice Items (14 marks)

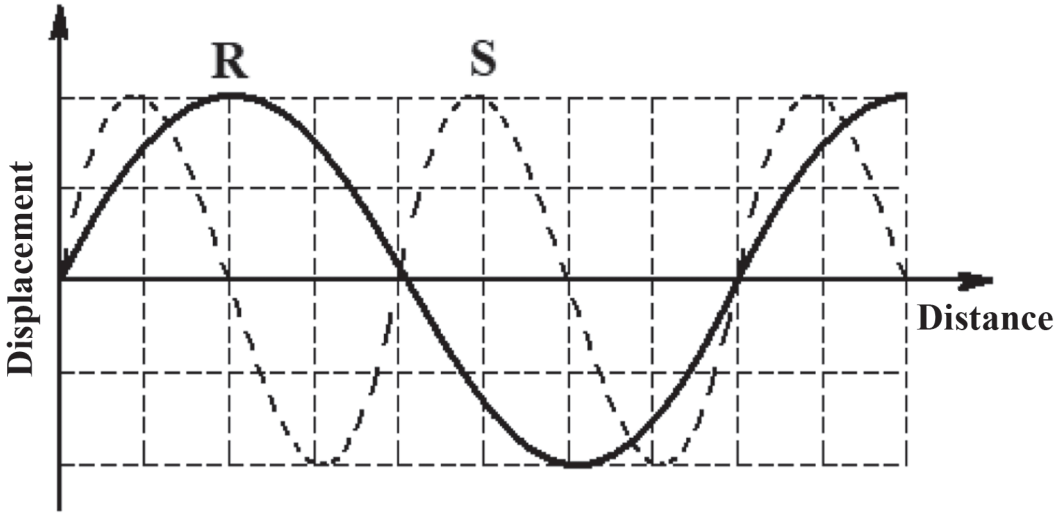
There are 14 multiple choice items worth one mark each.
Shade in the bubble (○) next to the **best** answer for each item.

1) The distance of a particle on a wave from its undisturbed position (rest position), is called:

○ Wavelength. ○ Amplitude.

○ Displacement. ○ Frequency.

2) The figure below shows two waves (R) and (S) moving with the same speed.



Which of the following rows shows the **correct** information about their properties?

	Amplitude (A)	Frequency (f)	Wavelength (λ)
○	$A_S > A_R$	$f_S > f_R$	$\lambda_S > \lambda_R$
○	$A_S > A_R$	$f_S < f_R$	$\lambda_S < \lambda_R$
○	$A_S = A_R$	$f_S < f_R$	$\lambda_S > \lambda_R$
○	$A_S = A_R$	$f_S > f_R$	$\lambda_S < \lambda_R$

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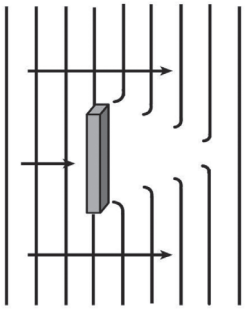
Question 1 continued

3) The figure below shows a standing wave on a stretched string. Which of the following rows shows the **correct** number of nodes and antinodes?

	Number of nodes	Number of antinodes
☐	5	4
☐	4	5
☐	4	4
☐	5	5

4) The figure below shows water waves passing around the edge of a barrier. What phenomenon of waves is being represented?



- ☐ Diffraction
- ☐ Interference
- ☐ Superposition
- ☐ Reflection

5) Young's double-slit experiment is performed using yellow light of wavelength ($600 \times 10^{-9}\ m$). The slits separation is ($8 \times 10^{-4}\ m$) and the screen is ($2\ m$) from the slits. What is the distance between two adjacent bright fringes?

- ☐ $1.5 \times 10^{-3}\ m$
- ☐ $2.4 \times 10^{-3}\ m$
- ☐ $2.7 \times 10^{-3}\ m$
- ☐ $9.6 \times 10^{-3}\ m$

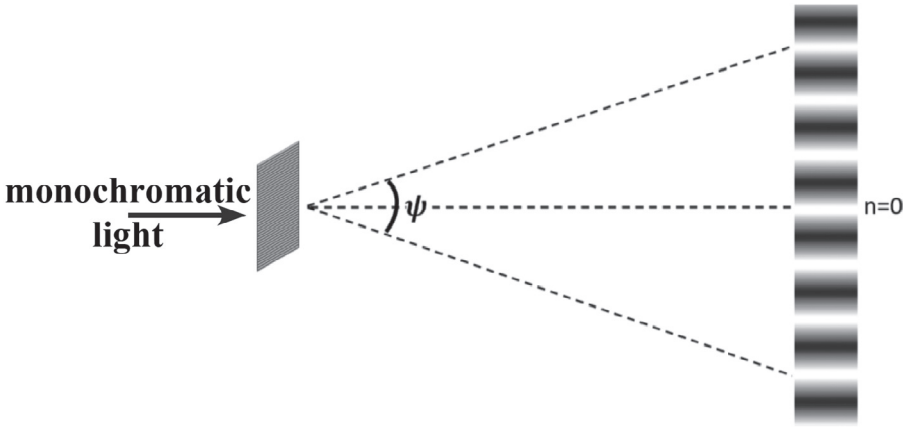
6) A string of a guitar is ($0.6\ m$) long and vibrates at a fundamental frequency of (110 Hz). What is the speed of the waves on the string?

- ☐ $15\ m/s$
- ☐ $33\ m/s$
- ☐ $66\ m/s$
- ☐ $132\ m/s$

Question 1 continued

7) The figure below shows a monochromatic light of wavelength ($460 \times 10^{-9}\ m$) incidents normally on a diffraction grating with (7×10^{4} lines/m).

What is the value of the angle (ψ)?



- ☐ 5.5°
- ☐ 7.4°
- ☐ 11.1°
- ☐ 14.8°

8) In the photoelectric effect, the minimum amount of energy needed to eject an electron from a metal surface, is called:

- ☐ Kinetic energy.
- ☐ Work function.
- ☐ Stopping voltage.
- ☐ Photon energy.

9) What is the de-Broglie wavelength of an electron moving with a speed of ($6.6 \times 10^{5}\ m/s$)?

- ☐ $2.4 \times 10^{-14}\ m$
- ☐ $6.0 \times 10^{-13}\ m$
- ☐ $1.1 \times 10^{-9}\ m$
- ☐ $7.3 \times 10^{-4}\ m$

10) A metal of work function (2.5 eV) is used in a photoelectric cell. What is the **longest** wavelength of the light source, which will eject electrons from the metal?

- ☐ $6.01 \times 10^{-7}\ m$
- ☐ $5.50 \times 10^{-7}\ m$
- ☐ $4.97 \times 10^{-7}\ m$
- ☐ $3.50 \times 10^{-7}\ m$

Question 1 continued

11) Rutherford's α-scattering experiment concludes that:

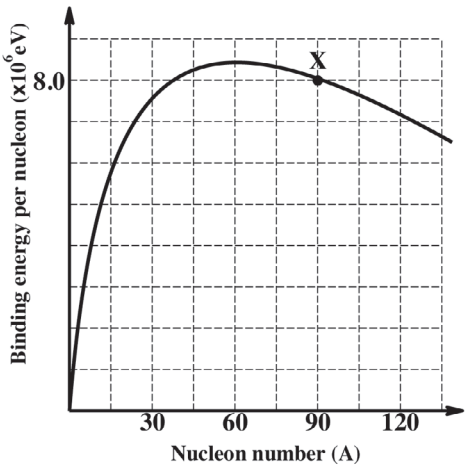
- ☐ Most of the atom is empty.
- ☐ The center of atom is uncharged.
- ☐ Velocity of all electrons is the same.
- ☐ Electrons are revolving around the nucleus.

12) The radioactive decay of uranium into thorium is represented by the following equation: $^{238}_{92}U \longrightarrow {}^{234}_{90}Th + X$

What does (X) represent?

- ☐ A proton.
- ☐ An electron.
- ☐ Beta particle.
- ☐ Alpha particle.

13) The figure opposite shows a graph of binding energy per nucleon versus the nucleon number. What is the mass defect of nucleus (X)?



- ☐ 1.42×10^{-29} kg
- ☐ 1.60×10^{-28} kg
- ☐ 4.27×10^{-28} kg
- ☐ 1.28×10^{-27} kg

14) Radioactive element (X) has half-life time of (50 min) and intially contained (N) number of nuclei. After (200 min), what is the number of undecayed nuclei of (X)?

- ☐ $\frac{N}{2}$
- ☐ $\frac{N}{4}$
- ☐ $\frac{N}{8}$
- ☐ $\frac{N}{16}$

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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) a. What is the relation between the intensity (I) and the square of the amplited (A^2) of a wave? **(Choose the correct answer)** (1 mark)

- ☐ Directly proportional
- ☐ Inversely proportional

b. An ambulance with a siren produces sound waves of wavelength of (2 m) and moves toward a stationary observer as shown in the figure below.

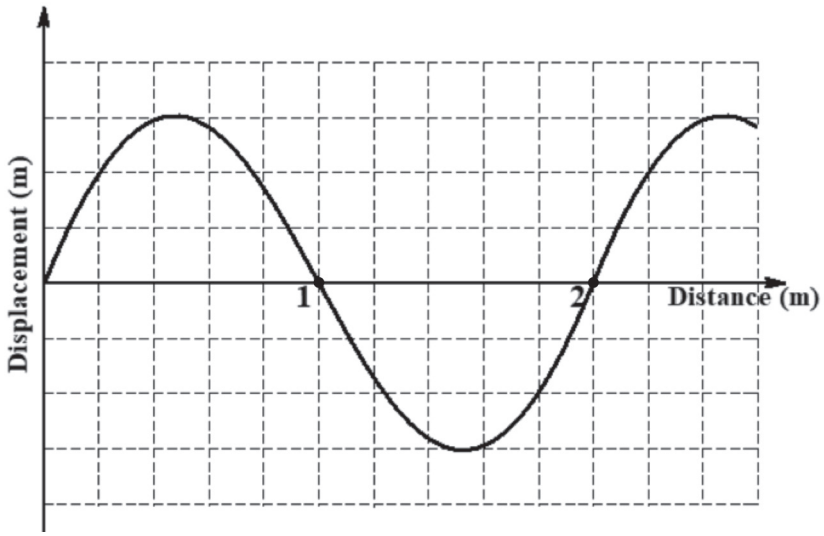
(i) Calculate the frequency of the sound waves produced by the siren (f_s). (1 mark)

(ii) Find the frequency of the waves heard by the observer (f_o). (3 marks)

Question 2 continued

16) a. Define the time period of a wave. (1 mark)

b. The figure below shows a displacement-distance graph of a wave produced by a tuning fork, which vibrates at a frequency of (500 Hz).



How long does the wave take to travel (0.5 m)? (2 marks)

Question 2 continued

Figure (1)

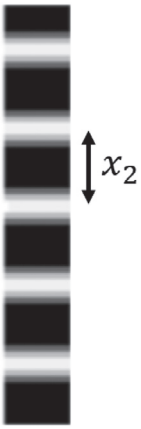


Figure (2)

17) Figures (1) and (2) opposite show two different interference patterns in Young's double-slit experiment using the same slits. Two different light sources are used alternatively a red light source of wavelength ($670 \times 10^{-9}\ m$) and a blue light source of wavelength ($480 \times 10^{-9}\ m$). The slit-to-screen distance is ($3.2\ m$).

a. Which color gives the patterns in: (2 marks)

(i) Figure (1) _____

(ii) Figure (2) _____

b. If the fringe width (x_1) is ($3.84 \times 10^{-3}\ m$), find the slit separation (a). (2 marks)

c. Calculate the fringe width, (x_2). (2 marks)

Question 2 continued

18) a. If a diffraction grating produces a third-order maximum for a green light of wavelength ($590 \times 10^{-9}\ m$) at an angle of (65°) from the central maximum.

At what angle will the second-order maximum appear for a violet light of wavelength ($400 \times 10^{-9}\ m$)? (4 marks)

b. In the table below, compare between constructive and destructive interference. (4 marks)

	Phase difference	Path difference
Constructive interference		
Destructive interference		

Question 2 continued

19) Figure (1) below shows the surface water waves in a ripple tank produced by two coherent sources (S_1) and (S_2) at time (t = 0).

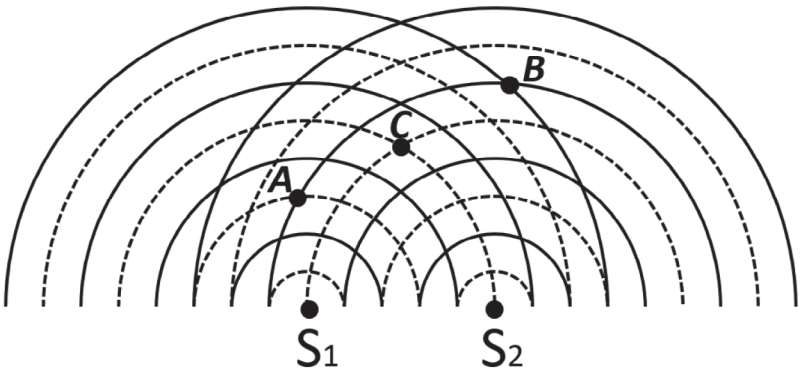


Figure (1)

a. If a small piece of cork is placed in the ripple tank, write two points at which the cork will bob up and down with greatest amplitude? (2 marks)

b. Figure (2) opposite represents the displacement-distance graph of the resultant wave of the interference presented in figure (1). If the amplitude of the waves of source (S_1) is ($A_1 = 3 \times 10^{-3}\ m$),

Find the following:

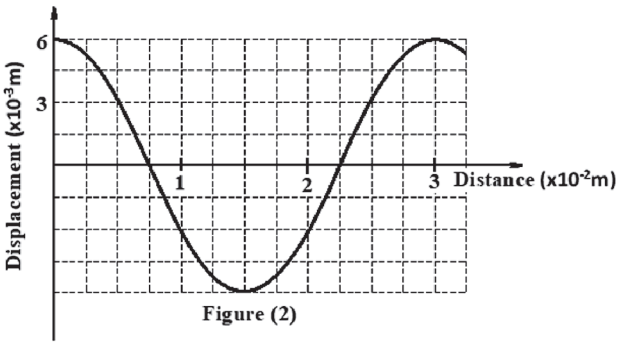


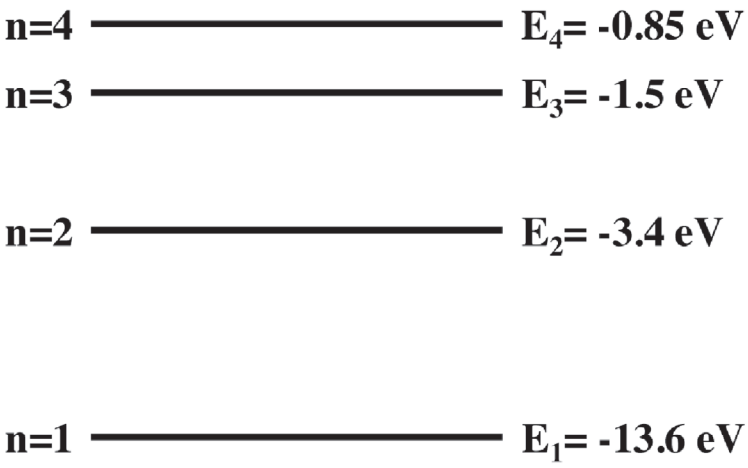
Figure (2)

(i) The amplitude of the waves of source (S_2). (2 marks)

(ii) The distance between source (S_2) and point (C). (2 marks)

Question 2 continued

20) The figure below shows the energy levels of a hydrogen atom.



a. Complete the table below: (2 marks)

Movement of an electron between energy levels	Transition result (Emission or Absorption) Spectra
Downwards transition	
Upwards transition	

b. When an electron transits from energy level (n=3) to a new energy level, it emits a photon of wavelength ($1.027 \times 10^{-7}\ m$).

(i) Calculate the energy of the emitted photon in (eV). (3 marks)

(ii) Find the new level to which the electron transits. (3 marks)

Do not write in this space

Do not write in this space

Question 2 continued

21) a. Write two phenomena that prove the wave nature of particles. (2 marks)

b. A metal has a threshold frequency (f_0). When it is illuminated by a light of frequency ($2f_0$), the maximum velocity of the ejected electrons is(v_1). If the same metal is illuminated by a light of frequency ($5f_0$), prove that the new maximum velocity (v_2) of the ejected electrons will be equal to($2v_1$). (2 marks)

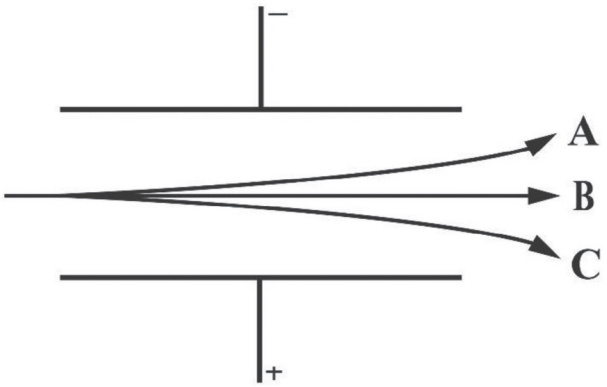
22) a. The figure below shows the behavior of alpha (α), beta (β–), and gamma (γ) radiations in an electric field.

Write the letter of the ray that represents the following: (3 marks)

(α):_____

(β–):_____

(γ):_____



Question 2 continued

b. If the mass of deuteron nucleus (${}^{2}_{1}H$) is (3.342 × 10^{-27} kg), calculate the binding energy per nucleon? (4 marks)

23) A count rate meter is used to measure the activity of a given sample. Initially, the meter shows (4750 counts/min). After (5 min), it shows (2700 counts/min).

a. Find the decay constant (λ). (2 marks)

b. Find the half-life of the sample ($T_{\frac{1}{2}}$). (2 marks)

Question 2 continued

24) **a.** What will happen to the total mass of the produced nuclei after fission and fusion reactions? (2 marks)

Reaction	Total mass of the produced nuclei after reaction (Increases or Decreases)
Fission	
Fusion	

b. How many alpha (α) and beta (β–) particles are emitted, when (${}^{238}_{92}U$) decays to (${}^{206}_{82}Pb$)? (3 marks)

[End of Examination]

FORMULA AND CONSTANTS

Units	FORMULA		CONSTANTS
Wave	$v = \lambda f$	$f_o = \frac{f_s v}{v \mp v_s}$	$e = 1.6 \times 10^{-19} C$ $m_e = 9.11 \times 10^{-31} kg$ $m_P = 1.673 \times 10^{-27} kg$ $m_n = 1.675 \times 10^{-27} kg$ $g = 9.8\ m/s^2$ $h = 6.63 \times 10^{-34} J.s$ $c = 3 \times 10^8 m/s$ $v_{sound\ (air)} = 340\ m/s$ $1eV = 1.6 \times 10^{-19} J$
	$f = \frac{1}{T}$	$v = \frac{d}{t}$	
Superposition	$dsin\theta = n\lambda$	$d = \frac{1}{N}$	
	$f_n = \frac{nv}{2L}$	$\lambda = \frac{ax}{D}$	
	$L = \frac{n\lambda}{2}$		
Quantum physics	$E = hf$	$hf = \phi + KE_{max}$	
	$\frac{1}{2}mv_{max}^2 = eV_O$	$\phi = hf_o$	
	$\Delta E = E_2 - E_1$ $= \frac{hc}{\lambda}$	$\lambda = \frac{h}{p}$ $= \frac{h}{mv}$	
Particle and nuclear physics	$E_b = \Delta mc^2$	$A = \frac{\Delta N}{\Delta t} = -N\lambda$	
	$E_n = \frac{E_b}{A}$	$A = A_0 e^{-\lambda t}$	
		$N = N_0 e^{-\lambda t}$	
		$\lambda = \frac{0.693}{T_{\frac{1}{2}}}$	

مُسَوَّدَة

مُسَوَّدَة

امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)

للعام الدراسي ١٤٤٣ هـ - ٢٠٢١ / ٢٠٢٢ م

الدور الثاني - الفصل الدراسي الثاني

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

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) The intensity of a wave is directly proportional to:

- ○ Wavelength.
- ○ Time period.
- ○ Square of speed.
- ○ Square of amplitude.

2) The figure below shows a sound source (**S**) moving away from a stationary observer (**Z**) towards a stationary observer (**X**) with velocity (v_s).

In the table below, which row **correctly** shows the relation between the velocities of the sound waves that reach both observers and the wavelengths of those waves.

	Velocities of the sound waves that reach both observers	Wavelengths of the sound waves that reach both observers
○	$v_x > v_z$	$\lambda_x < \lambda_z$
○	$v_x > v_z$	$\lambda_x > \lambda_z$
○	$v_x = v_z$	$\lambda_x < \lambda_z$
○	$v_x = v_z$	$\lambda_x > \lambda_z$

3) The two light sources will be **coherent**, if their waves have the:

- ○ Same frequency and same amplitude.
- ○ Same displacement and same amplitude.
- ○ Same frequency and constant phase difference.
- ○ Same displacement and constant phase difference.

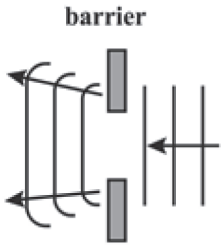
Do not write in this space

Question 1 continued

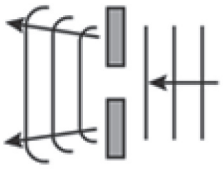
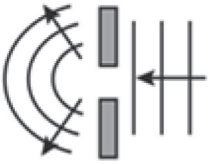
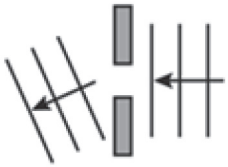
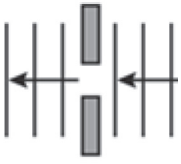
4) A monochromatic light is incident on two narrow slits which are (1×10^{-3} m) apart and (5 m) away from the screen. If the fringe width is (2×10^{-3} m), what is the wavelength of the light?

- ☐ 4×10^{-7} m
- ☐ 1×10^{-6} m
- ☐ 4×10^{-4} m
- ☐ 1×10^{-5} m

5) The figure below shows waves passing through a gap in a barrier.

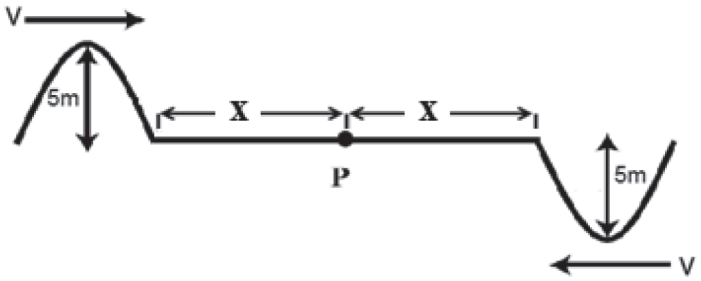


If the width of the gap is reduced, which of the following figures **correctly** represents the waves after passing through the gap?

- ☐ 
- ☐ 
- ☐ 
- ☐ 

Question 1 continued

6) The figure below shows two pulses travelling in opposite directions with the same speed (v).



If the two pulses travel the same distance and interfere at point (**P**), which row **correctly** shows the type of the interference and the resultant displacement at point (**P**)?

	Type of the interference	Resultant displacement at point P (m)
☐	Constructive	0
☐	Constructive	10
☐	Destructive	0
☐	Destructive	10

7) A standing wave is formed on a fixed string of length (L).Which of the following is **not** a wavelength of the standing wave on the string?

☐ $\frac{2L}{1}$ ☐ $\frac{2L}{3}$

☐ $\frac{L}{2}$ ☐ $\frac{3L}{2}$

Question 1 continued

8) Which of the following phenomena prove the particle nature of the light?

- ☐ Photoelectric effect.
- ☐ Diffraction.
- ☐ Reflection.
- ☐ Interference.

9) Which of the following electron transitions will emit a photon with the **shortest** wavelength?

	From	To
☐	$n = 3$	$n = 1$
☐	$n = 3$	$n = 2$
☐	$n = 4$	$n = 1$
☐	$n = 4$	$n = 2$

10) A neutron has a de Broglie wavelength (λ) and kinetic energy (KE). If its kinetic energy becomes (4KE), what will be the new de Broglie wavelength?

- ☐ $\frac{1}{4}\lambda$
- ☐ $\frac{1}{2}\lambda$
- ☐ 2λ
- ☐ 4λ

11) Which of the following represents the definition of isotopes?

- ☐ Nuclei with the same number of protons and the same number of neutrons.
- ☐ Nuclei with a different number of protons but the same number of neutrons.
- ☐ Nuclei with the same number of protons but a different number of neutrons.
- ☐ Nuclei with a different number of protons and a different number of neutrons.

Question 1 continued

12) How many electrons does an Oxygen atom (${}^{18}_{8}O$) have?

- ☐ 8
- ☐ 10
- ☐ 18
- ☐ 26

13) According to the following radioactive decay:

$${}^{200}_{92}X \longrightarrow {}^{168}_{80}Y$$

Which row in the table below **correctly** shows the number of alpha- particles (α) and beta-particles (β–) that emitted from the above decay?

	Number of (α) particles	Number of (β–) particles
☐	4	4
☐	4	8
☐	8	4
☐	8	8

14) A sample of a radioactive element initially has (6000 nuclei) and its half-life is (40 min). What is the number of decayed nuclei after (80 min)?

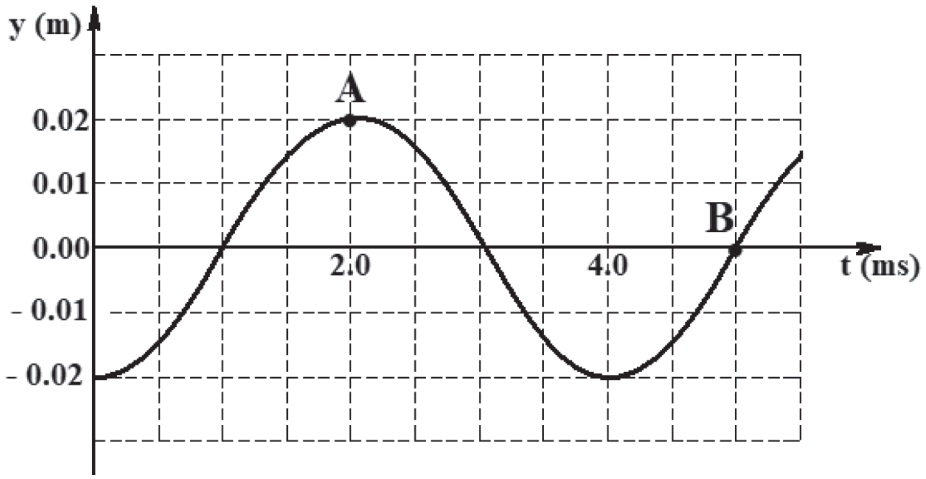
- ☐ 1500
- ☐ 3000
- ☐ 4500
- ☐ 6000

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) The figure below shows a graph of displacement (y) versus time (t) for a wave.



a. Define displacement. (1 mark)

b. Find the time period. (1 mark)

c. If the horizontal distance between points (A) and (B) is (0.6 m), calculate the speed of the wave. (3 marks)

Do not write in this space

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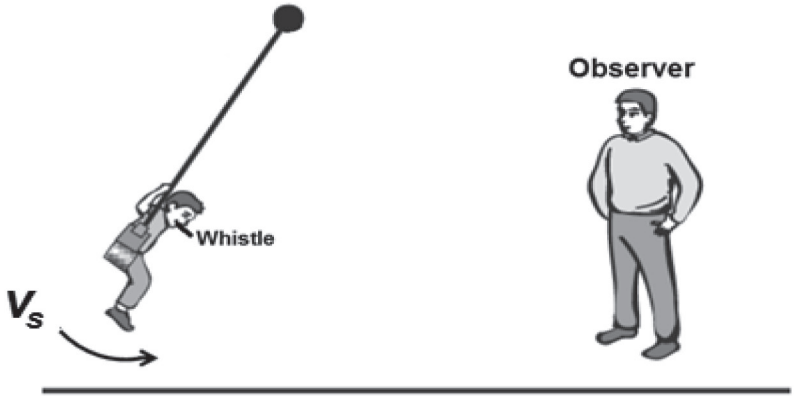
Question 2 continued

16) The figure below shows a child swinging and blowing a whistle that produced a sound of frequency (f_s). As the swing is **approaching** a stationary observer, the observer hears the whistle's sound at a frequency a (5%) higher than (f_s).

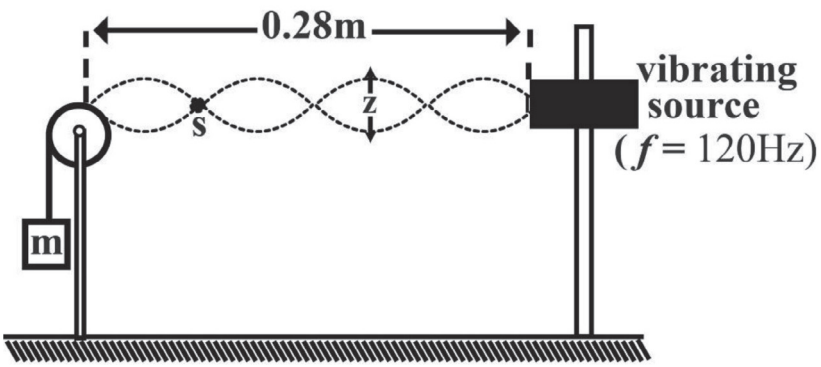


a. The frequency change is due to the relative motion between the source of sound waves and the observer. What is the name of this phenomenon? (1 mark)

b. Calculate the speed of the swing (v_s). (2 marks)

Question 2 continued

17) The figure below shows a standing wave formed on a stretched string attached to a vibrator.



a. State the principle of superposition of waves. (1 mark)

b. Which letter represents the positions of: (2 marks)

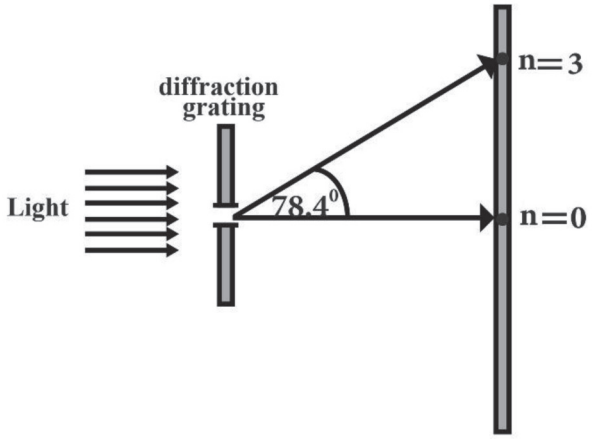
Node: _____ **Antinode**: _____

c. Calculate the wavelength of the standing wave. (2 marks)

d. Calculate the speed of the standing wave. (2 marks)

Question 2 continued

18) A light of wavelength (681×10^{-9} m) is incident normally on a diffraction grating. A third order maximum is observed, as shown in the figure below.



a. Define diffraction grating. (1 mark)

b. Find the number of slits per meter (N) for the grating. (3 marks)

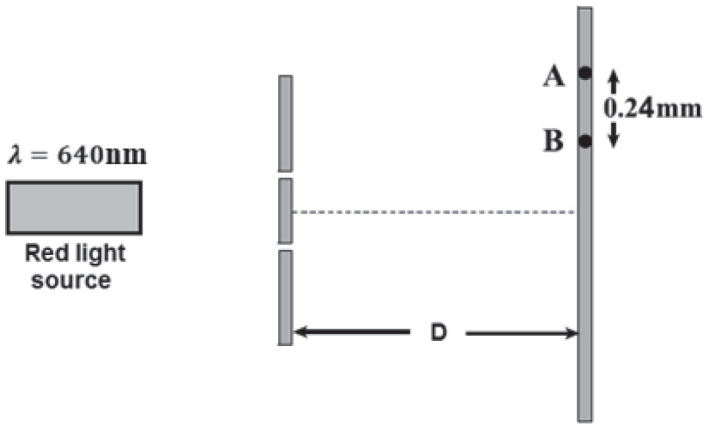
c. Show by calculation that a fourth order maximum **will not** appear on the screen. (3 marks)

Question 2 continued

19) a. In the table below compare between constructive and destructive interference: (2 marks)

	Constructive interference	Destructive interference
Path difference of the interfered waves.	_____	_____

b. The figure below shows a double-slit interference experiment. When a red light is used, the first two bright interference fringes (A) and (B) are produced.



If the red light source is replaced by a blue light of wavelength (400 nm), calculate by how much the fringe width will change (Δx). (4 marks)

_____

_____

_____

_____

_____

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Do not write in this space

Question 2 continued

20) a. In photoelectric effect, what is the effect of increasing the intensity of the light on the following: (2 marks)

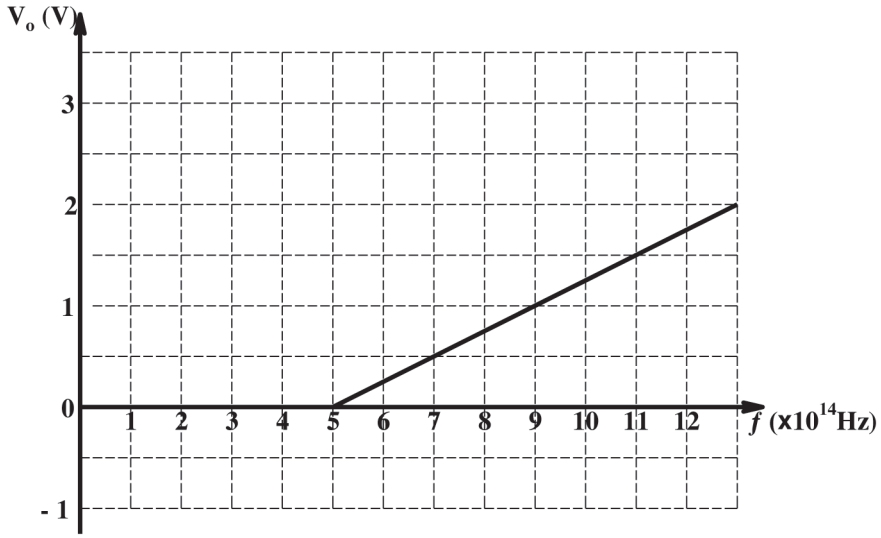
(i) Number of emitted electrons:

☐ Increases ☐ Decreases ☐ No change **(choose the answer)**

(ii) Energy of emitted electrons:

☐ Increases ☐ Decreases ☐ No change **(choose the answer)**

b. The figure below shows the variation of the stopping voltage (V_o) against the frequency of the incident light on the surface of a photoelectric-cell.



(i) Define photoelectric effect. (1 mark)

(ii) What is meant by threshold frequency. (1 mark)

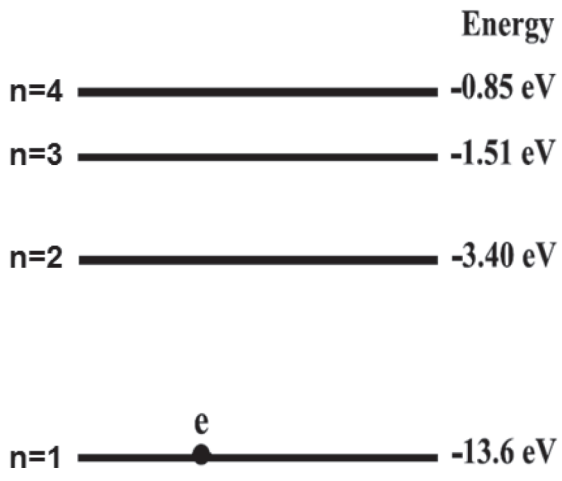
Question 2 continued

(iii) Calculate the work function (ϕ). (2 marks)

(iv) Calculate the longest wavelength that can eject an electron. (2 marks)

21) a. An electron has a velocity of (5.93×10^6 m/s). Calculate the de Broglie wavelength of the electron. (2 marks)

b. The figure opposite shows the energy levels of the Hydrogen atom with the electron in ground state. If the electron absorbs energy of (12.09 eV), calculate at what energy level does the electron excited? (2 marks)



Question 2 continued

22) a. In (**α - particles**) scattering experiment, most of (**α - particles**) have no deflection. How did Rutherford explain that? (1 mark)

b. Boron nucleus ($^{11}_{5}B$) has a mass of (1.795×10^{-26} kg). Calculate the following:

(i) Mass defect (Δm). (2 marks)

(ii) The binding energy of the nucleus. (2 marks)

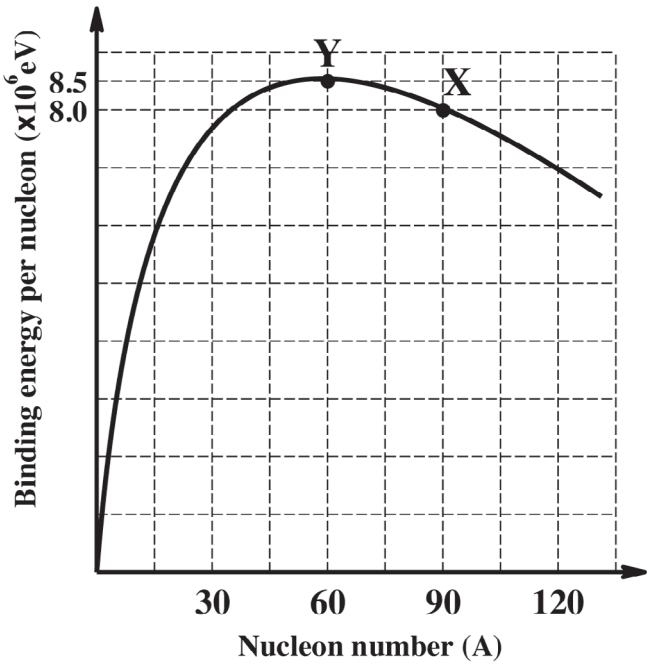
23) a. In the table below compare between **alpha-particle (α)** and **gamma-radiation (γ)**: (4 marks)

	α - particle	**γ - radiation**
Charge		
Nature		

Question 2 continued

b. The figure opposite shows the graph of binding energy per nucleon versus nucleon number.

Compare by calculation between the binding energy of nucleus (X) and nucleus (Y). (4 marks)



24) Two radioactive samples (M) and (K) initially contain an equal number of nuclei. Their half-life times are (1 hr) and (2 hr) respectively. After (2 hr) calculate the ratio of their activities $\left(\frac{A_m}{A_k}\right)$. (3 marks)

[End of Examination]

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FORMULA AND CONSTANTS

Units	FORMULA		CONSTANTS
Wave	$v = \lambda f$	$f_o = \frac{f_s v}{v \mp v_s}$	$e = 1.6 \times 10^{-19} C$ $m_e = 9.11 \times 10^{-31} kg$ $m_P = 1.673 \times 10^{-27} kg$ $m_n = 1.675 \times 10^{-27} kg$ $g = 9.8\ m/s^2$ $h = 6.63 \times 10^{-34} J.s$ $c = 3 \times 10^8 m/s$ $v_{sound\ (air)} = 340\ m/s$ $1eV = 1.6 \times 10^{-19} J$
	$f = \frac{1}{T}$	$v = \frac{d}{t}$	
Superposition	$dsin\theta = n\lambda$	$d = \frac{1}{N}$	
	$f_n = \frac{nv}{2L}$	$\lambda = \frac{ax}{D}$	
	$L = \frac{n\lambda}{2}$		
Quantum physics	$E = hf$	$hf = \phi + KE_{max}$	
	$\frac{1}{2} m v_{max}^2 = eV_O$	$\phi = hf_o$	
	$\Delta E = E_2 - E_1$ $= \frac{hc}{\lambda}$	$\lambda = \frac{h}{p}$ $= \frac{h}{mv}$	
Particle and nuclear physics	$E_b = \Delta mc^2$	$A = \frac{\Delta N}{\Delta t} = -N\lambda$	
	$E_n = \frac{E_b}{A}$	$N = N_0 e^{-\lambda t}$	
	$A = A_0 e^{-\lambda t}$	$\lambda = \frac{0.693}{T_{\frac{1}{2}}}$	

مُسَوَّدَة

امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)

للعام الدراسي ١٤٤٢ هـ - ٢٠٢٠ / ٢٠٢١ م

الدور الأول

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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Question 1: Multiple Choice Items (12 marks)

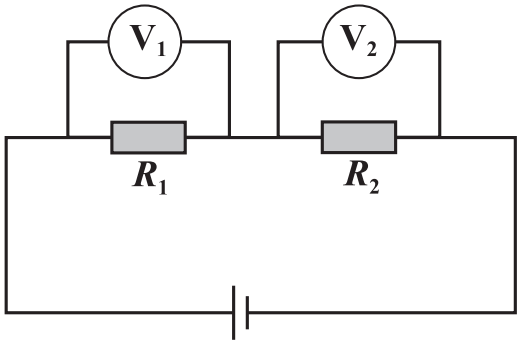
There are 12 multiple-choice items worth one mark each.
Shade in the bubble (○) next to the **best** answer for each item.

1) A charge passing a point in a circuit when there is a current of one ampere for one second is called:

○ Ohm. ○ Volt.

○ Coulomb. ○ Ampere.

2) The figure below shows an electric circuit.



If (R_2) is replaced by another resistor of less value, what will happen to the potential difference across (R_1) and (R_2)?

	Reading of voltmeter (V_1)	Reading of voltmeter (V_2)
○	Decrease	Increase
○	Increase	Decrease
○	Decrease	Decrease
○	Increase	Increase

3) A parallel plate capacitor has a capacitance of ($7.28\ \mu F$) and the potential difference between its plates is ($25\ \mathrm{V}$).What is the amount of the charge on the plates?

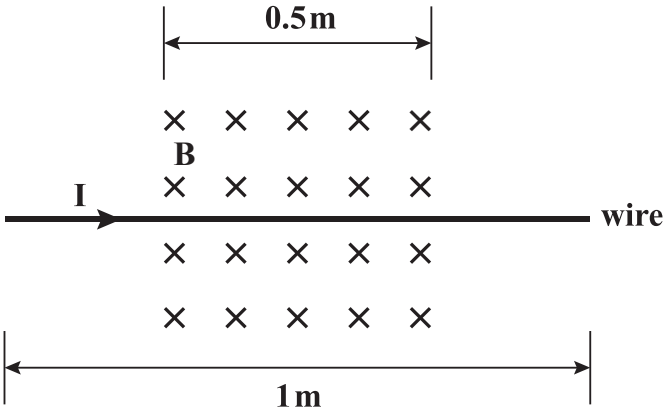
○ $2.91 \times 10^{-7}\ C$ ○ $1.82 \times 10^{-4}\ C$

○ $2.91 \times 10^{4}\ C$ ○ $3.43 \times 10^{6}\ C$

Do not write in this space

Question 1 continued

4) The figure below shows a current-carrying wire placed in a uniform magnetic field of flux density (0.002 T). If the magnetic force acting on the wire is (0.003 N), what is the magnitude of the current (I)?



- ☐ 0.8 A
- ☐ 1.0 A
- ☐ 1.5 A
- ☐ 3.0 A

5) In Fleming's right-hand rule, what does the thumb indicate?

- ☐ Force
- ☐ Field
- ☐ Motion
- ☐ Current

6) Which of the following rows best describes the turns ratio $\left(\frac{N_S}{N_P}\right)$ and the currents ratio $\left(\frac{I_S}{I_P}\right)$ for a step-up transformer?

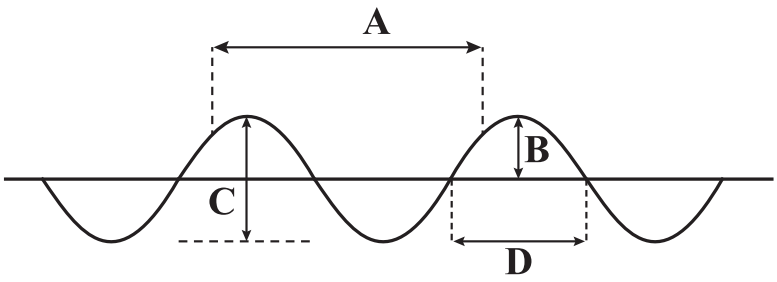
	$\left(\frac{N_S}{N_P}\right)$	$\left(\frac{I_S}{I_P}\right)$
☐	4.5	0.22
☐	4.5	4.5
☐	0.22	4.5
☐	0.22	0.22

Do not write in this space

Do not write in this space

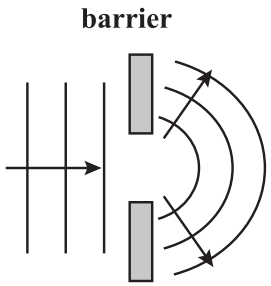
Question 1 continued

7) In the figure below, which letter represents the wavelength?

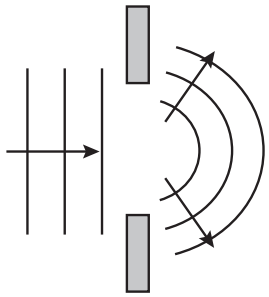
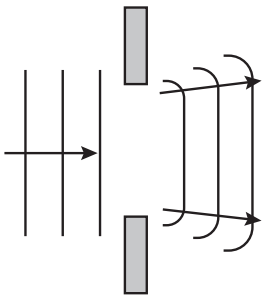
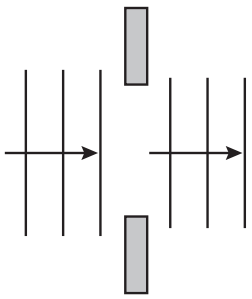
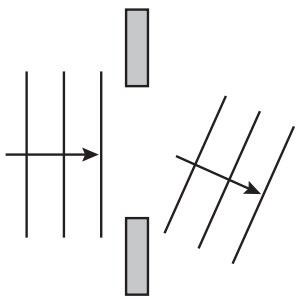


- ☐ A
- ☐ B
- ☐ C
- ☐ D

8) The figure below shows waves passing through a gap in a barrier.



If the width of the gap is increased, which of the following figures correctly represents the waves after crossing the gap?

- ☐ 
- ☐ 
- ☐ 
- ☐ 

Question 1 continued

9) An electron has a de Broglie wavelength (λ) and a kinetic energy (KE).If it is accelerated so that the de Broglie wavelength is doubled, what will the kinetic energy be?

- ☐ $\frac{1}{4}KE$
- ☐ $\frac{1}{2}KE$
- ☐ $2KE$
- ☐ $4KE$

10) The following table shows the energy levels of the hydrogen atom.

Levels	A	B	C	D	E	F
Energy (eV)	0	-0.54	-0.85	-1.51	-3.4	-13.6

What is the frequency of the emitted light when the electron falls from level ($\mathbf{C}$) to level ($\mathbf{E}$)?

- ☐ $3.85 \times 10^{35}\ Hz$
- ☐ $6.15 \times 10^{14}\ Hz$
- ☐ $1.66 \times 10^{-15}\ Hz$
- ☐ $2.60 \times 10^{-34}\ Hz$

11) The process occurs when two very light nuclei combine to form a nucleus of greater mass is called:

- ☐ Mass defect.
- ☐ Binding energy.
- ☐ Nuclear fission.
- ☐ Nuclear fusion.

12) How many neutrons a Uranium nucleus (${}^{235}_{92}U$) includes?

- ☐ 92
- ☐ 143
- ☐ 235
- ☐ 327

Question 2: EXTENDED QUESTIONS (48 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.

13) a. Define the electric current. (1 mark)

b. Figure (a) below shows a setup of an electric circuit that is used to determine the internal resistance of the power supply. Figure (b) shows the results of this experiment.

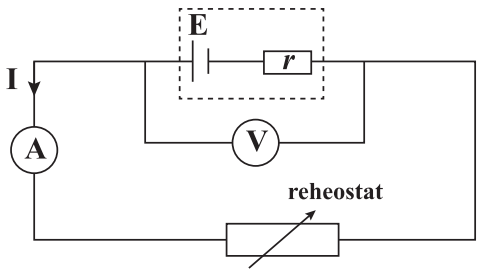


Figure (a)

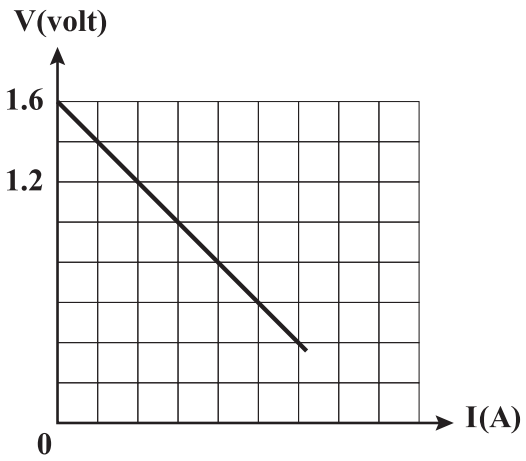


Figure (b)

If the internal resistance is (0.1 Ω), calculate the maximum current that can be driven from the power supply. (2 marks)

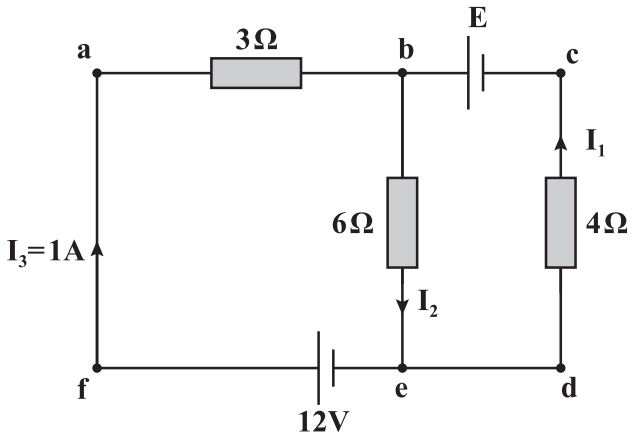
Question 2 continued

14) a. State:

(i) Kirchhoff's first law. (1 mark)

(ii) Kirchhoff's second law. (1 mark)

b. The figure below shows an electric circuit where ($I_3 = 1A$).

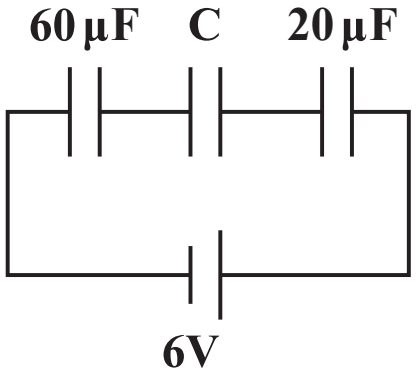


(i) Calculate the current (I_2). (2 marks)

Question 2 continued

(ii) Calculate the electromotive force (E). (3 marks)

15) The figure below shows an electric circuit.



a. Give one use of capacitors in electric circuits. (1 mark)

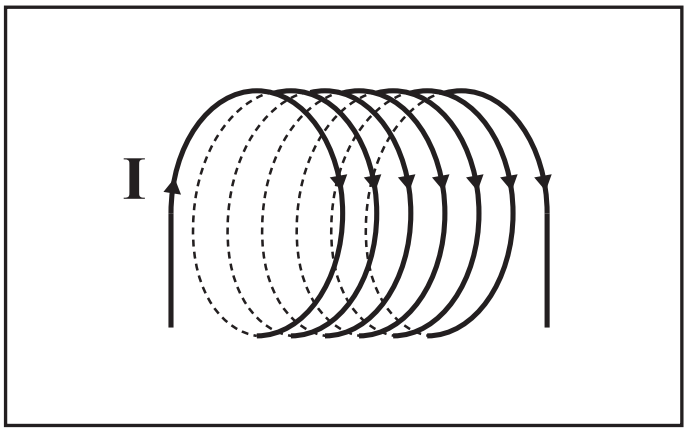
b. If the charge on each capacitor is (36 μC), calculate the capacitance of the capacitor (C). (3 marks)

Question 2 continued

c. If another capacitor is added in series to the previous combination, what will happen to the charge on each capacitor? **(Choose the correct answer)** (1mark)

☐ Will increase ☐ Will decrease ☐ Will not change

16) The figure below shows an electromagnet. Study the figure and answer the following questions.



a. What is the name of this shape of electromagnet? (1 mark)

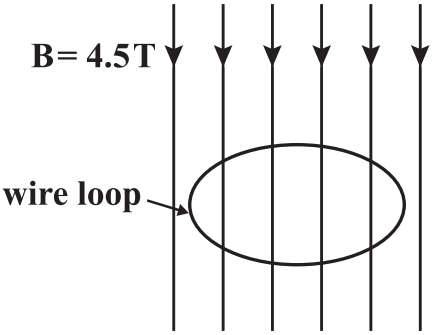
b. Sketch the magnetic field patterns with the correct direction on the figure above. (2 marks)

c. Explain why this type of magnet is considered as a temporary magnet. (1 mark)

17) **a.** State Faraday's law. (1 mark)

Question 2 continued

b. A circular wire loop of area (0.2 m^2) is placed perpendicular to a uniform magnetic field as shown in the figure opposite.



(i) Calculate the magnetic flux (Φ) that passes through the loop?

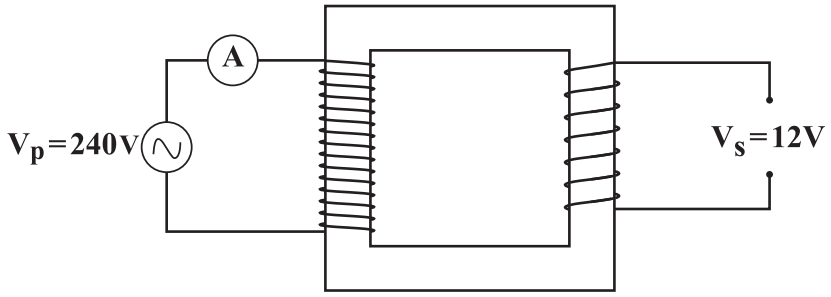
(1mark)

(ii) If the radius of the loop is doubled, what will happen to the magnitude of the magnetic flux (Φ) through the loop? **(Choose the correct answer)**

(1 mark)

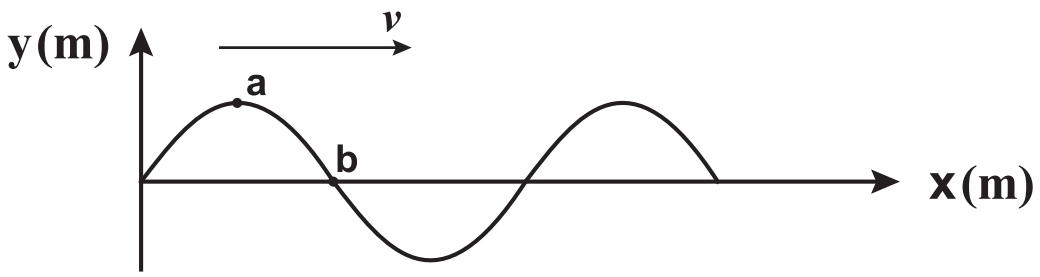
☐ Will halve ☐ Will double ☐ Becomes four times greater

c. The figure below shows a transformer. If the output current is (0.15 A), calculate the reading of the ammeter? (1 mark)



Question 2 continued

18) The figure below shows the displacement (y) versus the distance (x) graph for a wave travelling along a rope.



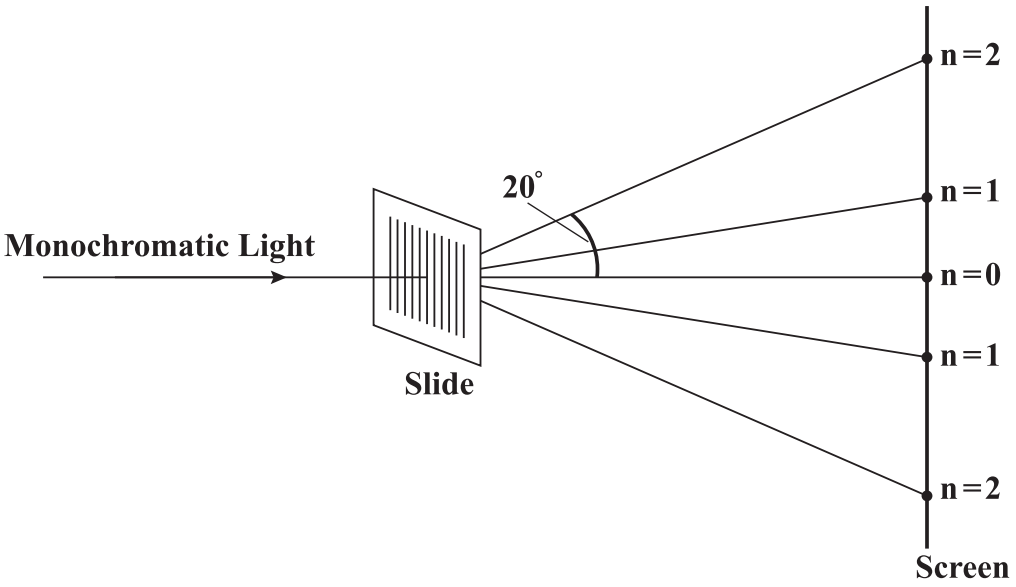
a. Define frequency. (1 mark)

b. If the time taken for the wave to propagate from point (a) to point (b) is (0.06 s), calculate the time period of the wave. (1 mark)

c. When the frequency is changed, the velocity of the wave will remain constant. Explain why? (1 mark)

Question 2 continued

19) A monochromatic light passes through a slide as shown in the figure below.



a. What is the slide shown in the figure called? (1 mark)

b. If the separation between the adjacent lines of the slide is (3.33×10^{-6} m), calculate the wavelength of the light. (2 marks)

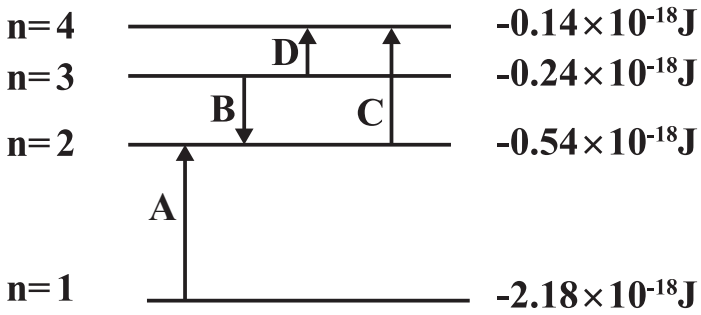
20) **a.** Define the work function. (1 mark)

Question 2 continued

b. A photon with a frequency of (1×10^{15} Hz) strikes a surface of a metal with a work function of (5.1 eV).

Using calculation; prove that the photoelectric effect is not possible. (3 marks)

21) The figure below shows four electron transitions (A, B, C and D) in a hydrogen atom.



a. Which transitions (A or B) produce the following spectra lines:

(i) Absorption line spectrum. _____ (1mark)

(ii) Emission line spectrum. _____ (1mark)

b. Calculate the energy required (in Joules) when the electron transfers from the first level (n = 1) to the third level (n = 3). (2 marks)

Do not write in this space

Do not write in this space

Question 2 continued

c. From the transitions (A, C and D), calculate the minimum wavelength of the required photon. (2 marks)

22) **a.** Compare between gamma (γ), alpha (α) and beta (β) radiations in terms of their nature. (3 marks)

(γ): _____

(α): _____

(β): _____

b. Calculate the binding energy of plutonium ($^{239}_{94}Pu$) (in Joules). (4 marks)

mass of proton = **1.673×10^{-27}** kg

mass of neutron = **1.675×10^{-27}** kg

mass of ($^{239}_{94}Pu$) nucleus= **$3.9682659 \times 10^{-25}$** kg

Question 2 continued

c. A student is studying the penetrating power of one type of radioactive particles. Figure (1) shows the reading of the counter when a thin card is placed between the source and the detector. In figure (2), the thin card is replaced by a sheet of lead of (1mm) thickness and the count rate is recorded.

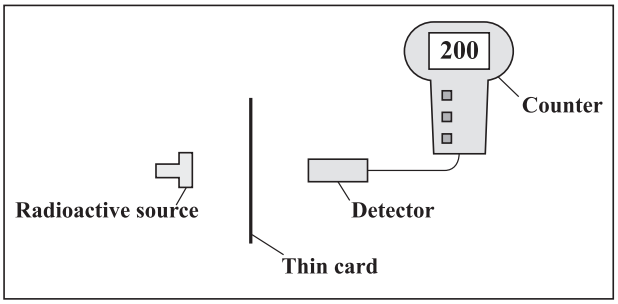


Figure (1)

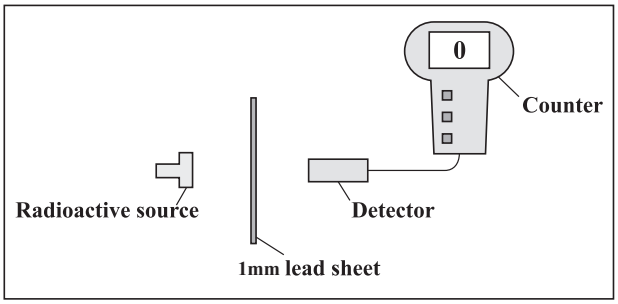


Figure (2)

Which type of radiation is emitted from the source? Give a reason for your answer. (2 marks)

[End of Examination]

FORMULA AND CONSTANTS

Units	FORMULA			CONSTANTS
Electricity	$V = IR$	$Q = Ne$	$Q = It$	$e = 1.6\times10^{-19}C$ $m_e = 9.11\times10^{-31}kg$ $m_P = 1.673\times10^{-27}kg$ $m_n = 1.675\times10^{-27}kg$ $g = 9.8\ m/s^2$ $h = 6.63\times10^{-34}J.s$ $c = 3\times10^{8}m/s$ $1eV = 1.6\times10^{-19}J$
	$I = Anvq$	$E = V_1 + V_2$	$I = I_1 + I_2$	
	$emf = E = IR + Ir$	$R = R_1 + R_2$	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$	
Capacitance	$C = C_1 + C_2$	$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$	$C = \frac{Q}{V}$	
Magnetic fields and electromagnetism	$F = BIlsin\theta$			
Electromagnetic induction	$\Phi = BAcos\theta$	$\Phi = BAsin\theta$	$emf = E = \frac{d(N\Phi)}{dt}$	
Alternating current	$\frac{N_S}{N_P} = \frac{V_S}{V_P} = \frac{I_P}{I_S}$			
Wave	$v = \lambda f$			
Superposition	$dsin\theta = n\lambda$		$d = \frac{1}{N}$	
Quantum physics	$E = hf$	$\phi = hf_o$	$hf = \phi + KE_{max}$	
	$\Delta E = E_2 - E_1 = \frac{hc}{\lambda}$	$KE = \frac{1}{2}mv^2$	$\lambda = \frac{h}{p} = \frac{h}{mv}$	
Particle and nuclear physics	$E_b = \Delta mc^2$	$E_n = \frac{E_b}{A}$		

مُسَوَّدَة

مُسَوَّدَة

مُسَوَّدَة

امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)

للعام الدراسي ١٤٤٢ هـ - ٢٠٢٠ / ٢٠٢١ م

الدور الثاني

تنبيه:
- المادة: الفيزياء.
- الأسئلة في (١٣) 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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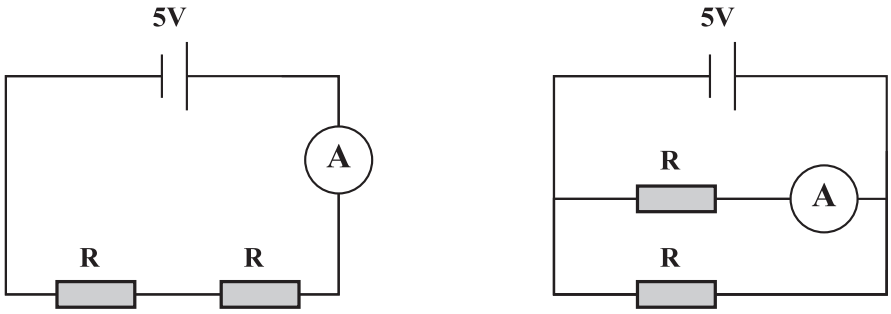
Question 1: Multiple Choice Items (12 marks)

There are 12 multiple-choice items worth one mark each.
Shade in the bubble (○) next to the **best** answer for each item.

1) The rate of the flow of electric charge past a point is called:

- ○ Coulomb.
- ○ Current.
- ○ Mean drift velocity.
- ○ Number density.

2) The figure below shows two circuits (1) and (2), with identical resistors.



circuit (1) circuit (2)

Which row in the table below describes the circuit that has the higher ammeter reading and the lower combined resistance?

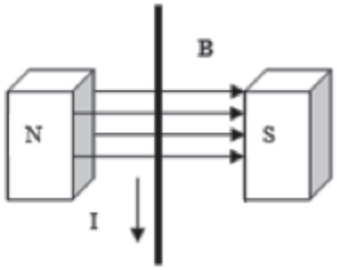
	Circuit with higher ammeter reading	Circuit with lower combined resistance
○	1	1
○	1	2
○	2	1
○	2	2

3) If the potential difference between the plates of a capacitor is increased from (18 V) to (34 V), the charge on the plates will increase by (24 μC).What is the value of the capacitance of the plates?

- ○ 0.7 μF
- ○ 1.3 μF
- ○ 1.4 μF
- ○ 1.5 μF

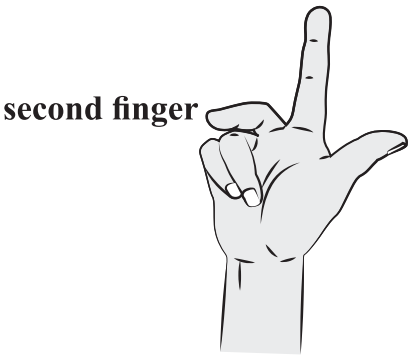
Question 1 continued

4) A wire carrying current (**I**) is placed in a magnetic field (**B**) as shown in the figure opposite. What is the direction of the magnetic force on the wire?



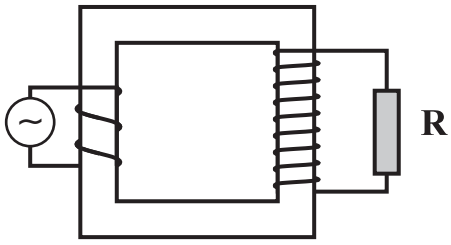
- ☐ To the right.
- ☐ Out of the page.
- ☐ To the left.
- ☐ Into the page.

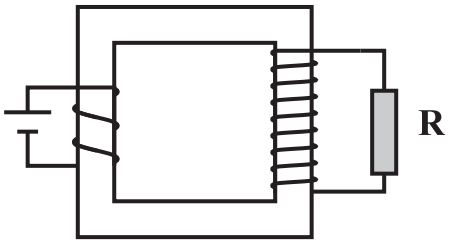
5) In Fleming's right hand rule, what does the second finger indicate?

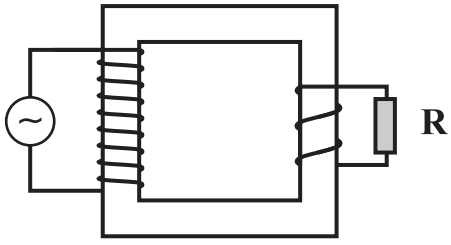


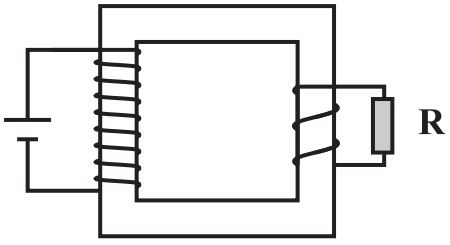
- ☐ Force
- ☐ Field
- ☐ Motion
- ☐ Current

6) In which of the following figures, the current ratio $\left(\frac{I_S}{I_P}\right)$ for a transformer is greater than 1?

- ☐ 

- ☐ 

- ☐ 

- ☐ 

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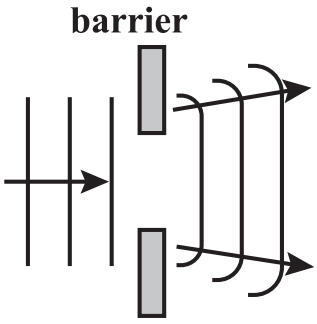
Question 1 continued

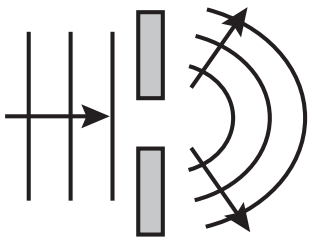
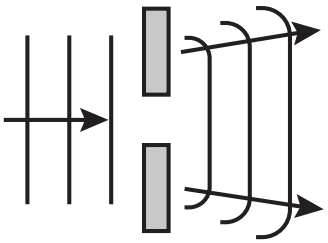
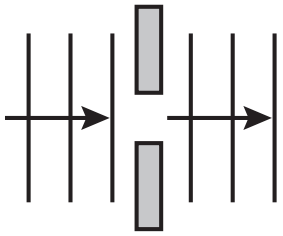
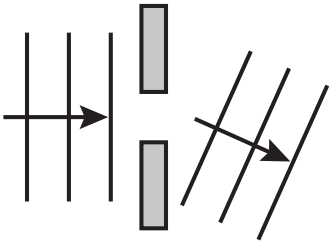
7) The shortest distance between two points that are vibrating in phase with each other is called:

- ○ Wavelength
- ○ Amplitude
- ○ Displacement
- ○ Period

8) The figure below shows waves passing through a gap in a barrier.



If the width of the gap is reduced, which of the following figures correctly represents the waves after passing the gap?

- ○ 
- ○ 
- ○ 
- ○ 

Question 1 continued

9) An electron has a de Broglie wavelength (λ). If it is accelerated so that its velocity is doubled, what will be the new de Broglie wavelength?

- ☐ $\frac{1}{4}\lambda$
- ☐ $\frac{1}{2}\lambda$
- ☐ 2λ
- ☐ 4λ

10) If the work function for Lithium is ($4.6 \times 10^{-19}\ J$), what is the longest wavelength of light that is required to release electrons from its surface?

- ☐ $6.94 \times 10^{14}\ m$
- ☐ $2.08 \times 10^{13}\ m$
- ☐ $4.32 \times 10^{-7}\ m$
- ☐ $1.44 \times 10^{-15}\ m$

11) Which row in the table below describes the nature of alpha (α) and gamma (γ) radiations?

	(α)	(γ)
☐	Proton	Electromagnetic radiation
☐	Proton	Electron
☐	Helium nucleus	Electromagnetic radiation
☐	Helium nucleus	Electron

12) How many protons are there in the isotope $\left({}^{79}_{34}Se\right)$?

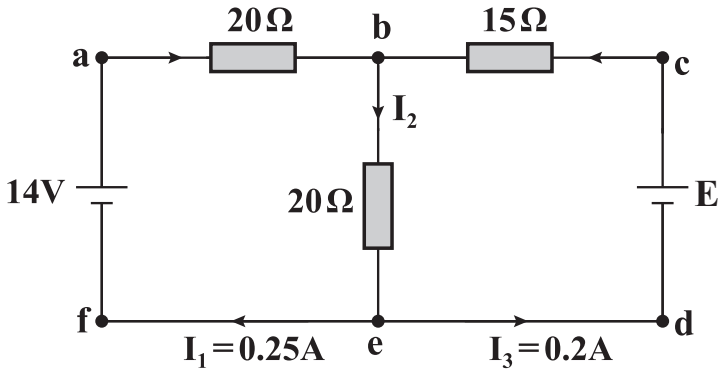
- ☐ 34
- ☐ 45
- ☐ 79
- ☐ 113

Question 2: EXTENDED QUESTIONS (48 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.

13) The figure below shows an electric circuit.



a. State Kirchhoff's first law. (1 mark)

b. Calculate the value of (I_2). (2 marks)

c. Calculate the value of the electromotive force (E). (3 marks)

Question 2 continued

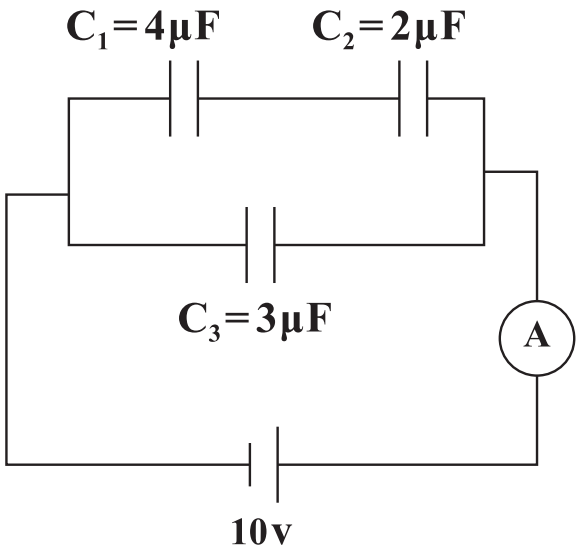
14) Electrons flow through a copper wire with a mean drift velocity of ($1.179 \times 10^{-4}\ m/s$). The wire has a volume of ($3.531 \times 10^{-10}\ m^3$) and a cross-sectional area of ($6.621 \times 10^{-6}\ m^2$).

a. State two factors the mean drift velocity of the electrons depends on. (2 marks)

b. Calculate the number of the conducting electrons passing through the wire if the current is (10.6 A). (2 marks)

Question 2 continued

15) The figure below shows an electric circuit.



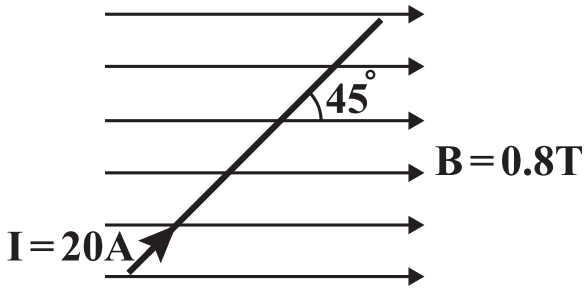
a. Define the capacitance. (1 mark)

b. Calculate the total charge stored on the above combination. (3 marks)

c. If the capacitor (C_2) is removed, what will happen to the total charge on the capacitors? (1mark)

Question 2 continued

16) A (0.10 m) long current carrying wire is placed in a magnetic field at an angle of (45°), as shown in the figure below.



a. What is the type of force acting on the wire? (1mark)

b. Calculate the magnitude of the force acting on the wire. (2marks)

c. What will happen to the magnitude of the force if the angle between the wire and the magnetic field is changed from (45°) to (25°)? (1 mark)

☐ Decreases ☐ Increases ☐ Remains constant

(Choose the correct answer)

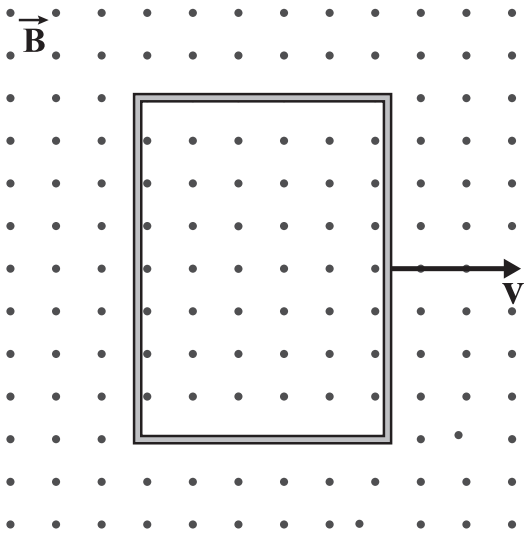
Question 2 continued

17) a. The magnetic flux through a conducting loop changes from (6×10^{-3} Wb) to (12×10^{-3} Wb) in (0.01 s).

(i) Define the magnetic flux. (1 mark)

(ii) Calculate the induced e.m.f (1 mark)

b. In the figure below, there is no induced e.m.f when a rectangular conductor is moved inside a uniform magnetic field. Explain why? (1 mark)

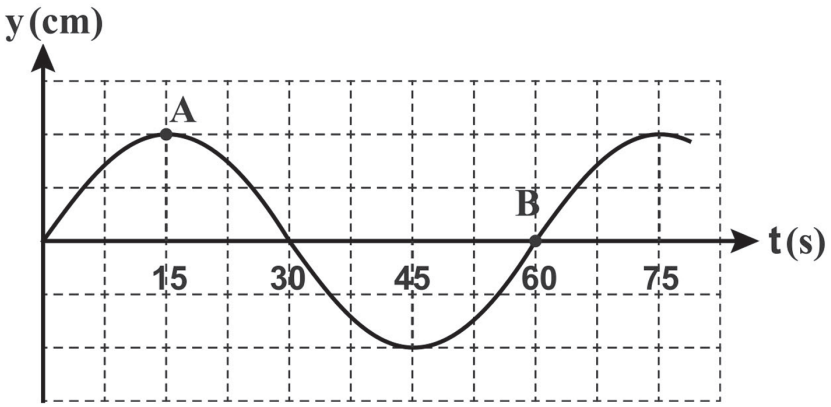


Question 2 continued

c. A primary coil of a transformer is connected to an alternating p.d of (5V) and the secondary coil has a p.d of (10 V). Calculate the turns ratio of the transformer $\left(\frac{N_S}{N_P}\right)$.

(1mark)

18) The following figure shows the displacement (y)– time (t) graph of a mechanical wave.



a. What is the maximum displacement of a point on a wave called? (1mark)

b. Calculate the frequency of the wave. (1mark)

c. If the horizontal distance between point (**A**) and point (**B**) on the graph is (0.6 m), calculate the wavelength of the wave. (1mark)

Question 2 continued

19) A red light of wavelength (λ) is incident normally on a diffraction grating having (3000 lines/cm). The second order maxima is found to be at an angle of (25°).

a. Define the diffraction. (1 mark)

b. Calculate the wavelength of the light (λ). (2 marks)

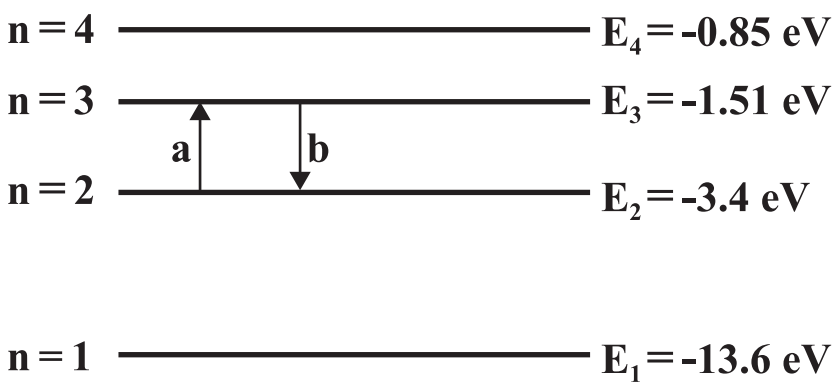
20) The work function for the selenium is (5.11 eV).

a. When a light shines on a metal surface, electrons are released from it.
What is this process called? (1 mark)

b. Calculate the threshold frequency for selenium. (2 marks)

Question 2 continued

21) The figure below shows the energy levels for a hydrogen atom.



a. Which arrow on the figure above represents: (2 marks)

(i) The emission line spectra _____

(ii) The absorption line spectra _____

b. Calculate the wavelength of the produced photon as an electron transfers from energy level (n = 4) to (n = 3). (3 marks)

c. When an electron in the energy level (n = 1) absorbs energy of (7.5 eV), it will remain at the same energy level. Prove that mathematically. (2 marks)

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Question 2 continued

22) a. What are the three main particles of atom? (3 marks)

b. The following equation shows a fusion reaction:

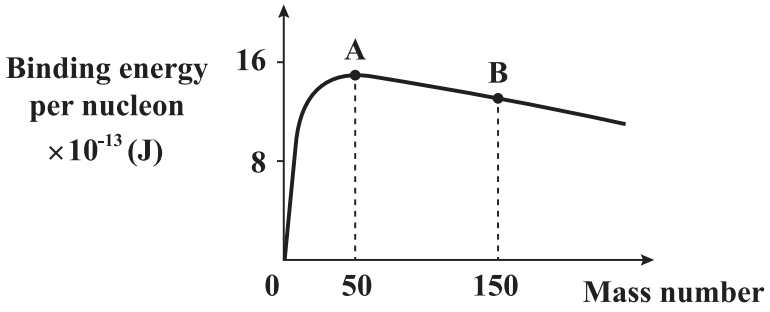
$$ {}_{1}^{1}H + {}_{1}^{2}H \longrightarrow {}_{2}^{3}He + energy $$

The total mass of the nuclei before reaction is (5.015491×10^{-27} kg) and the mass of helium ${}_{2}^{3}He$ is (5.006643×10^{-27} kg).

(i) Calculate the mass defect. (2 marks)

(ii) Calculate the released energy **(in joule).** (2 marks)

c. The graph below shows the binding energy per nucleon versus the mass number.



Which nuclei (**A**) or (**B**) is more stable? Explain your answer. (2 marks)

[End of Examination]

FORMULA AND CONSTANTS

Units	FORMULA			CONSTANTS
Electricity	$V = IR$	$Q = Ne$	$Q = It$	$e = 1.6 \times 10^{-19} C$ $m_e = 9.11 \times 10^{-31} kg$ $m_P = 1.673 \times 10^{-27} kg$ $m_n = 1.675 \times 10^{-27} kg$ $g = 9.8\ m/s^2$ $h = 6.63 \times 10^{-34} J.s$ $c = 3 \times 10^8 m/s$ $1eV = 1.6 \times 10^{-19} J$
	$I = Anvq$	$E = V_1 + V_2$	$I = I_1 + I_2$	
	$emf = E = IR + Ir$	$R = R_1 + R_2$	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$	
	Number of electrons=n×volume			
Capacitance	$C = C_1 + C_2$	$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$	$C = \frac{Q}{V}$	
Magnetic fields and electromagnetism	$F = BIlsin\theta$			
Electromagnetic induction	$\Phi = BAcos\theta$	$\Phi = BAsin\theta$	$emf = E = \frac{d(N\Phi)}{dt}$	
Alternating current	$\frac{N_S}{N_P} = \frac{V_S}{V_P} = \frac{I_P}{I_S}$			
Wave	$v = \lambda f$			
Superposition	$dsin\theta = n\lambda$		$d = \frac{1}{N}$	
Quantum physics	$E = hf$	$\phi = hf_o$	$hf = \phi + KE_{max}$	
	$\Delta E = E_2 - E_1 = \frac{hc}{\lambda}$	$KE = \frac{1}{2}mv^2$	$\lambda = \frac{h}{p} = \frac{h}{mv}$	
Particle and nuclear physics	$E_b = \Delta mc^2$	$E_n = \frac{E_b}{A}$		

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