VCE PHYSICS 2010

YEAR 12 TRIAL EXAM UNIT 4

Reading Time: 15 minutes **Writing Time: 1h 30m**

Structure of Booklet

Section	No of Questions	No of Questions to be answered	No of Marks
A. Core Area of Study			
1. Electric Power.	19	19	38
2. Interactions of Light & Matter.	11	11	26
B. Detailed Study			
1. Sound.	13	13	26
			90

Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, up to two pages (one A4 sheet) of pre-written notes (typed or handwritten) and a scientific calculator. Students are not permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

Materials Supplied
Question and answers booklet with detachable data sheet.

Instructions
Detach the data sheet during reading time.
Write your name in the space provided.
Answer all questions in the question and answers booklet when indicated.
Also show your workings where space is provided.
Where an answer box has a unit printed in it, give your answer in that unit.
All responses must be in English.
Students are not permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

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Data Sheet VCE Physics 2010 Year 12 Trial Exam Unit 4

1	photoelectric effect	$E_{k\max} = hf - W$
2	photon energy	$E = hf$
3	photon momentum	$p = \dfrac{h}{\lambda}$
4	de Broglie wavelength	$\lambda = \dfrac{h}{p}$
5	resistors in series	$R_T = R_1 + R_2$
6	resistors in parallel	$\dfrac{1}{R_T} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$
7	magnetic force	$F = I\,l\,B$
8	electromagnetic induction	emf : $\varepsilon = -N\dfrac{\Delta\Phi}{\Delta t}$ flux : $\Phi = BA$
9	transformer action	$\dfrac{V_1}{V_2} = \dfrac{N_1}{N_2}$
10	AC voltage and current	$V_{\text{RMS}} = \dfrac{1}{\sqrt{2}}V_{\text{PEAK}}$ $I_{\text{RMS}} = \dfrac{1}{\sqrt{2}}I_{\text{PEAK}}$
11	voltage; power	$V = RI$ $P = VI$
12	transmission losses	$V_{\text{drop}} = I_{\text{line}}R_{\text{line}}$ $P_{\text{loss}} = I^2_{\text{line}}R_{\text{line}}$
13	mass of the electron	$m_e = 9.11\times10^{-31}$ kg
14	charge on the electron	$e = -1.6\times10^{-19}$ C
15	Planck's constant	$h = 6.63\times10^{-34}$ J s $h = 4.14\times10^{-15}$ eV s
16	speed of light	$c = 3.0\times10^{8}$ m s^{-1}

Detailed Study 3.3 – Sound

17	speed, frequency and wavelength, period	$v = f\lambda$ $T = \dfrac{1}{f}$
18	intensity and levels	sound intensity level (in dB) $= 10\log_{10}\{\dfrac{I}{I_0}\}$ where $I_0 = 1.0\times10^{-12}$ W m^{-2}

Prefixes/Units

$p = \text{pico} = 10^{-12}$

$n = \text{nano} = 10^{-9}$

$\mu = \text{micro} = 10^{-6}$

$m = \text{milli} = 10^{-3}$

$k = \text{kilo} = 10^{3}$

$M = \text{mega} = 10^{6}$

$G = \text{giga} = 10^{9}$

$t = \text{tonne} = 10^{3}$ kg

Student Name....……………………..…………………..

VCE Physics 2010 Year 12 Trial Exam Unit 4

Student Answer Sheet

Instructions: use a **PENCIL** for **ALL** entries. For each question, shade the box that indicates your answer.

All answers must be completed like **THIS** example.
Marks will **NOT** be deducted for incorrect answers.

A	B	C (shaded)	D

NO MARK will be given if more than **ONE** answer is completed for any one question.
If you make a mistake, **ERASE** the incorrect answer – **DO NOT** cross it out.

SECTION B: Detailed Study 1 – 3.3 Sound

One answer per line

1	A	B	C	D	**2**	A	B	C	D
3	A	B	C	D	**4**	A	B	C	D
5	A	B	C	D	**6**	A	B	C	D
7	A	B	C	D	**8**	A	B	C	D
9	A	B	C	D	**10**	A	B	C	D
11	A	B	C	D	**12**	A	B	C	D
13	A	B	C	D					

VCE Physics 2010 Year 12 Trial Exam Unit 4

Section A – Core

Instructions for Section A
*Answer **all** questions **for both** Areas of Study in this section in the spaces provided.*
Where an answer box has a unit printed in it, give your answer in that unit.
You should take the value of g to be 10 m s^{-2}.
Where answer boxes are provided write your final answer in the box.

Area of Study 1 – Electric power

Questions 1 – 10 refer to the following information.
Figure 1 shows a model generator that Henry used to investigate electromagnetic induction. Henry turned the coil slowly in the direction shown at constant speed and observed the current reading shown on the centre-zero galvanometer.

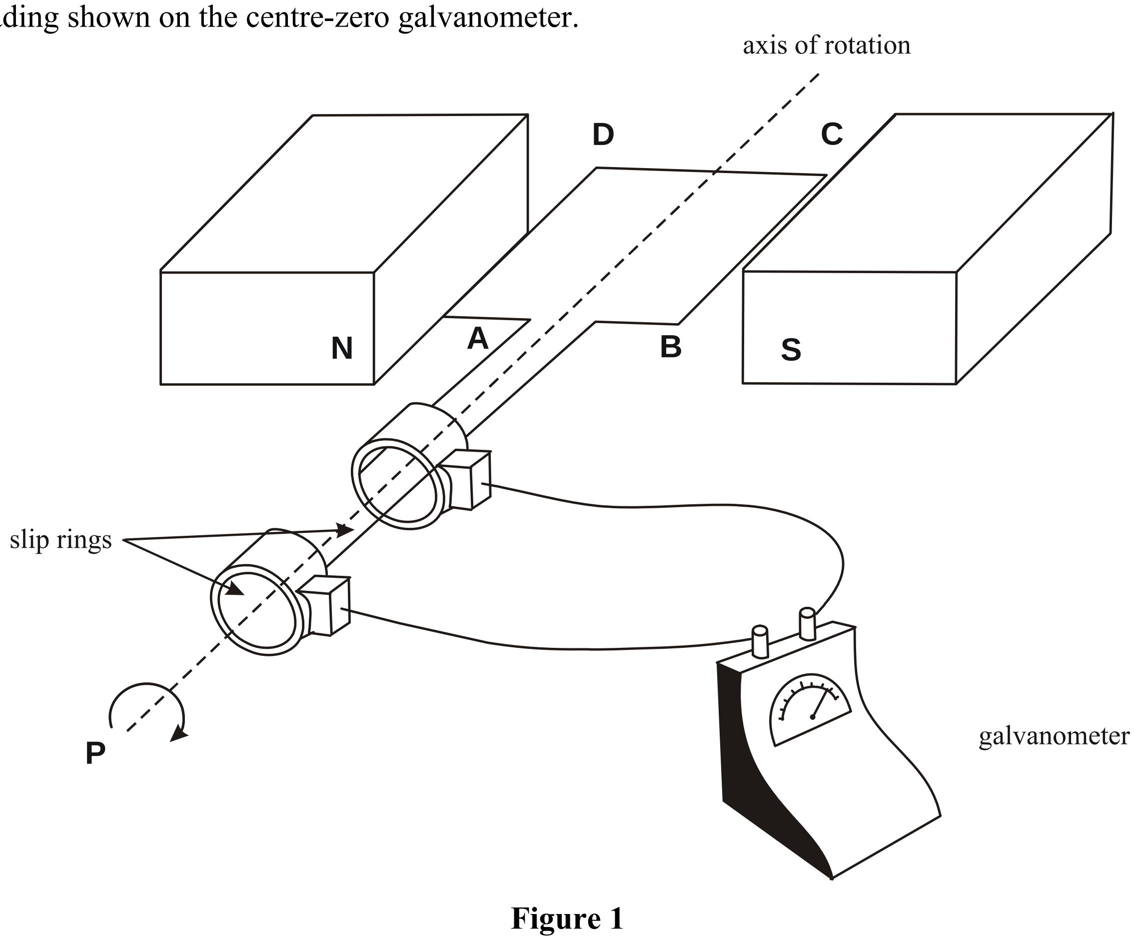


Figure 1

Figure 2 shows the coil in different orientations as viewed from position P. Arrows represent the magnetic field.

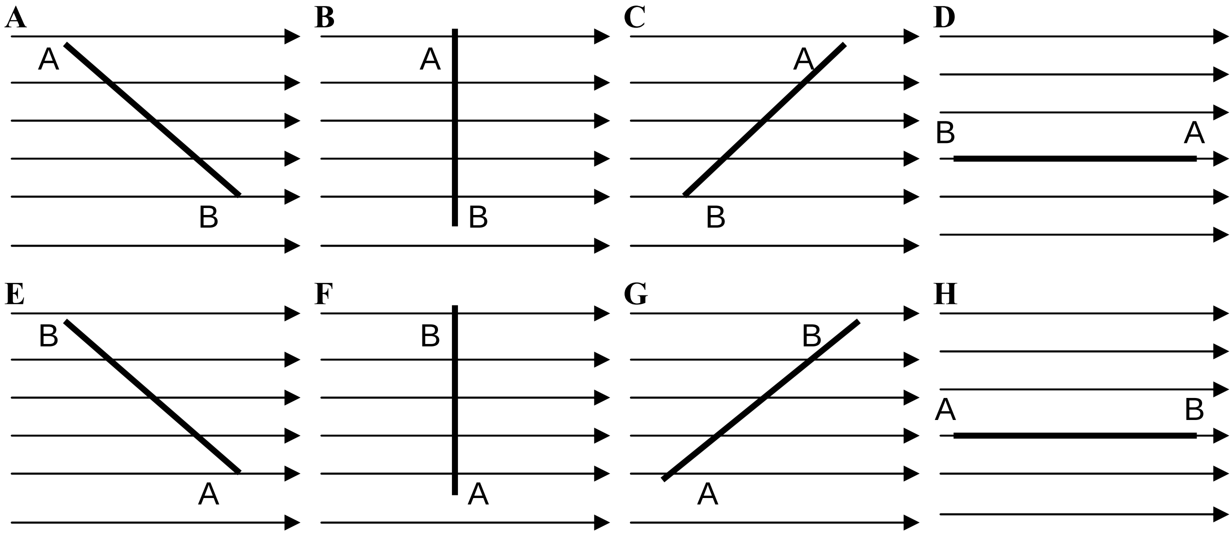


Figure 2

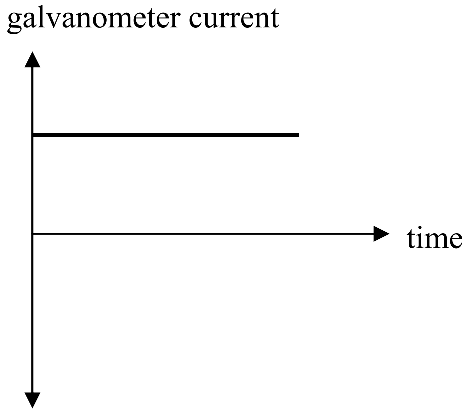
Question 1

In **Figure 2**, at which one or more positions, **A – H**, would the magnitude of the magnetic flux through the coil have been a minimum?

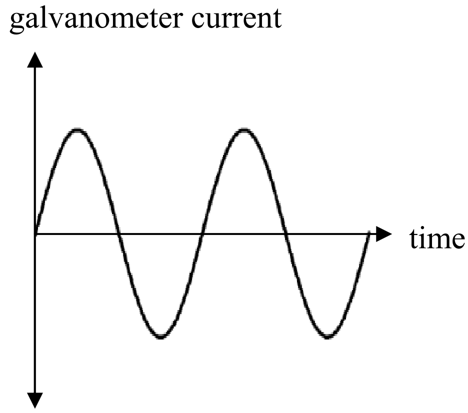
(2 marks)

Question 2
Which one of the following diagrams, **A – D**, best shows how the current through the galvanometer varied with time as Henry rotated the coil at a constant rate?

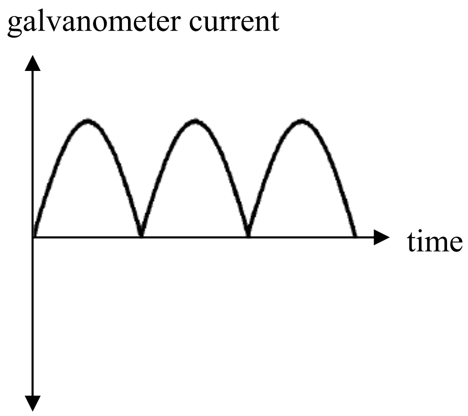
A.



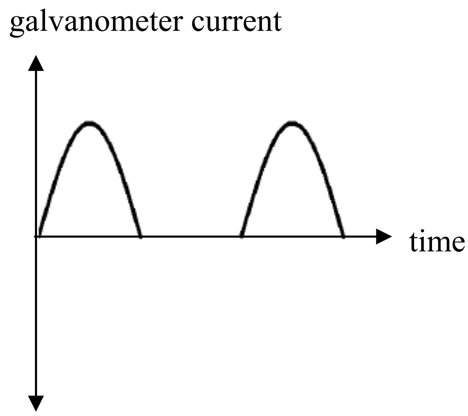
B.



C.



D.



(2 marks)

Henry then modified the generator by removing the slip rings and the galvanometer, and including a split-ring commutator as shown in **Figure 3**. Henry used a cathode ray oscilloscope (C.R.O.) to observe the variation of potential difference across the brushes with time.

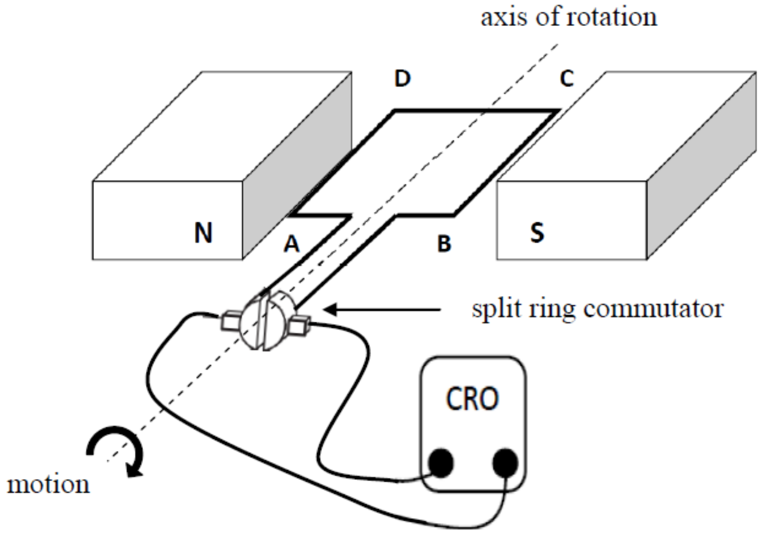
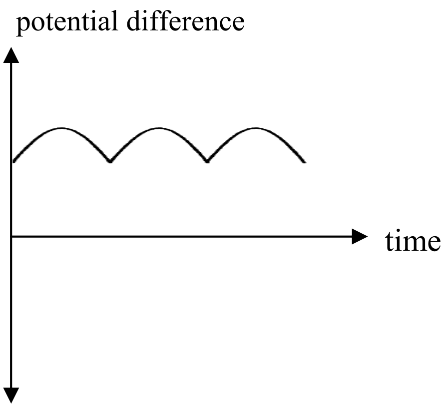
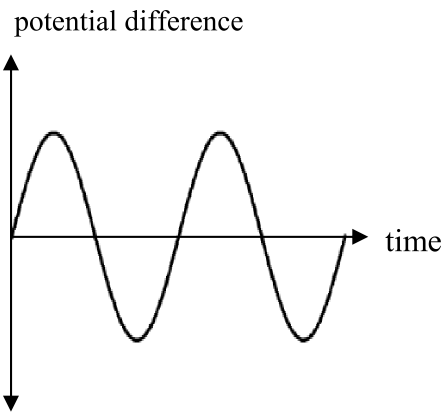
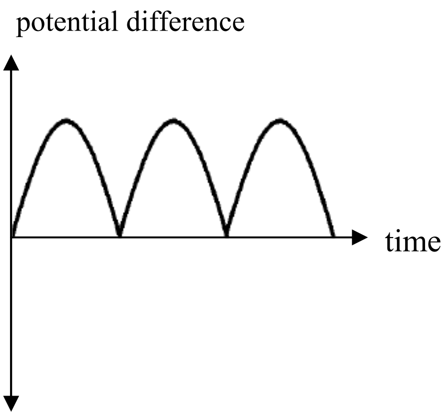


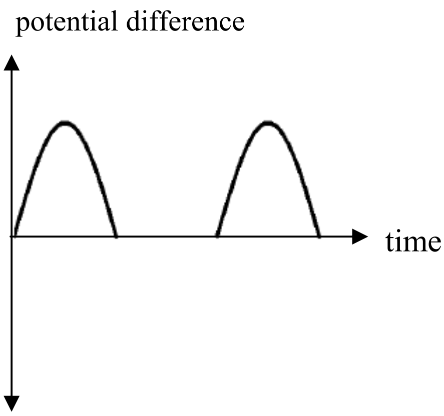
Figure 3

Question 3
Which one of the waveforms, **A – D** below, best shows what Henry observed on the C.R.O. when he rotated the coil as before?

A.


B.


C.


D.


(2 marks)

Henry then disconnected the C.R.O. from the modified generator, as shown in **Figure 3,** in order to operate it as a DC motor, as shown in **Figure 4**.

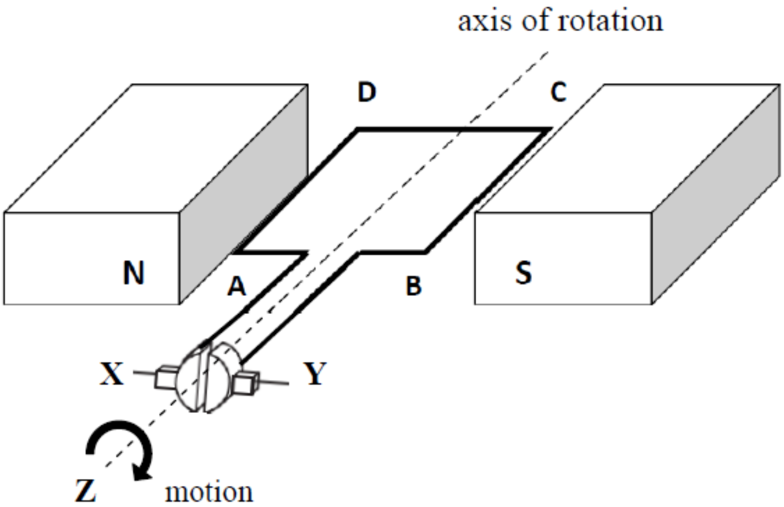


Figure 4

To construct the DC motor, Henry connected a battery across X and Y. He observed that the coil now rotated continuously in the direction of motion as indicated when viewed from position Z.

Question 4

Explain how the split-ring commutator enabled the coil to rotate continuously in the same direction.

____

____

____

____

(2 marks)

Question 5

Explain how the battery terminals should be connected to X and Y, to enable the coil to rotate in the direction shown as viewed from position Z.

____

____

____

____

(2 marks)

The coil Henry was using consisted of 5 turns of wire and each turn had an area of 1.5×10^{-3} m^2. The magnetic field strength was uniform at 0.050 T.

Question 6

Calculate the magnitude of the maximum flux passing through the coil.

Wb

(2 marks)

Side BC of the coil shown in **Figure 4** has a length of 0.030 m.

Question 7

The coil is in the orientation shown in **Figure 4.** Calculate the magnitude of the force on side BC when the current in the coil is 1.5 A.

N

(2 marks)

Question 8

Describe two changes that Henry could make to his motor that would increase the maximum torque on the coil.

____

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____

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(2 marks)

In another investigation, Henry used the equipment shown in **Figure 5** to investigate electromagnetic induction.

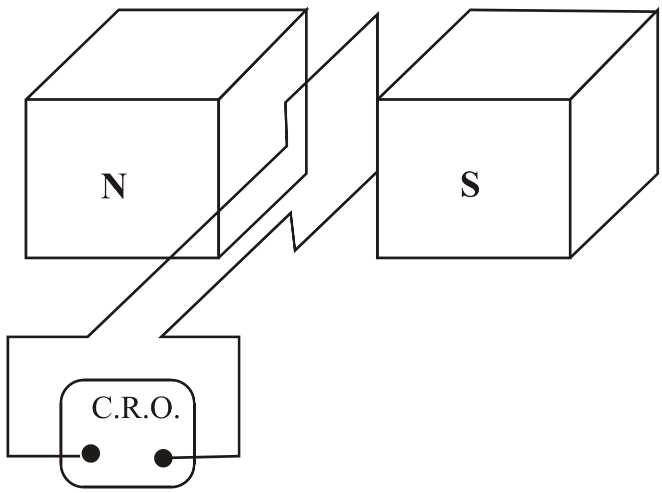


Figure 5

He used the same coil as before and placed it in the magnetic field as shown in **Figure 5**. Henry connected a C.R.O. to the ends of the coil to measure the potential difference. Henry then raised the coil out of the magnetic field at a constant speed. The entire coil was in the field from $t = 0$ until $t = 0.50$ s, and leaves the field between $t = 0.50$ and $t = 0.75$ s. **Figure 6** shows how the magnetic flux through the coil varies with time.

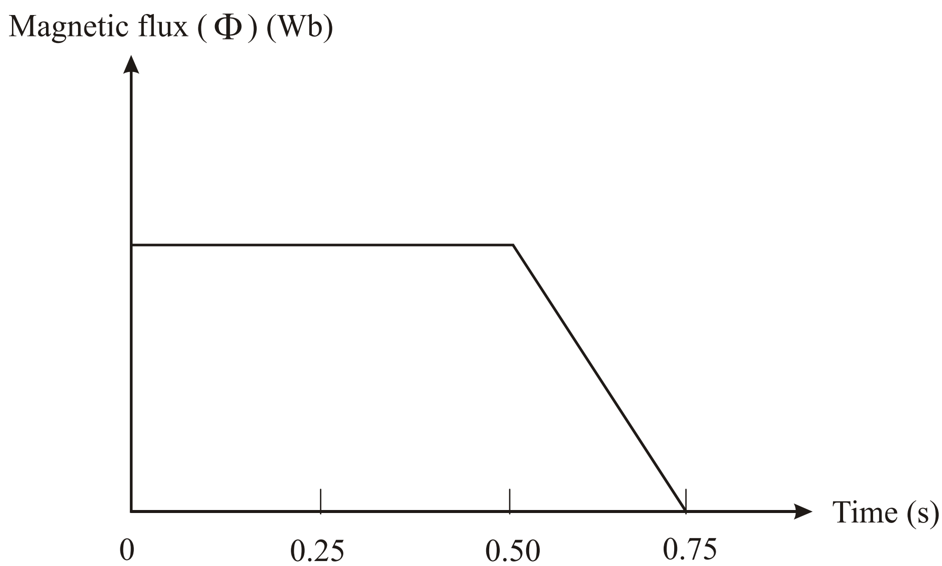
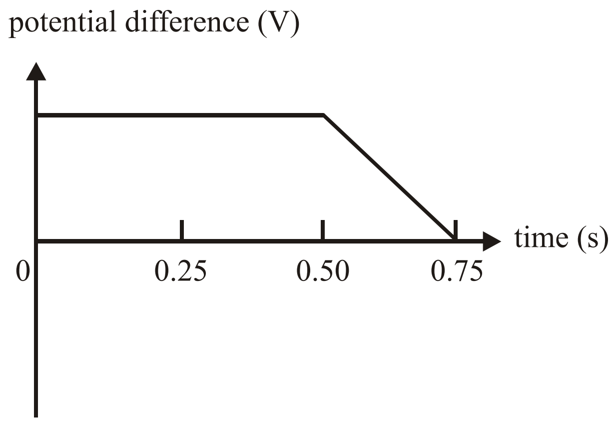
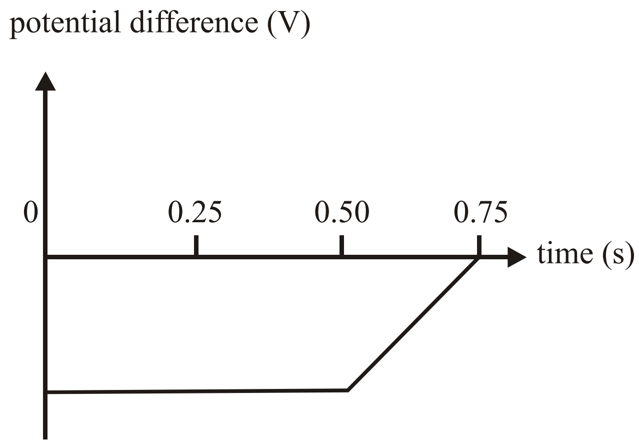


Figure 6

Question 9
Which one of the graphs, **A – D**, best shows how the potential difference across the ends of the coil varied with time?

A.


B.


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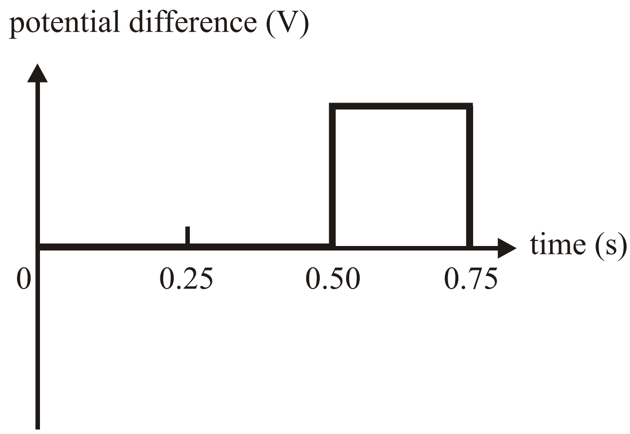
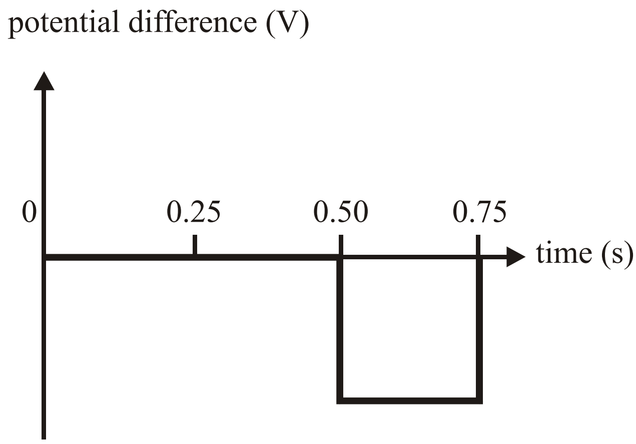


D.


(2 marks)

Question 10
Calculate the magnitude of the average potential difference induced across the ends of the coil for the time interval from $t = 0.50$ s to $t = 0.75$ s.

V

(2 marks)

Two long, identical bar magnets are placed under a horizontal piece of thin cardboard, as shown in **Figure 7**. The cardboard is covered with fine iron filings. The two north poles are a small distance apart and touching the cardboard. When the cardboard is gently tapped, the iron filings move into a pattern that shows the magnetic field lines.

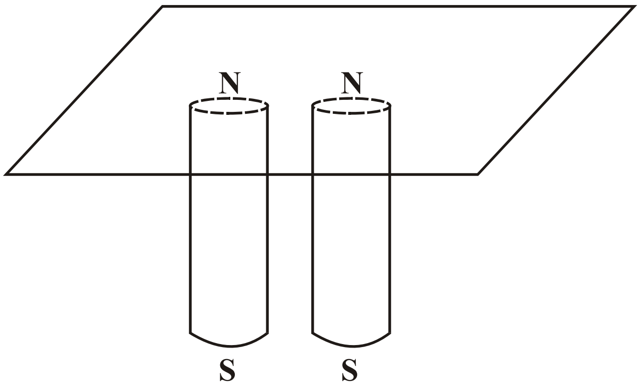
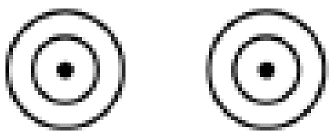


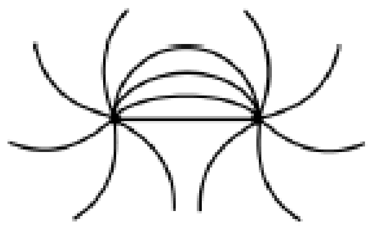
Figure 7

Question 11
Which one of the following best illustrates the pattern that results?

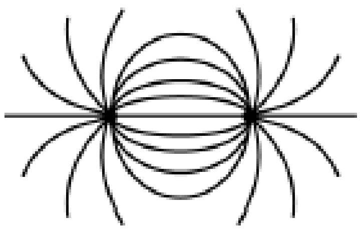
A.



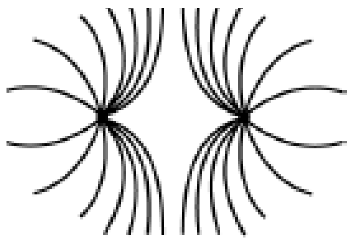
B.



C.



D.



(2 marks)

Questions 12 to15 refer to the following information.
A power station is designed to deliver 200 MW of electrical power to a terminal station. After the generated potential difference is stepped up to 500 kV_{RMS}, the power is delivered to the terminal station with a power loss of 2.0 MW.

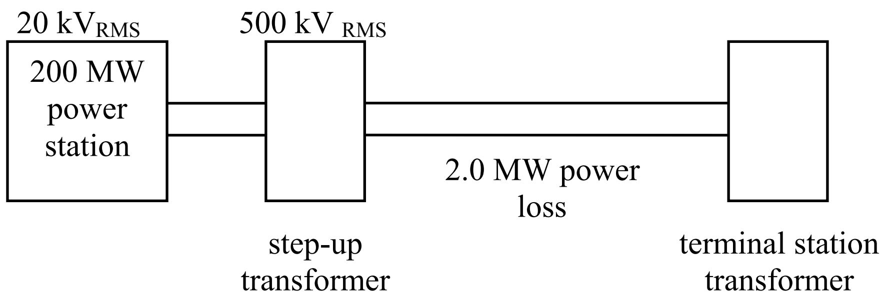


Figure 8

The power station generator produces energy at 20 kV_{RMS} that is stepped-up by the switchyard transformer to 500 kV_{RMS}.

Question 12

Calculate the value of the ratio

$$\frac{\text{number of turns on the secondary of the step-up transformer}}{\text{number of turns on the primary of the step-up transformer}}$$

(2 marks)

Question 13

Calculate the RMS current that flows in the secondary of the step-up transformer.

A

(2 marks)

Question 14
Calculate the potential difference, in kV, across the primary of the terminal station transformer.

kV

(2 marks)

Question 15
Calculate the resistance of the transmission wires between the step-up transformer and the terminal station transformer.

Ω

(2 marks)

Questions 16 and 17 refer to the following information.
Figure 9 shows an 11 kV electricity supply to a pole transformer. The secondary of the pole transformer is connected to a house and the potential difference across the secondary coil was measured to be 240 V_{RMS}. The connecting power cables from the pole transformer to the house have a resistance of 0.20 Ω.

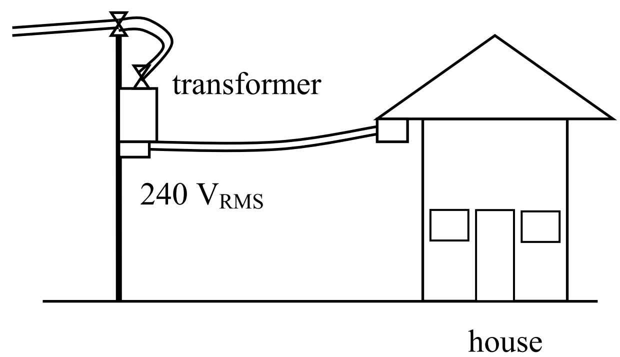


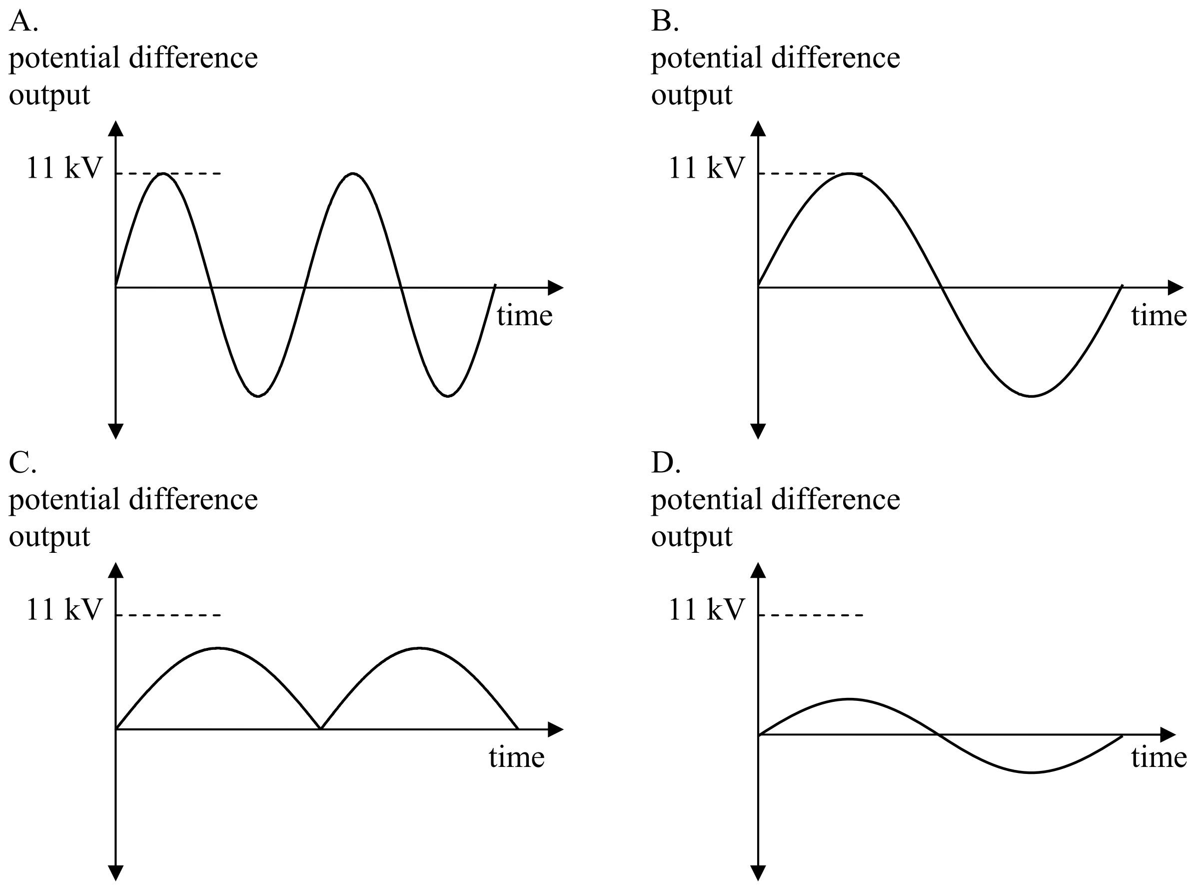
Figure 9

Question 16
Calculate the peak potential difference across the output terminals of the pole transformer.

V

(2 marks)

Question 17
For the transformer shown in **Figure 9**, with an input potential difference of 11kV, which one of the following diagrams best shows the output potential difference from the transformer?



(2 marks)

When electrical energy is transmitted over long distances, thick wires of low resistance are used and these are at very high voltage.

Question 18

Explain why a high voltage is used to transmit electrical energy over long distances.

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(2 marks)

A large, steady DC potential difference is applied to the primary coil of a transformer.

Question 19

Explain why there is no output at the transformer's secondary coil while the steady current is flowing.

____

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____

(2 marks)

Area of Study 2 – Interactions of Light and Matter

Questions 1-4 refer to the following information.
Julia performs a photoelectric effect experiment in which light of various frequencies is incident on a photosensitive metal plate. This plate, a second metal plate, and a power supply are connected in a circuit which also contains a microammeter and a voltmeter, shown in **Figure 1.**
Julia shines light of a specific frequency onto the plate. The potential difference on the power supply is then adjusted until there is no more current in the circuit, and this potential difference is recorded as the stopping potential. She then repeats the experiment several more times with light of different frequency and records the data in **Table 1**.

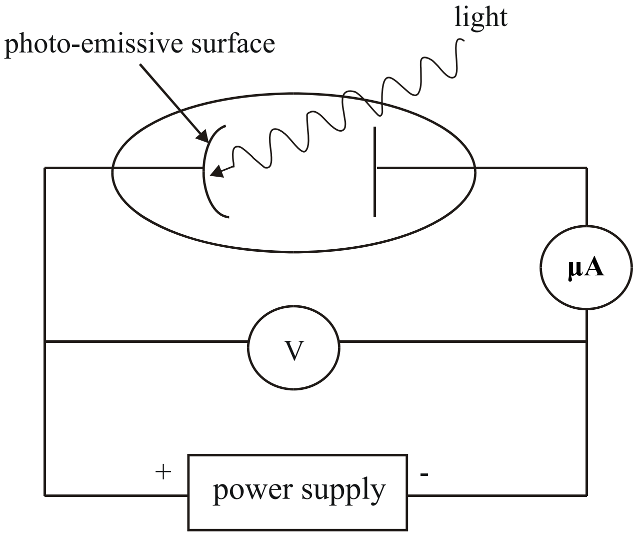
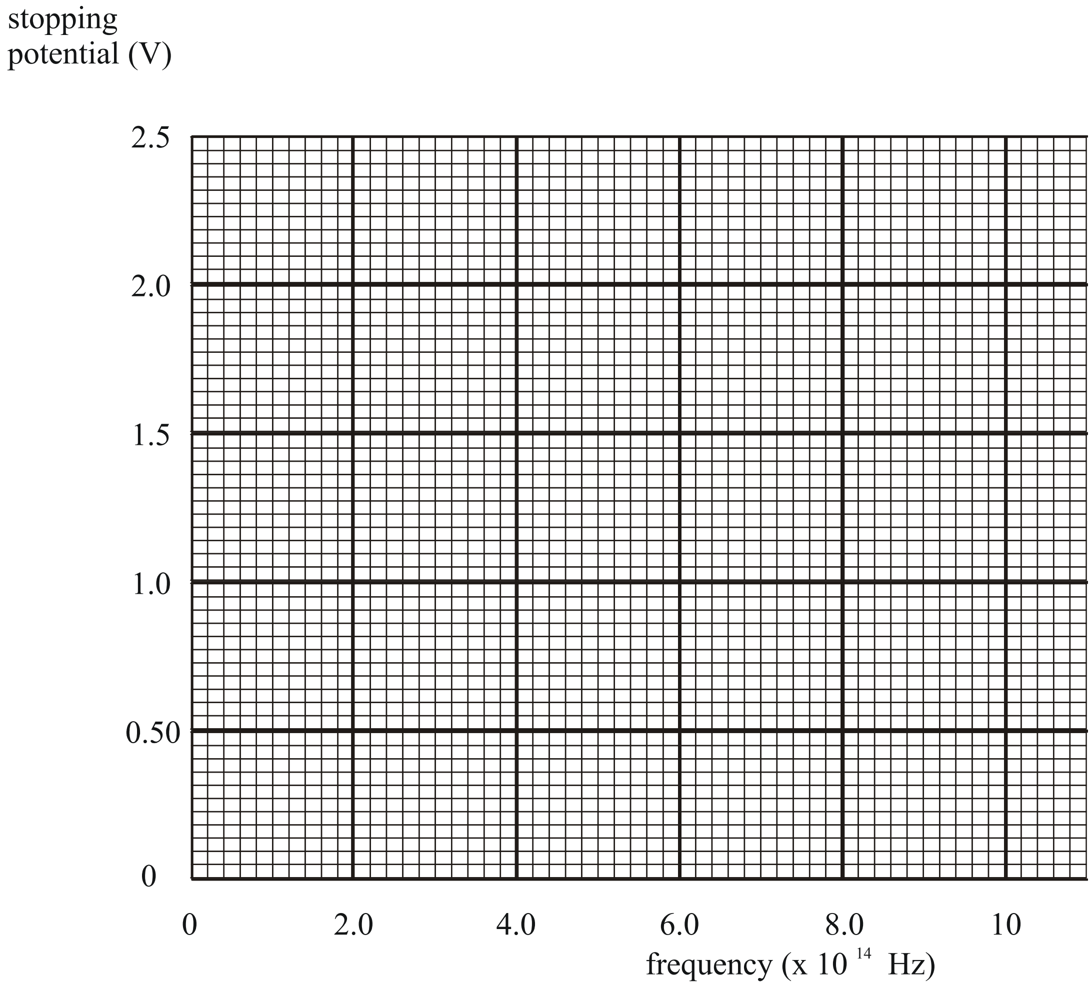


Figure 1

Colour of light used	Stopping potential (V)	Frequency (x 10^{14} Hz)
Red	1.0	4.4
Yellow	1.5	5.6
Green	2.0	6.8
Violet	2.5	8.0

Table 1

Question 1
Use the data in **Table 1** to plot a graph of stopping potential against frequency on the axes below, and draw a straight line of best-fit through the data.



(2 marks)

Question 2
Use the line of best-fit to calculate the experimental value for Planck's constant that Julia obtained.

(2 marks)

Question 3
Use the graph to determine the threshold frequency for this photo-emissive surface, and hence calculate the work function of this surface. (Use $h = 4.14 \times 10^{-15}$ eVs)

eV

(3 marks)

Question 4
Julia now uses a different metal with a larger work function, and again plots stopping potential against frequency. Discuss any similarities and differences between this graph and the first graph plotted.

(2 marks)

Questions 5 and 6 refer to the following information.
The apparatus used to demonstrate Young's double slit experiment is shown in **Figure 2**. A pattern of bright and dark bands is observed on the screen.

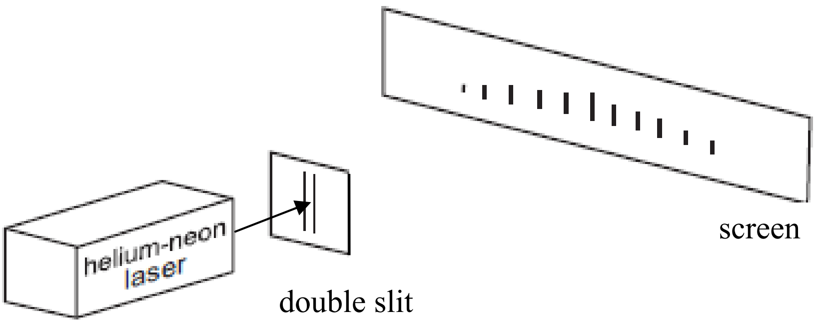


Figure 2

Question 5
Explain how the pattern on the screen is obtained, and describe the shape of the pattern.

(3 marks)

Question 6
Describe the effect on the pattern of lines on the screen if the screen is moved further away from the double slit.

____

____

(2 marks)

Figure 3 represents some electron transitions between energy levels in an atom.

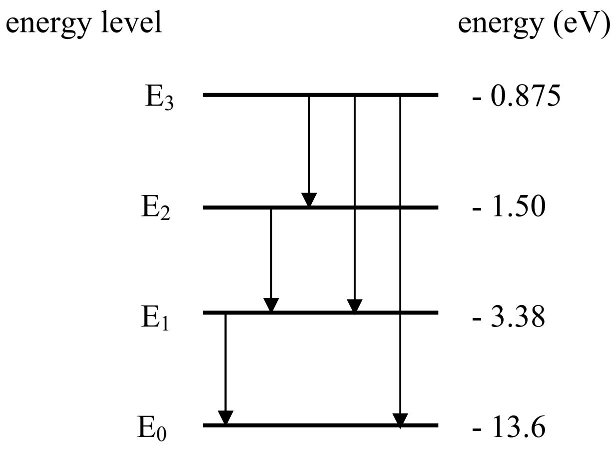


Figure 3

Question 7
Use the information given in **Figure 3** to calculate the wavelength, in nm, of the radiation emitted when an electron makes a transition from energy level E_3 to energy level E_0.

nm

(3 marks)

Question 8
Describe how the wave-particle duality of electrons can be used to explain the quantized energy levels of the atom.

(2 marks)

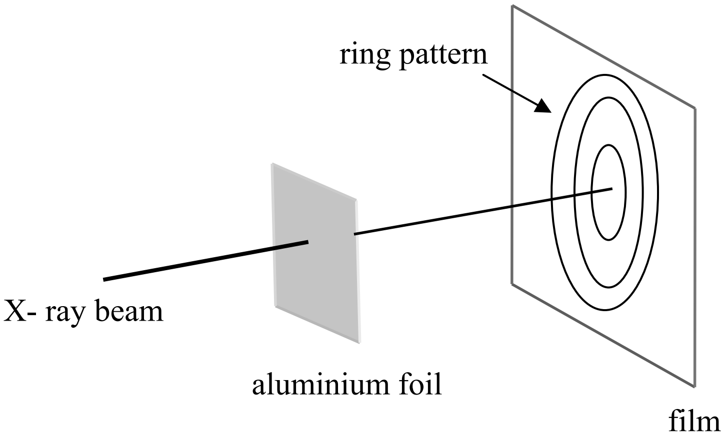


Figure 4

Figure 4 shows an experimental arrangement for producing a diffraction pattern characteristic of an aluminium target. The pattern shown on the film is for an incident monochromatic X-ray beam.

Question 9
Explain how the X-rays produce this pattern of rings.

(2 marks)

Use the following information to answer Questions 10 and 11.
An electron has a deBroglie wavelength of 0.20 nm.

Question 10

Calculate the momentum of the electron.

kg m s^{-1}

(2 marks)

Question 11

Calculate the energy, in eV, of the electron.

eV

(3 marks)

End of Section A

Section B – Detailed Study

Instructions for Section B
*Answer **all** questions from the Detailed study, in pencil, on the answer sheet provided for multiple choice questions.*
*Choose the response that is **correct** for the question.*
A correct answer scores 2, an incorrect answer scores 0.
*Marks will **not** be deducted for incorrect answers.*
No marks will be given if more than one answer is completed for any question.

Detailed Study 3.3 – Sound
S is a guitar string vibrating in air as shown by the arrows in **Figure 1**. A series of alternate compressions and rarefactions travel away from the string.

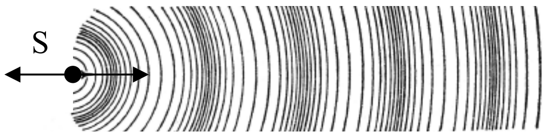


Figure 1

Question 1
The air molecules are
A. moving away from the string at all times.
B. vibrating about their mean positions and the disturbance is passed onto their neighbours.
C. vibrating and producing a transverse wave motion in air.
D. producing a standing wave.

Long, Andy and Dui are playing the saxophone, drums and violin respectively, in an auditorium with the door open. Henry rides past on his bike and notices that at point X, as shown in **Figure 2**, he can hear the music loudly. On reaching point Y, the music is still playing but only the drum can be heard, and only softly.

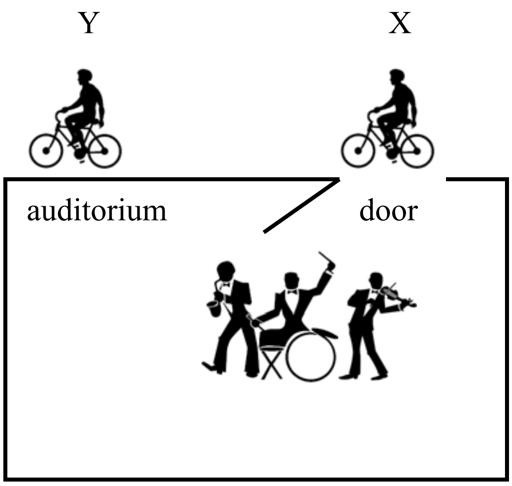


Figure 2

Question 2
The best explanation for Henry's observations is that
A. longer wavelengths are diffracted more than shorter wavelengths, and intensity diminishes with distance.
B. shorter wavelengths are diffracted more than longer wavelengths.
C. low frequency drum sounds diffract less than higher frequency violin and saxophone sounds.
D. higher frequencies are diffracted more than lower frequencies.

Question 3
The loudspeaker of an electric organ is vibrating in air 264 times each second. The wavelength of the sound in air when the speed of sound is 340 m s $^{-1}$ is
A. 1.3 m
B. 0.78 m
C. 9×10^4 m
D. 3.8×10^{-3} m

Questions 4 – 6 refer to the following information.

A long pipe containing fine powder is closed by a plunger. A loudspeaker at the other end is connected to a signal generator, as shown in **Figure 3**. The loudspeaker is switched on and the frequency is adjusted until a stationary sound wave is set up in the tube. The fine powder forms small piles, as shown in **Figure 3.** The distance between successive piles of powder is 84.0 mm.

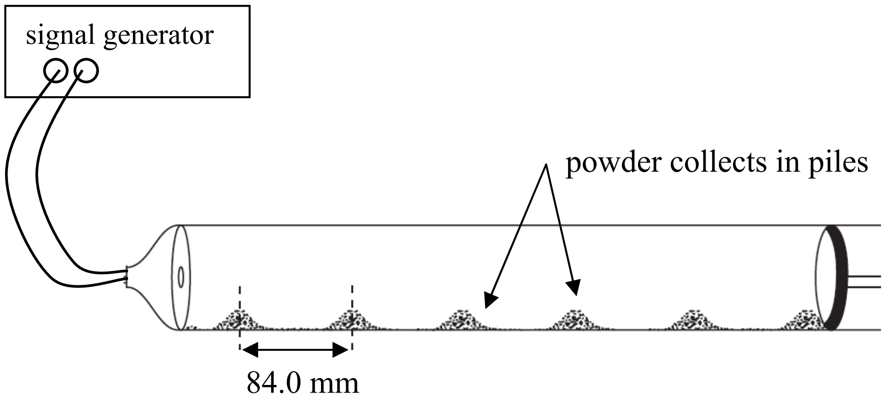


Figure 3

Question 4

A stationary wave is formed in the tube by

A. two systems of unequal waves travelling in the same direction.
B. two systems of unequal waves travelling in opposite directions.
C. two systems of equal waves travelling in the same direction.
D. two systems of equal waves travelling in opposite directions.

Question 5

The fine powder collects in small piles at positions of maximum pressure variation which are called

A. pressure nodes.
B. pressure antinodes.
C. rarefactions.
D. standing waves.

Question 6

The signal generator is set to 2.00 kHz. The speed of sound calculated from the measurements made in this experiment is closest to

A. 340 m s $^{-1}$
B. 350 m s $^{-1}$
C. 335 m s $^{-1}$
D. 345 m s $^{-1}$

Question 7

A tuning fork is set into vibration above a vertical open tube filled with water. Water is slowly run out of the tube and positions of resonance are found to be 33.0 cm apart.
The speed of sound in air at the time is 340 m s $^{-1}$. The frequency of the tuning fork is closest to

A. 103 Hz
B. 1030 Hz
C. 515 Hz
D. 113 Hz

Question 8

Our sensation of the loudness of a sound depends both on the intensity level and the frequency of the sound. **Figure 4** shows a series of curves, each one of which represents sounds that seemed to be equally loud.

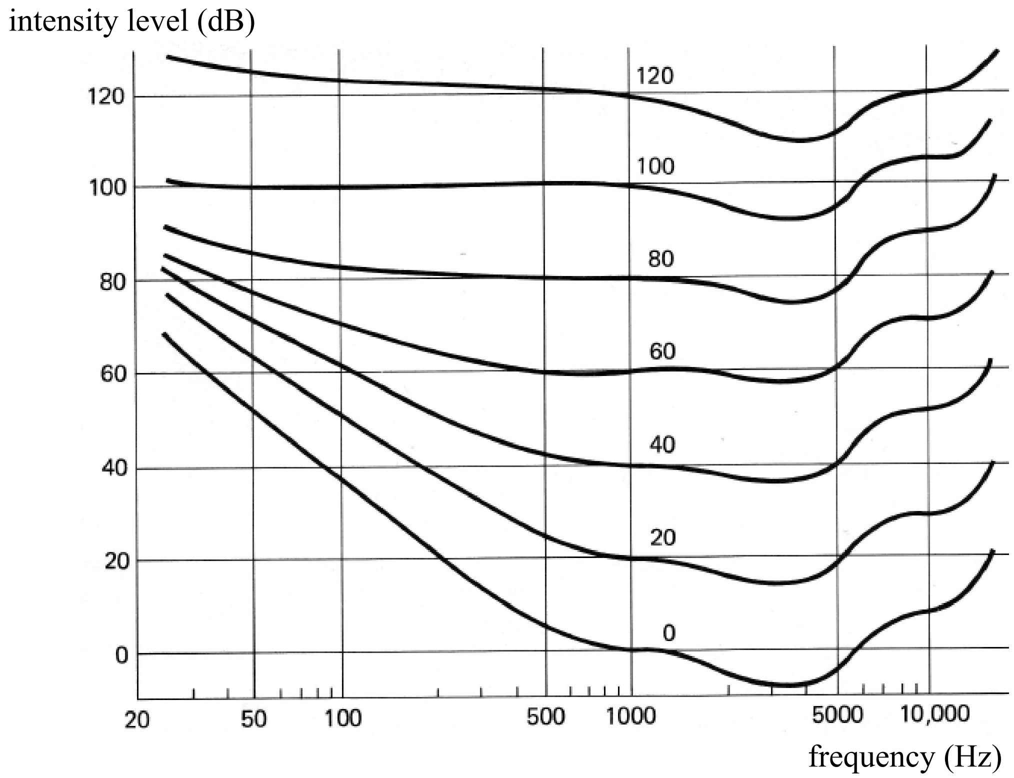


Figure 4

The intensity level of a 100 Hz tone to be heard equally as loud as a 5000 Hz tone with an intensity level of 60 dB must be

A. 38 dB
B. 70 dB
C. 62 dB
D. 84 dB

Questions 9 and 10 refer to the following information.

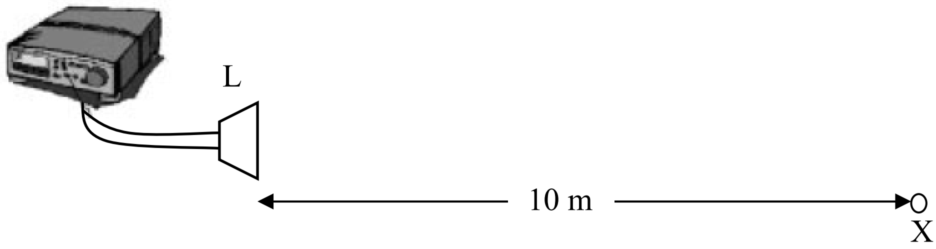


Figure 5

Andy sets up a loudspeaker (**L**) on the school oval to demonstrate the concept of loudness as shown in **Figure 5**. The loudspeaker emits sound equally in all directions with a wavelength of 1.0 m.
(Ignore any reflections from the ground.)
Dui stands at the point **X**, 10 m from the loudspeaker, and measures the intensity of the sound to be 9.2×10^{-8} W m^{-2}. Dui now moves to a place further away from the loudspeaker, and measures the intensity of the sound to be 2.3×10^{-8} W m^{-2}.

Question 9
The distance Dui is from the loudspeaker at this new position is
A. 20 m
B. 400 m
C. 40 m
D. 160 m

Question 10
The change in sound intensity level between the two readings is
A. 72 dB
B. 4.0 dB
C. 6.0 dB
D. 6.9 dB

Question 11
Which one of the following best describes the physical operating principle of the dynamic microphone?
A. Electrical resistance.
B. Piezo-electric effect.
C. Capacitance.
D. Electromagnetic induction.

A baffle board in a speaker refers to the material surrounding a loudspeaker, and in the simplest case, is a piece of wood on which the speaker is mounted.

Question 12

The purpose of the baffle board is

A. to resonate with the sound and increase the loudness.

B. to prevent sound loss to the rear of the speaker by preventing sound loss around the edges.

C. to avoid cancellation between the sound waves produced at the front and rear of the speaker, which have a phase difference of 180° due to the back and forth motion of the speaker diaphragm.

D. to enable cancellation of the sound waves produced at the front and rear of the speaker, and remove destructive interference effects.

A microphone's frequency response pattern is shown using a chart like **Figure 5** and referred to as a frequency response curve. The *x* axis shows frequency in hertz, the *y* axis shows response in decibels. This is a typical response curve for a vocal microphone.

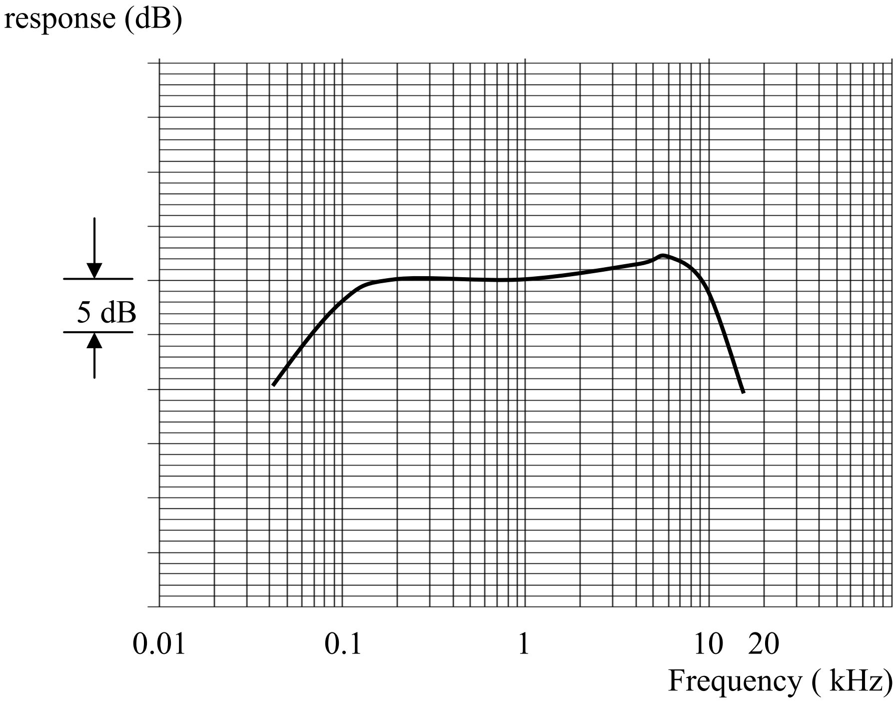


Figure 5

Question 13

For this microphone, the frequency response curve indicates that

A. frequencies below 0.10 kHz and above 10 kHz are attenuated and a frequency of 5.0 kHz is boosted.

B. the fidelity of sound reproduction is excellent over the range (30 Hz – 15kHz).

C. all frequencies between 0.03 kHz and 15 kHz are equally boosted.

D. responses are best below 0.01 kHz and above 5.0 kHz.

End of Section B

End of Trial Exam

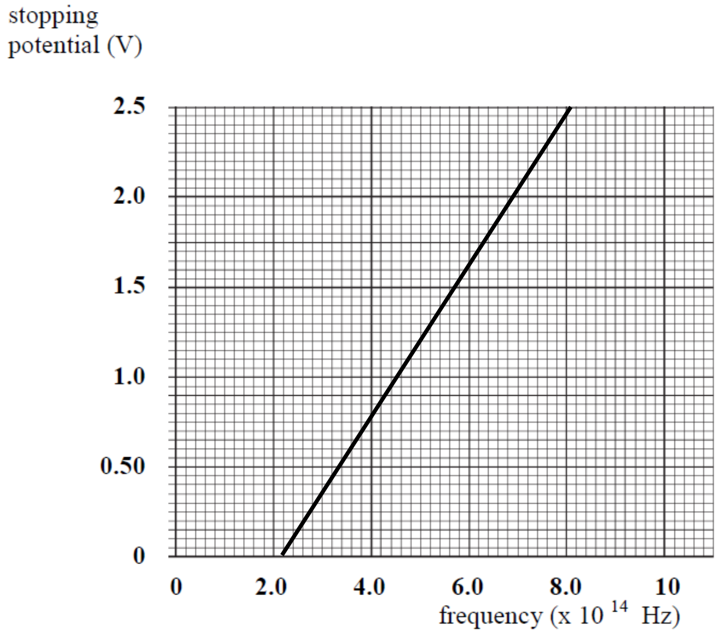
Suggested Answers

VCE Physics 2010 Year 12 Trial Exam Unit 4

Section A – Core

Question	Area of Study 1 – Electric Power	Mark allocation
1	There would be minimum magnetic flux when the coil is at positions D and H.	2
2	Graph B gives the current variation with time.	2
3	The waveform observed is shown by graph C.	2
4	Stationary brushes rub against the conducting commutator which turns with the coil. Every half revolution, the commutator changes its connection to the other brush, so that the current in the coil reverses every half revolution which is required for continuous rotation.	1 1
5	The force on side BC is down. Use the right hand rule to determine the direction of current flow (B to C). Y is connected to the positive terminal. X is connected to the negative terminal.	1 1
6	Use: $\phi = BA$ $= 0.050 \times 1.5 \times 10^{-3}$ $= 7.5 \times 10^{-5}$ Wb	1 1
7	Use: $F = nBIl$ $= 5 \times 0.050 \times 1.5 \times 0.030$ $= 1.1 \times 10^{-2}$ N	1 1
8	Any two of the following changes will increase the torque; • increase coil area • increase the current • increase the number of turns of the coil • increase the magnetic field strength	2
9	With constant flux the induced voltage is zero from time t = 0 s to t = 0.50 s. With constant decrease of magnetic flux with time, the induced potential difference across the ends of the coil will be constant from t = 0.50 to t = 0.75 s and positive. Answer: graph C	2

10	Use: $\xi = -N\dfrac{\Delta\Phi}{\Delta t}$ $= -N\dfrac{B\Delta A}{\Delta t}$ $= -5\times\dfrac{0.050\times(0-(1.5\times10^{-3}))}{0.75-0.50}$ $= 1.5\times10^{-3}$ V	1 1
11	The best illustration of the pattern formed is D.	2
12	Use: $\dfrac{N_2}{N_1} = \dfrac{V_2}{V_1}$ $= \dfrac{500\,\text{kV}}{20\,\text{kV}}$ $= 25$	1 1
13	Use: $P = VI$ $I = \dfrac{P}{V}$ $= \dfrac{200\times10^6}{500\times10^3}$ $= 400\,\text{A}$	1 1
14	There is a 2.0 MW power loss between the step-up transformer and the terminal station transformer. Since the current remains constant; $P = VI$ $V = \dfrac{P}{I}$ $= \dfrac{(200-2.0)\times10^6}{400}$ $= 4.95\,\text{kV}$	1 1
15	The power loss is due to the resistance of the cables. Use: $P = I^2R$ $R = \dfrac{P}{I^2}$ $= \dfrac{2.0\times10^6}{(400)^2}$ $= 13\ \Omega$	1 1

16	Use: $V_{PEAK} = V_{RMS} \times \sqrt{2}$ $= 240 \times \sqrt{2}$ $= 339\ \text{V}$	1 1
17	The pole transformer is a step-down transformer. Frequency of the output is the same as the input, but the output potential difference is less than the input potential difference. Answer: graph D	2
18	Power is calculated by the product of current and potential difference. For a given power, increasing the potential difference will decrease the current. Power loss in transmission of electricity is directly proportional to the square of the current flowing in the cables. To reduce power loss in transmission, high potential differences and lower currents must be used.	1 1
19	Transformers operate only on AC. A DC in the primary does not produce a changing flux, and therefore induces no emf in the secondary.	1 1
Question	**Area of Study 2 – Interactions of Light and Matter**	**Mark allocation**
1	Points plotted should give a line of best fit as shown.  	2
2	The gradient of the line gives a value for Planck's constant. $\text{gradient} = \frac{\text{rise}}{\text{run}}$ $= \frac{2.5 - 0}{(8.0 - 2.0) \times 10^{14}}$ $= 4.17 \times 10^{-15}$ $= 4.2 \times 10^{-15}\ \text{V s}$	1 1

3	The threshold frequency is 2.0×10^{14} Hz To calculate the work function; $W = hf_0$ $= 4.14\times10^{-15}\times2.0\times10^{14}$ $= 8.28\times10^{-1}$ $= 0.83$ eV	1 1 1
4	The stopping voltage – frequency graph of a metal with a larger work function would; • have the same gradient • have a higher cut-off frequency than this metal	 1 1
5	Laser light travelling through the slits is diffracted. On reaching the screen, various rays with path differences of an integral number of wavelengths, will constructively interfere and produce brightbands. Rays with path differences not an integral number of wavelengths, will destructively interfere, leaving dark bands. Bright bands further from the slits will be less intense.	1 1 1
6	Separation of bands on the screen is affected by the wavelength of the light used and the distance of the screen from the slits. As the screen is moved further away, the pattern of bright lines decreases in intensity and is spaced further apart.	 1 1
7	Use: $\Delta E = E_0 - E_3$ $= -0.875 - (-13.6)$ $= 12.73$ eV $= \frac{hc}{\lambda}$ $\lambda = \frac{4.14\times10^{-15}\times3.0\times10^{8}}{12.73}$ $= 9.75\times10^{-8}$ m = 98 nm	 1 1 1
8	The quantized orbits and energy states of electrons are due to the wave nature of the electron and the fact that only resonant standing waves can persist in certain orbits, which implies that electrons possess wave-particle duality.	1 1
9	X-rays are electromagnetic radiation of very short wavelength. X-rays can be diffracted from different planes of a crystal lattice at different angles, and for a metal, a series of circles is produced by constructive interference if the paths travelled by two rays differ by a whole number of wavelengths.	1 1

10	Use: $\lambda = \frac{h}{p}$ $p = \frac{h}{\lambda}$ $= \frac{6.63\times10^{-34}}{0.20\times10^{-9}}$ $= 3.3\times10^{-24}\ \text{kg ms}^{-1}$	1 1
11	Use: $\lambda = \frac{h}{mv}$ $v = \frac{h}{m\lambda}$ $= \frac{6.63\times10^{-34}}{9.1\times10^{-31}\times0.20\times10^{-9}}$ $= 3.64\times10^{6}\ \text{m s}^{-1}$ $E_K = \frac{1}{2}mv^2$ $= \frac{1}{2}\times9.1\times10^{-31}\times(3.64\times10^{6})^2$ $= 6.03\times10^{-18}\ \text{J}$ $= \frac{6.03\times10^{-18}\ \text{J}}{1.6\times10^{-19}}$ $= 38\ \text{eV}$	1 1 1

Section B – Detailed Study

Question		Detailed Study 3.3 – Sound
1	**B**	Air molecules vibrate around their mean positions and the disturbance is transferred to neighbours.
2	**A**	Longer wavelengths are diffracted more than shorter wavelengths, and the intensity of the sound diminishes with distance.
3	**A**	frequency = 264 Hz. speed = 340 m s $^{-1}$ Use: $\lambda = \frac{v}{f}$ $= \frac{340}{264}$ $= 1.3 \text{ m}$
4	**D**	A stationary wave consists of two systems of equal waves travelling in opposite directions.
5	**B**	The powder collects in well defined ridges at pressure antinodes.
6	**C**	Nodes are separated by one half of a wavelength (wavelength = 2 x 84.0 mm = 168 mm). The wavelength of the sound is therefore 0.168 m. Use: $v = f\lambda$ $= 2.00 \times 10^3 \times 0.168$ $= 336 \text{ m s}^{-1}$
7	**C**	The distance between consecutive positions of resonance is one half of a wavelength. The wavelength is then; $\lambda = 2 \times 0.33$ $= 0.66 \text{ m}$ $f = \frac{v}{\lambda}$ $= \frac{340}{0.66}$ $= 515 \text{ Hz}$
8	**B**	All frequencies on the same loudness curve are heard equally loud. 5000 Hz at 60 dB sounds as loud as 100 Hz at 70 dB.

9	**A**	Use: $I_1 \times d_1^2 = I_2 \times d_2^2$ $d_2^2 = \dfrac{I_1 \times d_1^2}{I_2}$ $= \dfrac{9.2 \times 10^{-8} \times 100}{2.3 \times 10^{-8}}$ $d = \sqrt{\dfrac{9.2 \times 10^{-8} \times 100}{2.3 \times 10^{-8}}}$ $= 20 \text{ m}$
10	**C**	**Use:** $\beta_1 = 10 \log_{10} \dfrac{9.2 \times 10^{-8}}{1.0 \times 10^{12}}$ $= 49.6 \text{ dB}$ $\beta_2 = 10 \log_{10} \dfrac{2.3 \times 10^{-8}}{1.0 \times 10^{-12}}$ $= 43.6 \text{ dB}$ The change in sound intensity level is 6.0 dB
11	**D**	When a magnet is moved near a coil of wire, an electrical current is generated in the wire. Using this electromagnet principle, the dynamic microphone uses a wire coil and magnet to create to create the audio signal.
12	**C**	The baffle board in a speaker prevents cancellation of waves produced at the front and back of the speaker, which have a phase difference of 180^0 due to the speaker cone vibration.
13	**A**	The frequency response curve indicates that frequencies below 0.10 kHz and above 10 kHz are attenuated and a frequency of 5.0 kHz is boosted.

End of Suggested Answers