Trial Examination 2006

VCE Physics Unit 4

Written Examination

Question and Answer Booklet

Reading time: 15 minutes
Writing time: 1 hour 30 minutes

Student's Name: ______________________________

Teacher's Name: ______________________________

Structure of Booklet

Section	Number of questions	Number of questions to be answered	Number of marks
A Core – Areas of study			
1. Electric power	16	16	40
2. Interactions of light and matter	11	11	25
B Detailed studies			
1. Synchrotron and its applications **OR**	10	10	25
2. Photonics **OR**	13	13	25
3. Sound	12	12	25
			Total 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 an approved scientific calculator. Students are NOT permitted to bring into the examination room: blank pieces of paper and/or white out liquid/tape.

Materials supplied

Question and answer booklet of 29 pages with a detachable data sheet in the centrefold.

Instructions

Detach the data sheet from the centre of this booklet during reading time.

Please ensure that you write your **name** and your **teacher's name** in the space provided on this booklet.

Answer all questions in the spaces provided.

Always show your working where space is provided because marks may be awarded for this working.

Where an answer box has a unit printed in it, give your answer in that unit.

All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other electronic communication devices into the examination room.

Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2006 VCE Physics Unit 4 Written Examination.

SECTION A – CORE

Instructions for Section A

Answer **all** questions **for both** Areas of study in this section of the paper.

Area of study 1 – Electric power

Two students, Alice and Joanna, use a rectangular current-carrying coil of wire placed in a magnetic field to model a simple DC motor. This is shown in Figure 1a below.

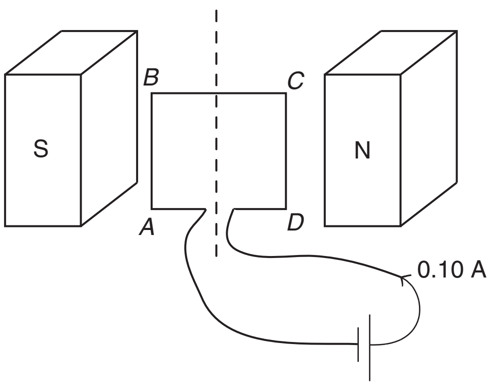

Figure 1a

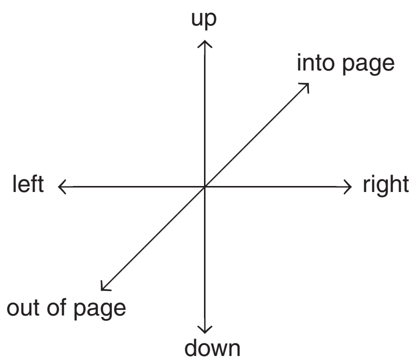

Figure 1b

The length of side AB is 0.15 m, side BC is 0.10 m and the magnetic field strength is equal to 0.20 T.
A current of 0.1 A flows through the coil in the direction indicated in Figure 1a. Figure 1b shows a key used to describe direction.

Question 1

If the total force on side AB is 0.15 N when the coil in the position shown in Figure 1a, calculate the number of turns of wire in the coil.

turns

2 marks

Question 2

Determine the size of the force on side BC when the coil is in the position shown in Figure 1a.

N

2 marks

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Question 3

Which of the following best describes the direction of the force on side *CD*?

A. left
B. right
C. up
D. down
E. out of page
F. into page
G. no force acts

2 marks

When the students test their model, they find that the motor does not rotate as expected. The coil rotates through 90° and, after some small oscillations, remains in this position.

Question 4

Explain why the motor stops after rotating through 90°.

3 marks

Alice suggests that a commutator should be added to the model so that the motor will continue to rotate.

Question 5

Explain the function of a commutator in a DC motor and how this would enable Alice and Joanna's motor to continue to rotate.

3 marks

Alice and Joanna now take another rectangular coil of wire consisting of 200 turns and with cross-sectional area 10.0 cm^2. The magnetic field strength is 0.20 T, in the orientation shown in Figure 2. Note that the plane of the coil is at right angles to the magnetic field.

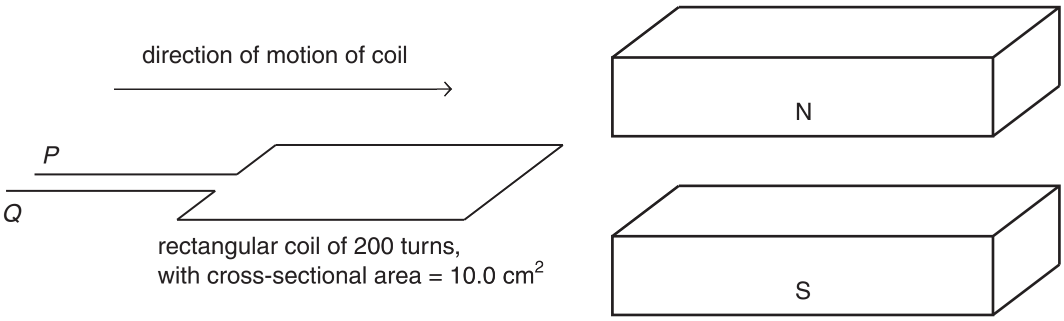


Figure 2

Figure 3 shows how flux through the coil varies with time as the coil is moved from left to right.

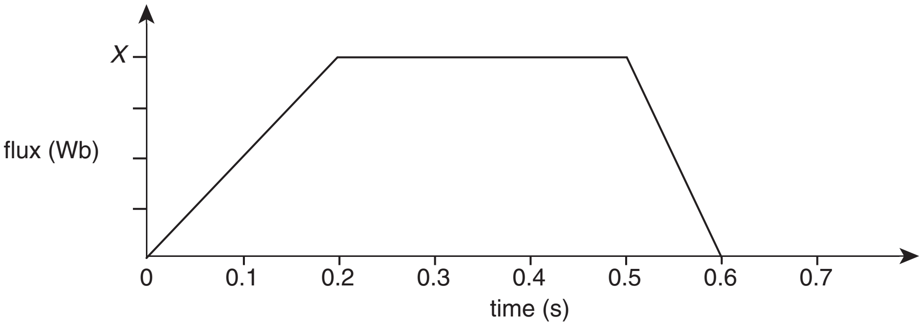


Figure 3

In Figure 3, *X* is the maximum flux through the coil as it passes through the magnetic field.

Question 6

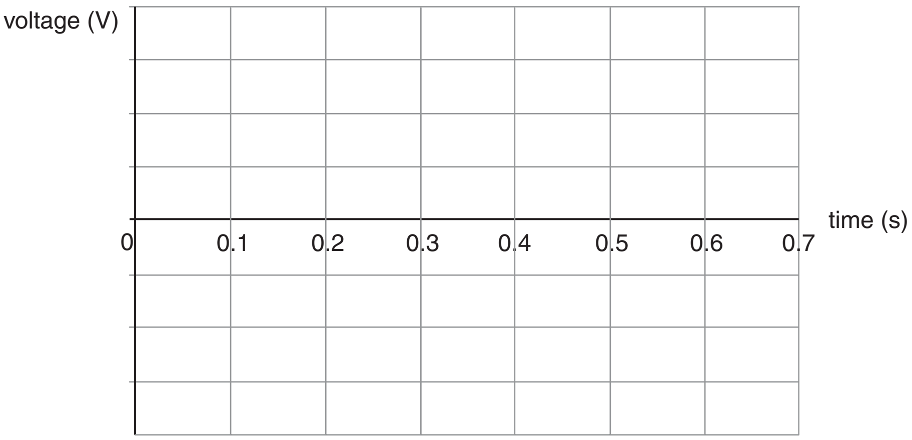
Calculate the value of *X*.

Wb

3 marks

Question 7

On the set of axes provided below, draw the graph of voltage induced between points *P* and *Q* as the coil passes through the magnetic field as a function of time. Include values on the vertical (voltage) axis.



4 marks

An AC generator has of a coil of cross-sectional area *A*. The coil rotates in a magnetic field of magnitude *B* and produces a maximum emf of magnitude ε.

The output of the generator is shown in Figure 4 below.

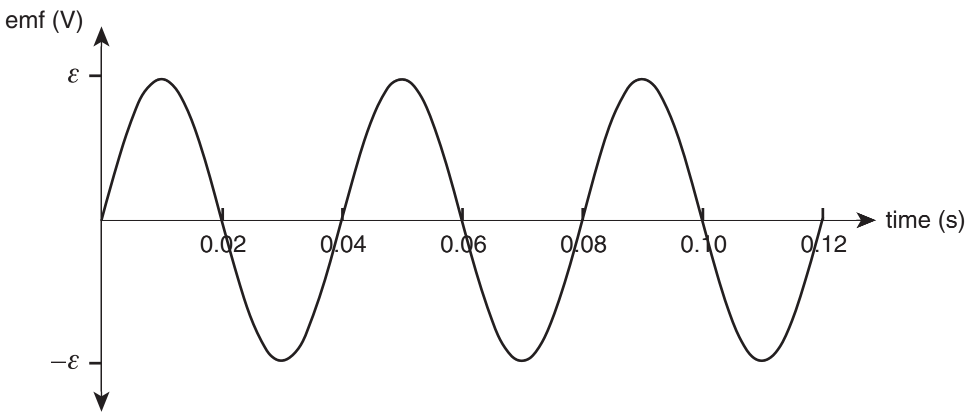


Figure 4

Question 8

What is the frequency of rotation of the generator?

Hz

2 marks

The frequency of rotation is now **halved**. The cross-sectional area of the coil and the magnetic field strength remain unchanged.

Question 9

On the axes in Figure 5, draw the resulting output of the generator. A copy of Figure 4 is provided to assist you.

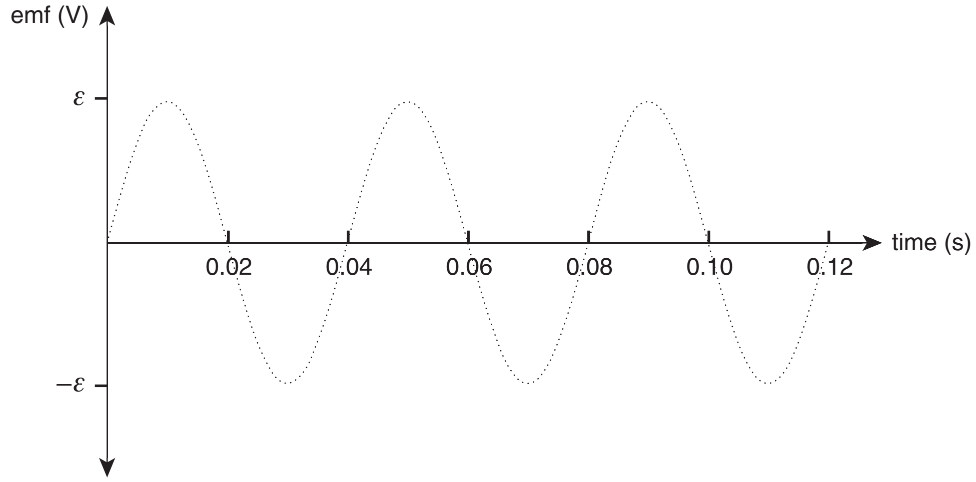


Figure 5

2 marks

Question 10

In the sentences below, options are given within the brackets. Only **one** of the options will be correct. Circle the best option.

[**Lenz's / Faraday's / Franklin's**] law states that induced emf is proportional to

the rate of change of [**voltage / flux / power**].

[**Lenz's / Faraday's / Franklin's**] law states that the direction of induced current produces a

magnetic field that [**is in the same direction as / opposes / is at right angles to**] the change in flux.

2 marks

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The solenoid shown in Figure 6 is used to produce a magnetic field. The direction of current in the solenoid is shown. Point *X* is inside the solenoid, point *Y* is at the end of the solenoid and point *Z* is below the solenoid. **A**–**G** represent possible magnetic field directions.

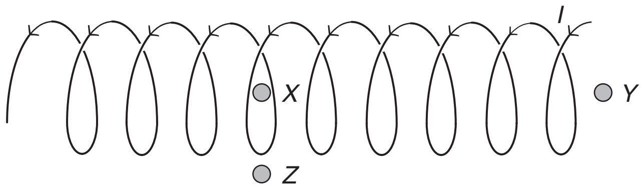


Figure 6

Question 11

Use the options **A**–**G** to represent the direction of the magnetic field at each of the points *X*, *Y* and *Z* indicated on Figure 6.

A. $\longrightarrow$ **B.** $\longleftarrow$ **C.** $\uparrow$ **D.** $\downarrow$

E. out of page **F.** into page **G.** no field

Direction of field at point *X*: ______

Direction of field at point *Y*: ______

Direction of field at point *Z*: ______

3 marks

Mary and Frank have recently acquired a remote historic property. It has no electricity or running water.

In order to establish facilities for tourists to visit the unique property, Mary and Frank decide that they will install a generator to provide an AC supply of 240 V RMS to the main house. They purchase an AC generator that produces a voltage of 1200 V RMS.

Question 12

Calculate the peak-to-peak voltage produced by the generator.

______ V

2 marks

The house requires a mains power supply operating at 240 V RMS. Mary purchases a transformer to step down the voltage produced by the generator.

Question 13

If there are 20 turns in the secondary coil of the step-down transformer, how many turns must there be in the primary coil?

turns

2 marks

The generator is both noisy and unattractive, so Mary and Frank decide to place it in an existing shed, 500 m from the main house. The total resistance of the wires connecting the generator to the main house is 5.0 Ω.

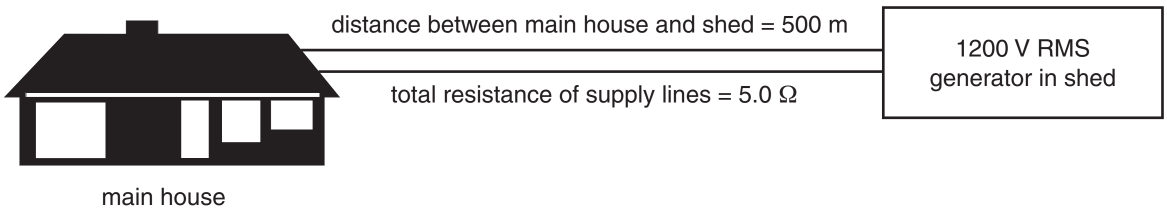


Figure 7

Mary and Frank ask their electrician to also install the step-down transformer in the shed so that it does not detract from the original facade of the main house. However, the electrician advises them to place the transformer as close to the main house as possible.

Question 14

Explain why the electrician would advise Mary and Frank to have the transformer installed as close as possible to the main house, rather than in the shed 500 m from the house.

3 marks

Mary and Frank ignore the electrician's advice, and install the step-down transformer in the shed. This arrangement is shown in Figure 8.

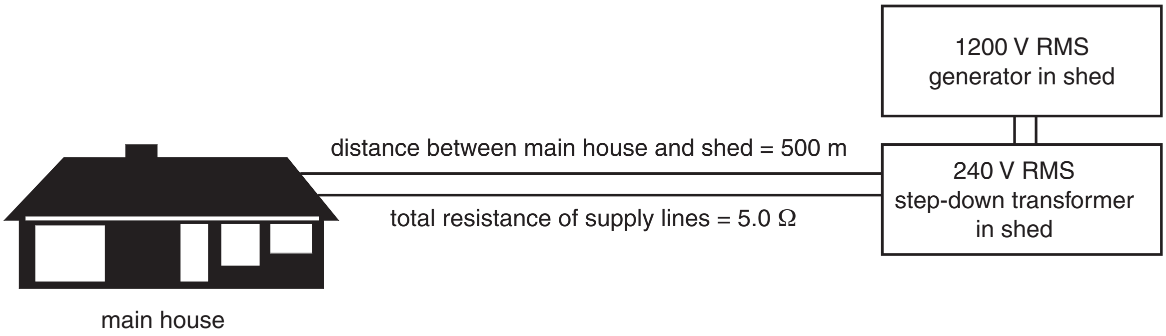


Figure 8

Question 15

When operating a number of appliances in the main house with the arrangement shown in Figure 8, Mary finds that the voltage supplied is only 180 V RMS.

Calculate the power loss in the supply lines under these conditions.

W

3 marks

Question 16

Determine the output power of the transformer under the conditions described in Question 15.

W

2 marks

Area of study 2 – Interactions of light and matter

Peta prepares a presentation on incoherent and coherent light sources. She is unsure about a few key phrases and has written in some alternatives.

Question 1

In the sentences below, options are given within the brackets. Only **one** of the options will be correct. Circle the best option.

Incoherent light is produced by sources such as [**the sun / lasers**].

All incoherent light sources rely on thermal [**emission / excitation**]. Atoms within the sources vibrate violently. As a result a photon is emitted. Because it is a random event the photons all have different [**frequencies / intensities / temperatures**].

3 marks

A group of students is performing Young's double-slit experiment. The apparatus used includes a red laser light pointer, a small film with two slits in it and a white screen, as shown in Figure 1.

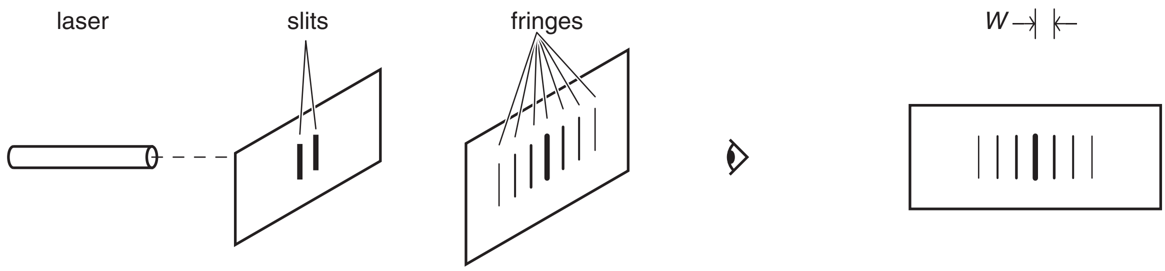


Figure 1

The students observe a pattern of bright fringes on the screen. They measure the distance separating two of the fringes, *W* m.

The two students Nicki and Narella are discussing what they see.

Nicki says:

'The bright fringes are occurring because of constructive interference of two crests only.'

Narella says:

'The bright fringes occur because of constructive interference for both crests and troughs.'

Question 2

Which of the students' explanations is most correct? Explain your answer.

4 marks

As an extension to the experiment the teacher supplies the students with a blue laser instead of the red one they originally had. They try to predict the outcome of the experiment if the blue laser is used under exactly the same conditions as before.

Question 3

Which **one** of the following descriptions (**A**–**D**) best describes the pattern of fringes that they will see using the blue laser?

A. Fringes will be brighter but the same distance apart.
B. Fringes will be the same brightness as before but closer together.
C. Fringes will be the same brightness as before but further apart.
D. Fringes will be further apart and the brightness will have increased.

1 mark

Question 4

The left-hand side of Table 1 shows the images obtained when a laser shines through different media. The right column of the table lists the media that produced these images.

Using arrows, match each image to the medium that was used to produce it.

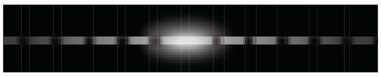
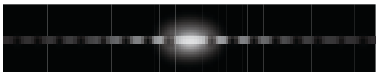
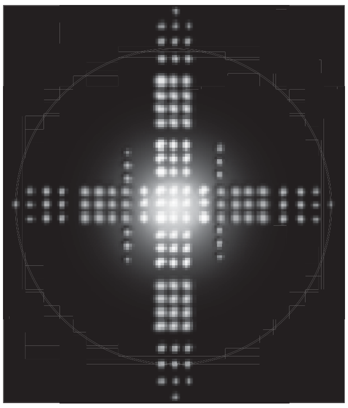
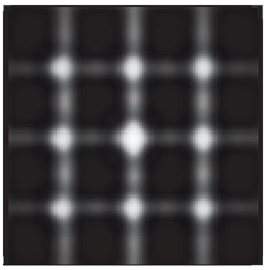
Image	Medium
	Fine mesh placed in front of the laser
	Crossed slits of 0.02 mm placed in front of the laser
	A single slit of 0.02 mm placed in front of the laser
	A single slit of 0.16 mm placed in front of the laser

Table 1

4 marks

The photocell in Figure 2a is used to investigate the photoelectric effect. Light of a fixed frequency shines on the metal cathode and photoelectrons are ejected. The ejected photons are stopped by a variable voltage that opposes the flow of the photoelectrons as measured by the micro-ammeter.

The photocell current is plotted against the variable voltage as shown in Figure 2b.

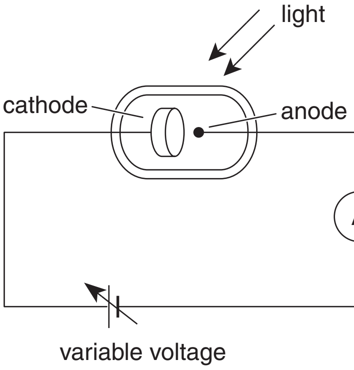


Figure 2a

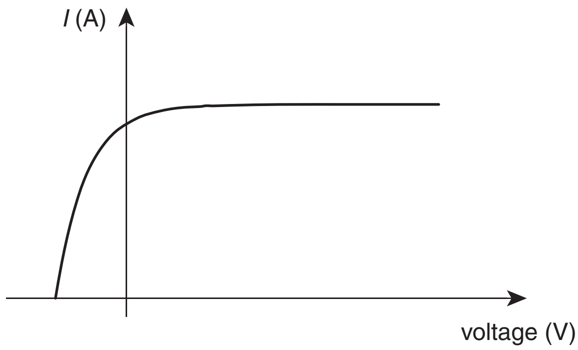


Figure 2b

The light source is changed so that the wavelength of the light decreases but the intensity of the light increases.

Question 5

On Figure 2b, sketch the graph of photoelectric current against voltage for the new conditions.

2 marks

It is found that the stopping voltage for the new conditions is 2.22 V.

Question 6

Calculate the momentum of the photoelectrons moving with maximum speed produced in this experiment.

kg m s^{-1}

3 marks

The photoelectric effect gave results that could not be explained by wave theory. The wave theory predicts that an intense beam of light that has a frequency below the threshold frequency will cause photoelectrons to be emitted.

Question 7

Which statement (**A–D**) best describes why the wave theory is incorrect in this case?

A. Increasing intensity increases the energy of the photoelectron.
B. Increasing intensity only changes the frequency of the photoelectron.
C. Increasing intensity increases the number of photoelectrons produced.
D. Each electron accumulates energy so intensity will affect the energy of the photoelectron.

1 mark

A crystal is subject to a test using X-rays of a particular wavelength and electrons of a particular energy. When X-rays are passed through the crystal a pattern is produced as seen in Figure 3a. When the electrons are passed through the crystal a pattern like that in Figure 3b is produced.

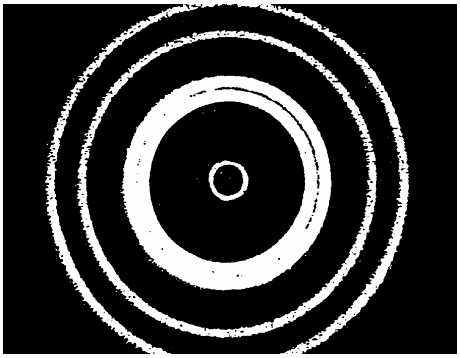


Figure 3a

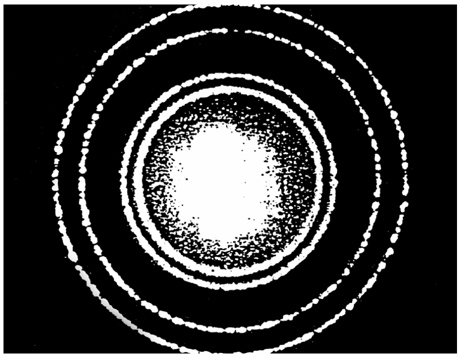


Figure 3b

Question 8

Which **one** of the following phenomena (**A**–**D**) has produced the circles?

A. interference
B. absorption
C. diffraction
D. refraction

1 mark

One of the electrons used in the experiment has a kinetic energy of 0.17 eV.

Question 9

What is the De Broglie wavelength of this electron?

m

3 marks

The diagram shown in Figure 4 illustrates an energy level model for hydrogen.

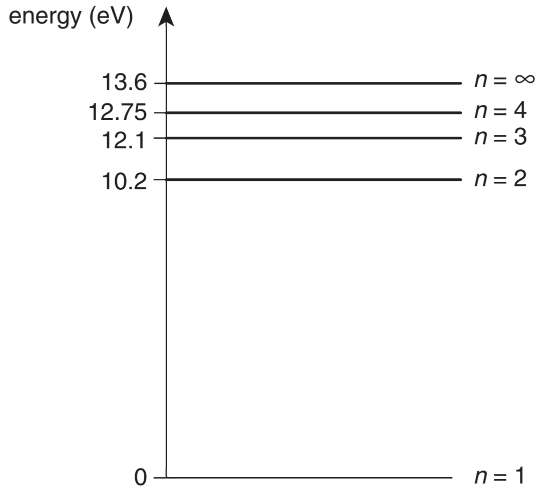


Figure 4

Question 10

Calculate the frequency of a photon of light that is emitted when an electron drops from the second excited state to the first excited state.

Hz

2 marks

The pattern shown in Figure 5 represents the standing wave state for an electron in a hydrogen atom.

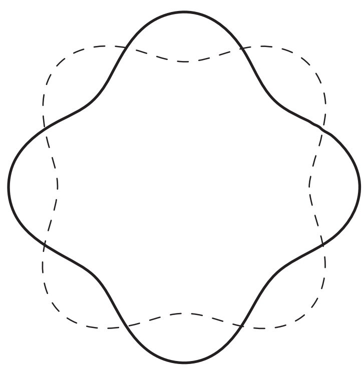


Figure 5

Question 11

What value of n would best describe this pattern?

1 mark

SECTION B – DETAILED STUDIES

Instructions for Section B

Choose **one** of the following **Detailed studies**. Answer **all** the questions on the **Detailed study** you have chosen.

Detailed study 1 – Synchrotron and its applications

Question 1

A number of different terms are often used to describe the unique properties of synchrotron X-ray radiation that make it so useful. Four of these terms are listed in column A of Table 1. In column B there are the associated explanations of the terms in column A, but they have been mixed up.

Column A: term	Column B: explanation
bright	A beam of specific wavelength can be selected.
wide spectrum	Radiation is far more intense than conventional X-rays.
tunable	Beam has a narrow angular spread.
collimated	Radiation is emitted in a range of frequencies.

Table 1

Draw lines to match each of the terms in column A with the correct explanation in column B.

3 marks

An electron, initially at rest, gains 4.0 keV of energy as it is accelerated between parallel charged plates in an electron gun.

Question 2

Calculate the voltage across the parallel charged plates.

V

2 marks

Question 3

Calculate the final speed of the electron. ($q = -1.6 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$ kg)

m s^{-1}

3 marks

Within the booster ring, bending magnets are used to change the path of electrons.

An electron is moving between two magnets as shown in Figure 1.

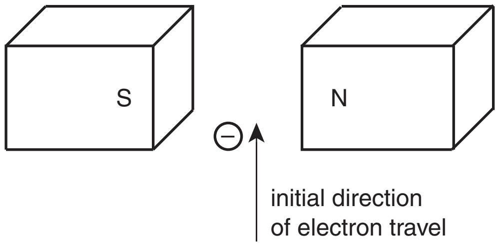


Figure 1

Question 4

Which of the directions below (**A**–**F**) correctly describes the direction of the force on the electron?

A. left
B. right
C. up
D. down
E. out of page
F. into page

2 marks

Question 5

In a particular region of a booster ring, the electrons travel at a speed of $0.1c$ in an arc of radius 0.8 m. Calculate the magnetic field strength required to deflect these electrons through this arc.

($q = -1.6 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$ kg, $c = 3.0 \times 10^{8}$ m s^{-1})

T

2 marks

X-rays of energy 6.0 keV are produced by a synchrotron and are incident on a sample of graphite.

Question 6

Calculate the wavelength of the incident X-ray photons. ($h = 4.14 \times 10^{-15}$ eV s, $c = 3.0 \times 10^{8}$ m s^{-1})

m

2 marks

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Trial Examination 2006

VCE Physics Unit 4

Written Examination

Data Sheet

Directions to students

Detach this data sheet before commencing the examination. This data sheet is provided for your reference.

Physics Unit 4 Data Sheet

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	$F = IlB$
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	$m_e = 9.1 \times 10^{-31}$ kg
14	charge on the electron	$e = -1.6 \times 10^{-19}$ C
15	Planck's constant	$h = 6.63 \times 10^{-34}$ J s $h = 4.14 \times 10^{-15}$ eV s
16	speed of light	$c = 3.0 \times 10^{8}$ m s^{-1}

Detailed study 1 – Synchrotron and its applications

17	energy transformations for electrons in an electron gun (< 100 keV)	$\dfrac{1}{2}mv^2 = eV$
18	radius of an electron beam	$r = \dfrac{p}{eB}$
19	force applied to an electron beam	$F = evB$
20	Bragg's law	$n\lambda = 2d\sin\theta$
21	electric field between charged plates	$E = \dfrac{V}{d}$

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Detailed study 2 – Photonics

22	band gap energy	$E = \frac{hc}{\lambda}$
23	Snell's law	$n_1 \sin i = n_2 \sin r$

Detailed study 3 – Sound

24	speed, frequency and wavelength	$v = f\lambda$
25	intensity and levels	sound intensity level (in dB) $= 10\log_{10}\left(\frac{I}{I_0}\right)$ where $I_0 = 1.0 \times 10^{-12}$ W m^{-2}

Prefixes/Units

p = pico = 10^{-12}

n = nano = 10^{-9}

μ = micro = 10^{-6}

m = milli = 10^{-3}

k = kilo = 10^{3}

M = mega = 10^{6}

G = giga = 10^{9}

t = tonne = 10^{3} kg

END OF DATA SHEET

Compton scattering involves an X-ray photon colliding with an electron and transferring some of its energy and momentum to the electron.

Question 7

An X-ray photon of energy 6.0 keV collides with a stationary electron and the electron moves off with a speed of 3.0×10^7 m s^{-1}. Calculate the wavelength of the scattered photon.

($m_e = 9.1 \times 10^{-31}$ kg, $q = -1.6 \times 10^{-19}$ C, $h = 6.63 \times 10^{-34}$)

m

4 marks

Question 8

Other photons undergo Thomson scattering. Calculate the wavelength of the photons that have undergone Thomson scattering.

m

2 marks

Bragg diffraction is a technique used to investigate the spacing between layers of atoms in crystals. Figure 2 below shows an arrangement used to observe this diffraction.

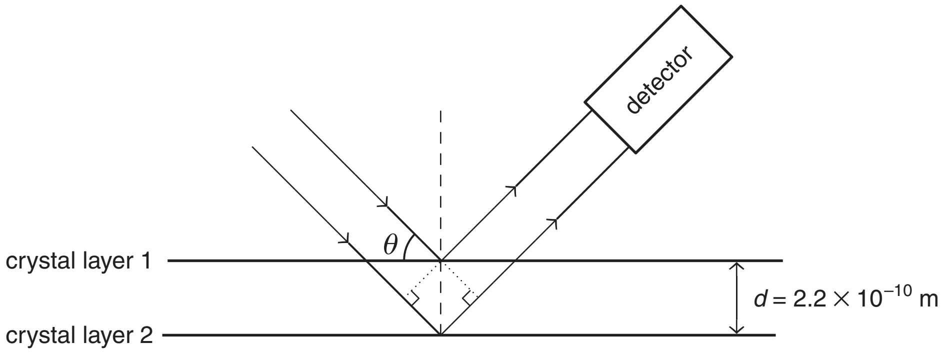


Figure 2

For a particular crystal, the spacing between layer 1 and layer 2 is found to be 2.2×10^{-10} m.

The number of X-rays detected at the detector first peaks when $\theta = 17.0°$.

Question 9

Calculate the wavelength of the X-rays used in this investigation.

m

2 marks

A student predicts that the next angle at which a peak in the number of X-rays detected will occur will be when $\theta = 34.0°$. The student made this prediction by doubling the angle at which the first peak occurred.

Question 10

Is the student correct (yes/no)? Use calculations to support your answer.

3 marks

Detailed study 2 – Photonics

Question 1

In the sentences below, options are given within the brackets. Only **one** of the options will be correct. Circle the best option.

> A light-emitting diode (LED) produces photons of light as an electron drops from the [**conduction band / valence band / orbiting band**] to the [**conduction band / valence band / ground band**]. The larger the drop, the greater the [**intensity / frequency / number**] of the photons.

3 marks

The structural composition of a commercially available optical fibre is shown in Figure 1. The core has a relative refractive index of 1.42. On testing the fibre it is found that an incident angle of 80.4° at the core–cladding boundary will result in the incident ray first experiencing total internal reflection.

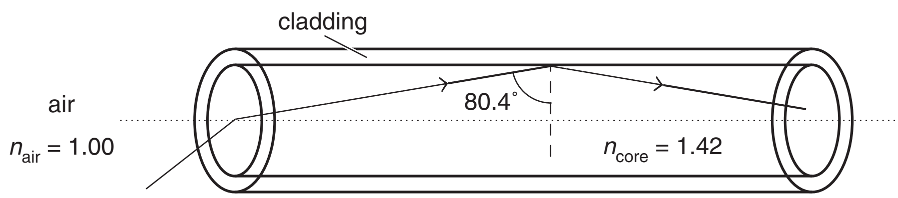


Figure 1

Question 2

Calculate the refractive index of the cladding used in the optical fibre.

2 marks

Question 3

Calculate the acceptance angle for this optical fibre.

°

2 marks

Optical fibres are sometimes used as part of a sensing unit that monitors the movement of a building in high winds. The optical fibre is bent into a semicircle as shown in Figure 2. Light is shone down the optical fibre and the intensity of the light at the end of the optical fibre is measured using a photodiode in a stationary sensor.

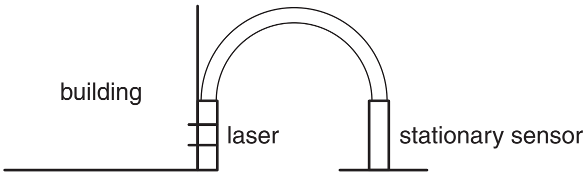


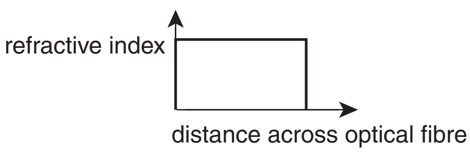
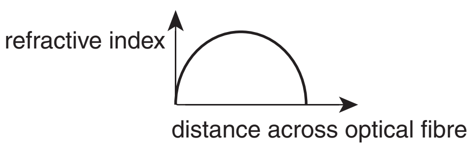
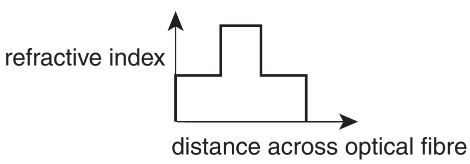
Figure 2

Question 4

Explain how the **movement of the building** is monitored using this photonic equipment.

3 marks

The table shown below has two columns. The left-hand column shows the graph of the refractive index of the material in various optical fibres as you move across from one side of the fibre to the other. The column on the right-hand side has a description of one characteristic of each of three different optical fibres.

<table>
<tr><th>Graph of refractive index across fibre</th><th>Characteristic of fibre</th></tr>
<tr><td>
</td><td>Higher-order rays take the same time to reach the end of the fibre as lower-order rays.</td></tr>
<tr><td>
</td><td>Multi-mode rays are possible but losses will occur.</td></tr>
<tr><td>
</td><td>It is only possible for a single mode of ray to be transmitted down this fibre.</td></tr>
</table>

Question 5

Draw lines to match the characteristic of the fibre with the refractive index of the fibre.

3 marks

A silica glass optical fibre is used to transmit information using laser light as the source.

Figure 3 shows the overall attenuation of the fibre per kilometre of its length when tested with light of various wavelengths.

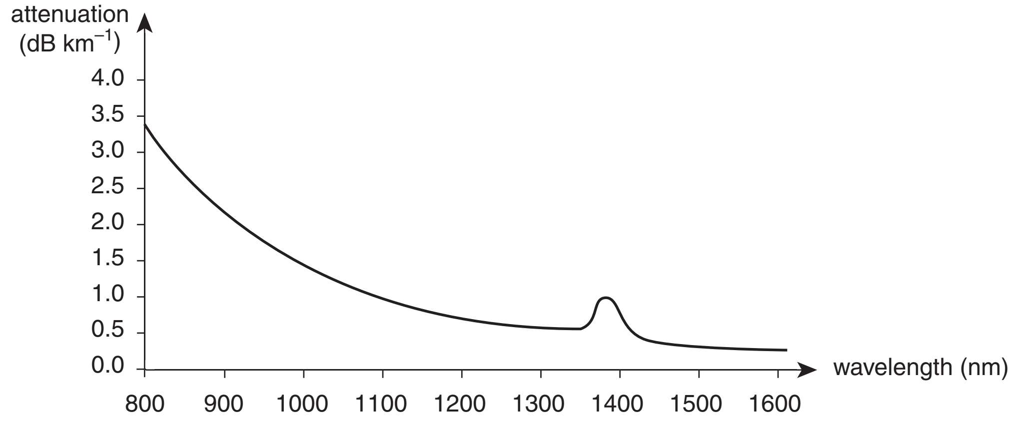


Figure 3

Question 6

Which of the following statements (**A**–**D**) best describes the method by which light is produced in the laser?

A. spontaneous absorption

B. spontaneous emission

C. stimulated emission

D. stimulated absorption

1 mark

A signal using light of wavelength 1300 nm is transmitted down the fibre.

Question 7

What are the two ways in which losses can occur in fibre-optic cables?

1 mark

Question 8

How does the wavelength of the light affect the type of loss that takes place?

2 marks

Impurities in the glass cause loss of power in the final signal.

Question 9

Which of the following statements (**A**–**D**) about the power dissipated by the optical fibre is true?

A. The power will be dissipated as heat only.
B. The power will be dissipated as scattering of light only.
C. The power will be dissipated as both heat and light.
D. The power will not be dissipated. It is reflected back to the input by the impurities.

1 mark

Question 10

Which factor (**A**–**E**) best describes the change in intensity of a ray travelling down an optical fibre due to Rayleigh scattering if the wavelength of the ray is doubled?

A. $\frac{1}{2}$
B. 2
C. 4
D. $\frac{1}{16}$
E. 16

1 mark

The fibre is tested using an input signal shown in Figure 4a. However, the output signal looks quite different and is shown in Figure 4b.

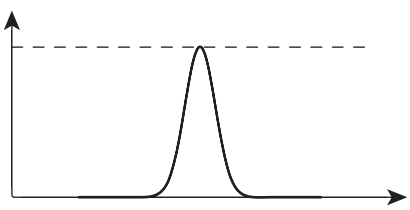


Figure 4a

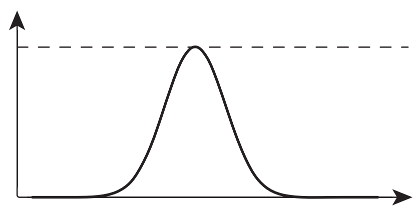


Figure 4b

Question 11

Explain the probable cause of the change to the signal and what could be done to rectify the problem.

3 marks

A coherent bundle of optical fibres is used to look for a small object under the ground as shown in Figure 5a. The casing of the bundle shows that although the bundle is bent it is not twisted. The object is a small, black, Y-shaped object. Figure 5b shows the input signal that is received by the bundle.

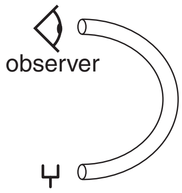


Figure 5a

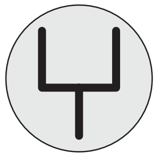


Figure 5b

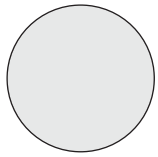


Figure 5c

Question 12

On Figure 5c, sketch what will be seen by the observer.

1 mark

Systems for communication over different lengths require different sources of light and different forms of optical fibre to transmit the information.

Question 13

Choose one or more objects from the following list (**A–E**) that would be most commonly used in a short-distance communication system.

A. LED
B. laser diode
C. multi-mode optical fibre
D. single mode optical fibre
E. gas laser

2 marks

Detailed study 3 – Sound

A student uses a slinky spring to demonstrate how sound is transmitted in air. After a period of time a photograph is taken of the slinky spring as shown in Figure 1.

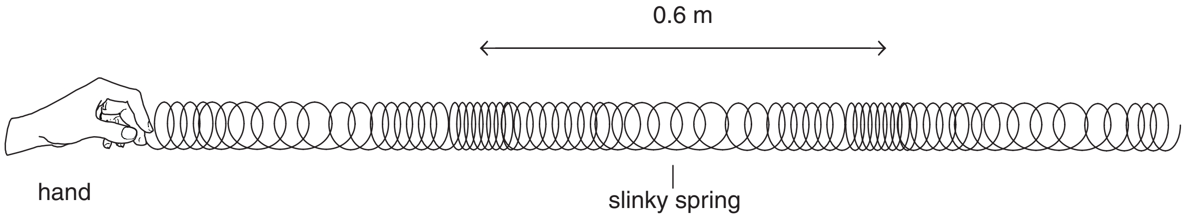


Figure 1

Question 1

In the sentences below, options are given within the brackets. Only **one** of the options will be correct. Circle the best option.

> The spring shows how the [**medium / material / energy**] is transmitted from the source to the listener by a series of [**crests and troughs / compressions and rarefactions**].
> We can see that the spring is transmitting a longitudinal wave because the wave is in the same [**period / phase / plane**] as the vibration that caused it.

3 marks

The wave moves at 0.8 m s^{-1} along the spring.

Question 2

Calculate how many times the student moves her hand through a full cycle in one minute.

2 marks

Three students, Trudy, Jo and Mary, are performing an experiment using a signal generator and a loudspeaker as shown in Figure 2. Trudy controls the amplitude of the signal whilst Jo and Mary listen to the sounds 4 m from the source.

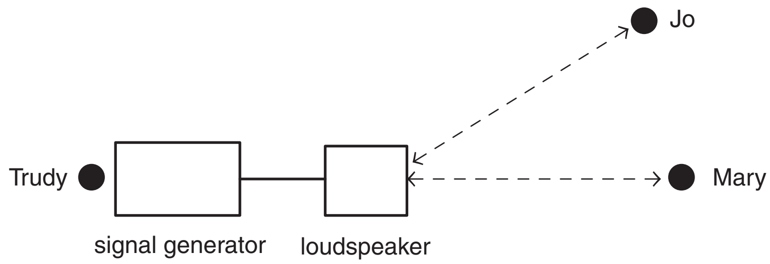


Figure 2

Jo says:

'Trudy, increase the sound so it is really loud; double the intensity level.'

Mary says:

'Trudy, increase the sound so it is really loud; double the intensity.'

Question 3

Who should Trudy listen to in order to enable the girls to hear the loudest sounds: Jo or Mary?
Use calculations to explain your answer.

4 marks

Jo measures the sound intensity using a sound intensity meter. At 4 m from the source she finds it is $0.02\ \text{W m}^{-2}$. She walks away from the source until the sound intensity she measures is $0.008\ \text{W m}^{-2}$.

Question 4

How far has Jo walked **from her original position**?

m

3 marks

The diagram shown in Figure 3 illustrates the sensitivity of the human ear.

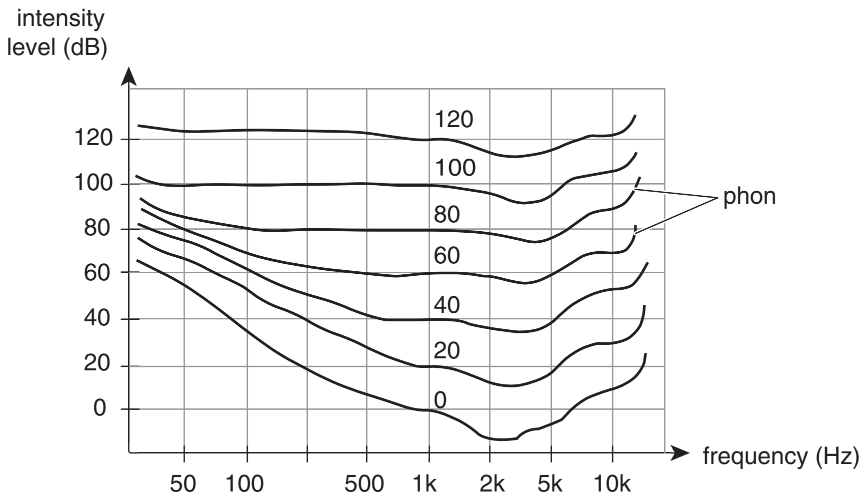


Figure 3

Question 5

From the following options (**A**–**D**), choose the sentence that best describes the curves in Figure 2.

A. The curves show sounds of the same decibel level.

B. The curves show sound levels that are equally loud.

C. The curves show sound levels perceived to be equally loud.

D. The curves show sound intensities that are equally loud.

1 mark

Two students listen to a sound of 50 Hz played at 50 dB.

Question 6

By what factor should the intensity be increased for the students to perceive a sound of 80 dB?

3 marks

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A typical speaker is shown in Figure 4. It comprises three individual diaphragms of different sizes, three ports, baffles and an enclosure.

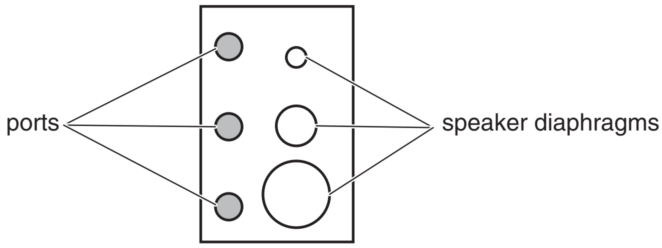


Figure 4

Question 7

Choosing from the following sentences (**A–D**), what is the main benefit of enclosing a speaker in a baffle and using a port?

A. It gives a louder sound.

B. The speaker can play lower frequencies.

C. It improves the diffraction of the sound.

D. It gives a flatter frequency response.

1 mark

Figure 5 shows a set of axes showing the frequency played by a speaker and its response.

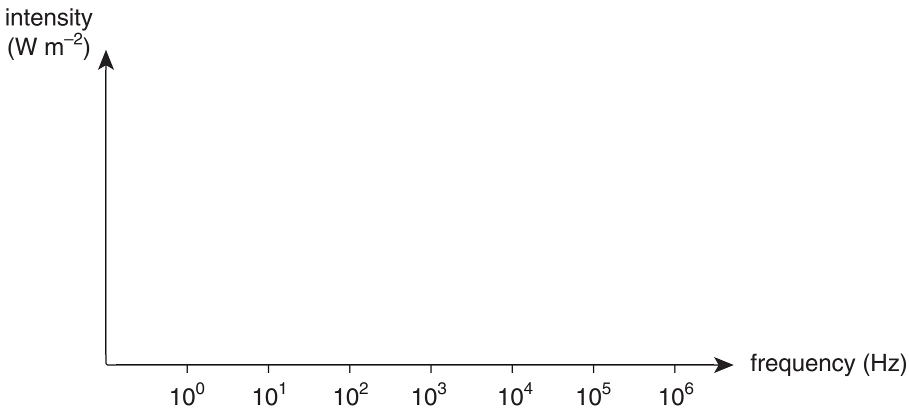


Figure 5

Question 8

On Figure 5, sketch what the frequency response curve is likely to be for the largest-diameter speaker.

1 mark

A tube of length 0.765 m, closed at one end and with a speaker at the open end, is used in a sound experiment. The set-up is shown in Figure 6. The frequency of the sound emitted from the speaker is increased from 0 Hz until a microphone situated 0.085 m in from the closed end of the tube detects a maximum intensity of sound.

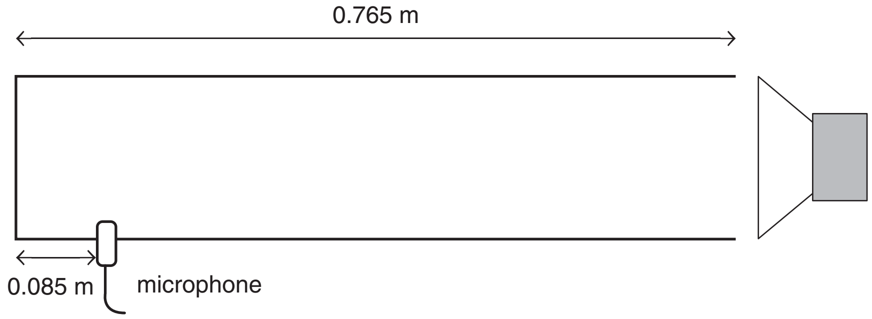


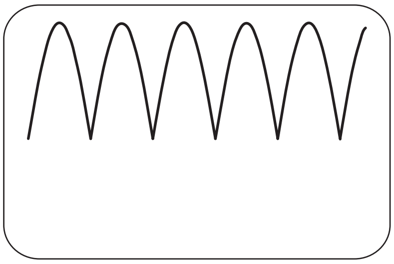
Figure 6

The microphone is attached to a cathode ray oscilloscope (CRO).

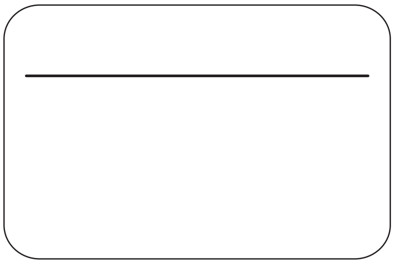
Question 9

Which of the following traces (**A–D**) will be observed on the screen of the CRO?

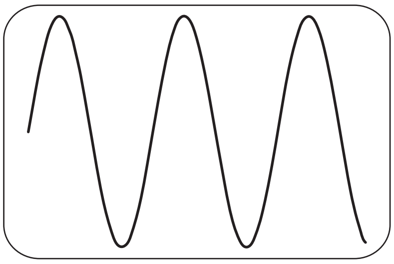
A.



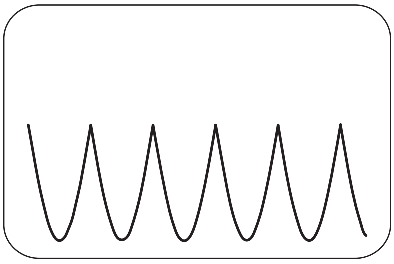
B.



C.



D.



1 mark

Question 10

What number harmonic is present when the microphone detects maximum amplitude for the first time?

2 marks

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Question 11

What frequency of sound is used when the microphone detects the first maximum amplitude?
(Take the speed of sound as 340 m s^{-1}.)

Hz

1 mark

Question 12

In the sentences below, options are given within the brackets. Only **one** of the options will be correct. Circle the best option.

The cheapest microphones we have in stock are piezoelectric microphones. The frequency response is stable to over [**5000 / 10 000 / 20 000**] Hz and over a wide range of conditions. Our most popular, however, is the electrodynamic microphone. The diaphragm in this microphone is connected to the [**amplifier / magnet / coil**] and oscillates as you speak into it. We have stopped carrying the electret condenser microphone because the plastic foil used in it often broke because it was [**highly charged / brittle / under high tension**].

3 marks

END OF QUESTION AND ANSWER BOOKLET