VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education
2011

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

Figures									Letter:
Words									

PHYSICS
Written examination 2

Tuesday 15 November 2011

Reading time: 11.45 am to 12.00 noon (15 minutes)
Writing time: 12.00 noon to 1.30 pm (1 hour 30 minutes)

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A – Core – Areas of study			
1. Electric power	18	18	37
2. Interactions of light and matter	13	13	29
B – Detailed studies			
1. Synchrotron and its applications **OR**	12	12	24
2. Photonics **OR**	12	12	24
3. Sound	12	12	24
			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 one 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 answer book of 42 pages. A formula sheet.
- Answer sheet for multiple-choice questions.

Instructions
- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.
- All written responses must be in English.

At the end of the examination
- Place the answer sheet for multiple-choice questions inside the front cover of this book.

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

SECTION A – Core

Instructions for Section A

Answer **all** questions **for both** Areas of study in this section in the spaces provided. Write using black or blue pen.

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.

In questions worth more than 1 mark appropriate working should be shown.

Unless otherwise indicated, diagrams are not to scale.

Areas of study **Page**

Area of study 1 – Electric power

Use the following information to answer Questions 1 and 2.

Two identical bar magnets of the same strength are arranged at right angles and are equidistant from point P, as shown in Figure 1.

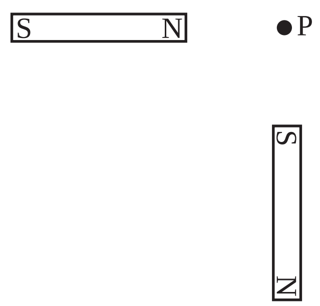


Figure 1

For Question 1 only, ignore Earth's magnetic field.

Question 1

At point P on the diagram, draw an arrow indicating the direction of the combined magnetic field of the bar magnets.

1 mark

Question 2

The bar magnets are replaced by two weaker magnets. The two new magnets are identical to each other. They are arranged at right angles and are equidistant from point P.

The magnitude of the magnetic field of a **single** bar magnet at point P is the same as the magnitude of magnetic field of Earth at point P. The direction of Earth's magnetic field is shown in Figure 2.

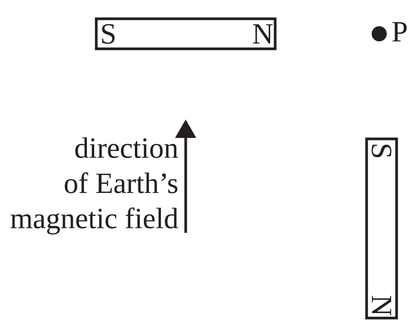


Figure 2

At point P on the diagram, draw an arrow indicating the direction of the combined magnetic field of the bar magnets and Earth.

2 marks

Use the following information to answer Questions 3–7.

Figure 3 shows a schematic diagram of a DC electric motor. The motor has a rectangular coil, JKLM, of 50 turns. The permanent magnets provide a uniform magnetic field of 0.30 T in the region of coil JKLM. The commutator with contacts X and Y is connected to a source of constant DC current.

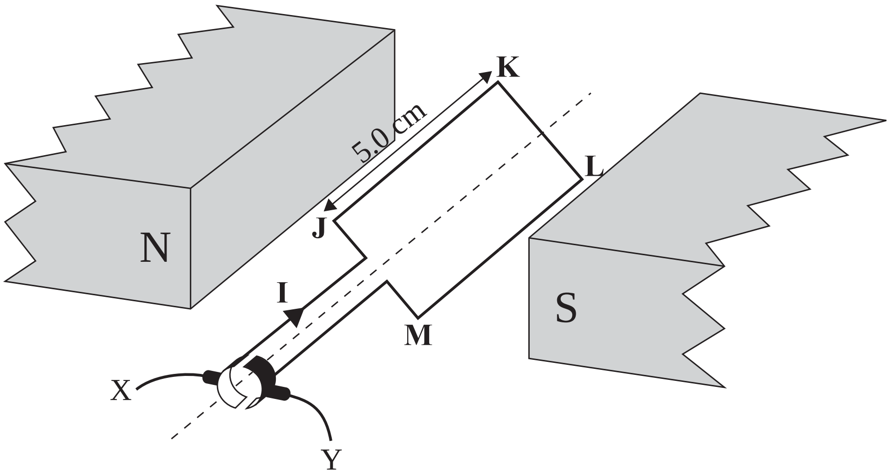


Figure 3

Question 3

Explain the role of the commutator in the operation of the motor.

3 marks

Question 4

A current, I, is flowing through the rectangular coil in the direction shown.

When the coil is in the position shown in the diagram, draw an arrow on side JK to show the direction of the magnetic force on side JK.

1 mark

Question 5

A current of 6.0 A is flowing in the 50-turn rectangular coil. The length of side JK is 5.0 cm.

Calculate the magnitude of the magnetic force acting on side JK when it is in the position shown in Figure 3.

N

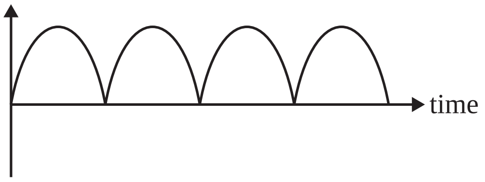
2 marks

Coil JKLM is now disconnected from the source of steady current, and the coil is turned by hand at a constant speed. Points X and Y are now connected to an oscilloscope.

Question 6

Which of the following graphs best shows the shape of the voltage-time display on the oscilloscope?

A.



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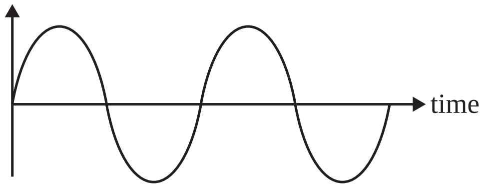
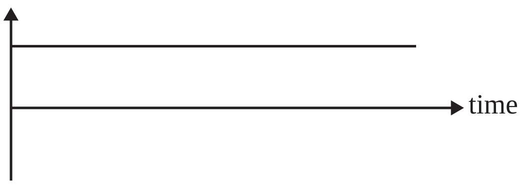


C.



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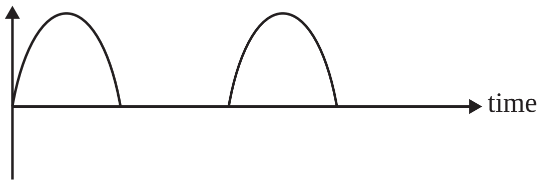


1 mark

Question 7

Explain your answer to Question 6.

2 marks

Use the following information to answer Questions 8 and 9.

Figure 4 shows a 50-turn rectangular coil of area 0.020 m^2 that can rotate in a uniform magnetic field of 2.0 T. The coil is shown in three different orientations, A, B and C.

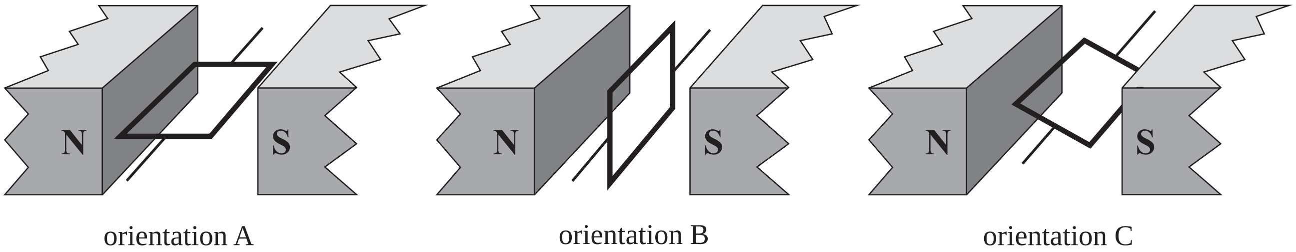


Figure 4

In orientation A the coil is horizontal; in orientation B it is vertical; and in orientation C it is inclined at 45° to the vertical.

Question 8

Which of the following is the closest to the value of the magnetic flux through the coil when it is at orientation C?

A. 0 Wb

B. 0.03 Wb

C. 0.04 Wb

D. 1.5 Wb

2 marks

Question 9

The 50-turn coil is rotated from orientation A to orientation B in a time of 0.15 s.

Calculate the average emf generated in the coil over this time period.

V

2 marks

Use the following information to answer Questions 10–12.

A small bar magnet is moved through a circular wire loop, as shown in Figure 5. The magnet moves with **constant** speed through the centre of the loop, in the direction shown by the arrow. An emf is generated in the wire loop. The wire loop is connected to an oscilloscope, as shown in Figure 5.

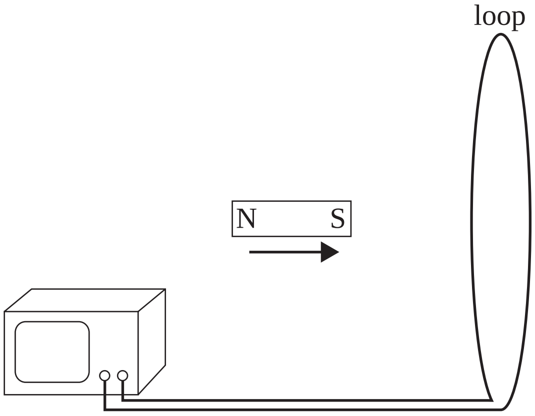


Figure 5

Question 10

Explain why an emf is generated in the wire loop.

2 marks

Question 11

On the graph axes below, sketch the variation of the emf with time, from when the magnet is a long way to the left of the loop, through the loop, to when it is a long way to the right of the loop. Note that you can take either upwards or downwards as positive.

2 marks

Question 12

After the magnet has passed through the wire loop, and is moving away from the loop, current flows around the loop in an **anticlockwise** direction, as viewed from the left in Figure 5.

Use Lenz's law to explain why the current flows in an **anticlockwise** direction.

3 marks

Use the following information to answer Questions 13–16.

A small town is supplied with electricity from a small hydroelectric generation plant about 20 km from the town. Electricity is transmitted to the town through a two-wire high-voltage transmission line.

The input voltage to the transmission lines at the generator end is 50 000 V_{RMS} AC.

The current in the lines is 15 A_{RMS}. At the edge of town, a transformer converts this into 250 V_{RMS} AC for use in the town.

The system is shown in Figure 6.

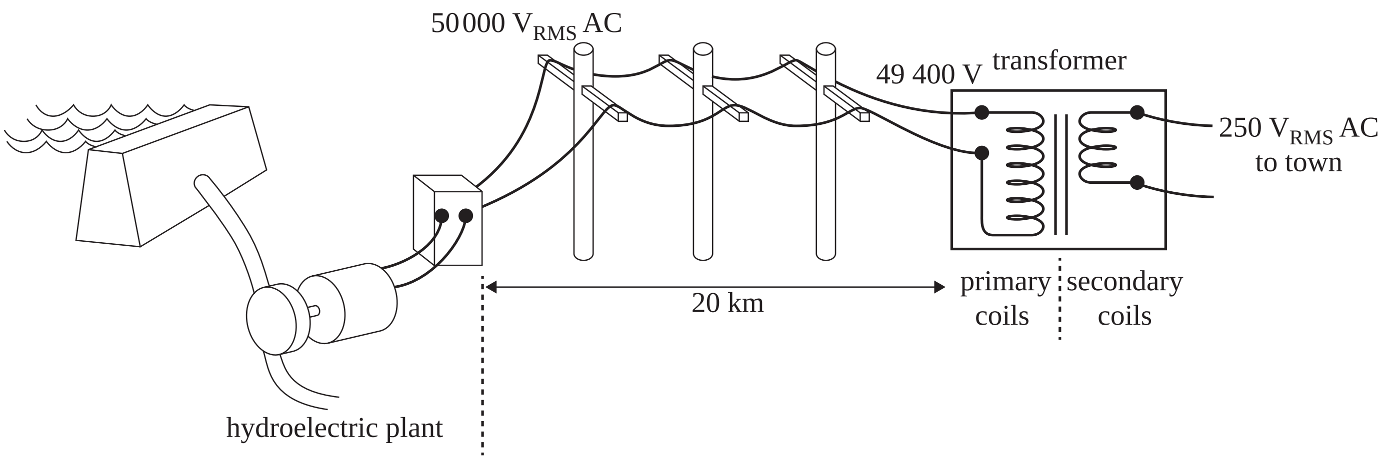


Figure 6

Question 13

Calculate the power supplied to the transmission lines. Show your working.

W

2 marks

Question 14

Some townspeople are concerned about the high voltages, and propose that the same power could be transmitted more safely at a lower transmission voltage.

Explain clearly why this proposal would increase power losses in the transmission process.

3 marks

The proposal is not accepted, and the transmission lines operate as originally designed.

With a current in the transmission lines of 15 A_{RMS} the total power loss in the transmission lines is 9000 W.

Question 15

Calculate the total resistance of the transmission lines.

Ω

2 marks

At the edge of town, a transformer is used to reduce the voltage to 250 V_{RMS} AC for use in the town. The voltage at the input to the substation is 49 400 V_{RMS}.

Question 16

Assuming that the transformer is ideal, calculate the value of

$$\frac{\text{current in the secondary coils}}{\text{current in the primary coils}}$$

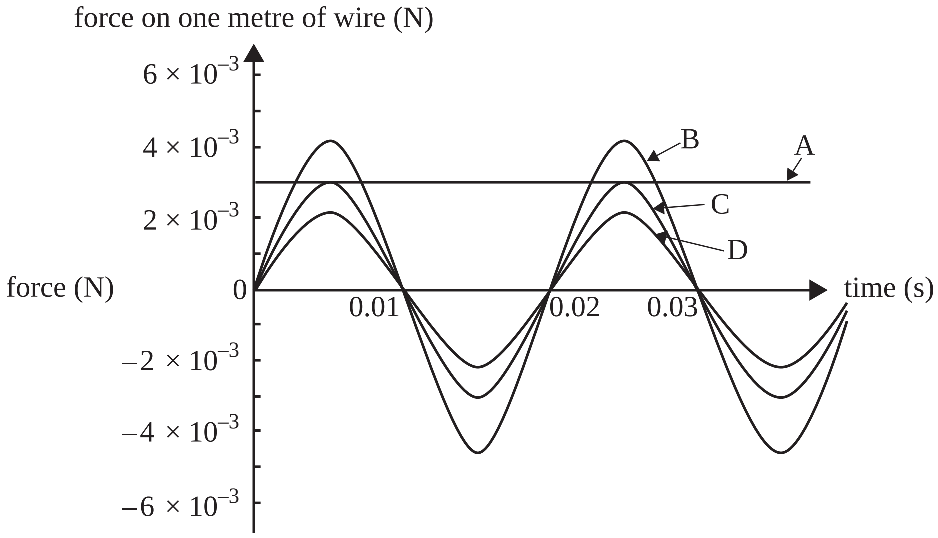
2 marks

NO WRITING ALLOWED IN THIS AREA

In a part of Victoria, a section of one wire of a transmission line is running horizontally from east to west. The current in the transmission line is 30 $A_{RMS.}$
Earth's magnetic field there is pointing directly north, parallel to the ground, of strength 1.0×10^{-4} T.

Question 17

Which of the graphs (A–D) below best illustrates how the electromagnetic force acting on each metre of wire varies as a function of time? Show a numerical calculation to justify your answer.



2 marks

Question 18

Students are using a 12 V battery to power some lighting circuits. They connect the battery to each of the following two circuits shown in Figure 7 below. All the lights in both circuits are operating normally.

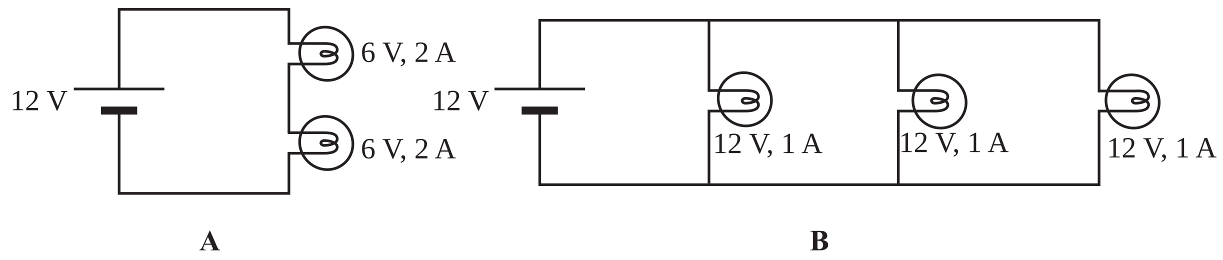


Figure 7

The students notice that one circuit requires more power from the battery than the other circuit.

Identify which of the circuits, A or B, uses more power and explain why this is the case, using numerical calculations in your answer.

3 marks

Area of study 2 – Interactions of light and matter

Use the following information to answer Questions 1–4.

Students set up the apparatus shown in Figure 1 to repeat Young's double-slit experiment.

They use a laser of $\lambda = 560$ nm as the light source.

In the first experiment, the separation, d, of the two narrow slits, S_1 and S_2, is 0.32 mm.

P is a point on the interference pattern at the centre of the second dark band out from the centre of the pattern, C.

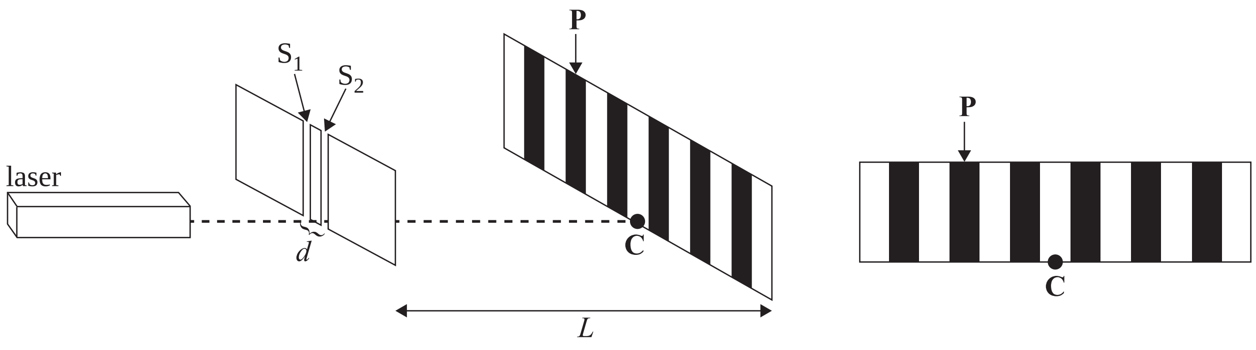


Figure 1

Question 1

Calculate the path difference $S_2P - S_1P$. Show your working.

nm

2 marks

Question 2

The distance, L, is now increased.

Describe the effect of this change on the spacing of the observed interference pattern.

1 mark

Question 3

L is reset to its original value.

The separation of the slits, *d*, is then decreased.

Describe the effect of this change on the spacing of the observed interference pattern.

2 marks

Question 4

Explain how the observations in Young's experiment led to his conclusion about the wave-like nature of light.

3 marks

Use the following information to answer Questions 5–9.

Students set up the apparatus shown in Figure 2 to study the photoelectric effect.

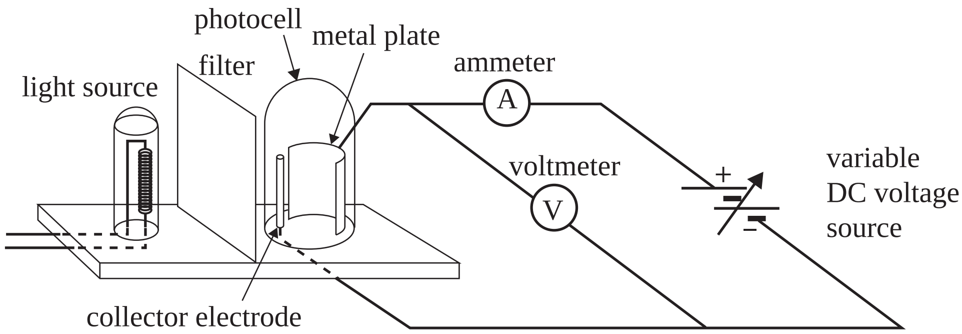


Figure 2

The apparatus consists of

- a source of white light
- a set of filters that only allow light of selected wavelengths to pass through
- a metal plate and a collector electrode enclosed in an evacuated (no air) glass case
- a voltmeter (V), ammeter (A) and variable DC voltage source in a circuit, as shown in Figure 2.

With a particular filter in place, the students gradually increase the voltage as measured by the voltmeter, V, from zero.

They plot the current measured through the ammeter, A, as a function of the voltage measured by the voltmeter, V. This is shown in Figure 3.

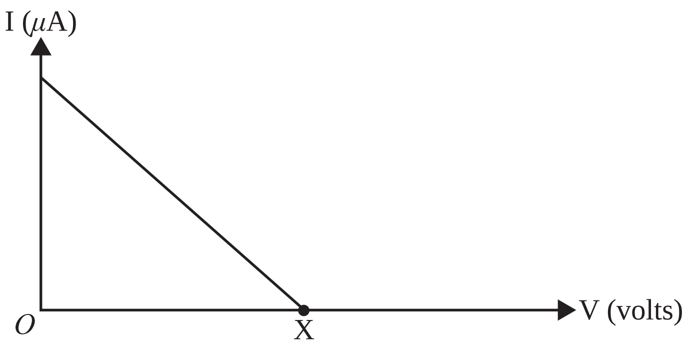


Figure 3

Question 5

Explain why the current drops to zero at point X.

2 marks

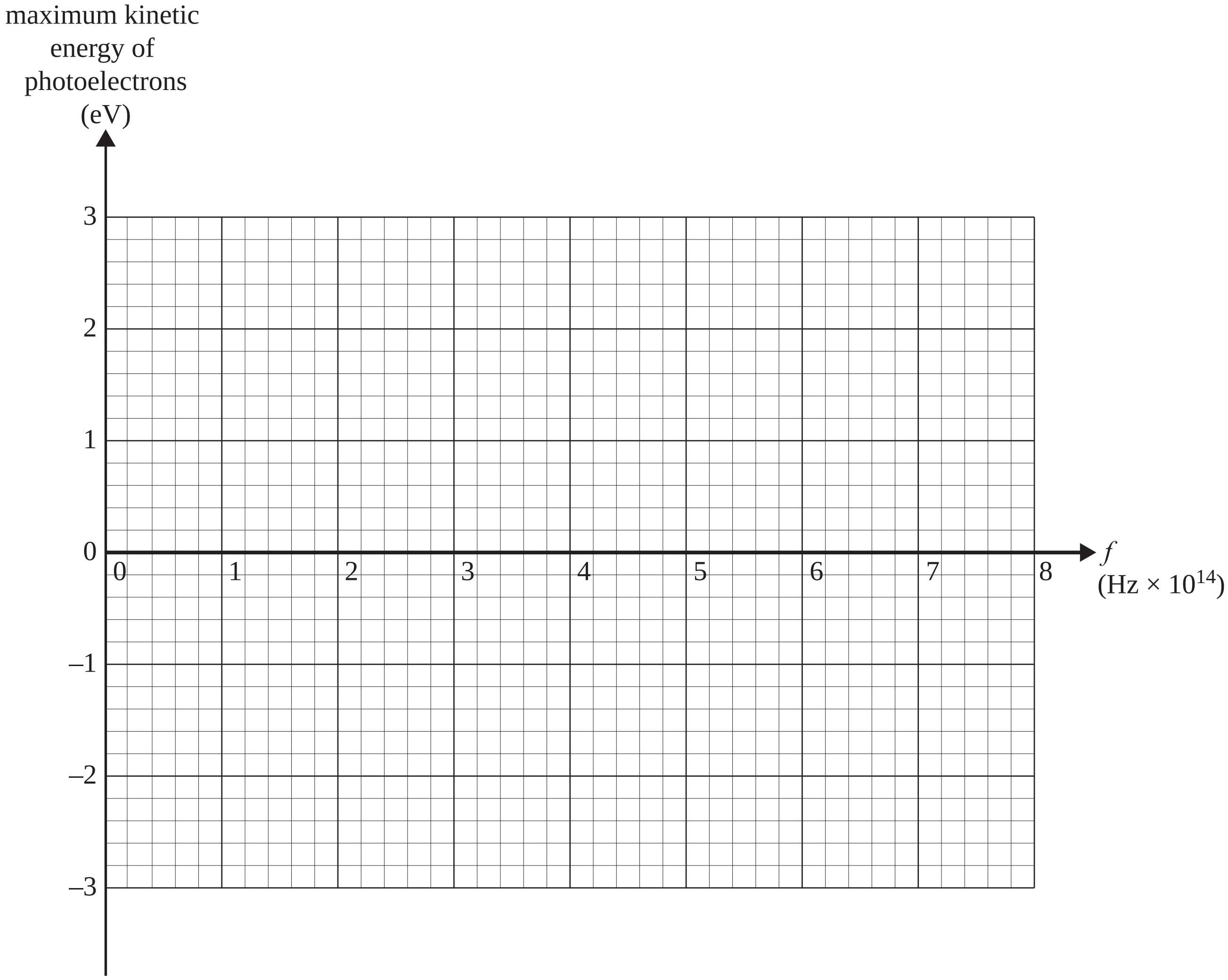
The students now use five different filters to give five frequencies of light falling on the plate, and measure the stopping voltage on the voltmeter for each frequency.

Their data is shown below.

Frequency (Hz)	Stopping voltage (V_S)
4.5×10^{14}	1.3
5.0×10^{14}	1.5
6.1×10^{14}	2.0
6.9×10^{14}	2.5
7.6×10^{14}	2.8

Question 6

From this data, plot these points on the axes below and hence draw a line of best fit to show the maximum kinetic energy of the emitted electrons versus frequency falling on the metal plate.



3 marks

Question 7

From your graph, what value of *h*, Planck's constant, would the students have obtained?

Show your working.

eV s

2 marks

Question 8

From your graph, what is the **longest wavelength** which would cause a photoelectron to be emitted?

nm

2 marks

Question 9

Outline the conclusions about the nature of light that Einstein made from the observations of photoelectric experiments.

3 marks

NO WRITING ALLOWED IN THIS AREA

Use the following information to answer Questions 10–12.

X-rays of wavelength 0.20 nm are directed at a crystal and a diffraction pattern is observed.

Question 10

Calculate the energy, in eV, of a photon of these X-rays.

eV

2 marks

Question 11

The X-ray beam is replaced by a beam of electrons. A similar diffraction pattern is observed with the same spacing as in Question 10.

What must be the energy, in eV, of each electron to produce this pattern?

eV

2 marks

Question 12

Explain why these electrons also produce a diffraction pattern with the same spacing as the X-rays.

2 marks

Question 13

Figure 4 shows the energy level diagram for the hydrogen atom.

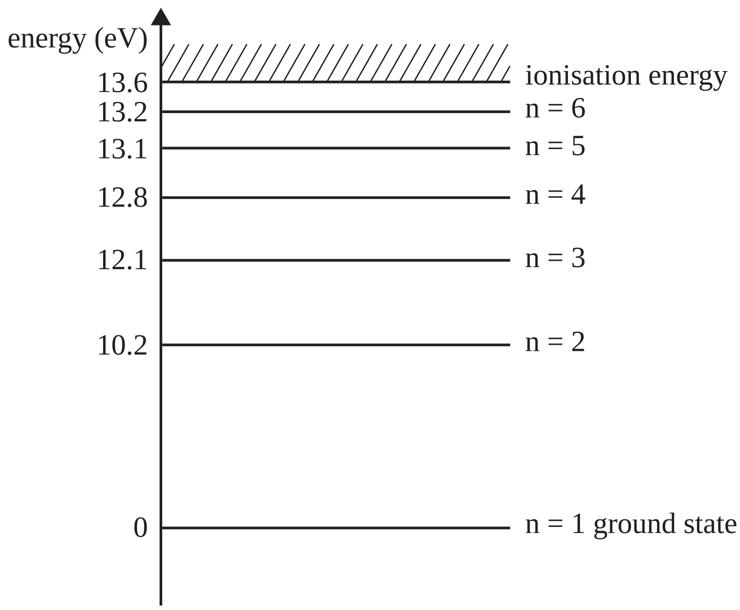


Figure 4

An atom of hydrogen is in the n = 4 state.

List below all the possible energies, in eV, of photons that could be emitted as this atom decays to the ground state.

3 marks

END OF SECTION A

SECTION B – Detailed studies

Instructions for Section B

Select **one** Detailed study.

Answer **all** questions from the Detailed study, **in pencil**, on the answer sheet provided for multiple-choice questions.

Write the name of your chosen Detailed study on the multiple-choice answer sheet **and** shade the matching box.

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.

You should take the value of g to be 10 m s^{-2}.

Unless indicated, diagrams are not to scale.

Detailed study **Page**

Detailed study 1 – Synchrotron and its applications

Question 1

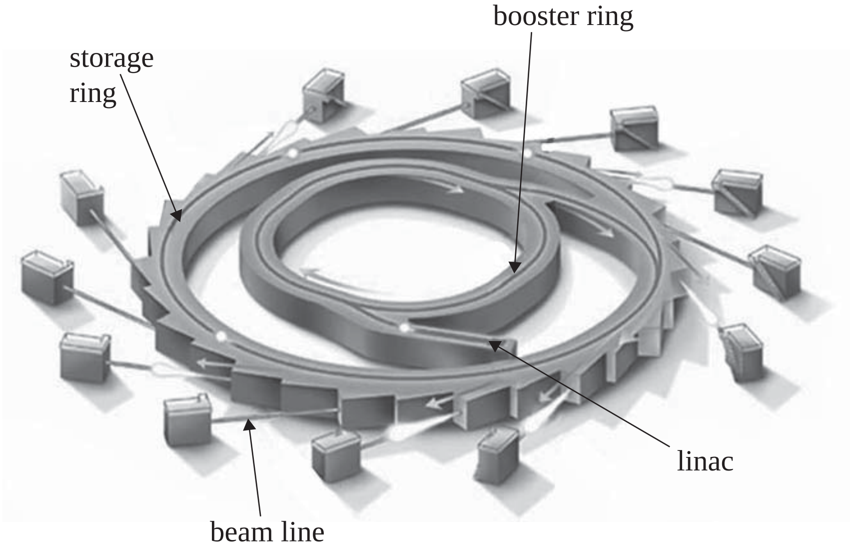


Figure 1

The main components in the Australian Synchrotron are shown in Figure 1 above.

The main purpose of the **storage ring** is to

A. store the high energy X-rays for experiments.

B. increase the energy of the electrons to the maximum value.

C. maintain the energy of the electrons at the maximum value.

D. focus the electron beam for injection into one of the beam lines.

Question 2

Figure 2 shows the injector gun of a synchrotron.

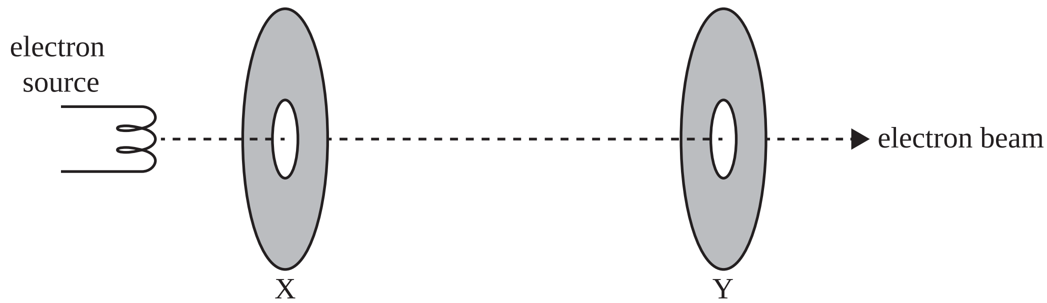


Figure 2

The electrons enter the injector at X with practically zero speed, and emerge from the injector at Y with a speed of 2.65×10^{7} m s^{-1} .

Point X at the entry point of the injector is at a potential of zero volts.

An electron has a mass of 9.1×10^{-31} kg and a charge of -1.6×10^{-19} C.

Which of the following is the best estimate of the potential (voltage) of point Y with respect to point X?

A. + 2000 V

B. – 2000 V

C. + 15000 V

D. – 15000 V

Use the following information to answer Questions 3 and 4.

Electrons with a velocity of 1.30×10^{6} m s^{-1} are injected into a uniform magnetic field, and move in a semicircle of radius 0.350 m, as shown in Figure 3. The mass of an electron is 9.1×10^{-31} kg and charge -1.6×10^{-19} C.

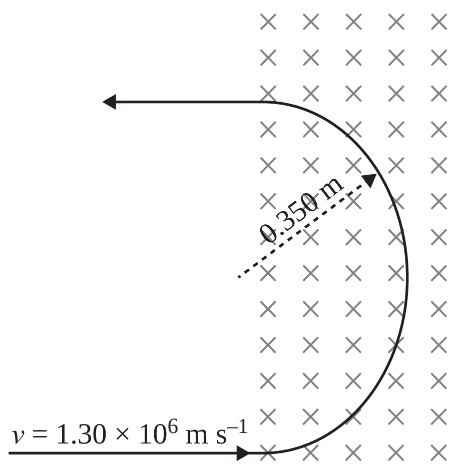


Figure 3

Question 3

Which of the following best gives the value of the magnetic field?

A. 5.9×10^{-13} T

B. 2.1×10^{-5} T

C. 4.2×10^{-2} T

D. 27.5 T

Question 4

Which of the following best gives the speed of the electrons as they exit the magnetic field?

A. 0 m s^{-1}

B. much less than 1.30×10^{6} m s^{-1}

C. 1.30×10^{6} m s^{-1}

D. greater than 1.30×10^{6} m s^{-1}

Question 5

The process for the production of synchrotron radiation in a synchrotron is best described as

A. slowing down of electrons in the storage ring.

B. change of direction of electrons in the storage ring.

C. linear acceleration of electrons in the storage ring.

D. linear acceleration of electrons in the booster ring.

Question 6

Scientists are considering the spectrum width (frequency spread) from three different types of X-ray sources.

- X-rays entering the beam line of a synchrotron from the storage ring
- X-rays from an X-ray laser
- X-rays from a high-voltage X-ray tube

Which of the following best gives the order of these sources, in terms of the width of the X-ray frequency spread, from narrowest to widest?

A. synchrotron, X-ray tube, laser

B. laser, X-ray tube, synchrotron

C. synchrotron, laser, X-ray tube

D. X-ray tube, laser, synchrotron

Question 7

Undulators are positioned in the storage ring to increase the intensity of synchrotron radiation.

They achieve this by

A. increasing the intensity of the electron beam.

B. increasing the speed of the electrons in the storage ring.

C. decreasing the speed of the electrons, so radiating X-rays.

D. sharply changing the direction of the electron beam in the storage ring.

Use the following information to answer Questions 8–10.

X-rays of wavelength 0.140 nm emerge from a synchrotron beam line onto a crystal under investigation.

Question 8

Which of the following best gives the energy, in eV, of these X-rays?

A. 1.7×10^{-15} eV

B. 8.9×10^{-6} eV

C. 3450 eV

D. 8900 eV

When these X-rays are scattered from the crystal, the first maximum of the Bragg diffraction pattern occurs at an angle of 15° to the atomic plane of the crystal.

Question 9

Which of the following best gives the spacing between the planes of the crystal?

A. 0.072 nm

B. 0.27 nm

C. 0.54 nm

D. 2705 nm

Question 10

At which of the following angles would Bragg diffraction also be observed?

A. 5.0° and 7.5°

B. 30° and 45°

C. 31° and 51°

D. 45° and 89°

Question 11

A broad spectrum beam from a synchrotron is incident on and passes through a thin metal foil and into a spectrum analyser.

An absorption spectrum is observed, with lines (among others) at wavelengths of 0.081 and 0.063 nm.

Which of the following pairs gives the energies of the photons absorbed to produce this pattern?

A. 0.015 keV and 0.020 keV
B. 2.46 keV and 3.15 keV
C. 15.3 keV and 19.7 keV
D. 24.6 keV and 31.5 keV

Question 12

A beam of X-rays of wavelength 0.25 nm undergoes Compton scattering.

Which of the following is a likely wavelength of the observed scattered beam?

A. 0.025 nm
B. 0.24 nm
C. 0.25 nm
D. 0.26 nm

Detailed study 2 – Photonics

Question 1

The light reaching Earth from the Sun is best described as

A. wide spectrum and coherent.

B. narrow spectrum and coherent.

C. wide spectrum and incoherent.

D. narrow spectrum and incoherent.

Question 2

Which of the following best describes how light is produced in a light-emitting diode (LED)?

A. thermal motion of valence electrons

B. transition of electrons from the conduction band to the ground state

C. transition of electrons from the conduction band to the valence band

D. transition of electrons from the valence band to the conduction band

Use the following information to answer Questions 3 and 4.

Question 3

A light-emitting diode (LED) emits red light of wavelength 620 nm.

Which of the following best gives the band-gap energy of the semiconductor material of this diode?

A. 2.6×10^{-21} eV

B. 3.2×10^{-19} eV

C. 2.0×10^{-9} eV

D. 2.0 eV

Question 4

As the width of the band gap in an LED increases, the colour of the light emitted changes.

Which of the following gives the correct sequence of colours emitted by LEDs, in **increasing** order, as the band gap is increased?

A. blue, red, green

B. green, red, blue

C. red, green, blue

D. blue, green, red

Use the following information to answer Questions 5 and 6.

The characteristics of an LED are shown in Figure 1.

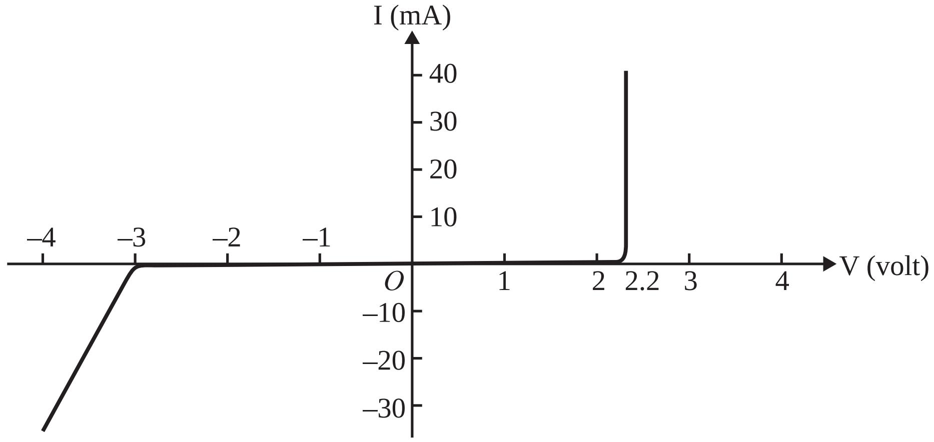


Figure 1

This LED is placed in the circuit shown in Figure 2, and operates correctly.

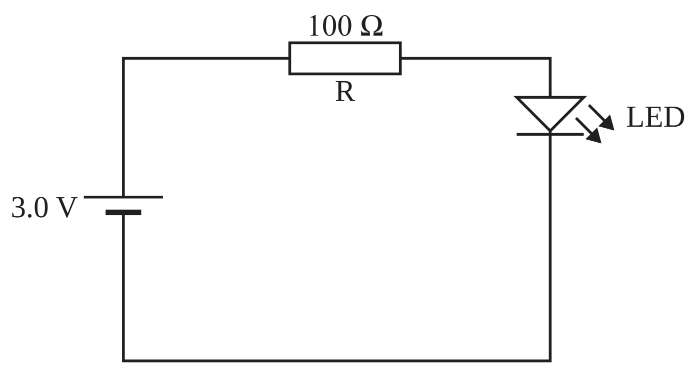


Figure 2

Question 5

Which of the following gives the best estimate of the current through the LED?

A. 0 mA

B. 5 mA

C. 8 mA

D. 30 mA

Question 6

Another identical LED, LED 2, is then placed in series with the first, as shown in Figure 3.

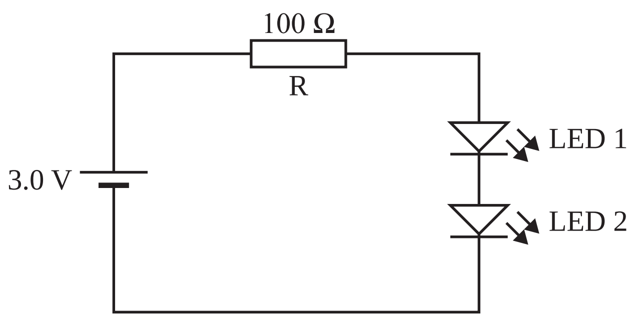


Figure 3

Which of the following statements best describes the effect of this change?

A. Both LEDs will continue to operate at the same light output.

B. Both LEDs will continue to operate but at a lower light output.

C. LED 1 will operate but not LED 2.

D. Neither LED will operate.

Question 7

Green light produced by a laser and green light from an LED of the same average wavelength are being compared.
Which of the following statements is true?

A. The light from the laser is incoherent but the LED light is coherent.

B. The light from the laser is coherent but the LED light is incoherent.

C. The laser can only operate intermittently but the LED light is continuous.

D. The spectrum of light from the LED light consists of a narrower range of wavelengths than from the laser.

Question 8

A stepped-index fibre cable is shown in Figure 4.

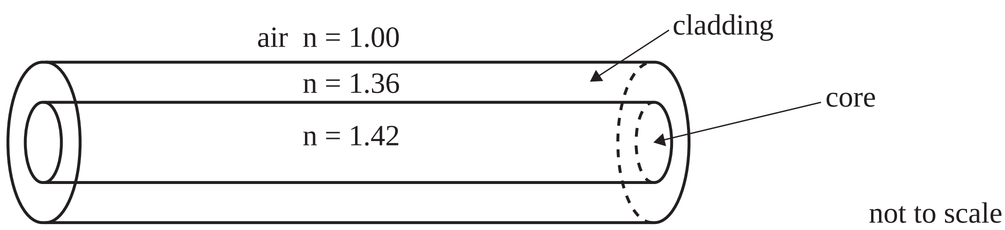


Figure 4

The cladding has a refractive index of 1.36, and the core a refractive index of 1.42.
Which of the following best gives the critical angle for total internal reflection at the core-cladding interface?

A. 17°

B. 45°

C. 47°

D. 73°

NO WRITING ALLOWED IN THIS AREA

Use the following information to answer Questions 9 and 10.

In a different optical fibre, the cladding has a refractive index of 1.32 and the core 1.48 and the critical angle is 63°. Light enters from air. This is shown in Figure 5.

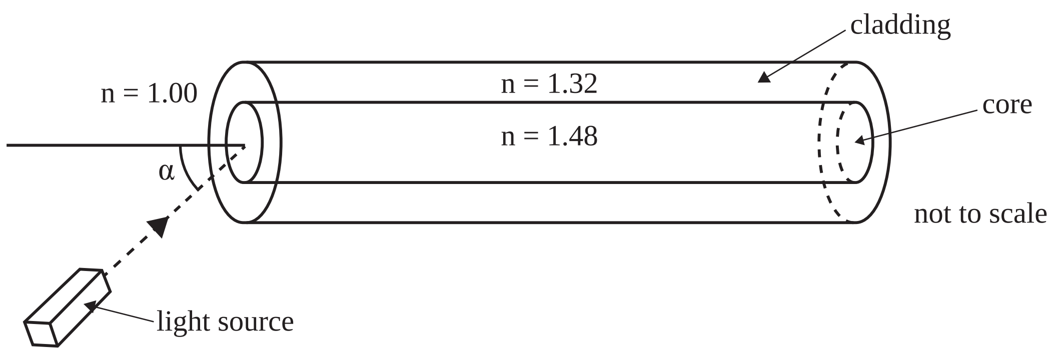


Figure 5

Question 9

Which of the following best gives the acceptance angle, α?

A. 18°
B. 27°
C. 37°
D. 42°

Question 10

The cable and the light source are now placed in water, as shown in Figure 6.

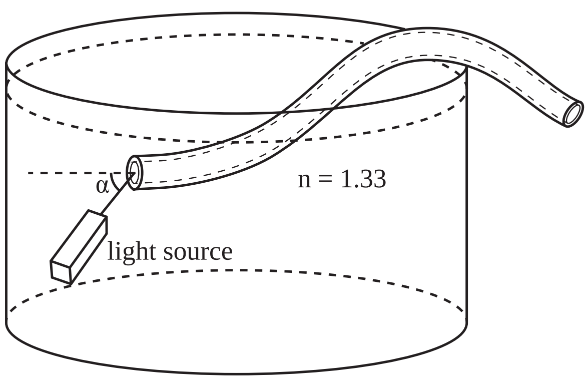


Figure 6

Which of the following statements is true of this changed situation?

A. critical angle the same, acceptance angle greater
B. critical angle the same, acceptance angle less
C. critical angle less, acceptance angle greater
D. critical angle less, acceptance angle less

Question 11

A graded-index optical fibre has an advantage over a step-index fibre because it reduces the

A. absorption.

B. modal dispersion.

C. material dispersion.

D. Rayleigh scattering.

Question 12

A fibre-optic transmission line has a length of 3.0 km. The material in the line causes the power of the signal to be attenuated by 50% for each kilometre travelled. The minimum power that can be detected clearly by the receiver is 2.0 μW.

Which of the following best gives the minimum power required in the laser at the transmission end for the signal to be clearly received?

A. 6.0 μW

B. 8.0 μW

C. 16 μW

D. 20 μW

END OF DETAILED STUDY 2

Detailed study 3 – Sound

A very small particle of dust is stationary in front of a loudspeaker which is switched off, as shown in Figure 1.

Figure 1

The loudspeaker is now switched on, emitting a sound of constant frequency of 20 Hz.
The speed of sound in air is 320 m s^{-1}.

Question 1

Which of the following best describes the motion of the dust particle when the speaker is switched on?

A. It oscillates about its rest position 20 times per second in direction RS.
B. It moves in direction S with a constant speed less than 320 m s^{-1}.
C. It oscillates about its rest position 20 times per second in direction PQ.
D. It moves in direction S at a constant speed of 320 m s^{-1}.

Use the following information to answer Questions 2 and 3.

A small source is emitting sound equally in all directions. At point X, a distance of 2.5 m from the source, the sound intensity is measured to be 1.1×10^{-4} W m^{-2}.

Question 2

Which of the following options is the best estimate of the **sound intensity level** at point X?

A. 10 dB
B. 20 dB
C. 80 dB
D. 90 dB

Question 3

Point Y is 1.25 m from the source.

Which of the following best gives the **sound intensity** at point Y?

A. 2.7×10^{-5} W m^{-2}
B. 5.5×10^{-5} W m^{-2}
C. 2.2×10^{-4} W m^{-2}
D. 4.4×10^{-4} W m^{-2}

Use the following information to answer Questions 4 and 5.

Ashley is doing an experiment at school using audio equipment. The equipment includes an oscillator that provides signals of adjustable frequency and amplitude, an amplifier and a high-quality loudspeaker, as shown in Figure 2.

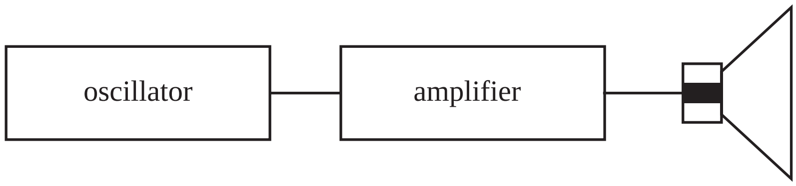


Figure 2

The frequency response curve for Ashley's hearing is shown in Figure 3 below.

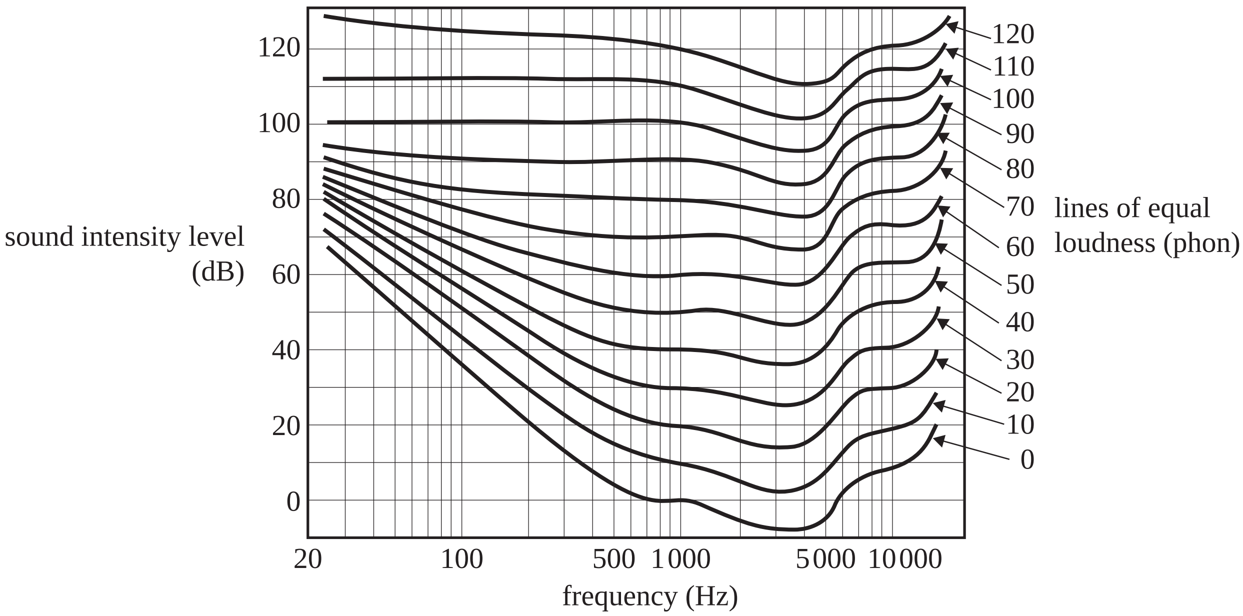


Figure 3

Question 4

With the frequency set to 3 000 Hz, the amplifier gain is adjusted to give a sound intensity level of 40 dB at Ashley's ear.

Which of the following best gives the loudness, in phons, which Ashley will hear?

A. 30

B. 37

C. 40

D. 43

NO WRITING ALLOWED IN THIS AREA

Someone adjusts the oscillator to a frequency of 100 Hz.

Question 5

Which of the following gives the best estimate of the sound intensity level (dB) for Ashley to hear the sound at 20 phon?

A. 20 dB

B. 35 dB

C. 50 dB

D. 80 dB

Use the following information to answer Questions 6 and 7.

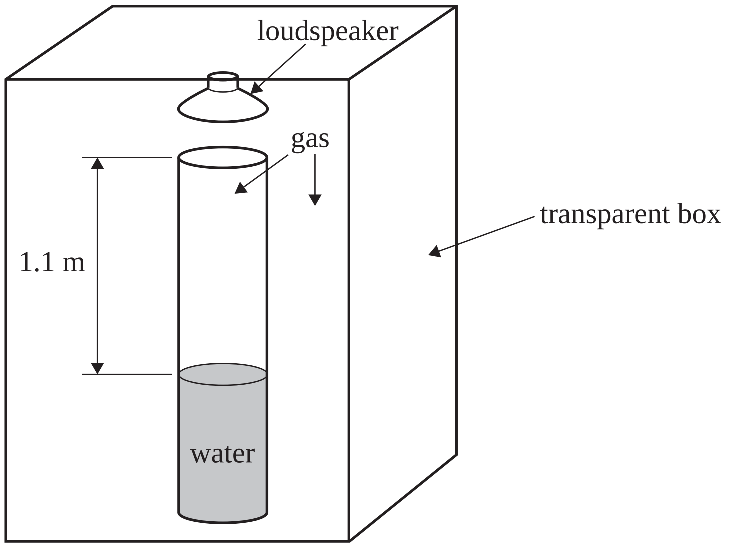


Figure 4

Lee has been given the task of determining the speed of sound in a particular gas. The equipment he uses is shown in Figure 4. A large transparent box is filled with the gas and Lee sets up a tube, containing water, with a small loudspeaker above it. The water level is set as shown in Figure 4 to give a length of gas column of 1.1 m. The frequency of the speaker is increased from zero until Lee hears the first (lowest) resonance at 90 Hz.

Figure 5 below shows possible standing **pressure** waves in the top section of the tube. The pressure scale represents the amount the pressure in the tube differs from the normal pressure of the gas in the transparent box.

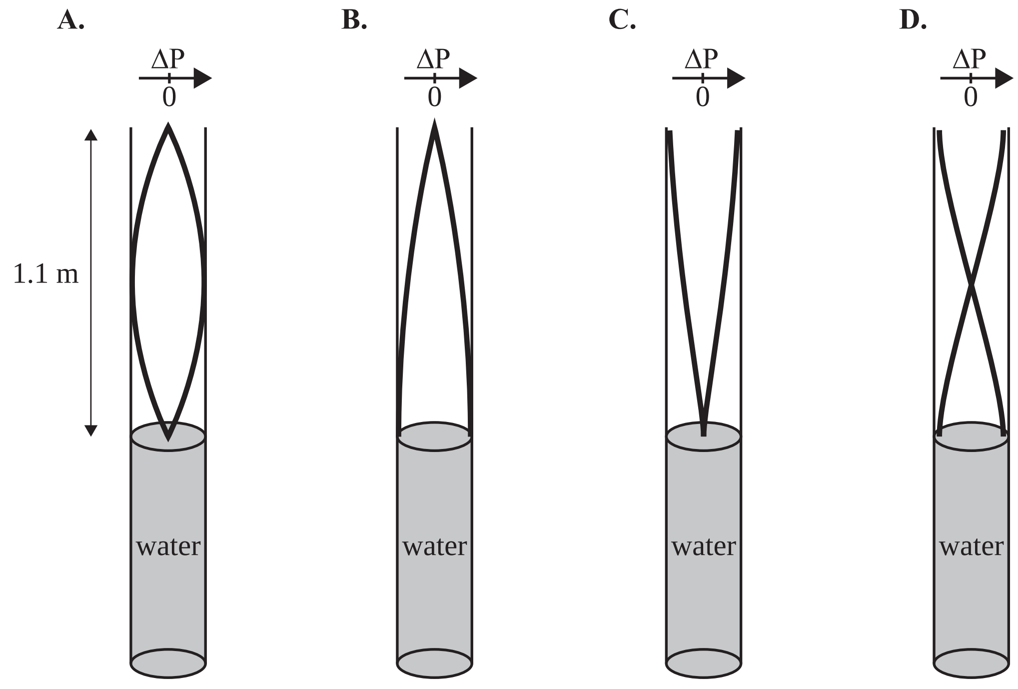


Figure 5

Question 6

Which of the diagrams in Figure 5 best represents the **pressure variation**, **ΔP**, of the sound wave that Lee observes for the lowest resonance?

Question 7

Which of the following options is the best estimate of the speed of sound in the gas?

A. 300 m s^{-1}

B. 320 m s^{-1}

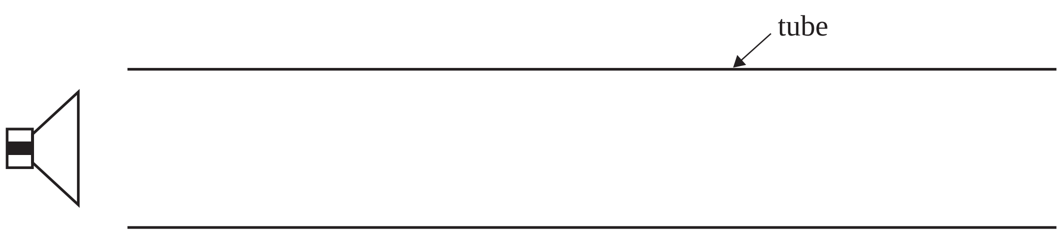
C. 360 m s^{-1}

D. 400 m s^{-1}

Question 8

Pat has a metal tube that is open at both ends, and a loudspeaker that is connected to an audio oscillator.

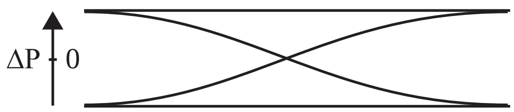
With the speaker near one end of the tube, Pat increases the frequency of the oscillator from zero until the **first (lowest) resonance** in the tube can be heard.



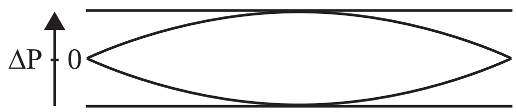
Assume that end effects can be neglected.

Which of the diagrams in Figure 6 below best represents the pressure variation, ΔP, of the air within the tube?

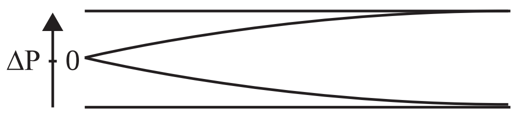
A.



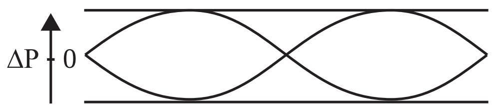
B.



C.



D.



Question 9

Robin is asked to address a large crowd on an oval at the school athletics day. There are two public address systems; each system has a total power output of 160 W. Option A (see Figure 6a) has a single loudspeaker of diameter 0.10 m that can handle 160 W. The other system, option B (see Figure 6b), has a long line of 32 speakers of total length 3.2 m connected in parallel. Each speaker is 0.10 m in diameter and capable of handling 5 W.

The long line of speakers can be treated as a single wide source.

The layout of the oval and two possible public address systems are shown in Figures 6a and 6b.

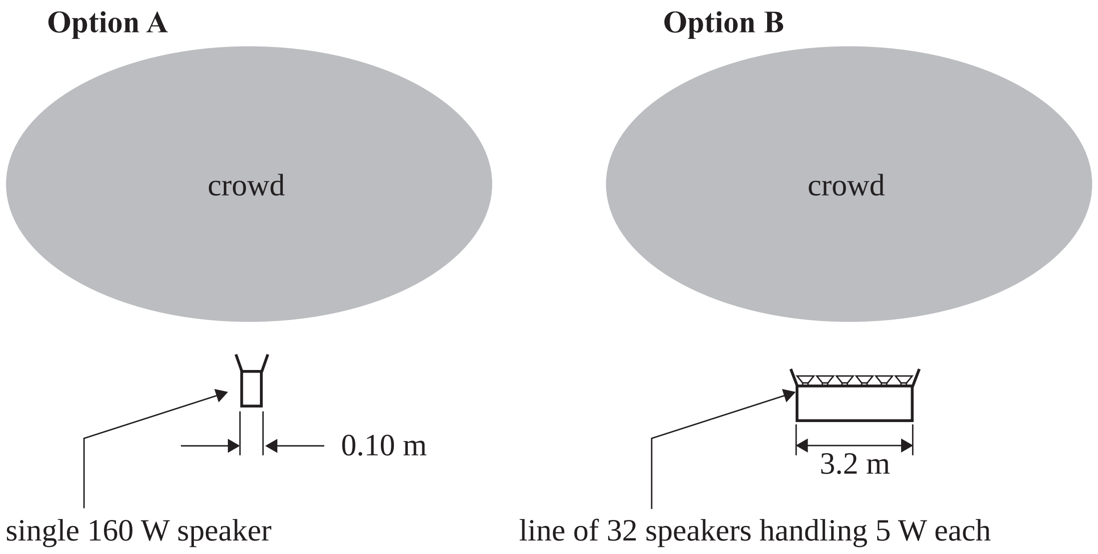


Figure 6a **Figure 6b**

Robin must choose the system that will ensure that most of the people, dispersed all over the oval, will be able to hear.

Which of the statements below gives the correct choice, and the best reason for the choice?

A. System A, since diffraction effects produce a wide maximum.

B. System A, since a single loudspeaker produces a better quality sound.

C. System B, since it produces more audio power.

D. System B, since diffraction effects produce a wide maximum.

Question 10

Microphones are transducers that convert sound energy into electrical energy; loudspeakers convert electrical energy into sound energy. The method used to make such conversions depends on the type of microphone or loudspeaker used.

Which one of the following statements is correct?

A. Crystal microphones rely on electromagnetic induction for their operation.

B. Velocity microphones rely on the piezo-electric effect for their operation.

C. Electret-condenser microphones rely on electromagnetic induction for their operation.

D. Dynamic loudspeakers rely on electromagnetic forces for their operation.

Question 11

A band is marching down a narrow street, as shown from above in Figure 7. Meredith is standing at position X in another street and can hear the music. However, the sound is not what Meredith expected.

The sound of the bass drum and the low-frequency instruments is relatively loud, but the high-frequency instruments, flutes and recorders, can hardly be heard.

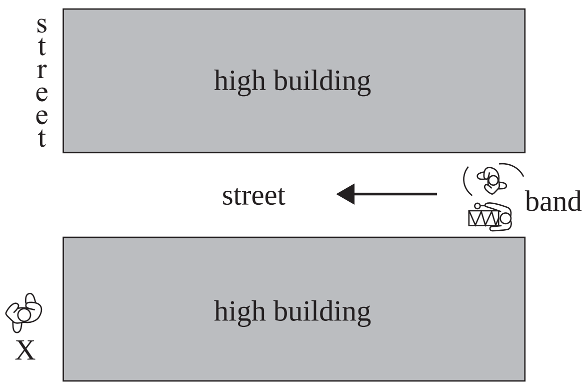


Figure 7

Which of the following statements best explains Meredith's observation?

A. Long wavelength sound diffracts more readily than shorter wavelength sound.

B. High-frequency sound is diffracted around the corner of the street.

C. Recorders and flutes are always softer than other instruments.

D. Short wavelength waves are diffracted around the corner of the street.

Question 12

Hilary has a small loudspeaker that she connects to an amplifier. The sound is very weak and particularly lacks the low frequencies. Fortunately there is a rigid sheet of timber available, and it has an aperture suitable for mounting the speaker, as shown in Figure 8.

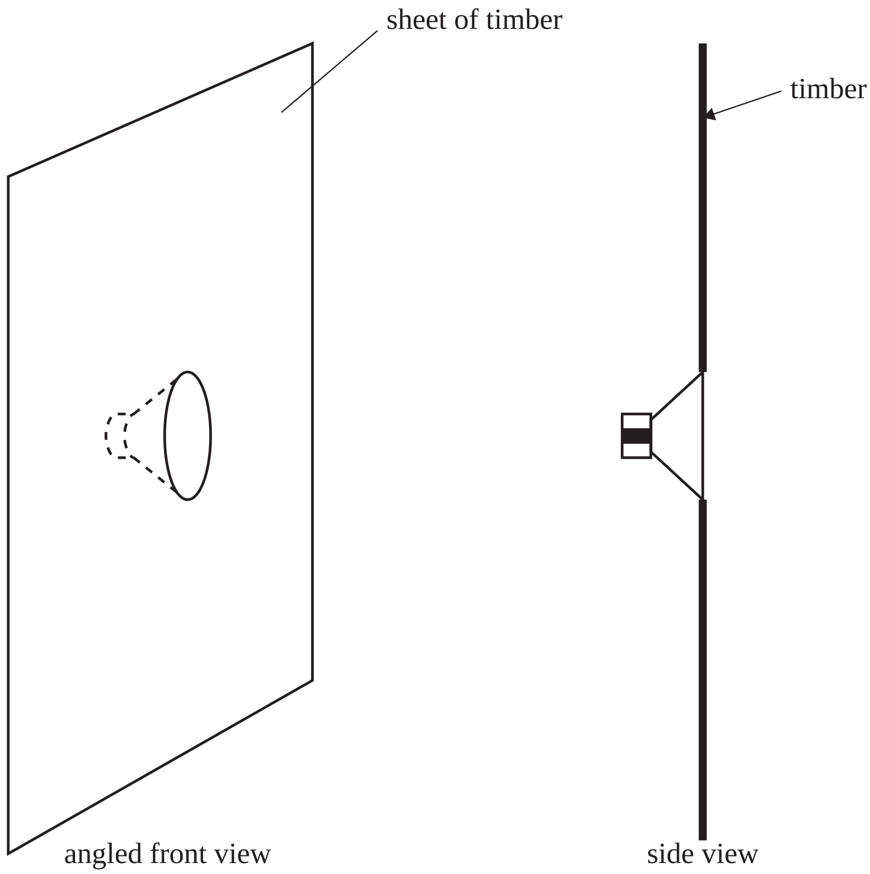


Figure 8

After securing the speaker, the sound quality is greatly improved.

Which of the following options best explains why this is so?

A. The aperture in the sheet confines the sound to a narrow cone.

B. The rigid sheet allows the speaker cone to vibrate over a greater area.

C. The sheet reduces interference between waves from the rear and front of the speaker.

D. Because of the sheet, cancellation between high and low frequency sound is eliminated.

END OF QUESTION AND ANSWER BOOK

VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education
2011

PHYSICS

Written examination 2

Tuesday 15 November 2011

Reading time: 11.45 am to 12.00 noon (15 minutes)
Writing time: 12.00 noon to 1.30 pm (1 hour 30 minutes)

FORMULA SHEET

Directions to students

- A question and answer book is provided with this formula sheet.

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

1	photoelectric effect	$E_{K\max} = hf - W$
2	photon energy	$E = hf$
3	photon momentum	$p = \frac{h}{\lambda}$
4	de Broglie wavelength	$\lambda = \frac{h}{p}$
5	resistors in series	$R_T = R_1 + R_2$
6	resistors in parallel	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$
7	magnetic force	$F = I\,l\,B$
8	electromagnetic induction	emf : $\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$ flux: $\Phi = BA$
9	transformer action	$\frac{V_1}{V_2} = \frac{N_1}{N_2}$
10	AC voltage and current	$V_{RMS} = \frac{1}{\sqrt{2}}V_{peak}$ $I_{RMS} = \frac{1}{\sqrt{2}}I_{peak}$
11	voltage; power	$V = RI$ $P = VI$
12	transmission losses	$V_{drop} = I_{line}R_{line}$ $P_{loss} = I^2_{line}R_{line}$
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}
17	Acceleration due to gravity at Earth's surface	$g = 10$ m s^{-2}

Detailed study 3.1 – Synchrotron and applications

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

Detailed study 3.2 – Photonics

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

Detailed study 3.3 – Sound

25	speed, frequency and wavelength	$v = f\lambda$
26	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 FORMULA SHEET