



Online & home tutors Registered business name: itute ABN: 96 297 924 083

PHYSICS

2010

Trial Examination 2

Electric power
Interactions of light and matter
Sound

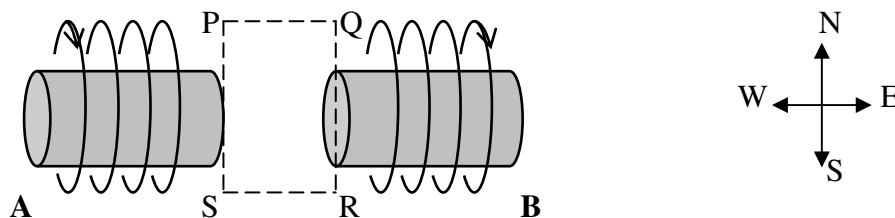
(Note: Use information in the formula data sheet supplied by VCAA)

SECTION A – Core

Instructions for Section A: Answer **all** questions for **both** Areas of study.

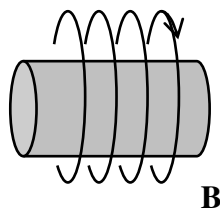
Area of study 1 – Electric power (38 marks)

Two electromagnets **A** and **B** are shown below. The electric current direction in each one is indicated by an arrow. PQRS is a **horizontal plane** between the two electromagnets.



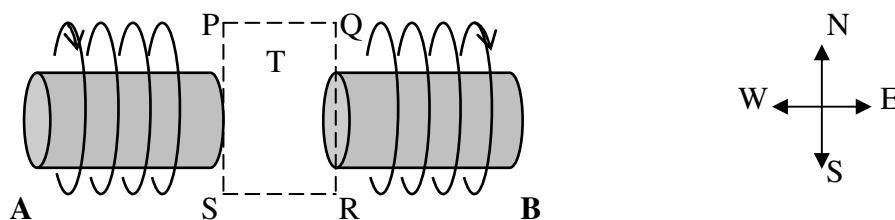
Question 1 Draw 3 appropriate magnetic field lines to indicate the magnetic field pattern of electromagnet **B** alone.

2 marks



Question 2 Draw 3 appropriate magnetic field lines in the plane PQRS to indicate the magnetic field pattern produced by electromagnets **A** and **B**.

2 marks

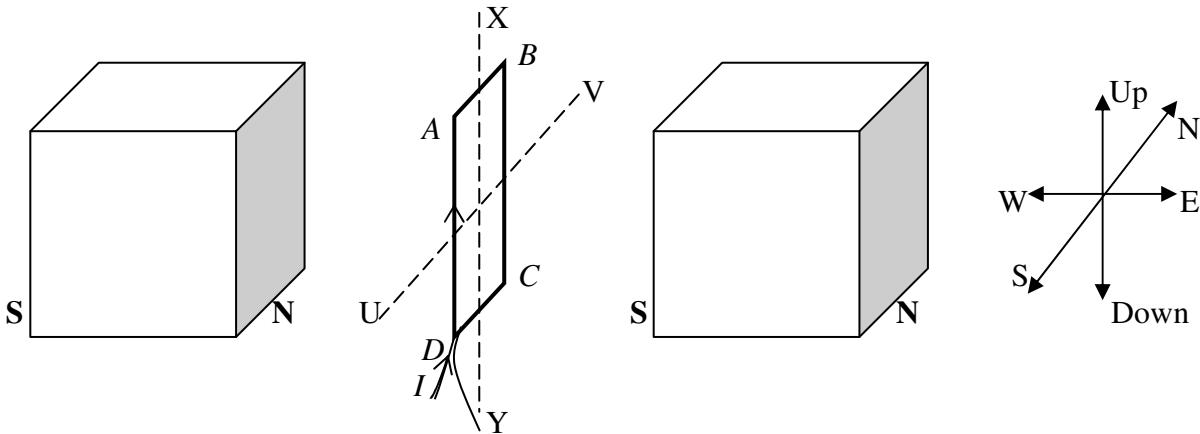


Question 3 Assuming the earth's magnetic field is negligible, a compass needle placed at point T (see diagram in **Question 2**) on plane PQRS will align itself in the direction closest to

- A. North-south B. East-west C. North-west D. North-east E. Upward (Out of the page) F. Downward (Into the page)

2 marks

Two permanent magnets produce a uniform magnetic field of 0.50 tesla in the region between them. $ABCD$ is a rectangular current-carrying coil of 20 turns. *Initially* it is at rest and the uniform magnetic field is perpendicular to it. $I = 30 \text{ mA}$, $AB = 5.0 \text{ cm}$ and $BC = 10 \text{ cm}$.



Question 4 Calculate the magnitude of the magnetic force on side AB . Ignore the earth’s magnetic field. 3 marks

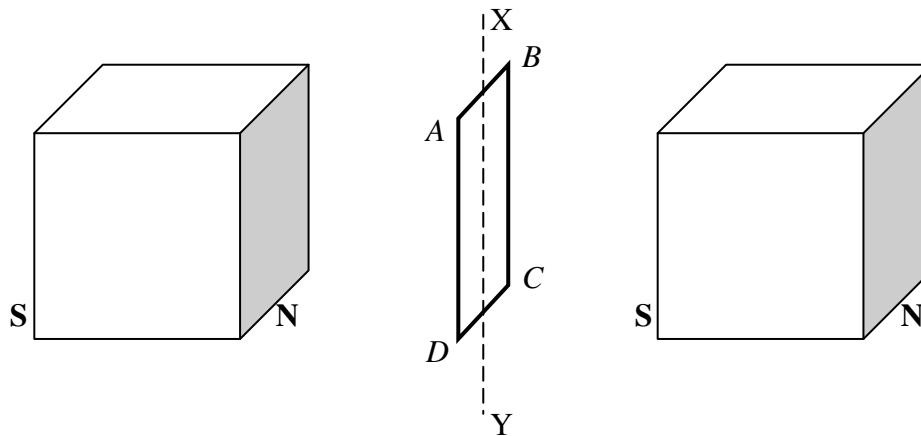
N

Question 5 The direction of the magnetic force on side AB is

- A. North
B. South
C. East
D. West
E. Upward
F. Downward
- 2 marks

Question 6 Describe and explain the motion (if any) of the coil relative to the axes UV or XY . 3 marks

Two permanent magnets produce a uniform magnetic field of 0.50 tesla in the region between them. $ABCD$ is a closed rectangular circuit of 20 turns of continuous insulated wire. $AB = 5.0\text{ cm}$ and $BC = 10\text{ cm}$. *Initially* the uniform magnetic field is perpendicular to the circuit $ABCD$.



Question 7 Calculate the magnetic flux through the coil.

2 marks

Wb

Question 8 Describe and explain the direction of the induced current in the coil when the coil is rotated (i) *clockwise* by 60° (viewing from above) and, (ii) *anticlockwise* from its initial orientation by 60° (viewing from above). XY is the axis of rotation.

3 marks

Question 9 In **Question 8**, the magnitude of the average induced emf is 0.25 volts. Calculate the time taken to rotate the 60° angle.

3 marks

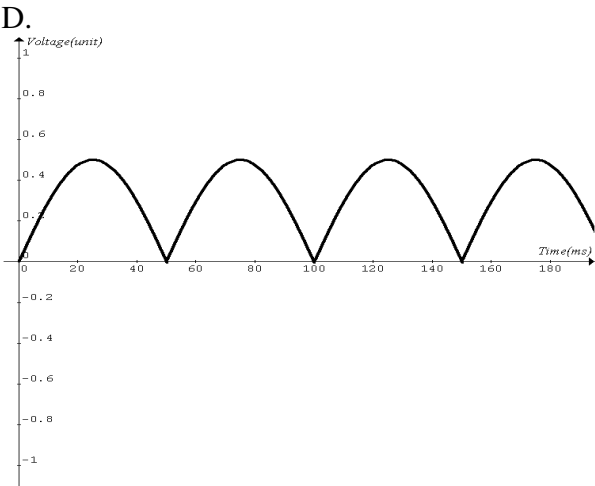
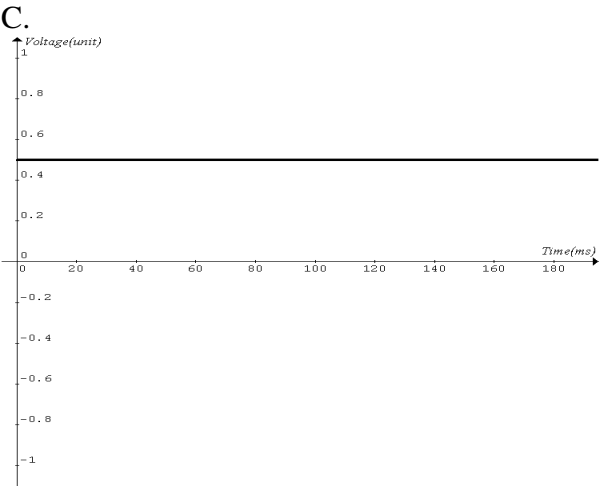
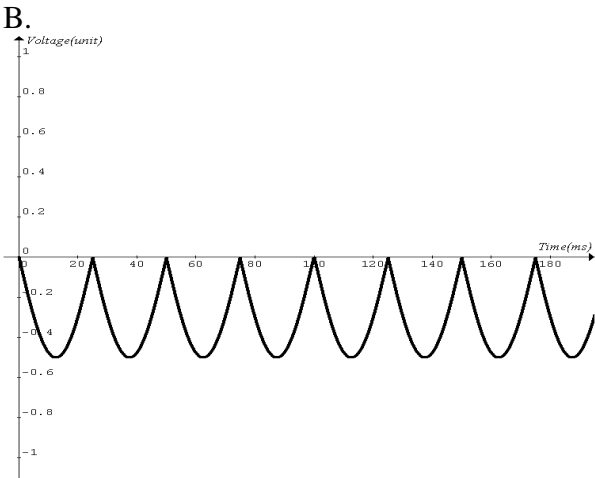
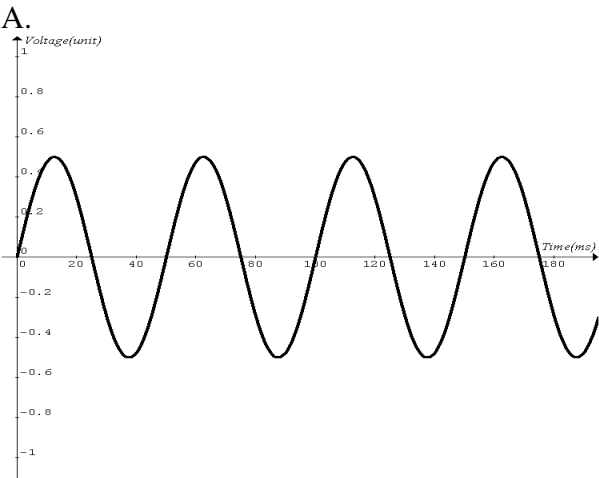
s

A simple dc motor has 2 half-ring commutators. It is used as a generator by rotating the axle manually at a frequency of 20 Hz. The peak voltage generated is 0.50 V.

Question 10 Determine the period of the output voltage. 2 marks

ms

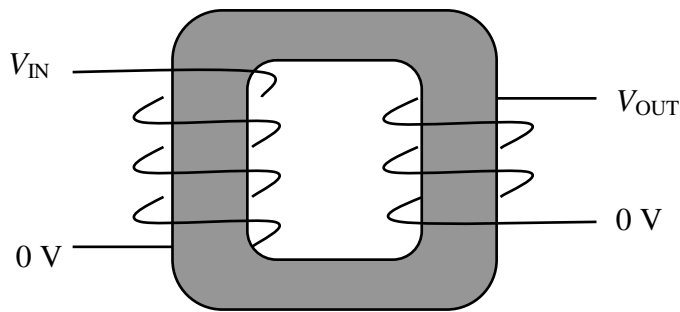
Question 11 Which one of the following voltage-time graphs gives the best indication of the generator output? 2 marks



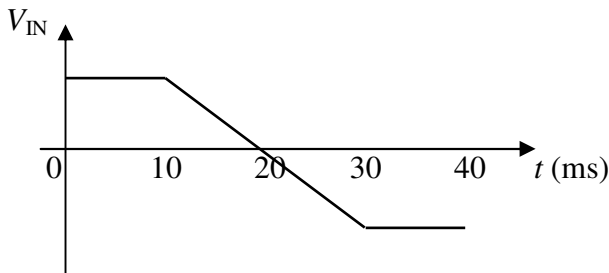
Question 12 What is the *rms* voltage of the generator output? 2 marks

V

The following diagram shows a simple transformer. **The transformer has an efficiency of 95%.**



Question 13 The voltage at V_{IN} is shown below.



The shape of the voltage at V_{OUT} is best represented by

- A.
- B.
- C.
- D.

2 marks

Question 14 The average output power of the transformer is 12.0 W. What is the average input power of the transformer? 1 mark

W

A student builds a model circuit to show the transmission of electricity from a power station (power pack set at 6 V *DC*) to a home (6 V 20 W light globe). The long transmission wires have a total resistance of 1.2 Ω .

Question 15 The measured voltage across the light globe is 3.8 V. What is the current in the transmission wires? 2 marks

A

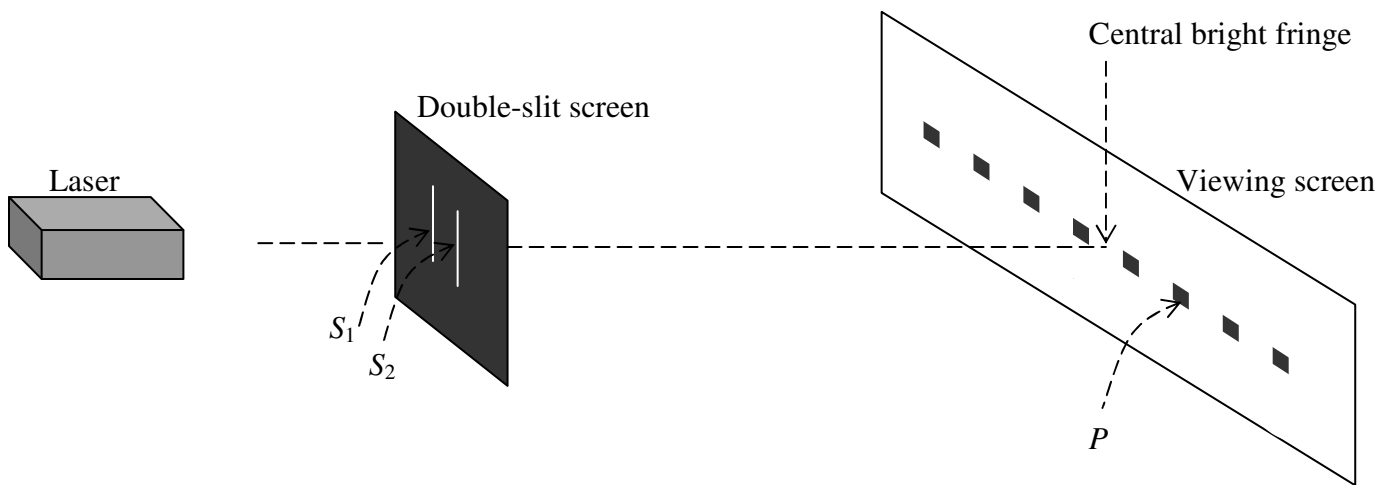
Question 16 What percentage of the power from the power pack is lost during transmission? 2 marks

%

Question 17 Without shortening the transmission wires how would you ensure a voltage of 6.0 V across the light globe? Show calculations to support your answer. 3 marks

Area of study 2 – Interactions of light and matter (28 marks)

Setup of Young's double-slit experiment is shown below. The wavelength of the laser light is 630 nm.



Question 1 Why is it necessary to use laser light instead of light from a light globe?

2 marks

Question 2 Calculate the difference between distance PS_1 and distance PS_2 .

2 marks

m

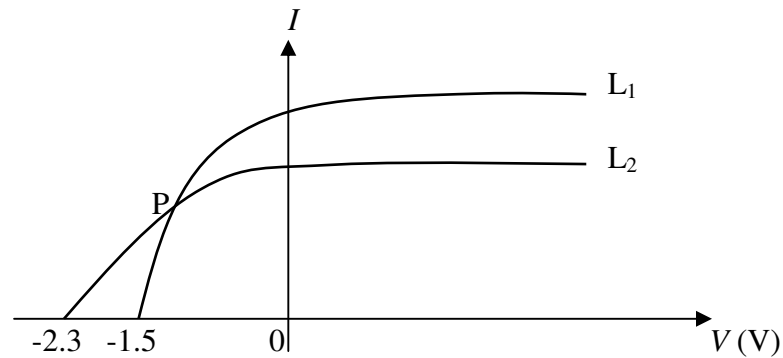
Question 3 Which **one or more** of the following changes will decrease the fringe spacing on the screen?

- A. Increase the width of the slits.
- B. Move the laser closer to the double-slit screen.
- C. Decrease the distance between the double-slit screen and the viewing screen.
- D. Decrease the separation between the two slits.
- E. Increase the wavelength of the laser light.

--

2 marks

A photocell is used to investigate the photoelectric effect. Two sets of data (photoelectric current I versus applied voltage V) are shown below. One set of data is for light L_1 , the other set for light L_2 . P is the intersection of the two sets of data.



Question 4 Which one of the following statements is true?

2 marks

- A. Light of the same frequency and intensity is used to produce the two sets of data.
- B. At point P the light used has the same frequency and intensity.
- C. The light used to produce one of the two sets of data has longer wavelength and higher intensity.
- D. The light used to produce one of the two sets of data has higher frequency and intensity.

Question 5 One set of data has the highest photoelectron kinetic energy. Calculate this highest kinetic energy in joules.

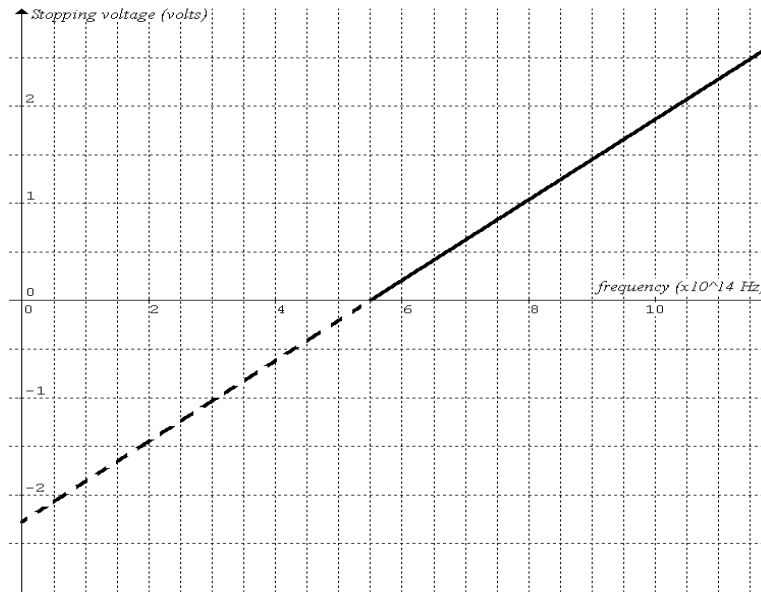
2 marks

 J

Question 6 If the cathode of the photocell is replaced with a different metal, does L_1 or L_2 has a better chance of producing photoelectrons? Explain your answer in terms of threshold frequency?

3 marks

In another photoelectric effect experiment, a set of data is collected and shown in the following *stopping voltage V_o versus frequency f* graph.



Question 7 What is the work function of the metal in eV?

1 mark

eV

Question 8 Photoelectrons are emitted when UV light (10.1×10^{14} Hz) is directed at the cathode of the photocell. Determine the range of kinetic energy (J) of the electrons emitted.

3 marks

J

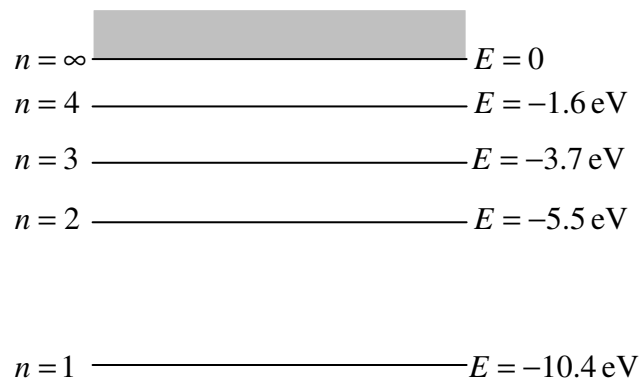
Question 9 Now the cathode is replaced with a different metal and the experiment is repeated. The threshold frequency is 2.5×10^{14} Hz. Accurately draw a graph showing the results of the experiment on the same set axes shown above.

2 marks

Question 10 Determine whether or not significant diffraction will occur when a beam of electrons (moving at $1.2 \times 10^6 \text{ ms}^{-1}$) passes through the gap between atoms in a crystal. The arrangement of the atoms in the crystal is lattice-like, and the layers of atoms are separated by a distance of 0.8 nm approximately. Show calculations and explanation.

3 marks

The energy level diagram for the mercury atom is shown below.



Question 11 Describe the result of a collision between a photon of energy 11.3 eV and a mercury atom in the ground state. Include energy calculation in your answer.

3 marks

Question 12 A mercury atom makes a transition from the $n = 3$ state to a lower energy state. Calculate the shortest wavelength of light emitted.

3 marks

m

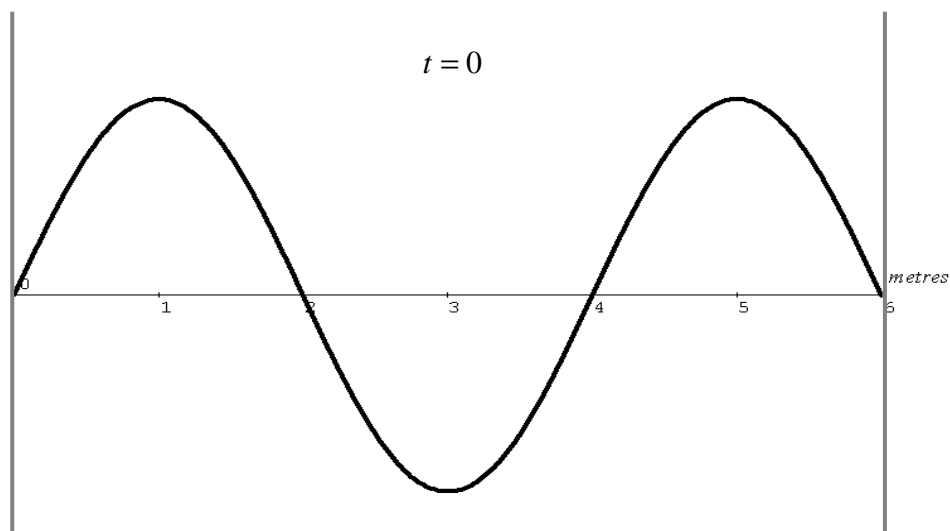
SECTION B – Detailed studies

Detailed study 3 – Sound (24 marks)

Answer **all** the questions.

Use the following information to answer Questions 1, 2 and 3

The graph shows the pressure variation of a standing sound wave set up between two parallel walls 6 metres apart. The wave reaches its *maximum* amplitude at $t = 0$ as shown below. The speed of sound is 338 ms^{-1} .

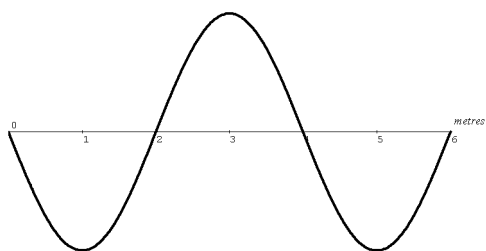


Question 1 The frequency (Hz) of the sound wave is closest to

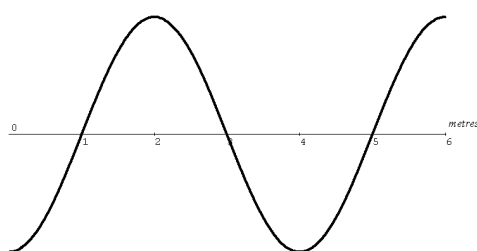
- A. 42 B. 85 C. 169 D. 0.0012

Question 2 At $t = \frac{1}{4} \times \text{the period of the sound wave}$, the graph of the pressure variation is closest to

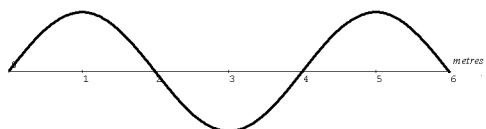
A.



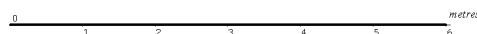
B.



C.



D.

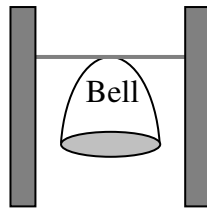


Question 3 Which one of the following statements is true?

- A. The standing sound wave is a transverse wave.
- B. The standing sound wave has two pressure antinodes at $t = 0$.
- C. The standing sound wave always has three pressure antinodes.
- D. The standing sound wave will not be affected if there is a change in air temperature between the walls.

Use the following information to answer Questions 4 and 5

Not drawn to scale



A ----- 20 m ----- B

Point A is some distance from the bell, and point B is 20 m further from the bell. At A the sound intensity is 0.45 Wm^{-2} . At B it is reduced to 0.05 Wm^{-2} .

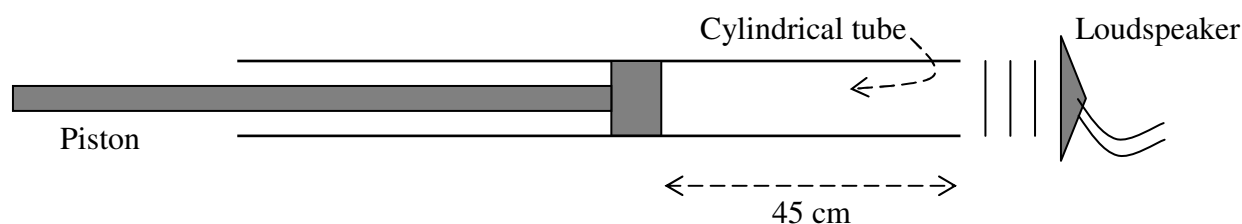
Question 4 The distance of point A from the bell is closest to

- A. 5 m
- B. 10 m
- C. 15 m
- D. 20 m

Question 5 The difference in sound intensity level (dB) between A and B is closest to

- A. 5
- B. 10
- C. 15
- D. 20

Use the following information to answer Questions 6, 7 and 8



The sound wave produced by the loudspeaker has a frequency of 564 Hz. The 45-cm cylindrical tube resonates at this frequency. Speed of sound is 338.4 ms^{-1} . By moving the piston the cylindrical tube can be lengthened or shortened.

Question 6 The 45-cm cylindrical tube resonates at

- A. its fundamental frequency
- B. its first harmonic
- C. its second harmonic
- D. its third harmonic.

Question 7 The cylindrical tube will also resonate when its length (cm) is

- A. 15
- B. 30
- C. 60
- D. 90

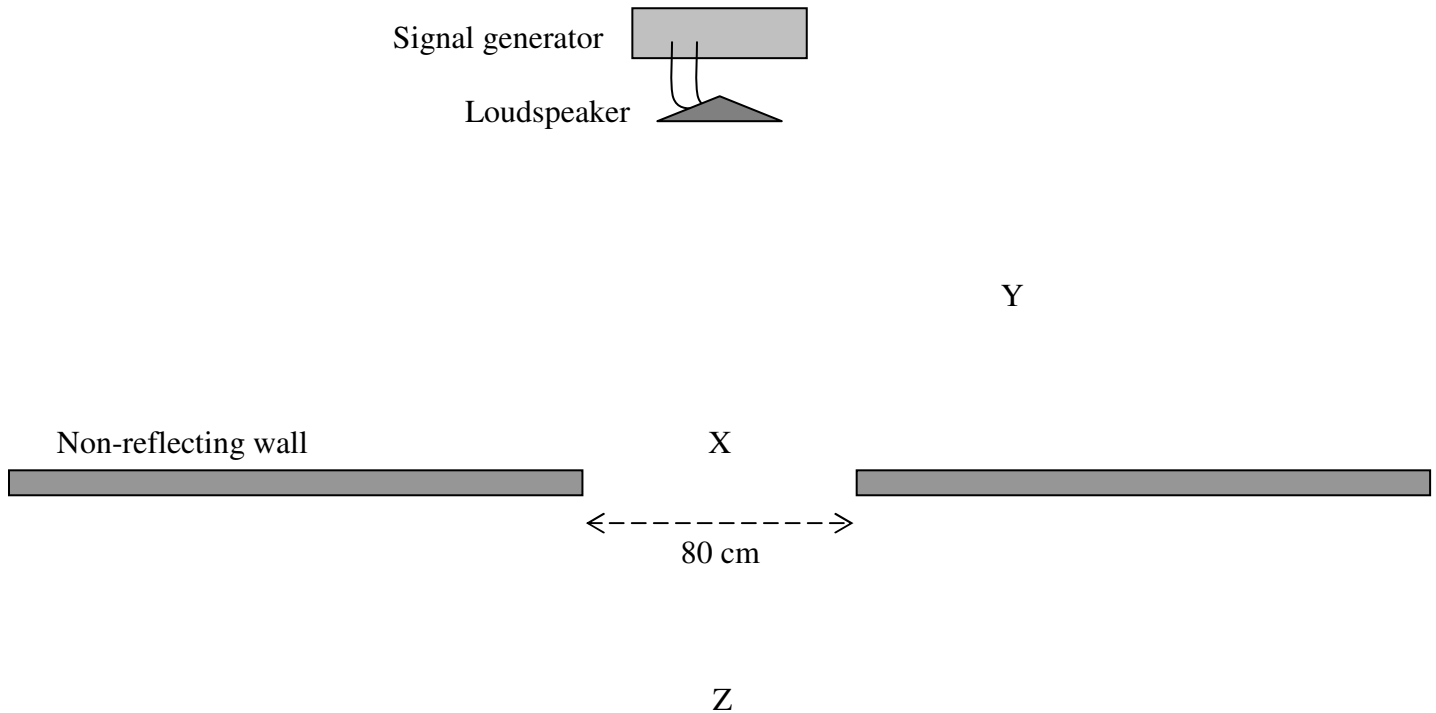
The length of the cylindrical tube is kept at 45 cm. Now the frequency of the sound wave is varied.

Question 8 The cylindrical tube will also resonate when the frequency (Hz) of the sound wave is

- A. 376
- B. 752
- C. 940
- D. 1128

Use the following information to answer Questions 9 and 10

The loudspeaker sends out two sound waves of frequencies 100 Hz and 10 kHz. At point X the sound intensity is the same for both frequencies. The wall in front of the loudspeaker is non-reflecting. X and Y are the same distance from the loudspeaker. I_{100} and I_{10k} represent the sound intensities of the 100 Hz and 10 kHz sound waves respectively.



Question 9 Which one of the following statements is correct **at point Y**?

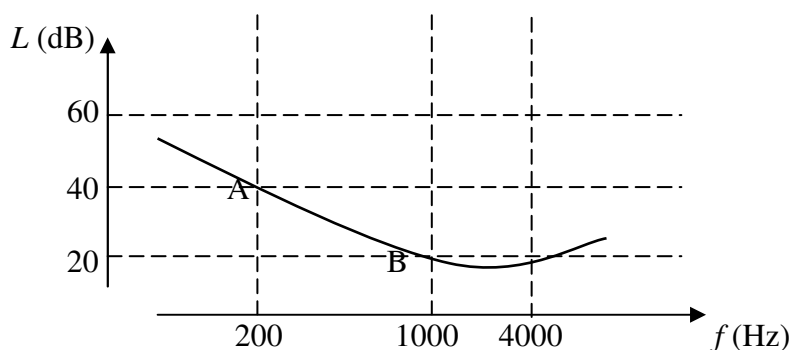
- A. $I_{100} = I_{10k}$, but less than the sound intensity at point X.
- B. $I_{100} > I_{10k}$
- C. $I_{100} < I_{10k}$
- D. $I_{100} = I_{10k}$, but greater than the sound intensity at point X.

Question 10 Which one of the following statements is correct **at point Z**?

- A. $I_{100} = I_{10k}$, but less than the sound intensity at point X.
- B. $I_{100} > I_{10k}$
- C. $I_{100} < I_{10k}$
- D. $I_{100} = I_{10k}$, but greater than the sound intensity at point X.

Use the following information to answer Questions 11 and 12

The following graph shows the frequency response of the hearing of a person. Any sounds on the curve are equally loud as perceived by the person. Two sounds are marked as A and B.



Question 11 The two sounds A and B

- A. have the same sound intensity level and the same phon level.
- B. have the same sound intensity level but different phon level.
- C. have the same phon level but different sound intensity level.
- D. have different phon level and different sound intensity level.

Question 12 The person is most sensitive to sound frequency (Hz) in the range

- A. lower than 200
- B. 200 - 1000
- C. 1000 - 4000
- D. higher than 4000.

End of Exam 2