

**PHYSICS  
HIGHER LEVEL  
PAPER 1**

Tuesday 5 November 2002 (afternoon)

1 hour

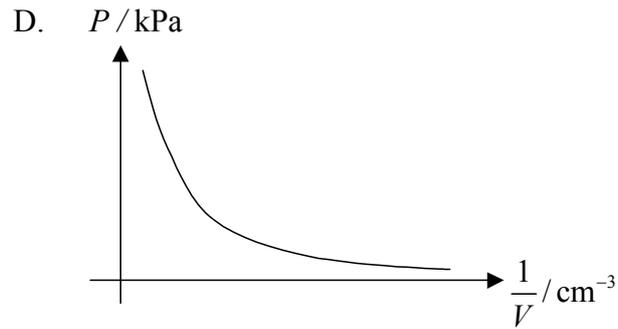
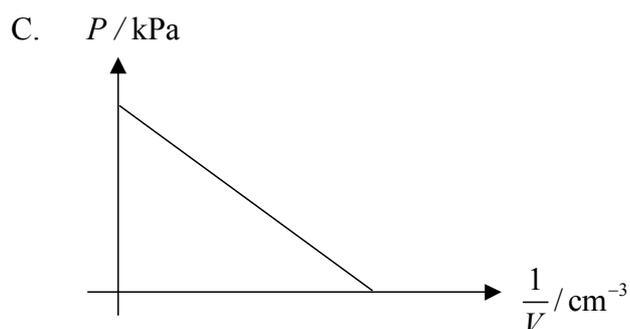
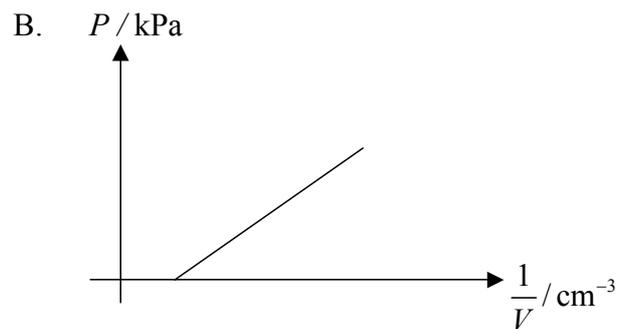
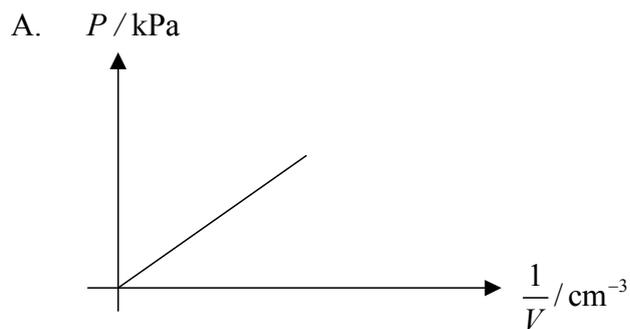
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**INSTRUCTIONS TO CANDIDATES**

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.

1. The pressure  $P$ , and volume  $V$ , of a sample of a gas are measured at constant temperature and a graph of  $P$  against  $\frac{1}{V}$  is plotted.

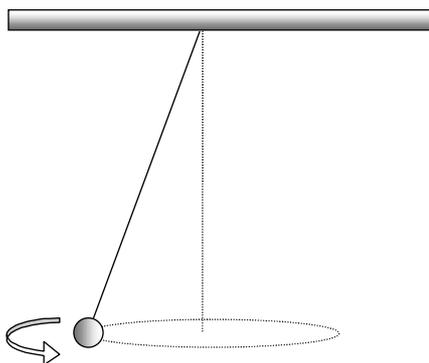
Which **one** of the following graphs would be obtained if  $P$  is proportional to  $\frac{1}{V}$  and there is a systematic error in the measurement of  $P$ ?



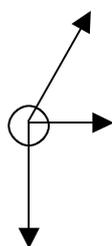
2. The resultant force acting on an object is measured to an accuracy of  $\pm 4\%$ . The mass of the object is measured to an accuracy of  $\pm 2\%$ . The acceleration of the object can be calculated to an accuracy of approximately

- A.  $\pm 2\%$ .  
 B.  $\pm 4\%$ .  
 C.  $\pm 6\%$ .  
 D.  $\pm 8\%$ .

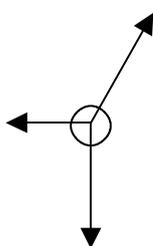
3. A ball is swinging in a horizontal circle as shown in the diagram below.



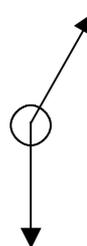
Which **one** of the following diagrams best shows the forces acting on the ball when it is at the position shown above?



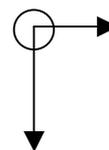
A.



B.

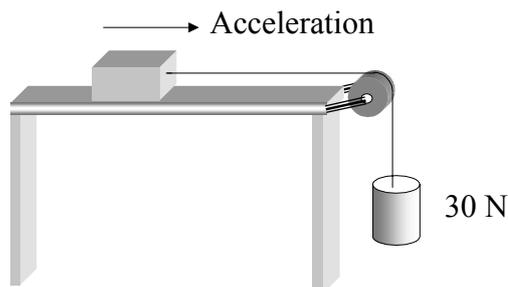


C.



D.

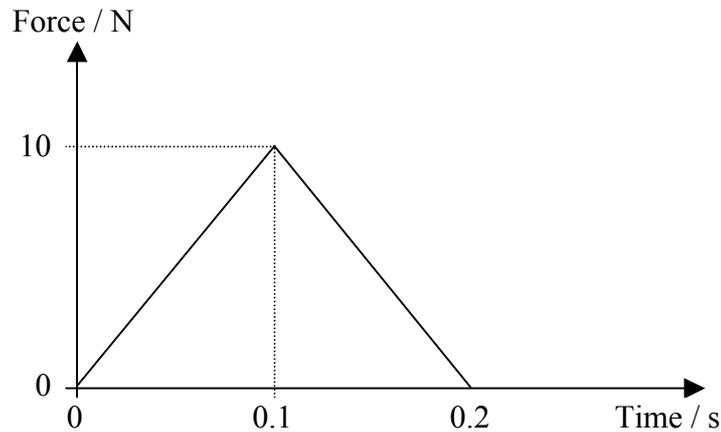
4. In the situation below, a 30 N weight is attached to a block. The block accelerates along a horizontal surface. Friction is negligible.



The tension in the string is

- A. greater than 30 N.
- B. 30 N.
- C. less than 30 N.
- D. zero.

5. A ball is thrown vertically upwards into the air. At the highest point, its **acceleration** is
- A. zero but about to become upwards.
  - B. zero but about to become downwards.
  - C. upwards.
  - D. downwards.
6. An object accelerates uniformly from rest in a straight line. During the first 10 seconds it travels a total of 25 m. Its velocity **at 10 s** is
- A.  $5.0 \text{ ms}^{-1}$ .
  - B.  $2.5 \text{ ms}^{-1}$ .
  - C.  $0.5 \text{ ms}^{-1}$ .
  - D.  $0.0 \text{ ms}^{-1}$ .
7. A varying force acts upon an object. The graph below shows how the force varies with time.



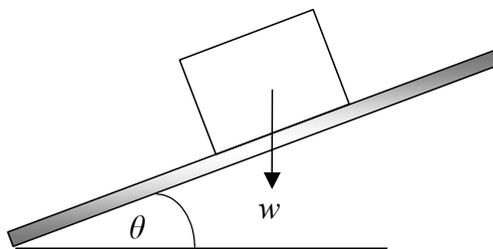
The impulse received by the object is

- A. 100 N s.
- B. 10 N s.
- C. 2 N s.
- D. 1 N s.

8. A car **accelerates uniformly** from rest. It attains a speed  $v$  after having travelled a distance  $d$ . If air resistance can be ignored, the best estimate for the speed attained after having travelled a distance  $2d$  is

- A.  $v$ .
- B.  $\sqrt{2}v$ .
- C.  $2v$ .
- D.  $4v$ .

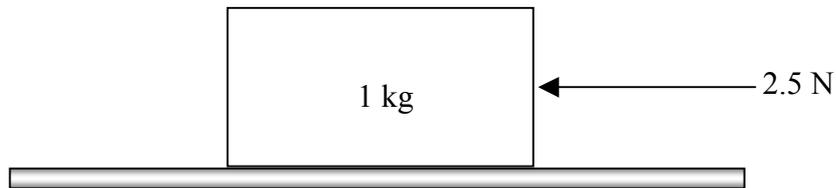
9. A block of weight  $w$  is at rest on a slope as shown below.



If the coefficient of static friction is  $\mu$  and the angle between the slope and the horizontal is  $\theta$ , then the frictional force between the slope and the block is

- A. zero.
- B.  $w \cos \theta$ .
- C.  $\mu w \cos \theta$ .
- D.  $\mu w \sin \theta$ .

10. A block of mass 1.0 kg is placed on a rough horizontal surface and a horizontal force of 2.5 N is applied to the block as shown below.



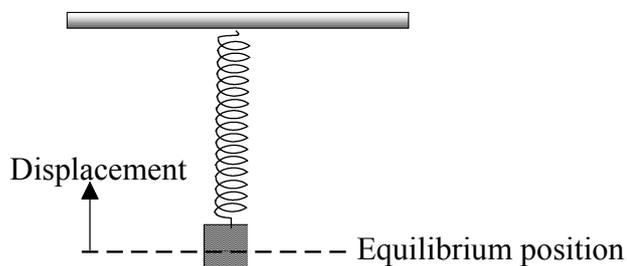
The following data is available:

- Coefficient of **static** friction = 0.3
- Coefficient of **dynamic** friction = 0.2
- Acceleration due to gravity =  $10 \text{ ms}^{-2}$ .

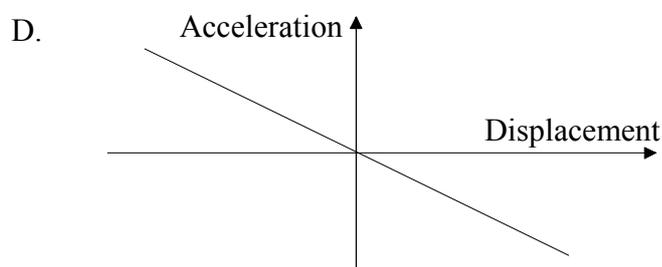
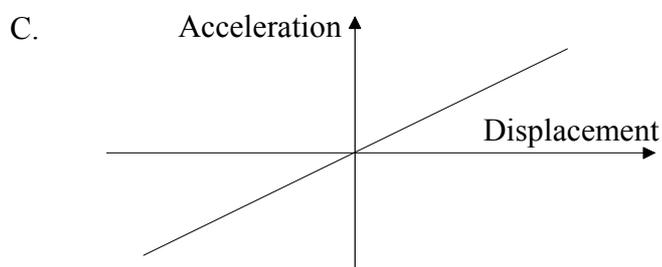
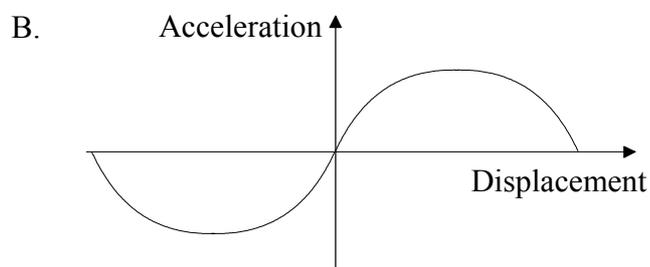
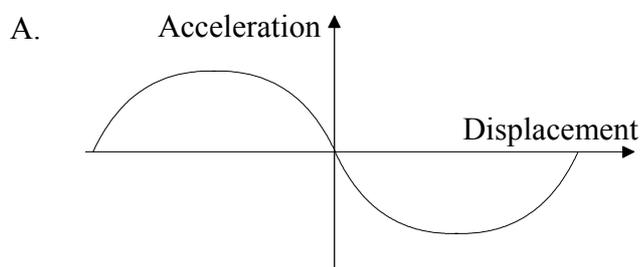
Based on this data, it can be deduced that the block will

- A. not move.
- B. move at steady speed.
- C. move with constant acceleration.
- D. move with increasing acceleration.

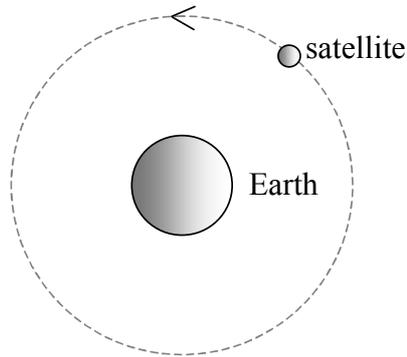
11. A mass on the end of a spring undergoes simple harmonic motion about an equilibrium position as shown below.



If the upward direction is taken as positive, which graph best represents how the **acceleration** of the mass varies with **displacement** from the equilibrium position?



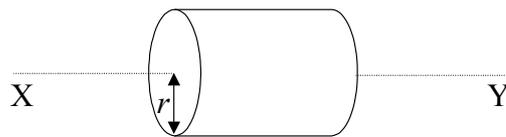
12. A satellite orbits the Earth as shown below.



In the table below, which row gives the correct sign for the satellite's potential and kinetic energies?

	Potential energy	Kinetic energy
A.	Positive	Positive
B.	Negative	Positive
C.	Positive	Negative
D.	Negative	Negative

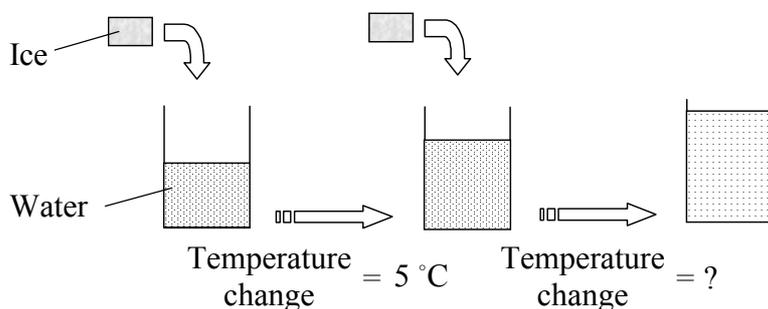
13. A solid cylinder of radius  $r$  has a moment of inertia  $I$ , about the axis through XY as shown below.



A cylinder of the same mass, but with a radius  $2r$ , will have a moment of inertia about the same axis XY equal to

- A.  $\frac{I}{2}$ .
- B.  $I$ .
- C.  $2I$ .
- D.  $4I$ .

14. When a lump of ice was added to a beaker of warm water, the resulting water temperature was  $5^{\circ}\text{C}$  less than the initial temperature of the warm water.

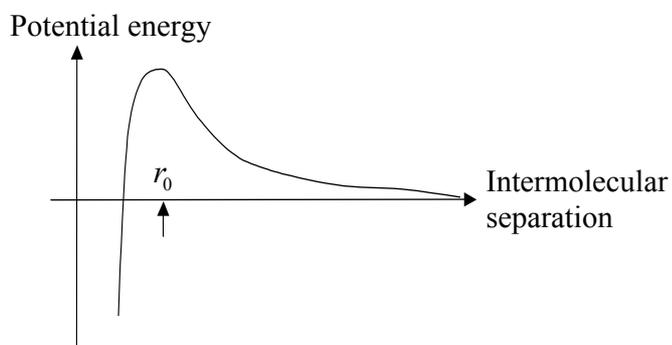


If another identical lump of ice is added to the same beaker, the temperature will

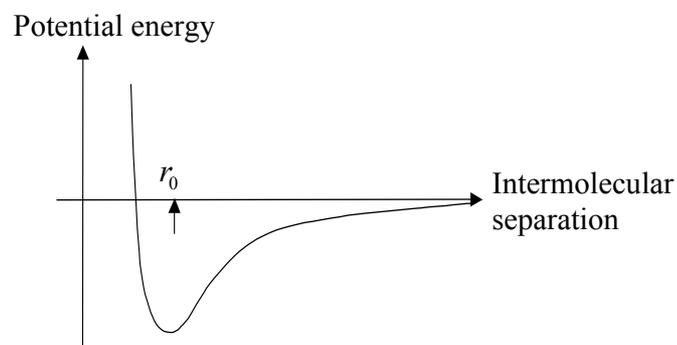
- A. go down by another  $5^{\circ}\text{C}$ .
  - B. not go down at all.
  - C. go down by more than  $5^{\circ}\text{C}$ .
  - D. go down by less than  $5^{\circ}\text{C}$ .
15. When a gas is compressed at constant temperature, the pressure increases. This is because the molecules of the gas
- A. repel each other.
  - B. are squashed together.
  - C. hit the walls of the container at a greater average speed.
  - D. hit the walls of the container more often in a given time.

16. Two molecules have an equilibrium separation  $r_0$ . Which **one** of the following graphs correctly shows the variation of intermolecular potential energy of the molecules as a function of intermolecular separation?

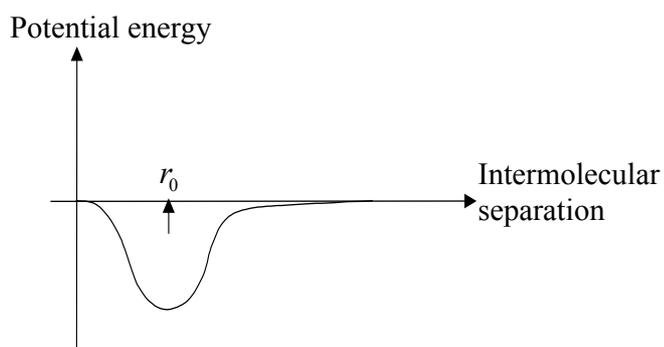
A.



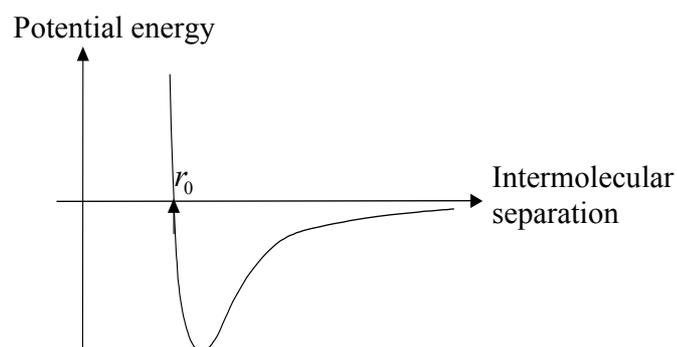
B.



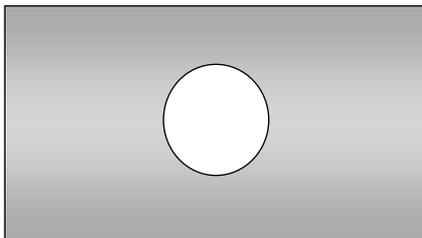
C.



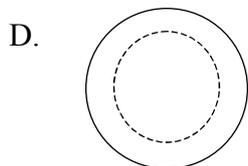
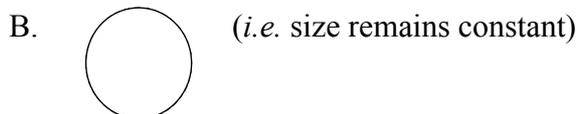
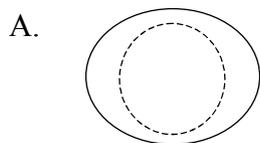
D.



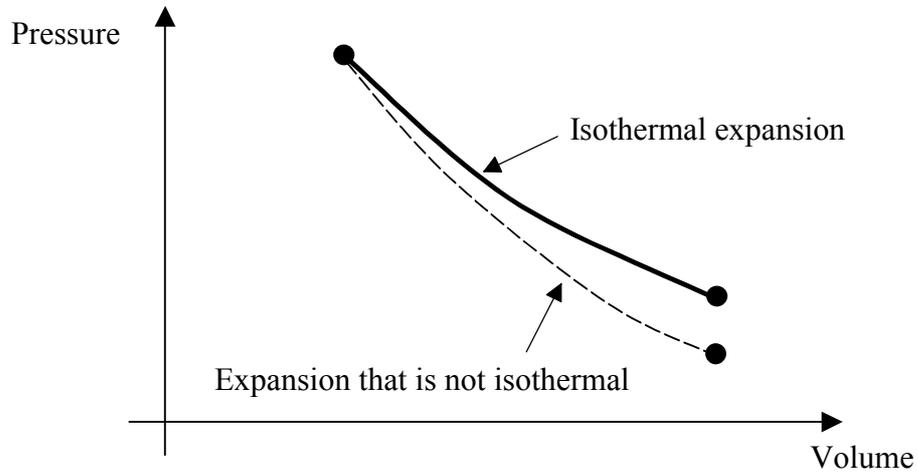
17. A rectangular sheet of metal has a hole in its centre as shown in the diagram below.



When the sheet is heated it expands. Which **one** of the diagrams below best represents the new size and shape of the hole? The original hole is shown as a dashed line.

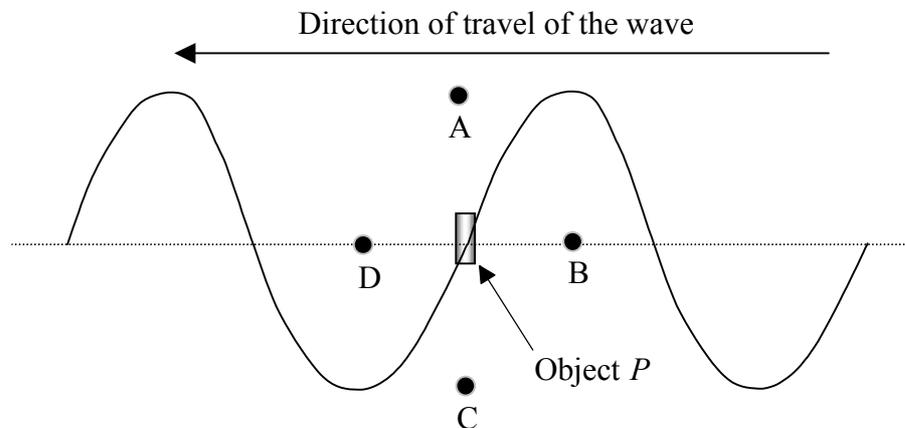


18. The solid line on the graph below represents the pressure-volume changes for an ideal gas undergoing an isothermal expansion. The dashed line on the graph shows the pressure-volume changes for an expansion that is not isothermal.

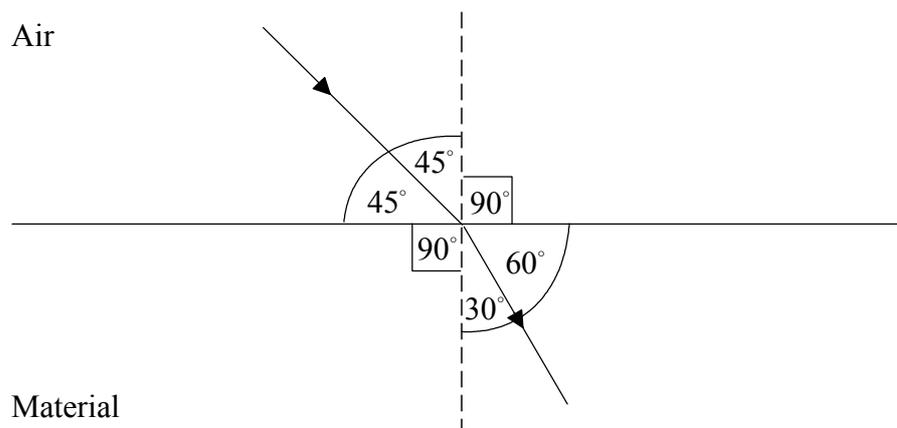


In the expansion that is not isothermal, the internal energy of the gas

- A. increases.
  - B. decreases.
  - C. stays the same.
  - D. changes but whether it decreases or increases cannot be determined from the graph alone.
19. The diagram below shows ripples on the surface of water at one instant of time. The ripples are moving **right to left** and a small object, *P*, is floating in the water. After a **quarter** of a time period, which letter correctly shows the position of the floating object?



20. Light is refracted at the interface between air and a material as shown below.



The table below lists the value for the sine of various angles.

<b>Angle</b>	0°	30°	45°	60°	90°
<b>Sin (angle)</b>	0.00	0.50	0.71	0.87	1.00

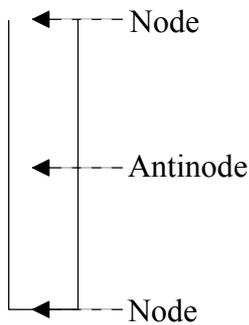
Which **one** of the following is the best estimate for the refractive index of the material?

- A. 0.8
- B. 1.2
- C. 1.4
- D. 1.7

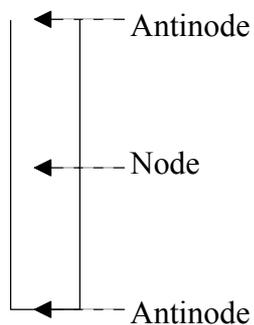
21. An organ pipe is closed at one end and open at the other as shown below.



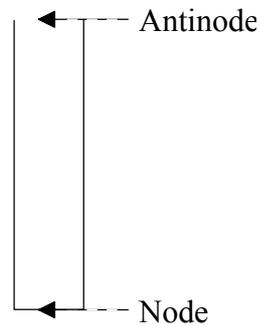
Which **one** of the following diagrams correctly shows the positions of the displacement nodes and antinodes when the **fundamental** standing wave is formed in the tube?



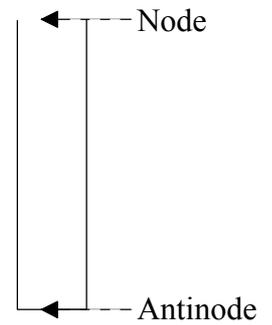
A.



B.

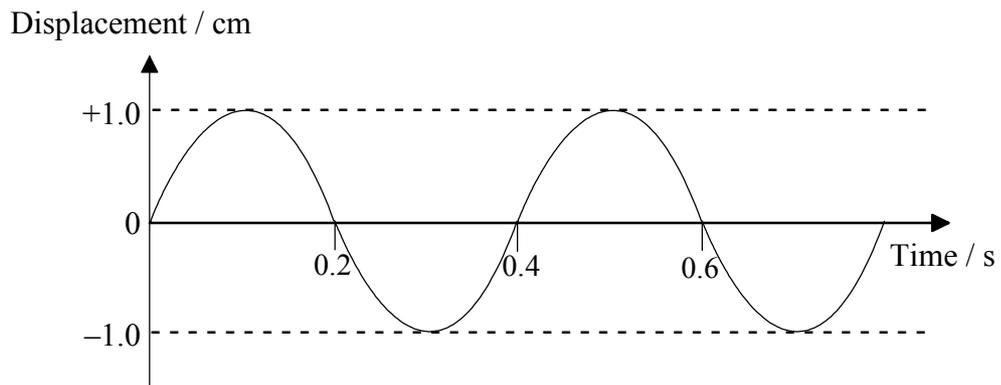


C.



D.

22. A longitudinal wave travels down a spring. The graph below shows the variation of **displacement with time** for one piece of the spring.



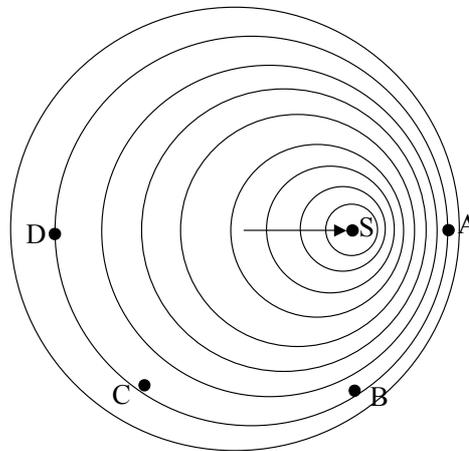
Which **one** of the following quantities **cannot** be determined from the graph?

- A. The amplitude of the wave
- B. The time period of the oscillations
- C. The speed of the wave
- D. The frequency of the wave

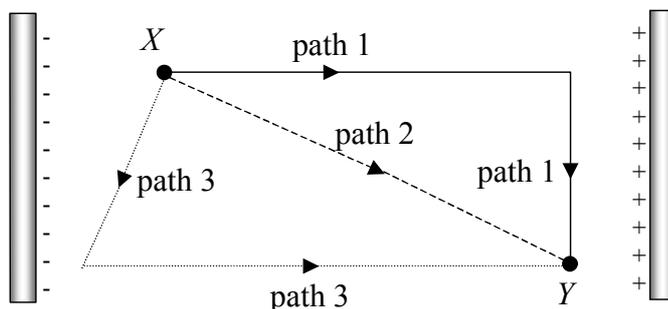
23. Which **one** of the following phenomena accounts for the colours seen on the surface of a soap bubble?

- A. Absorption
- B. Diffraction
- C. Dispersion
- D. Interference

24. The diagram below represents the wavefronts spreading out from a moving source of sound S. The positions of four observers are also shown. If the frequency of the source is  $f$ , which observer hears a sound closest in value to this frequency when the source is at the position shown?



25. A small positively charged sphere is moved between two points X and Y that are between two parallel charged plates. Three paths between X and Y are shown.



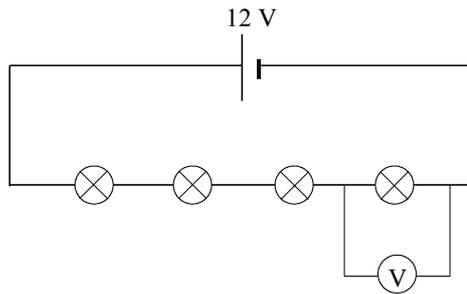
Which statement is correct?

- A. Path 1 requires the most amount of work.
- B. Path 2 requires the most amount of work.
- C. Path 3 requires the most amount of work.
- D. All the paths require the same amount of work.

26. A rechargeable battery has “1.2 V 700 mA h” printed on its side by the manufacturer. (1 mA h = 1 milliampere  $\times$  1 hour).

A battery charger runs off the electrical mains. If the cost of using 1 kW h of electrical energy is 10 cents, a reasonable estimate for the cost of recharging the battery is

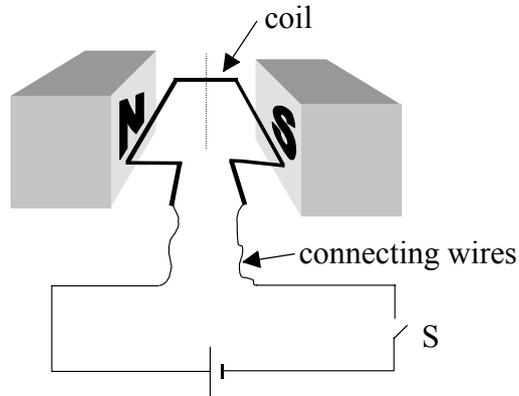
- A. a lot less than 1 cent.
  - B. about 1 cent.
  - C. about 100 cents.
  - D. a lot more than 100 cents.
27. A voltmeter is used to measure the potential difference,  $V$ , across one of four identical filament light bulbs that are connected in series to a 12.0 V battery as shown in the diagram below. The reading on the voltmeter is 3.0 V.



If the filament of the bulb being measured **breaks**, the reading on the voltmeter will be

- A. 12.0 V.
- B. 4.0 V.
- C. 3.0 V.
- D. zero.

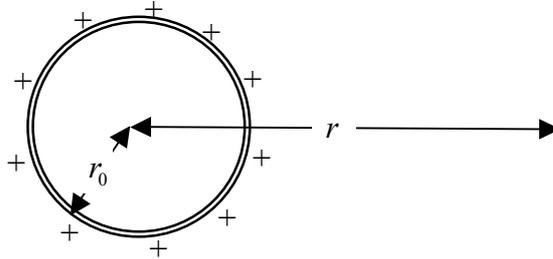
28. Jorge builds a simple electric motor but makes a mistake. He forgets to include the commutator and brushes and connects the coil directly to the power supply. The setup is represented in the diagram below (only one turn of the coil is shown).



With the coil in the position shown, when the switch S is closed the coil will

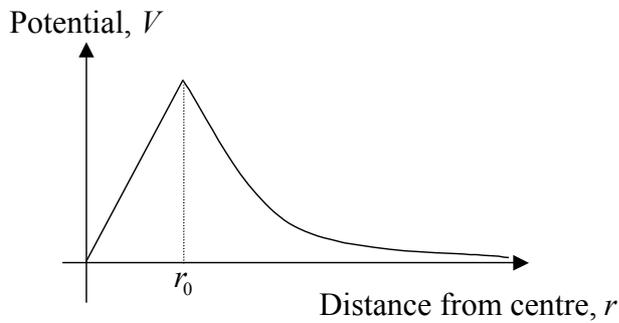
- A. rotate normally – but the wires would tangle.
  - B. stop after half a revolution.
  - C. stop after a quarter of a revolution.
  - D. not move.
29. The output voltage from a step-up transformer is greater than the input voltage. This does not contradict the law of conservation of energy because
- A. energy is taken from the mains supply.
  - B. energy is taken from the magnetic field.
  - C. the output current is less than the input current.
  - D. the efficiency of the transformer is greater than 1.

30. The electric potential,  $V$ , due to a uniformly charged hollow sphere of radius  $r_0$  is measured as a function of distance  $r$  away from the centre of the sphere.

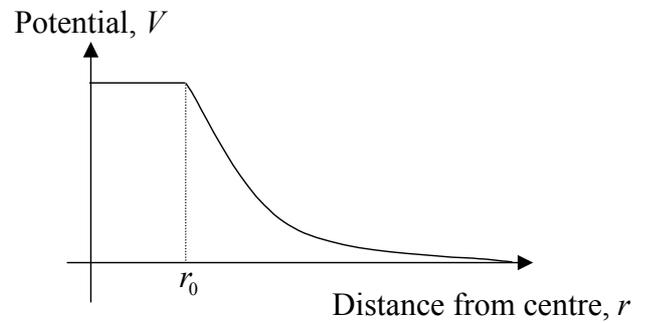


Which **one** of the following graphs best represents how  $V$  varies as a function of  $r$ ?

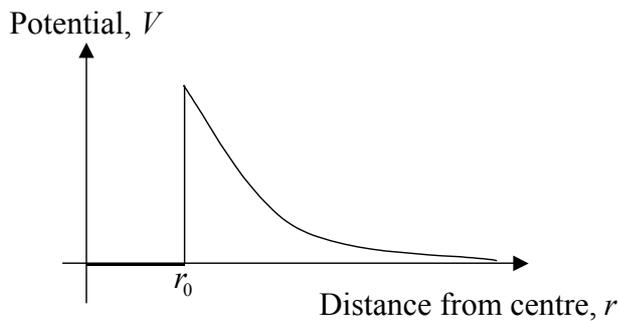
A.



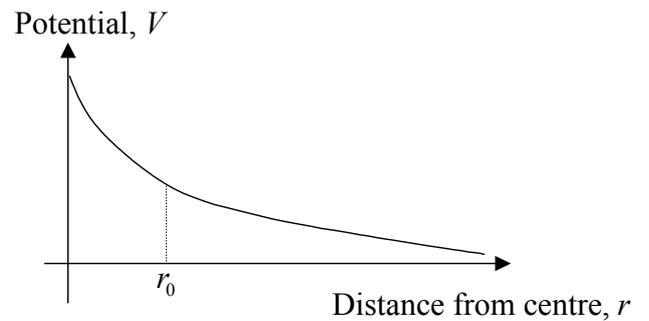
B.



C.



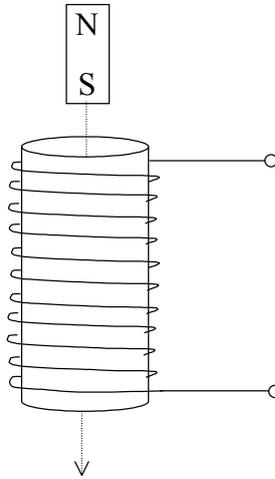
D.



31. The definition of the ampere involves the force

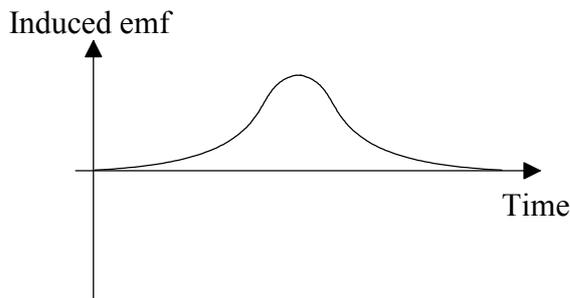
- A. between two stationary point charges.
- B. between two current carrying wires.
- C. on a current carrying wire near a magnet.
- D. on a current carrying wire inside a solenoid.

32. A small bar magnet is dropped vertically from rest. It passes down through the centre of a long coil of wire and leaves from the other end as shown below.

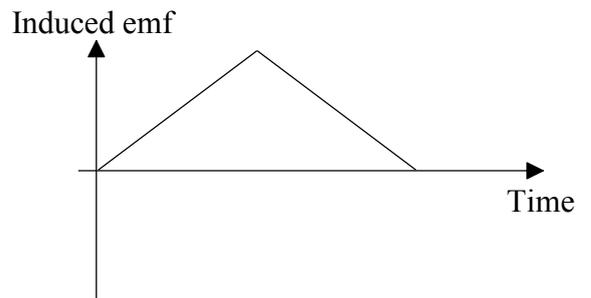


Which **one** of the following graphs best represents the induced emf in the coil as a function of time during this process?

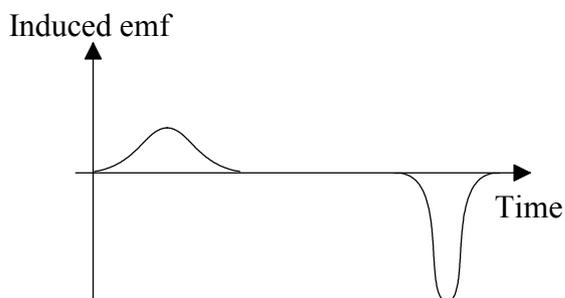
A.



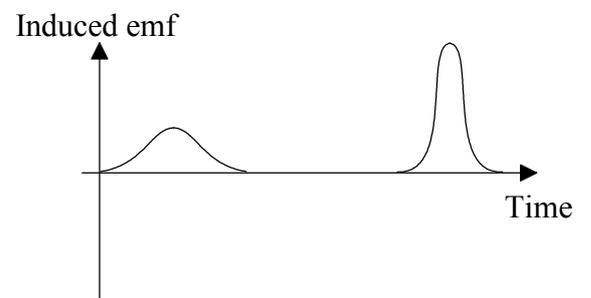
B.



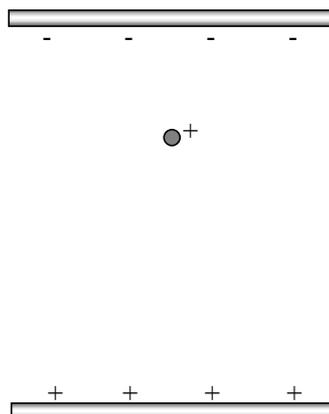
C.



D.



33. A positively charged oil drop is held stationary between two charged plates as shown below.



If a magnetic field  $B$  directed **into** the page is now applied, the charged drop would

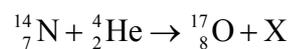
- A. move into the page.
  - B. move upwards.
  - C. move to the right.
  - D. stay where it is.
34. The nucleus of one of the isotopes of sodium is made up of the following particles.

Protons	Neutrons
11	14

An isolated atom of this isotope undergoes radioactive **beta** decay. Which **one** of the following choices correctly predicts the number of protons and neutrons that will remain after the decay?

	Protons	Neutrons
A.	11	14
B.	9	12
C.	12	13
D.	12	14

35. When the nucleus  ${}^{14}_7\text{N}$  is bombarded with alpha particles the following nuclear reaction can occur.

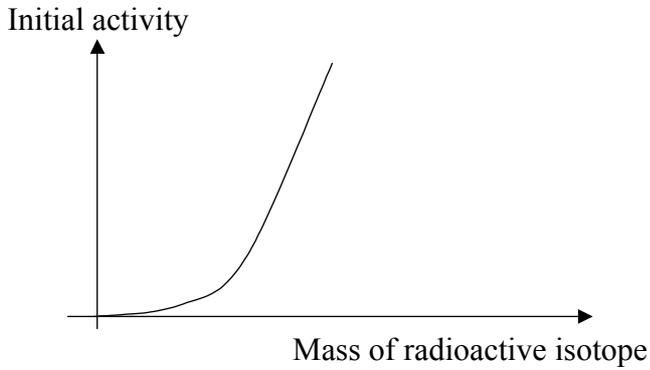


The particle X is a

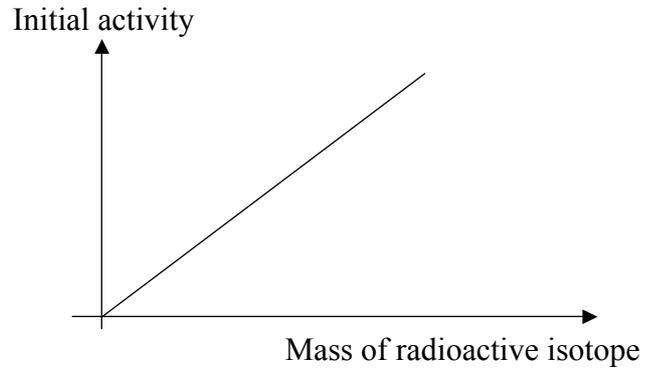
- A. beta particle.
  - B. proton.
  - C. neutron.
  - D. photon.
36. If a single free neutron undergoes beta decay, the total number of particles after the decay is
- A. 1.
  - B. 2.
  - C. 3.
  - D. 4.

37. Which **one** of the following graphs best represents how the initial activity of a sample of radioactive isotope depends on the initial mass of the sample?

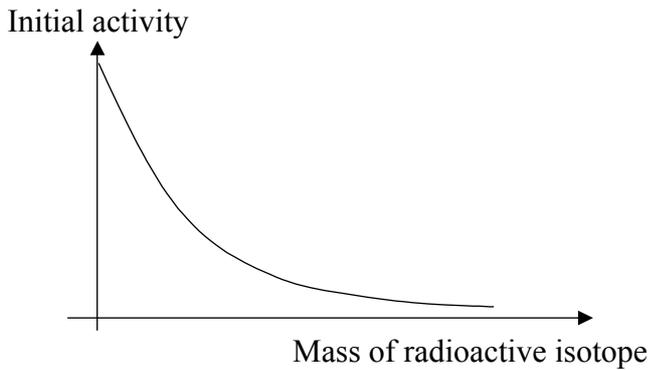
A.



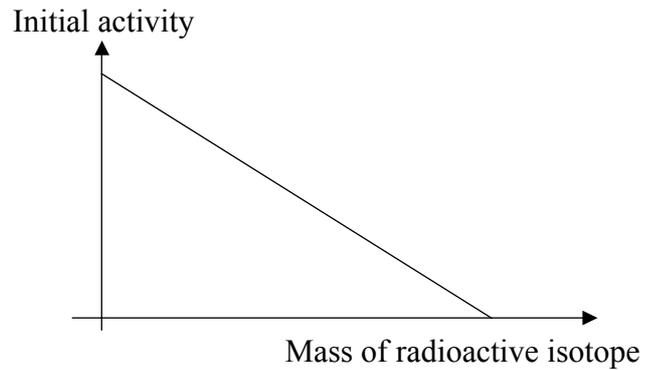
B.



C.



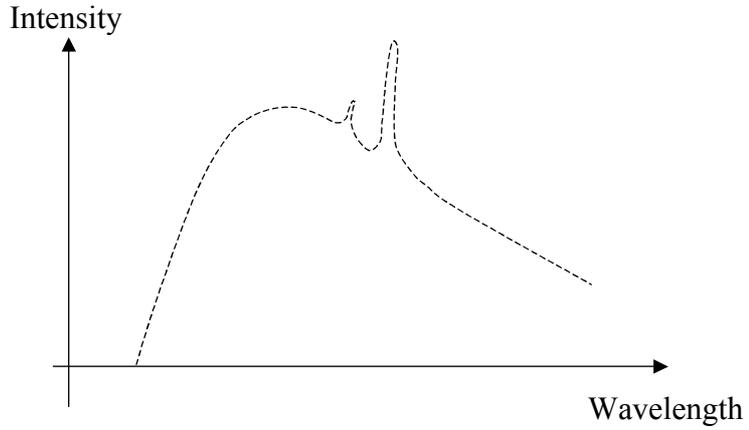
D.



38. Different nuclei have different **total** binding energies. As a general trend, as the atomic number increases, the **total** binding energy for the nucleus

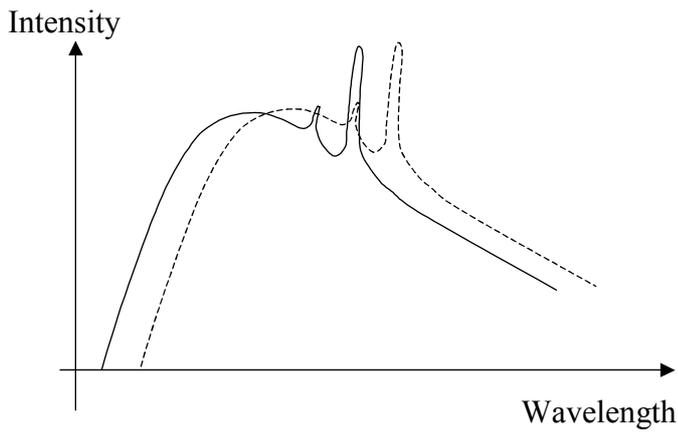
- A. always increases.
- B. always decreases.
- C. increases then decreases.
- D. decreases then increases.

39. X-rays are emitted from a particular X-ray tube with the following spectrum.

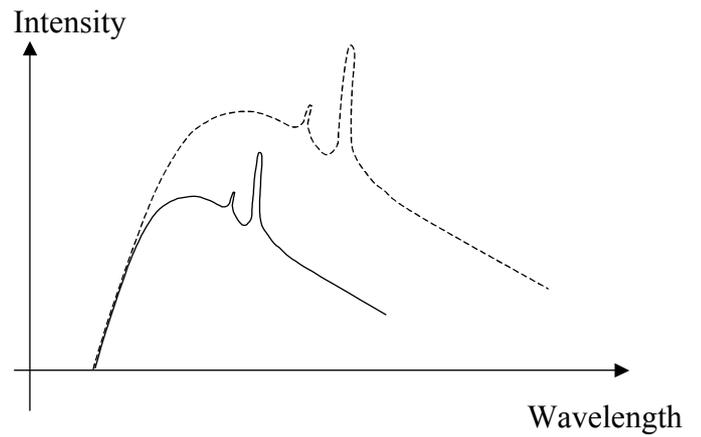


If the accelerating potential difference is **reduced**, which **one** of the following graphs shows the new spectrum produced? The original spectrum is shown as the dashed line.

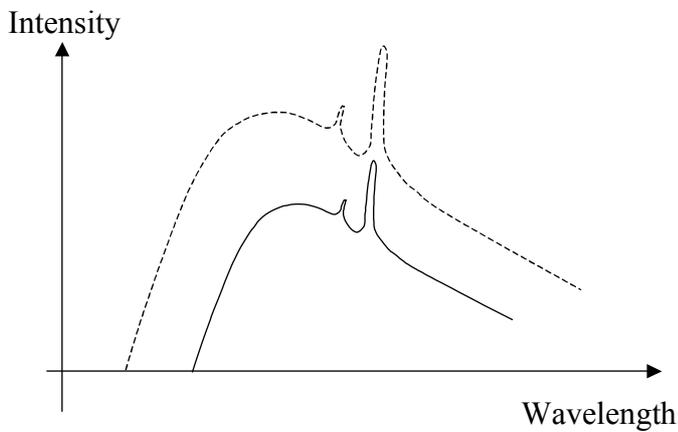
A.



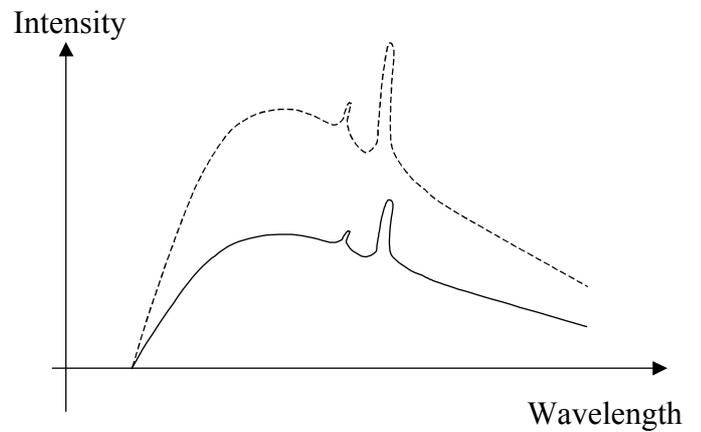
B.



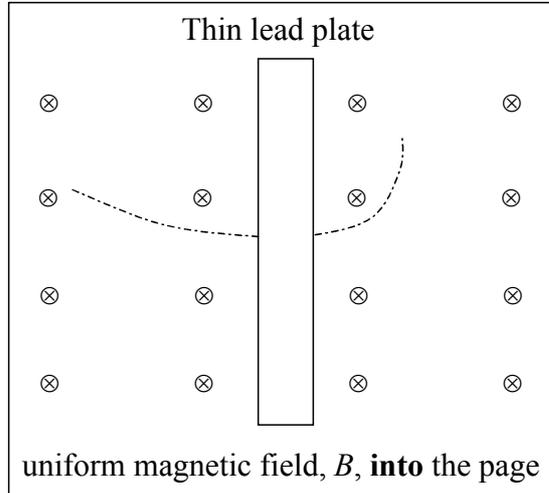
C.



D.



40. The diagram below represents the photographic track in a cloud chamber of an unknown particle travelling through a thin lead plate. The track is curved because there is a uniform magnetic field,  $B$ , **into** the page. The change in curvature is due to the particle losing energy as it passes through the thin lead plate.



From this recorded data, it can be deduced that the particle is

- A. positive and travelling from left to right.
- B. negative and travelling from left to right.
- C. negative and travelling from right to left.
- D. positive and travelling from right to left.