IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

PHYSICS
STANDARD LEVEL
PAPER 1

Tuesday 4 May 2004 (afternoon)

45 minutes

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 diameter of the nucleus of a hydrogen atom is of the order of

A. 10^{-8} m .

B. 10^{-15} m .

C. 10^{-23} m .

D. 10^{-30} m .

2. The unit, the electron-volt is equivalent to

A. 1.6×10^{19} J .

B. 1.0 J .

C. 1.6×10^{-19} J .

D. 9.1×10^{-31} J .

3. The time period T of oscillation of a mass m suspended from a vertical spring is given by the expression

$$T = 2\pi\sqrt{\frac{m}{k}}$$

where k is a constant.

Which **one** of the following plots will give rise to a straight-line graph?

A. T^2 against m

B. $\sqrt{T}$ against $\sqrt{m}$

C. T against m

D. $\sqrt{T}$ against m

4. Which **one** of the following is a vector quantity?

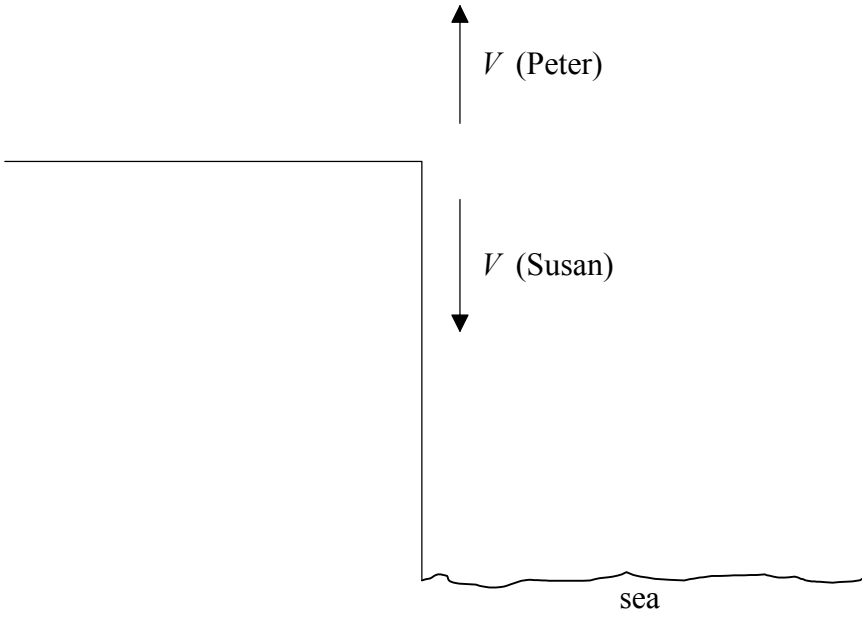
A. Electric power

B. Electrical resistance

C. Electric field strength

D. Electric potential difference

5. Peter and Susan both stand on the edge of a vertical cliff.



Susan throws a stone vertically downwards and, at the same time, Peter throws a stone vertically upwards. The speed V with which both stones are thrown is the same. Neglecting air resistance, which **one** of the following statements is true?

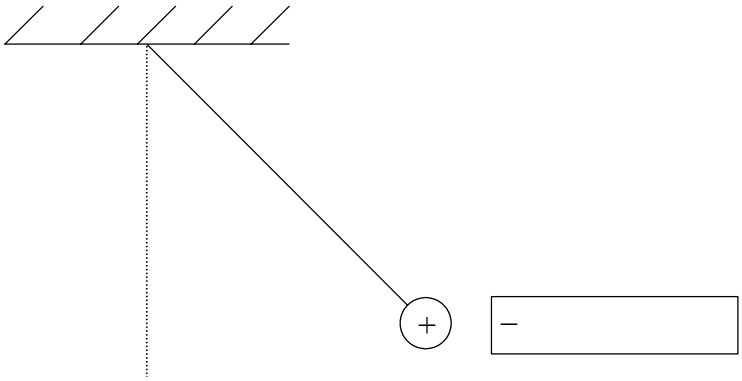
A. The stone thrown by Susan will hit the sea with a greater speed than the stone thrown by Peter.

B. Both stones will hit the sea with the same speed no matter what the height of the cliff.

C. In order to determine which stone hits the sea first, the height of the cliff must be known.

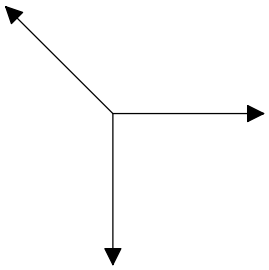
D. In order to determine which stone hits the sea first both the height of the cliff and the mass of each stone must be known.

6. A small electrically charged sphere is suspended vertically from a thread. An oppositely charged rod is brought close to the sphere such that the sphere is in equilibrium when displaced from the vertical by an angle of 45°.



Which **one** of the following best represents the free body diagram for the sphere?

A.



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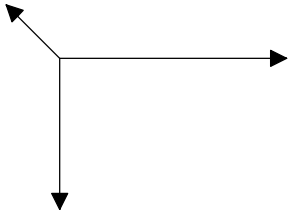
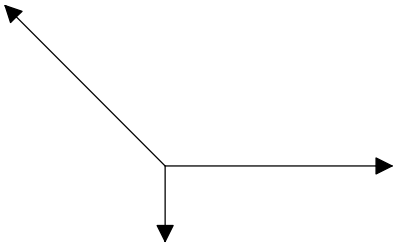


C.



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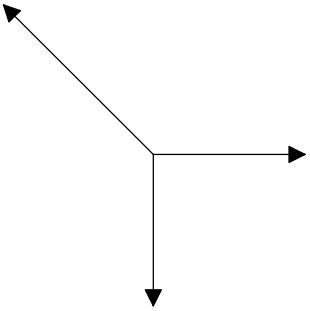
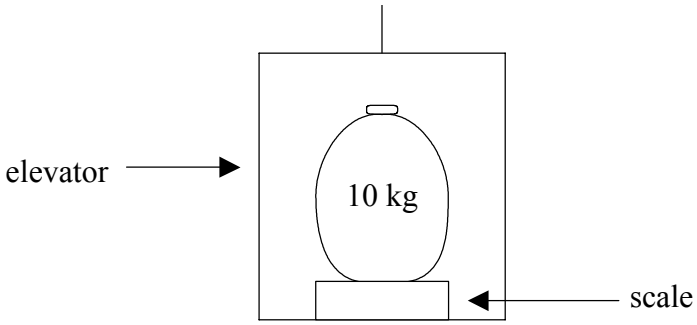


7. An elevator (lift) is used to either raise or lower sacks of potatoes. In the diagram, a sack of potatoes of mass 10 kg is resting on a scale that is resting on the floor of an accelerating elevator. The scale reads 12 kg.



The best estimate for the acceleration of the elevator is

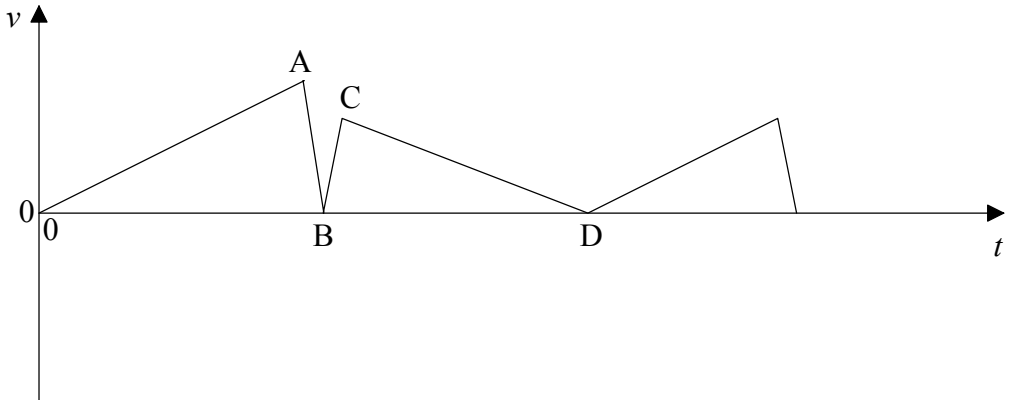
A. $2.0\ \mathrm{m\,s^{-2}}$ downwards.

B. $2.0\ \mathrm{m\,s^{-2}}$ upwards.

C. $1.2\ \mathrm{m\,s^{-2}}$ downwards.

D. $1.2\ \mathrm{m\,s^{-2}}$ upwards.

8. A ball is dropped from rest at time $t = 0$ on to a horizontal surface from which it rebounds. The graph shows the variation of time t with **speed** v of the ball.



Which **one** of the following best represents the point at which the ball just loses contact with the surface after the first bounce?

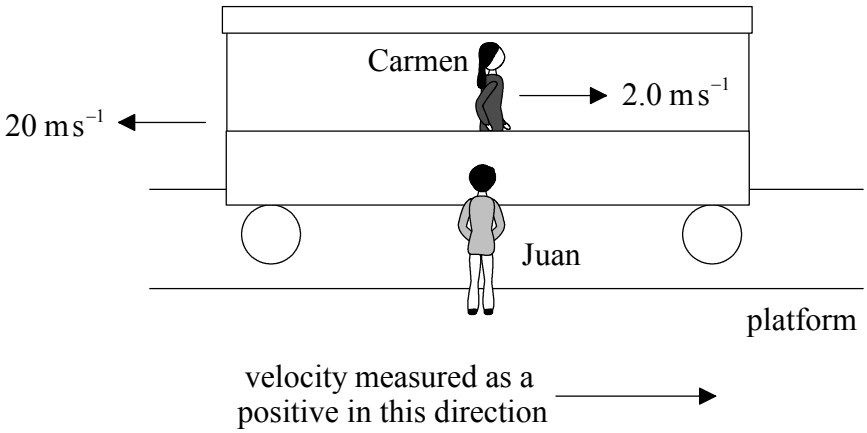
A. A

B. B

C. C

D. D

9. Juan is standing on the platform at a railway station. A train passes through the station with speed $20\ \text{m s}^{-1}$ in the direction shown measured relative to the platform. Carmen is walking along one of the carriages of the train with a speed of $2.0\ \text{m s}^{-1}$ measured relative to the carriage in the direction shown. Velocity is measured as positive in the direction shown on the diagram.



The **velocity** of Carmen relative to Juan is

A. $-22\ \text{m s}^{-1}$.

B. $-18\ \text{m s}^{-1}$.

C. $+18\ \text{m s}^{-1}$.

D. $+22\ \text{m s}^{-1}$.

10. A ball of mass *m*, travelling in a direction at right angles to a vertical wall, strikes the wall with a speed v_1. It rebounds at right angles to the wall with a speed v_2. The ball is in contact with the wall for a time Δt. The magnitude of the force that the ball exerts on the wall is

A. $\dfrac{m(v_1 + v_2)}{\Delta t}$.

B. $m(v_1 + v_2)\Delta t$.

C. $\dfrac{m(v_1 - v_2)}{\Delta t}$.

D. $m(v_1 - v_2)\Delta t$.

11. A truck collides head on with a less massive car moving in the opposite direction to the truck. During the collision, the average force exerted by the truck on the car is F_T and the average force exerted by the car on the truck is F_C. Which **one** of the following statements is correct?

A. F_T will always be greater in magnitude than F_C.

B. F_T will always be equal in magnitude to F_C.

C. F_T will be greater in magnitude than F_C only when the speed of the car is less than the speed of the truck.

D. F_T will be equal in magnitude to F_C only when the speed of the truck is equal to the speed of the car.

12. A machine lifts an object of weight 1.5×10^3 N to a height of 10 m. The machine has an overall efficiency of 20 %. The work done by the machine in raising the object is

A. 3.0×10^3 J.

B. 1.2×10^4 J.

C. 1.8×10^4 J.

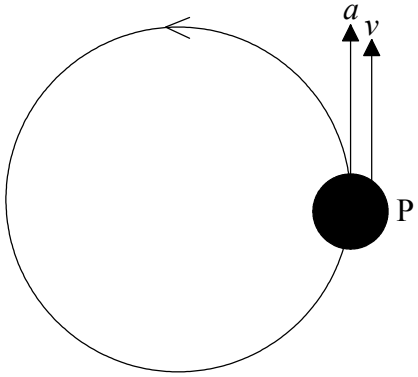
D. 7.5×10^4 J.

13. Joe is standing on the surface of a frozen pond and he throws a ball horizontally. Considering Joe and the ball together, which **one** of the following correctly describes the change in the magnitude of the momentum and the change in the kinetic energy of Joe and the ball immediately after the ball is thrown?

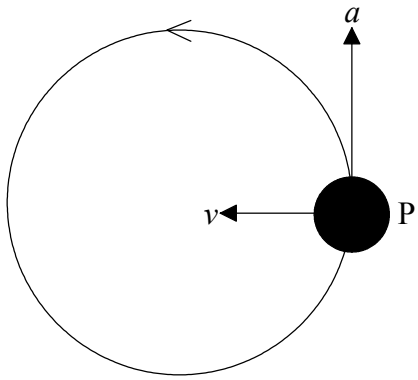
	Magnitude of momentum of Joe and ball	**Kinetic energy of Joe and ball**
A.	No change	Increases
B.	Increases	Increases
C.	No change	No change
D.	Increases	No change

14. A particle P is moving in a circle with uniform speed. Which **one** of the following diagrams correctly shows the direction of the acceleration *a* and velocity *v* of the particle at one instant of time?

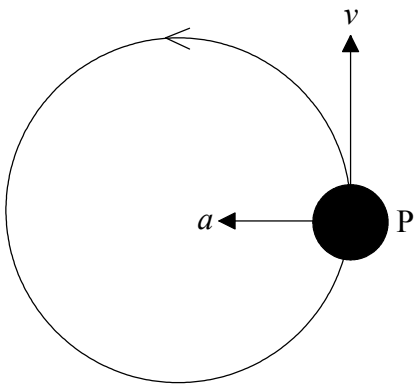
A.



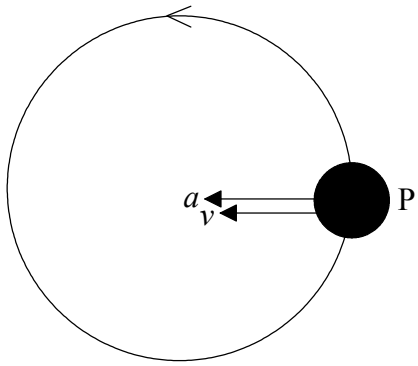
B.



C.



D.



15. The kelvin temperature of an object is a measure of

A. the total energy of the molecules of the object.

B. the total kinetic energy of the molecules of the object.

C. the maximum energy of the molecules of the object.

D. the average kinetic energy of the molecules of the object.

16. Two identical boxes X and Y each contain an ideal gas.

Box X	**Box Y**
n moles	$2n$ moles
temperature T	temperature $\frac{T}{3}$
pressure P_X	pressure P_Y

In box X there are n moles of the gas at temperature T and pressure P_X. In box Y there are $2n$ moles of the gas at temperature $\frac{T}{3}$ and pressure P_Y .

The ratio $\frac{P_X}{P_Y}$ is

A. $\frac{2}{3}$.

B. $\frac{3}{2}$.

C. 2.

D. 3.

17. The specific latent heat of fusion of a substance is defined as the amount of thermal energy required to change the phase of

A. the substance at constant temperature.

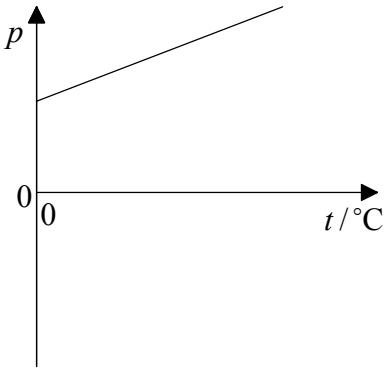
B. unit mass of the substance to liquid at constant temperature.

C. unit mass of the substance at constant temperature.

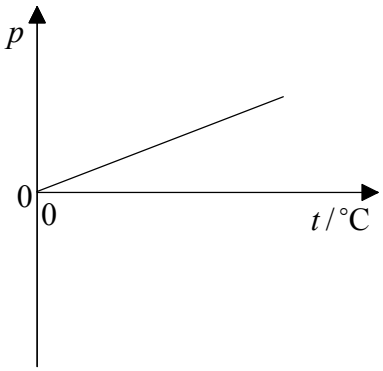
D. the substance to gas at constant temperature.

18. A fixed mass of an ideal gas is heated at constant volume. Which **one** of the following graphs best shows the variation with Celsius temperature t with pressure p of the gas?

A.



B.



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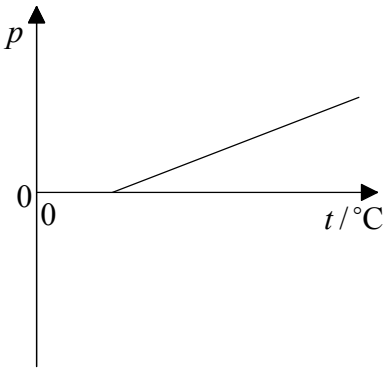

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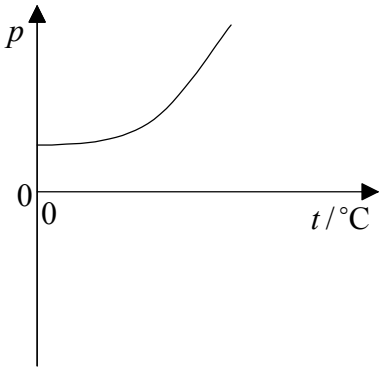
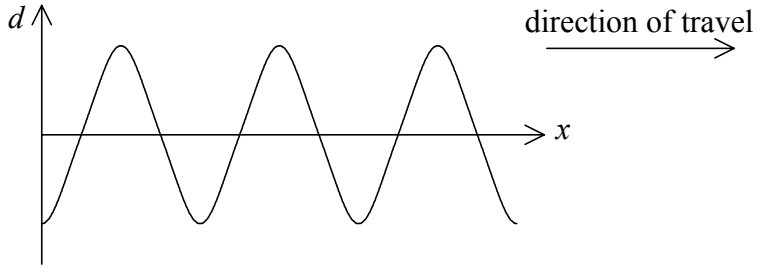


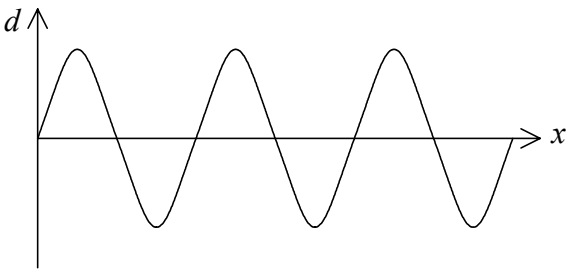
19. The diagram shows the variation with distance x along a wave with its displacement d.

The wave is travelling in the direction shown.

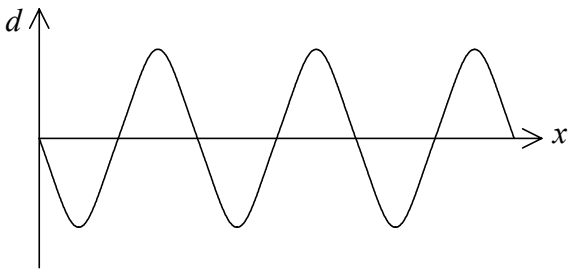


The period of the wave is T. Which **one** of the following diagrams shows the displacement of the wave at a time $\frac{T}{4}$ later?

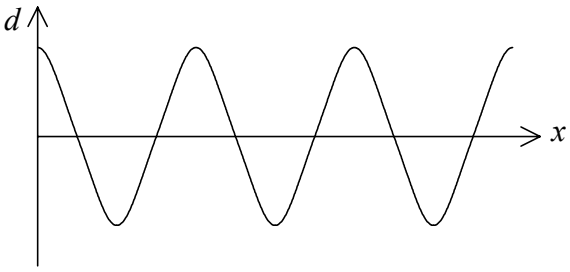
A.



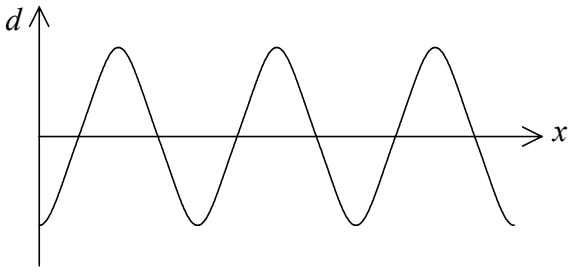
B.



C.



D.



20. When a wave crosses the boundary between two media, which **one** of the following properties of the wave does **not** change?

A. Amplitude

B. Wavelength

C. Frequency

D. Speed

21. A pipe, open at both ends, has a length L. The speed of sound in the air in the pipe is v. The frequency of vibration of the fundamental (first harmonic) standing wave that can be set up in the pipe is

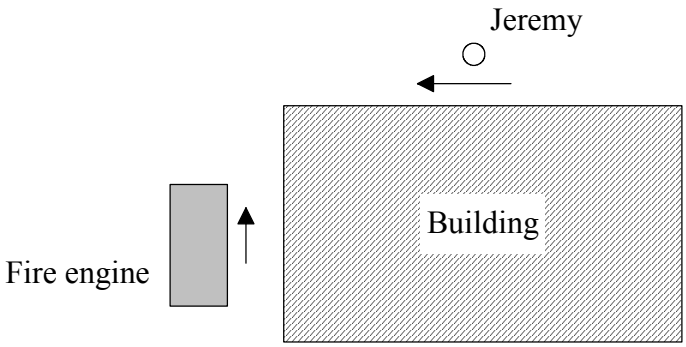
A. $\frac{v}{2L}$.

B. $\frac{L}{2v}$.

C. $\frac{4v}{L}$.

D. $\frac{L}{4v}$.

22. Jeremy is walking alongside a building and is approaching a road junction. A fire engine is sounding its siren and approaching the road along which Jeremy is walking.



Jeremy cannot see the fire engine but he can hear the siren. This is due mainly to

A. reflection.

B. refraction.

C. the Doppler effect.

D. diffraction.

23. *Electric field strength* is defined as

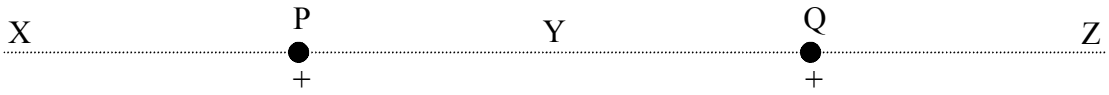
A. the force exerted on a test charge.

B. the force per unit positive charge.

C. the force per unit charge.

D. the force per unit charge exerted on a positive test charge.

24. Two **positive** point charges P and Q are held a certain distance apart.



At which point(s) could the electric field strength, due to the charges, be zero?

A. X only

B. Y only

C. Z only

D. X and Z only

25. The *ampere* is defined in terms of

A. the force between a magnet and a coil carrying a current.

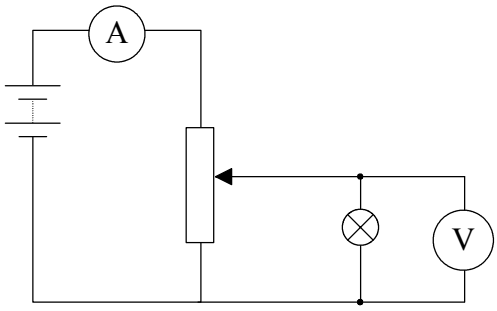
B. the force between two long current carrying wires.

C. the amount of charge that passes any cross-sectional area of a wire in unit time.

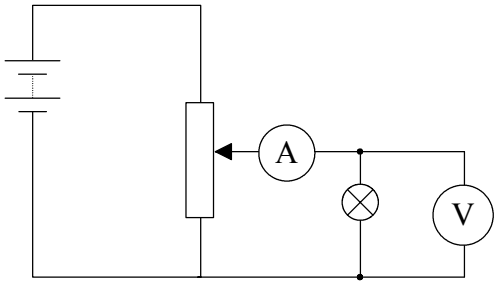
D. the number of electrons that pass any cross-sectional area of a wire in unit time.

26. Which **one** of the following shows a correct circuit, using ideal voltmeters and ammeters, for measuring the *I-V* characteristic of a filament lamp?

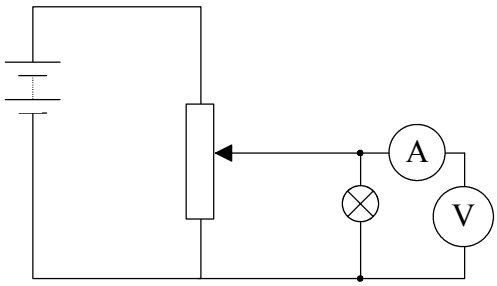
A.



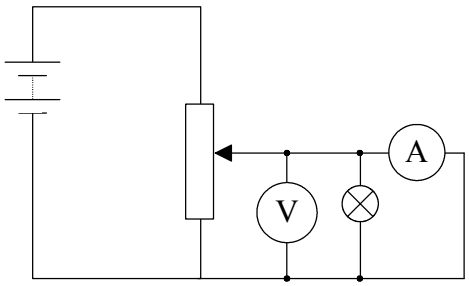
B.



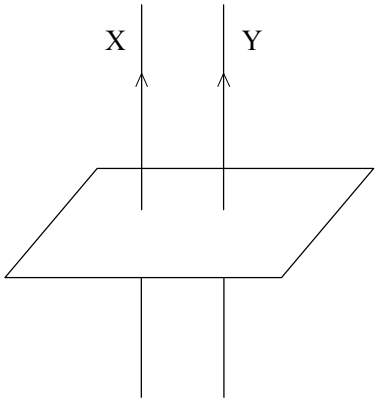
C.



D.

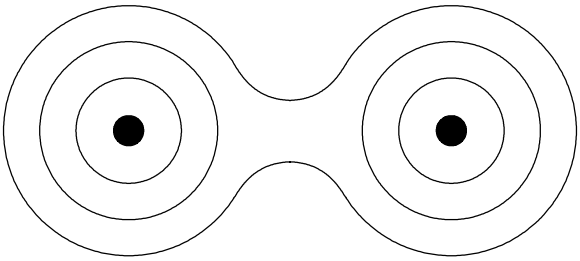


27. Two long, vertical wires X and Y carry currents in the same direction and pass through a horizontal sheet of card.



Iron filings are scattered on the card. Which **one** of the following diagrams best shows the pattern formed by the iron filings? *(The dots show where the wires X and Y enter the card.)*

A.



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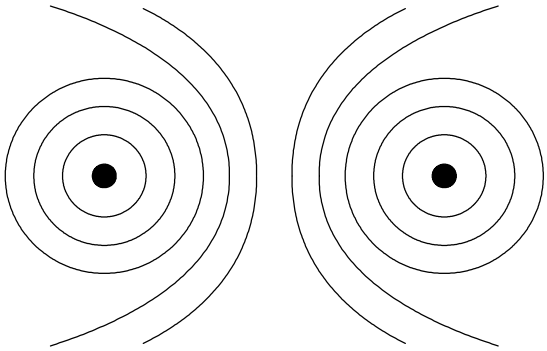
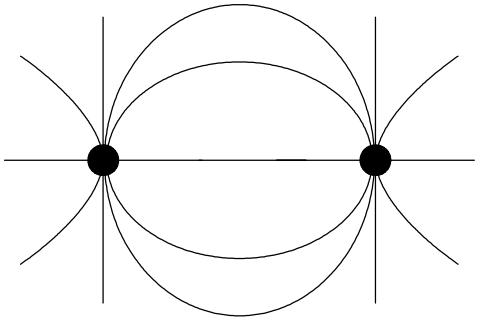
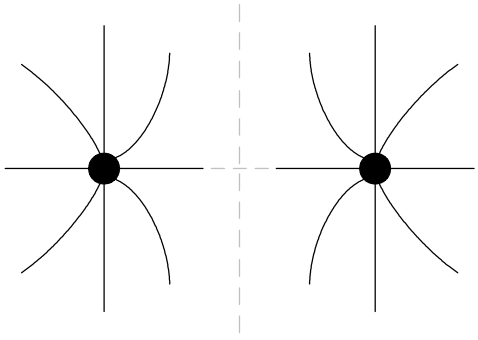


C.



D.



28. Which **one** of the following correctly identifies the atomic (proton) number and mass (nucleon) number of a nucleus that has neutrons *n* and protons *p*?

	Atomic number	Mass number
A.	p	n
B.	p	$n + p$
C.	n	p
D.	$n + p$	p

29. In a laboratory when aluminium nuclei are bombarded with α-particles, the following reaction may take place.

$$^{4}_{2}\mathrm{He} + ^{27}_{13}\mathrm{Al} \rightarrow ^{30}_{15}\mathrm{P} + ^{1}_{0}\mathrm{n}$$

This reaction is an example of

A. nuclear fission.

B. nuclear fusion.

C. natural radioactive decay.

D. artificial transmutation.

30. Isotopes provide evidence for the existence of

A. protons.

B. electrons.

C. nuclei.

D. neutrons.