



**PHYSICS**  
**STANDARD LEVEL**  
**PAPER 1**

Friday 10 November 2000 (afternoon)

45 minutes

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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 frequency of oscillation  $f$  of a mass  $m$  suspended from a vertical spring is given by

$$f = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$$

where  $k$  is the spring constant.

Which **one** of the following plots would produce a straight-line graph?

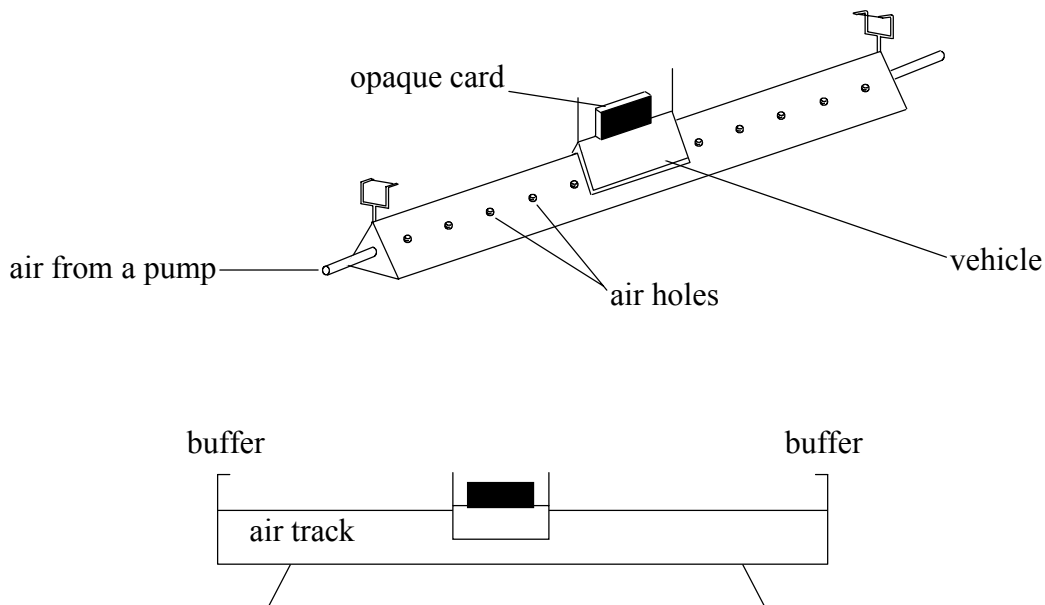
- A.  $f$  against  $m$
- B.  $f^2$  against  $\frac{1}{m}$
- C.  $f$  against  $\sqrt{m}$
- D.  $\frac{1}{f}$  against  $m$
2. The power  $P$  dissipated in a resistor of resistance  $R$  in which there is a current  $I$  is given by

$$P = I^2 R$$

The uncertainty in the value of resistance of a particular resistor is  $\pm 10\%$  and the uncertainty in the value of the current in the resistor is  $\pm 3\%$ . The best estimate for the uncertainty of the power dissipated is

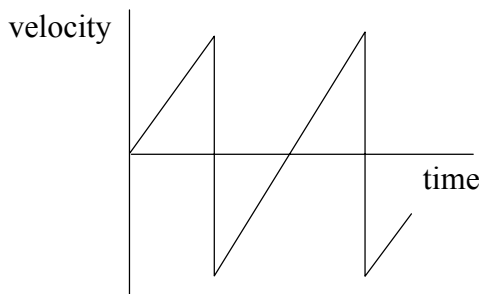
- A.  $\pm 6\%$ .
- B.  $\pm 9\%$ .
- C.  $\pm 16\%$ .
- D.  $\pm 19\%$ .
3. When a car is moving at a speed  $v$  in a straight line the total force opposing its motion is  $F$ . The product  $Fv$  is a measure of the
- A. power developed by the car.
- B. rate of change of momentum of the car.
- C. work done by the car against the frictional forces.
- D. rate of change of kinetic energy of the car.

4. The diagram shows a glider travelling on a friction-free linear air track.

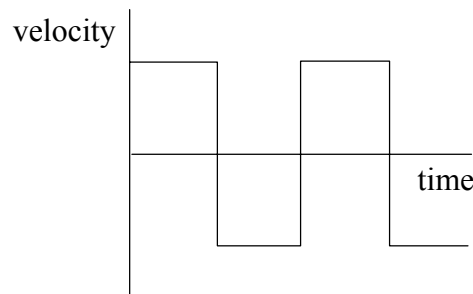


Which **one** of the following graphs best represents the variation of velocity with time as the glider bounces back and forth between the elastic buffers?

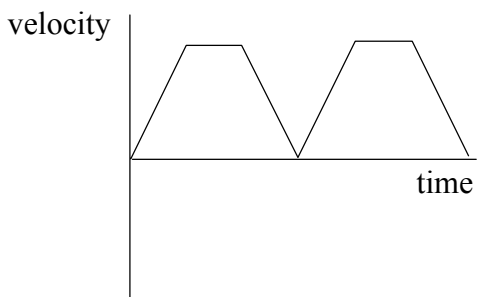
Graph A



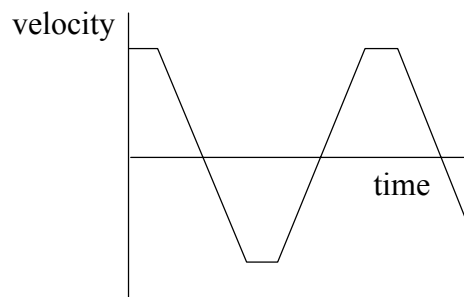
Graph B



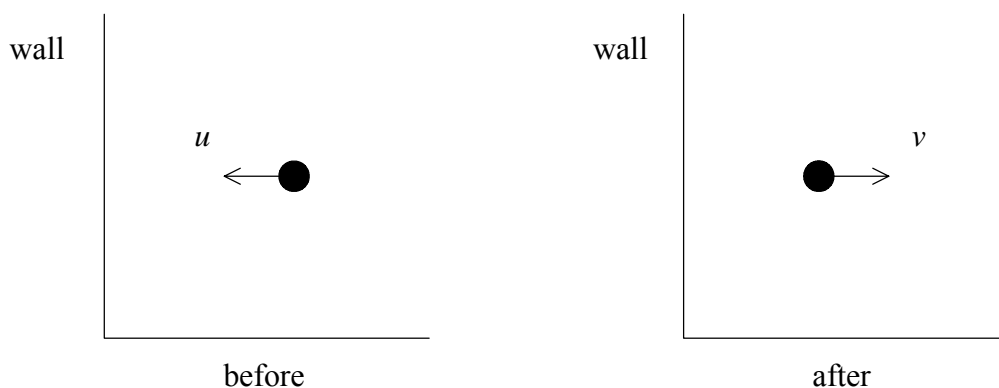
Graph C



Graph D



5. The diagrams show the direction and speed  $u$  of a ball before it strikes a vertical wall and its direction and speed  $v$  after striking the wall.

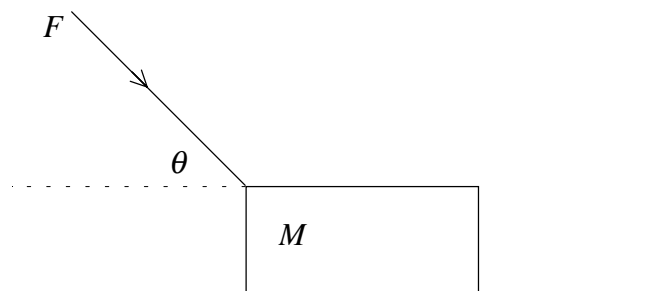


The ball is in contact with the wall for a time  $\Delta t$ .

The magnitude of the average force  $F$  exerted on the ball by the wall is given by

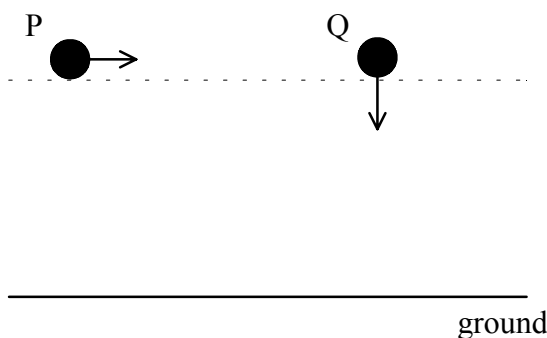
- A.  $F = \frac{mu - mv}{\Delta t}$ .
- B.  $F = (mu - mv)\Delta t$ .
- C.  $F = \frac{mu + mv}{\Delta t}$ .
- D.  $F = (mu + mv)\Delta t$ .
6. A particle moves in a circular path of radius  $r$ . The magnitude of the force acting on the particle is  $F$ . The work done by the force in one complete orbit of the particle is
- A.  $2\pi Fr$ .
- B.  $\frac{F}{2\pi}$ .
- C.  $\frac{2\pi}{F}$ .
- D. zero.

7. A block of mass  $M$  is pushed along a horizontal, frictionless surface by a force of magnitude  $F$ . The force makes an angle  $\theta$  with the horizontal.



The magnitude of the acceleration of the block is

- A. zero.
- B.  $\frac{F \cos \theta}{M}$ .
- C.  $\frac{F \sin \theta}{M}$ .
- D.  $\frac{F}{M}$ .
8. The diagram shows two balls P and Q at the same height above the ground. Ball P is projected horizontally and at the same instant ball Q is allowed to fall vertically.

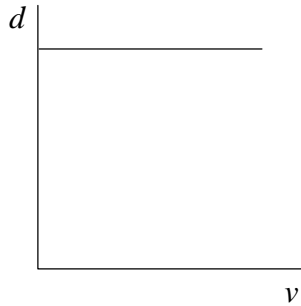


Which **one** of the following statements is **true**?

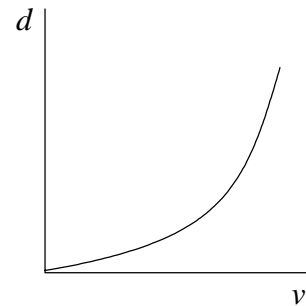
- A. Both balls hit the ground with the same velocity.
- B. Both balls take the same time to reach the ground.
- C. Both balls hit the ground with the same speed.
- D. The balls have different accelerations whilst falling.

9. A car that brakes when travelling at speed  $v$  along a horizontal road comes to rest in a certain distance  $d$ . Assuming that the braking force remains constant which **one** of the following graphs best shows how the stopping distance  $d$  depends on the initial speed  $v$ ?

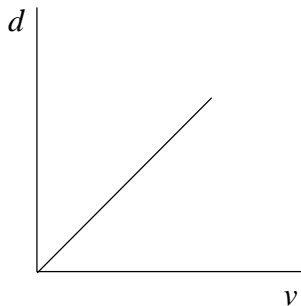
Graph A



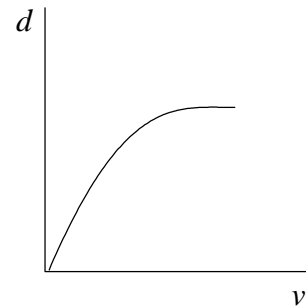
Graph B



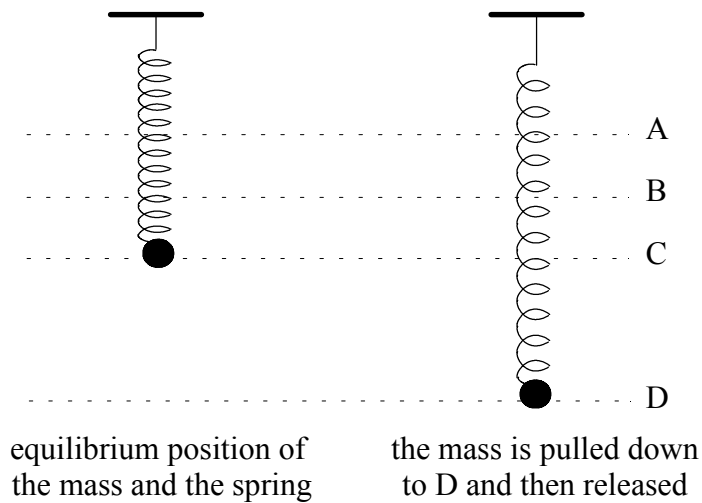
Graph C



Graph D



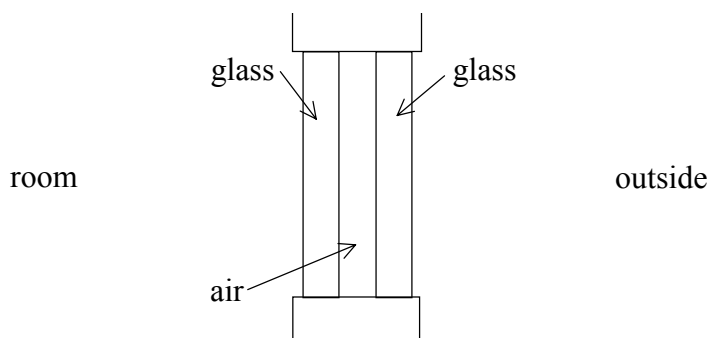
10. A mass is suspended from a vertical spring. It is set into oscillation by pulling it down a short distance and then releasing it. At which **one** of the labelled points, during the subsequent motion, will the **acceleration** be zero?



11. A person stands on bathroom scales that rest on the floor of an elevator (lift). When the elevator is stationary the scales register 50 kg. When the lift accelerates upwards the scales register 60 kg. Taking the acceleration of gravity to be  $10 \text{ m s}^{-2}$  the best estimate for the acceleration of the lift is

- A.  $100 \text{ m s}^{-2}$ .
- B.  $11 \text{ m s}^{-2}$ .
- C.  $8 \text{ m s}^{-2}$ .
- D.  $2 \text{ m s}^{-2}$ .

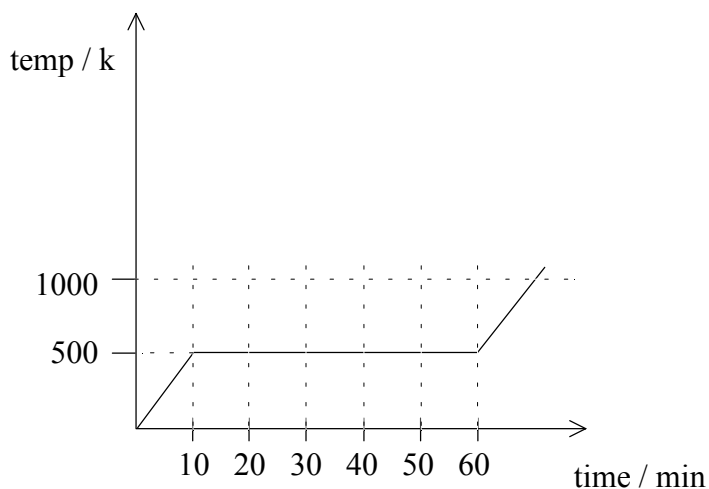
12. The diagram shows a section of double glazed window. The panes of glass are separated by an air gap that is of the same thickness as the two panes of glass. The room temperature is greater than the outside temperature and both temperatures are constant.



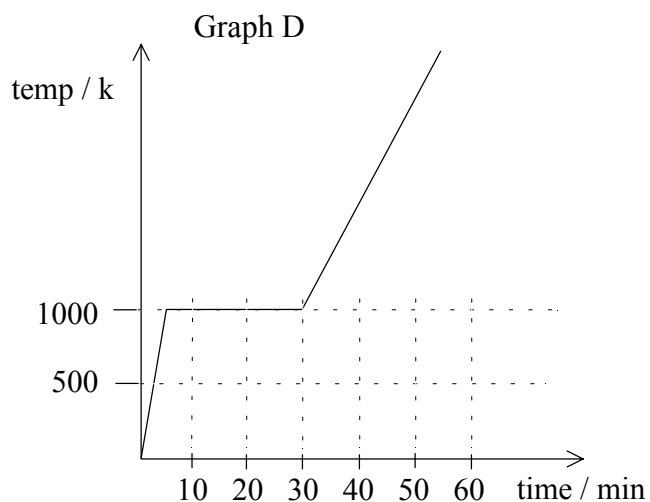
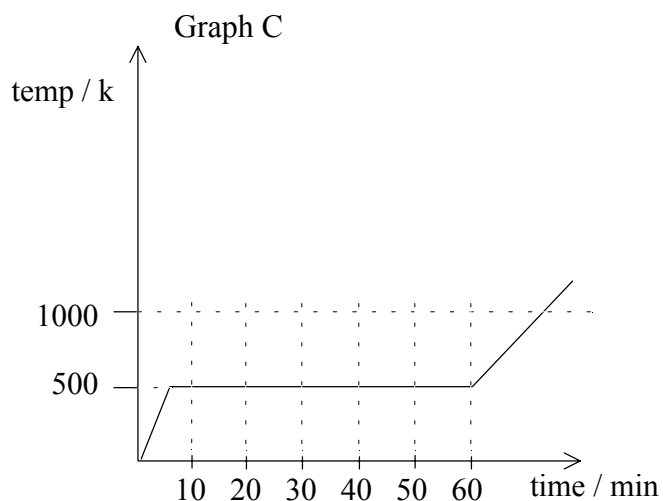
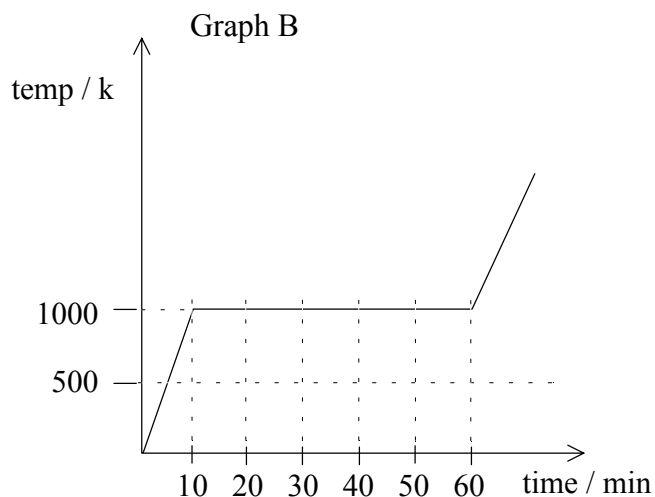
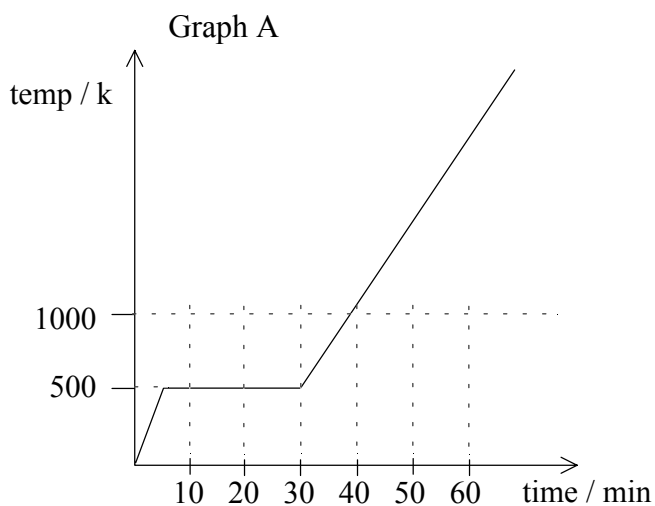
Which **one** of the following statements is **true**?

- A. There is no energy transfer from the room to the outside.
  - B. The rate of energy transfer across the glass is the same as that across the air gap.
  - C. The rate of energy transfer across the glass is greater than that across the air gap.
  - D. The rate of energy transfer across the glass is less than that across the air gap.
13. A gas is contained in a cylinder by a moveable piston. When the gas is compressed rapidly by the piston the temperature of the gas rises. This can be understood from the fact that the molecules of the gas
- A. have now been pushed closer together.
  - B. now collide more often with each other.
  - C. now have a smaller volume in which to move.
  - D. have gained energy from the moving piston.

14. A substance is heated at a constant rate. The graph below shows how the temperature of the substance varies with time.



Which **one** of the following graphs best shows how the temperature varies with time if half the mass of the substance is now heated from the same starting temperature and at the same rate?

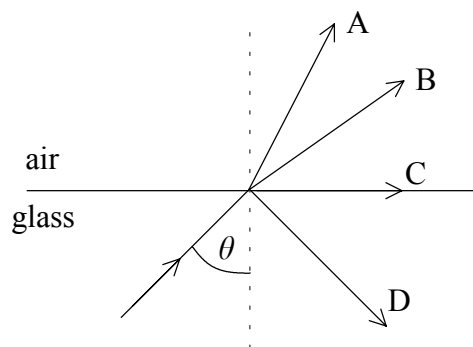




15. When light waves travel from air to glass which **one** of the following happens to the frequency and wavelength of the light?

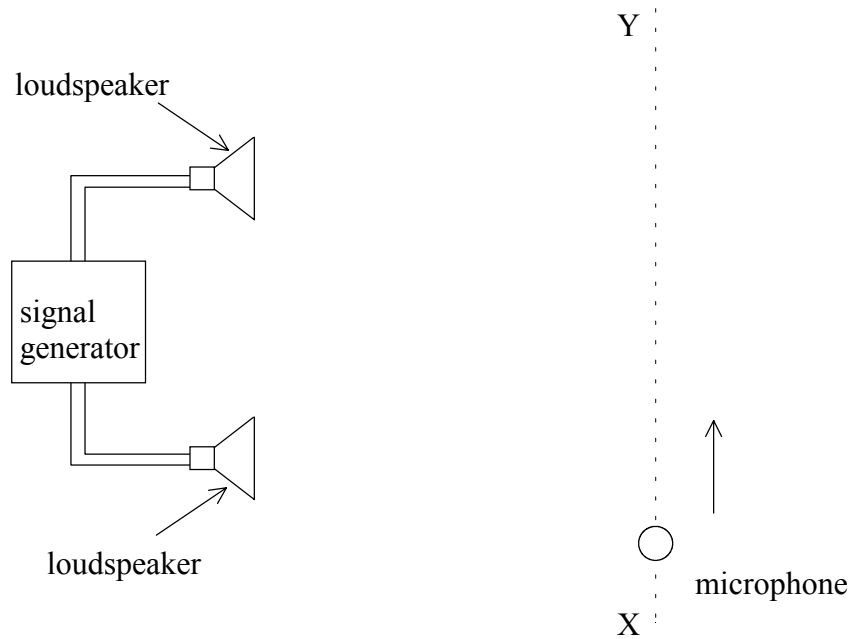
	Frequency	Wavelength
A.	stays the same	decreases
B.	decreases	increases
C.	stays the same	increases
D.	increases	decreases

16. A ray of light travelling in glass is incident on the glass-air boundary at an angle  $\theta$  to the normal as shown in the diagram. If  $\theta$  is greater than the critical angle which **one** of the rays best shows the path of the ray?



17. Which **one** of the following correctly places the named parts of the electromagnetic spectrum in order of **increasing** wavelength?
- A.  $\gamma$ -rays, radio waves, x-rays, ultra-violet rays
  - B.  $\gamma$ -rays, x-rays, ultra-violet rays, radio waves
  - C. radio waves, ultra-violet rays, x-rays,  $\gamma$ -rays
  - D. ultra-violet rays, x-rays,  $\gamma$ -rays, radio waves

18. The diagram shows two loudspeakers connected to the same signal generator. As a microphone is moved along the path XY a series of maximum and minimum sound levels is detected.

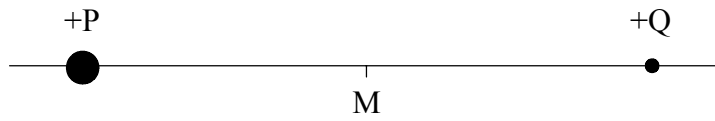


Which **one** of the following actions on its own will **increase** the separation between the maximum and minimum sound levels?

- A. Moving the speakers closer to the line XY.
  - B. Increasing the separation between the speakers.
  - C. Increasing the amplitude of the sound waves.
  - D. Decreasing the frequency of the sound waves.
19. A vibrating string has a length of  $L$ . If the speed of the waves in the string is  $c$  the frequency of the fundamental mode of vibration of the string will be

- A.  $\frac{2L}{c}$ .
- B.  $\frac{c}{L}$ .
- C.  $\frac{c}{2L}$ .
- D.  $\frac{2c}{L}$ .

20. Two positive point charges P and Q are fixed at the points shown. The charge of P is greater than that of Q. M is the mid-point between the charges.



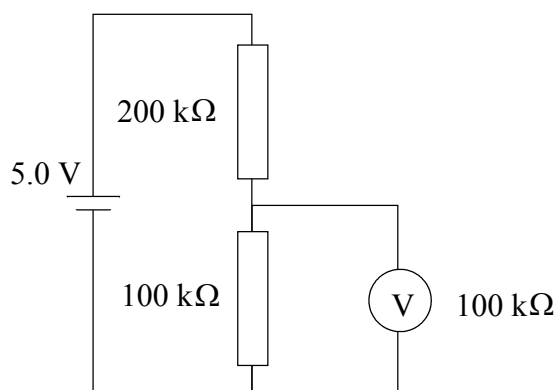
The electric field due to the two charges will be zero at a point, other than at infinity, that is

- A. to the left of P.
  - B. between P and M.
  - C. between M and Q.
  - D. to the right of Q.
21. Two resistors of equal resistance are connected in **series** to a battery with negligible internal resistance. The current drawn from the battery is 1.0 A.

When the two resistors are connected in **parallel** to the battery the current drawn will be

- A. 0.5 A.
- B. 1.0 A.
- C. 2.0 A.
- D. 4.0 A.

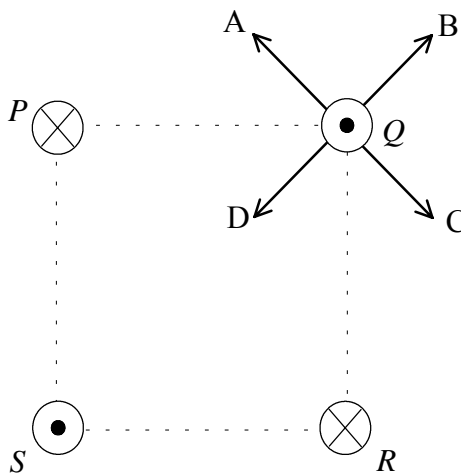
22. In the diagram the voltmeter V has a resistance of  $100\text{ k}\Omega$  and is connected such as to measure the potential difference across the  $100\text{ k}\Omega$  resistor. The battery has an emf of  $5.0\text{ V}$  and negligible internal resistance.



The reading on the voltmeter will be

- A. 4.0 V.
- B. 2.5 V.
- C. 1.0 V.
- D. zero.

23. In the diagram four long wires are placed at the corner of a square and carry equal currents. The direction of the current in wires P and R is into the plane of the paper and in wires Q and S is out of the plane of the paper.



Which labelled arrow correctly shows the direction of the resultant force on wire Q?

- A. Arrow A
  - B. Arrow B
  - C. Arrow C
  - D. Arrow D
24. A cell has an emf  $E$  and an internal resistance  $r$ . An external resistor which also has resistance  $r$  is connected across the terminal of the cell. The power dissipated in the **external resistor** is

- A.  $\frac{E^2}{r}$ .
- B.  $\frac{E^2}{2r}$ .
- C.  $\frac{E^2}{4r}$ .
- D. zero.

25. An electric immersion heater has a power rating of 3 kW and is designed to operate from a 250 V supply. For safety reasons the value of the fuse that should be used is

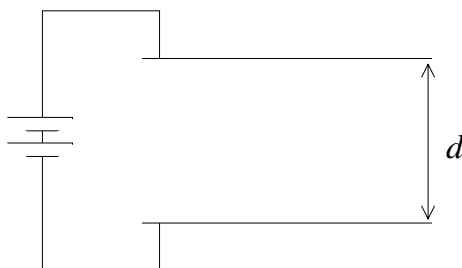
- A. 3 A.
- B. 5 A.
- C. 10 A.
- D. 13 A.

26. The **primary** of an ideal transformer has 1000 turns and the **secondary** 100 turns. The current in the primary is 2 A and the input power to the primary is 12 W.

Which **one** of the following about the **secondary current** and the **secondary power output** is true?

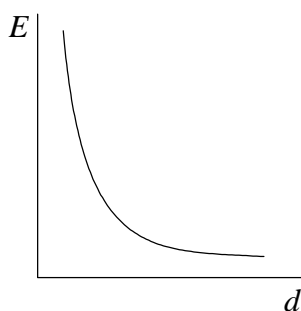
	<b>secondary current</b>	<b>secondary power output</b>
A.	20 A	1.2 W
B.	0.2 A	12 W
C.	0.2 A	120 W
D.	20 A	12 W

27. Two metal parallel plates are connected to a battery as shown. The separation of the plates is  $d$ .

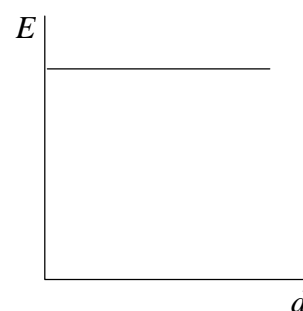


Which **one** of the graphs below best shows how the electric field strength  $E$  varies with the separation  $d$  of the plates?

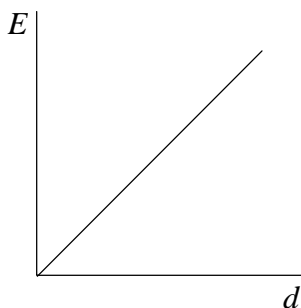
Graph A



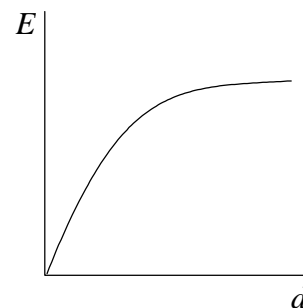
Graph B



Graph C



Graph D



28. An alpha particle is fired at a thin piece of gold foil and as a result passes close to a gold nucleus. As it approaches the gold nucleus which **one** of the following is true about the potential energy and the magnitude of the momentum of the alpha particle?

	<b>potential energy</b>	<b>momentum</b>
A.	decreases	unchanged
B.	increases	decreases
C.	decreases	decreases
D.	increases	unchanged

29. The isotope Francium-224 has a half-life of 20 minutes. A sample of the isotope has an initial activity of 800 disintegrations  $s^{-1}$ . The approximate activity of the sample an hour later will be
- A. 270 disintegrations  $s^{-1}$ .
  - B. 200 disintegrations  $s^{-1}$ .
  - C. 100 disintegrations  $s^{-1}$ .
  - D. zero.
30. The nuclide  ${}_{82}^{214}\text{Pb}$  is radioactive and decays to a nuclide X by emitting a negative beta particle. Which **one** of the following gives the atomic number and mass number of the nuclide X?

	<b>Mass number</b>	<b>Atomic number</b>
A.	214	83
B.	210	80
C.	213	83
D.	214	81

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