

Anglo-Chinese Junior College

Physics Preliminary Examination

Higher 1



A Methodist Institution
(Founded 1886)

PHYSICS

Paper 1 Multiple Choice

8866/01

30 Aug 2016

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your Name and Index number in the answer sheet provided.

There are **30** questions in this section. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this Question Paper.

Data

speed of light in free space,

$$c = 3.00 \times 10^8 \text{ m s}^{-1}$$

elementary charge,

$$e = 1.60 \times 10^{-19} \text{ C}$$

the Planck constant,

$$h = 6.63 \times 10^{-34} \text{ J s}$$

unified atomic mass constant,

$$u = 1.66 \times 10^{-27} \text{ kg}$$

rest mass of electron,

$$m_e = 9.11 \times 10^{-31} \text{ kg}$$

rest mass of proton,

$$m_p = 1.67 \times 10^{-27} \text{ kg}$$

acceleration of free fall,

$$g = 9.81 \text{ m s}^{-2}$$

Formulae

uniformly accelerated motion,

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

work done on/by a gas,

$$W = p \Delta V$$

hydrostatic pressure,

$$p = \rho g h$$

resistors in series,

$$R = R_1 + R_2 + \dots$$

resistors in parallel,

$$1/R = 1/R_1 + 1/R_2 + \dots$$

1 Which estimate is realistic?

- A The order of magnitude of the frequency of a Bluetooth signal is 10^9 Hz.
- B The acceleration of a Singapore MRT when moving off from a station is 10 m s^{-2} .
- C The density of air at atmospheric pressure is 1.2 g cm^{-3} .
- D The order of magnitude of pressure of air in a car tyre is 10^3 Pa .

2 When computing systematic and random errors, the following pairs of properties of errors in an experimental measurement may be obtained:

X_1 : error can possibly be eliminated

X_2 : error cannot possibly be eliminated

Y_1 : error is of constant sign and magnitude

Y_2 : error is of varying sign and magnitude

Z_1 : error can be reduced by averaging repeated measurements

Z_2 : error cannot be reduced by averaging repeated measurements

Which properties apply to the **random errors**?

A X_1, Y_1, Z_2

B X_1, Y_2, Z_2

C X_2, Y_2, Z_1

D X_2, Y_1, Z_1

3 In an experiment to determine the thickness of the glass of a boiling tube, the following readings were taken using a vernier caliper.

Internal diameter, $d_1 = (2.064 \pm 0.004) \text{ cm}$

External diameter, $d_2 = (2.560 \pm 0.004) \text{ cm}$

The uncertainty in the thickness of the glass is

A $\pm 0.002 \text{ cm}$

B $\pm 0.004 \text{ cm}$

C $\pm 0.008 \text{ cm}$

D $\pm 0.016 \text{ cm}$

4 Which pair includes a vector quantity and a scalar quantity?

A displacement, magnetic flux density

B voltage, frequency

C torque, work

D spring constant, electric potential

5 A ball is dropped from a height of 20 m and rebounds with a speed which is $\frac{3}{4}$ of the speed with which it hits the ground. (Assume that g is 10 m s^{-2}).

What is the time interval between the first and second bounce?

A 2.0 s

B 2.5 s

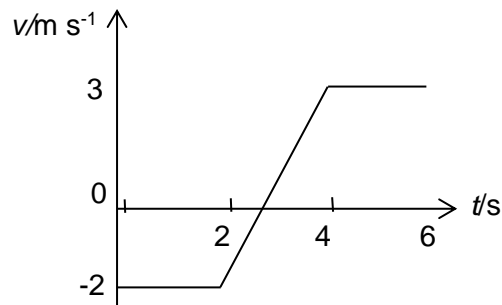
C 3.0 s

D 3.5 s

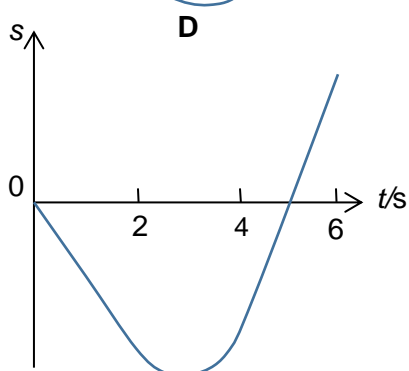
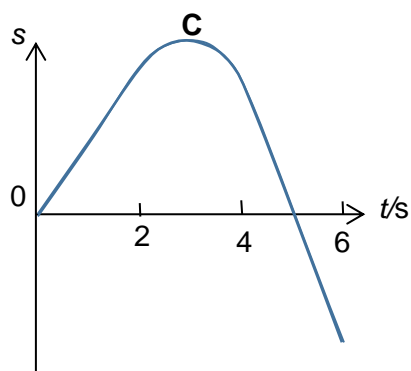
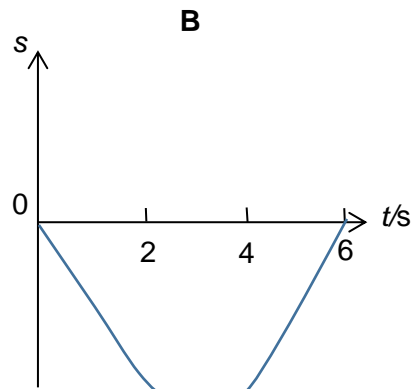
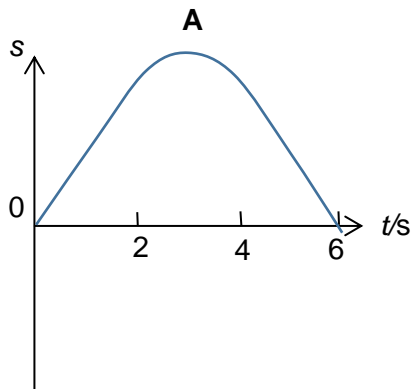
- 6 Two stones, X and Y, of different mass are dropped from the top of a cliff. Stone Y is dropped a short time after stone X. Air resistance is negligible.

Whilst the stones are falling, the distance between them will

- A decrease if the mass of Y is greater than the mass of X.
 - B increase if the mass of X is greater than the mass of Y.
 - C decrease whether the mass of X is greater or less than the mass of Y.
 - D increase whether the mass of X is greater or less than the mass of Y.
- 7 The figure below shows the velocity vs time ($v - t$) graph of an object. At time $t = 0$ s, the object's displacement from the origin is 0 m.



Which of the following best shows the corresponding displacement versus time ($s - t$) graph of the object?



- 8 An object is projected horizontally from a high platform with velocity v_o . The velocity with which it strikes the ground is v_A .

If air resistance is neglected, the time of flight is

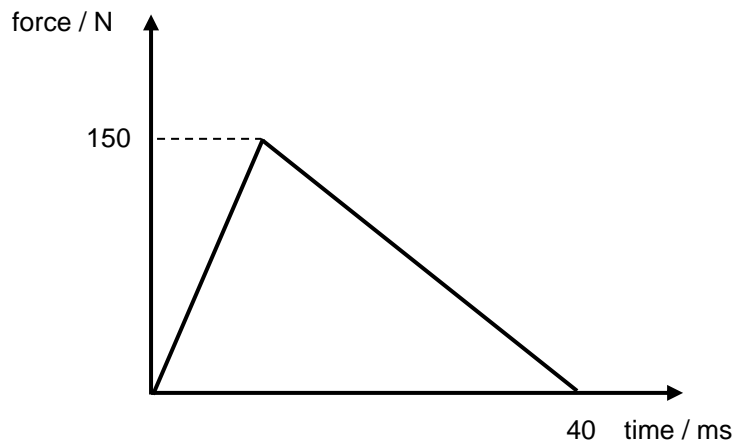
A $\frac{\sqrt{v_A^2 - v_o^2}}{2g}$
B $\frac{\sqrt{v_A^2 - v_o^2}}{g}$
C $\frac{v_A - v_o}{g}$
D $\frac{v_o - v_A}{g}$

- 9 A tractor of mass 1000 kg pulls a trailer of mass 1000 kg. The total resistance to motion has a constant value of 4000 N. One quarter of this resistance acts on the trailer.

When the acceleration of the tractor and trailer is 2 m s^{-2} , the force exerted on the tractor by the trailer is

A 1000 N
 B 2000 N
 C 3000 N
 D 5000 N

- 10 When a player serves a tennis ball of mass 0.060 kg, it is given an impulse of the form shown by the diagram.



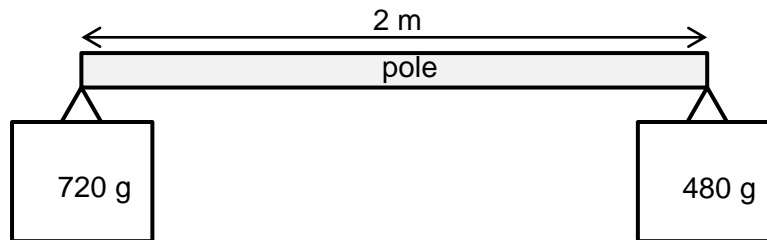
Assuming the tennis ball was moving normally to the racket at 5.0 m s^{-1} just before the racket hits it, its speed, in m s^{-1} , when it leaves the racket is

A 45
 B 50
 C 55
 D 95

- 11** A car of mass 1000 kg moving at 5.0 m s^{-1} on an icy road collides with another car of mass 600 kg moving at 3.0 m s^{-1} in the opposite direction. After the collision, the lighter car moves off at 2.5 m s^{-1} in the initial direction of the heavier car.

What is the speed of the heavier car after the collision?

- A** 0.5 m s^{-1} **B** 1.7 m s^{-1} **C** 5.3 m s^{-1} **D** 8.3 m s^{-1}
- 12** A pole of length 2 m has non-uniform composition, so that the centre of gravity is not at its geometrical centre. The pole is laid on supports across two weighing balances as shown in the diagram below. The balances (previously set to zero) recorded readings of 720 g and 480 g respectively.



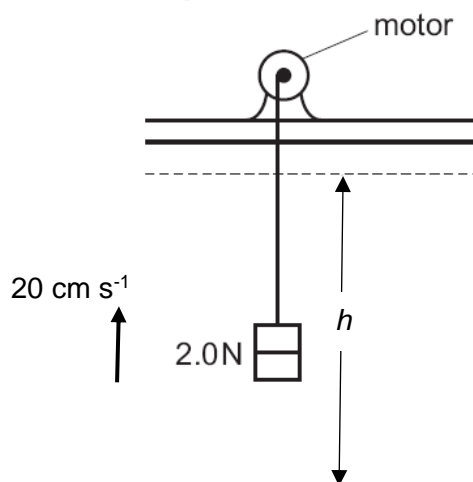
Where is the centre of gravity of the pole with respect to its geometrical centre?

- A** $\frac{1}{5}$ metre to the left
B $\frac{1}{5}$ metre to the right
C $\frac{1}{3}$ metre to the left
D $\frac{1}{3}$ metre to the right
- 13** A force of 1000 N is needed to lift the hook of a crane at a steady velocity. The hook is then used to lift a load of mass 1000 kg at a velocity of 0.50 m s^{-1} .

How much of the power developed, in kW, by the motor of the crane is used in lifting the load?

- A** 4.9 **B** 5.0 **C** 5.4 **D** 5.5

- 14 A small electric motor is used to raise a weight of 2.0 N at a constant speed of 20 cm s^{-1} through a certain height h .



The efficiency of the motor is 20 %.

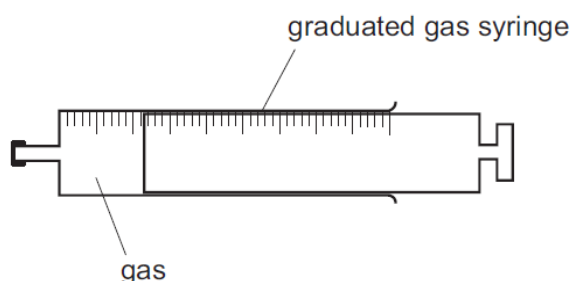
What is the electrical power supplied to the motor?

- A** 0.080 W **B** 0.80 W **C** 2.0 W **D** 200 W
- 15 A beam of positively charged particles is directed horizontally into vertical downward field of force.

Which row shows the possible nature of the force acting on the beam with the correct shape of the beam?

	Force	Shape of the beam
A	Gravitational Force	Horizontal line
B	Electric Force	Curve downwards
C	Gravitational Force	Vertical line downwards
D	Electric Force	Vertical line downwards

- 16 A gas is contained inside a sealed syringe as shown.



The volume of gas at room temperature is 2.0 cm^3 .
Atmospheric pressure is 101 kPa.

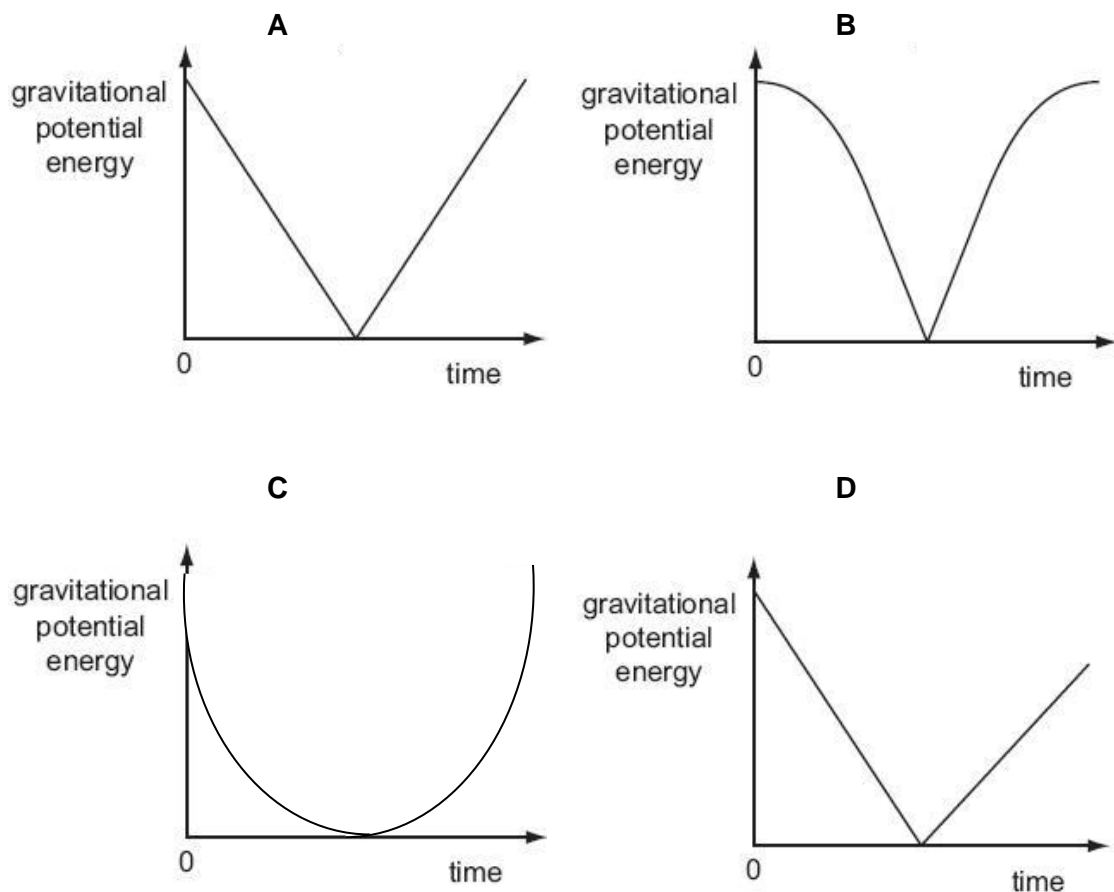
What is the work done by the gas when it is heated and expands to a volume of 6.0 cm^3 ?

- A** 404 μJ **B** 404 mJ **C** 404 J **D** 404 kJ

- 17 A ball is released from rest. It falls vertically, hits the ground and bounces back up. Energy losses are negligible.



Which graph shows how the gravitational potential energy of the ball changes during the bounce?

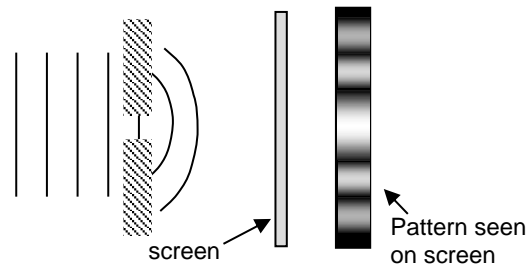


- 18 Polarisation is a phenomenon associated with a certain type of wave.

Which condition must be fulfilled if a wave is to be polarised?

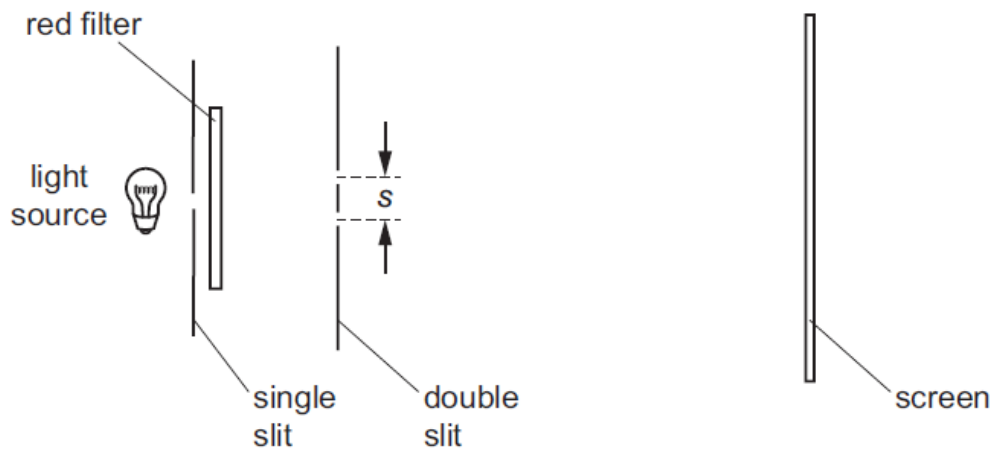
- A It must be a sound wave.
- B It must be a longitudinal wave.
- C It must be a radio wave.
- D It must be a transverse wave.

- 19 A student carried out an experiment on diffraction of water waves in a ripple tank. He passed plane water waves through a single slit, where the wavelength of water waves is comparable to the slit separation. He obtained the following results.



What is the best explanation for the interference pattern seen on the screen?

- A The waves reflected from the surrounding walls.
 - B The waves are not coherent.
 - C There are secondary wavelets within the single slit.
 - D There are secondary wavelengths within the plane wave.
- 20 A student sets up an experiment to investigate double-slit interference of light but finds that the interference fringes observed on the screen are too close to each other to be distinguished.



Which change would help the student to distinguish the fringes?

- A Decrease the distance s between the two slits.
 - B Increase the width of each slit.
 - C Move the screen closer to the light source.
 - D Use a blue filter instead of a red filter.
- 21 Which pair of sources is coherent?
- A Two identical light sources.
 - B Two loudspeakers emitting sounds of frequency f and $2f$.
 - C Two ripple tank dippers oscillating at identical frequencies in antiphase.
 - D Two tuning forks, each producing a single frequency but having a constant frequency difference.

- 22** The current in a component is reduced uniformly from 100 mA to 20 mA over a period of 8.0 s.

What is the charge that flows during this time?

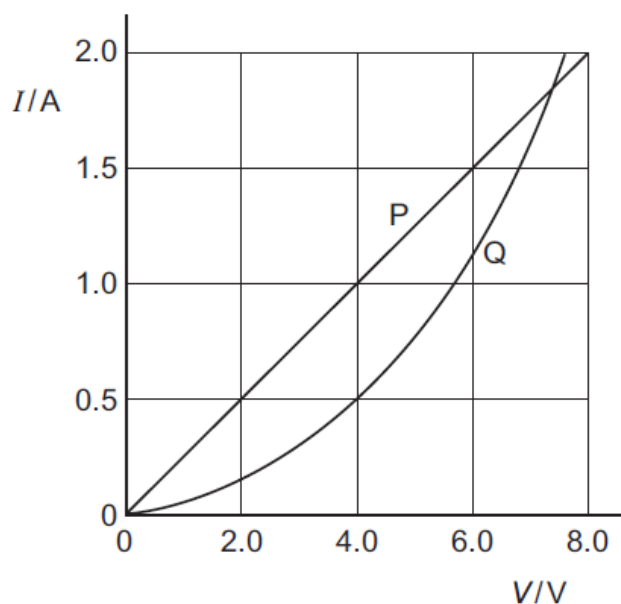
- A** 160 mC **B** 320 mC **C** 480 mC **D** 640 mC

- 23** Two wires made of the same material and of the same length are connected in parallel to the same voltage supply. Wire P has a diameter of 2 mm. Wire Q has a diameter of 1 mm.

What is the ratio of $\frac{\text{current in P}}{\text{current in Q}}$?

- A** $\frac{1}{4}$ **B** $\frac{1}{2}$ **C** 2 **D** 4

- 24** The I - V characteristics of two electrical components P and Q are shown below.



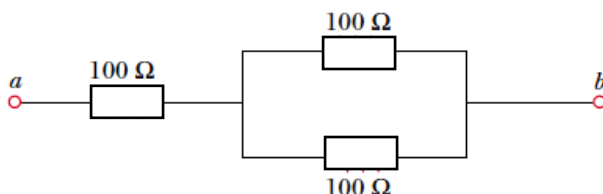
Which statement is correct?

- A** P is a resistor and Q is a filament lamp.
B The resistance of Q increases as the current in it increases
C At 1.9 A the resistance of Q is approximately half that of P.
D At 0.5 A the power dissipated in Q is double that in P.

- 25** The current in a circuit is tripled when a $500\ \Omega$ resistor is connected in parallel with the resistance of the circuit.

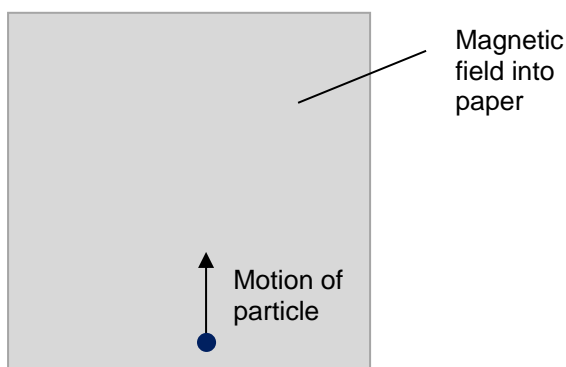
What is the resistance of the circuit in the absence of the $500\ \Omega$ resistor?

- A** $250\ \Omega$ **B** $500\ \Omega$ **C** $1000\ \Omega$ **D** $1500\ \Omega$
- 26** Three $100\ \Omega$ resistors are connected as shown below. The maximum power that can safely be delivered to any one resistor is $25.0\ \text{W}$.



What is the maximum voltage that can be applied to the terminals a and b ?

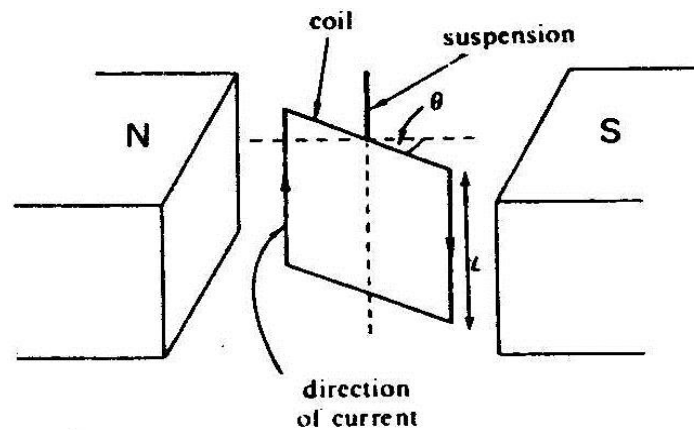
- A** $50\ \text{V}$ **B** $75\ \text{V}$ **C** $100\ \text{V}$ **D** $150\ \text{V}$
- 27** At one instant, a negatively charged particle is moving towards the top of the page.
A magnetic field is directed at right angles to its path into the paper.



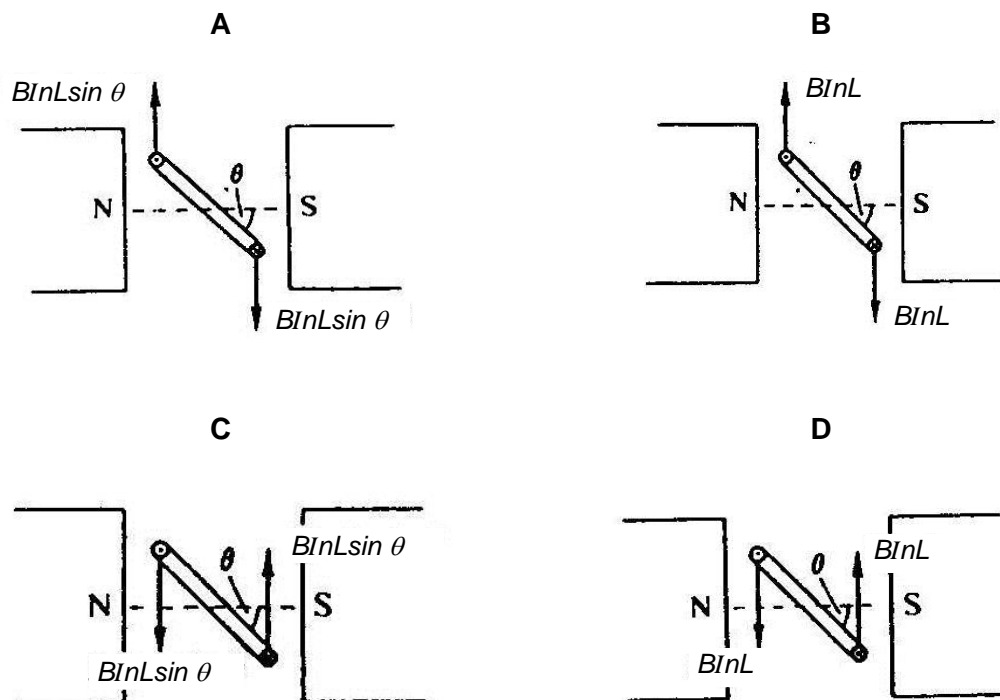
At this instant, in which direction is the force due to the magnetic field on the charged particle?

- A** Into the page.
B To the left
C To the right
D Out of the page

- 28 A current I is carried by a square coil of n turns and side L suspended vertically as shown in a uniform horizontal magnetic field of flux density B .



Which one of the following plan (*top-view*) diagrams correctly shows the magnitude and direction of the forces acting on the vertical sides of the coil?



- 29** Electrons gain kinetic energy and accelerate when a potential difference is applied.

Through what potential difference (p.d.) must electrons be accelerated so they will have

- (a) the same associated wavelength as an x-ray of wavelength 0.150 nm, and
 (b) the same energy as the x-ray of wavelength 0.150 nm?

	p.d. to accelerate electrons to have the same associated wavelength as an x-ray of wavelength 0.150 nm	p.d. to accelerate electrons to have the same energy as the x-ray of 0.150 nm
A	67 V	67 V
B	67 V	8300 V
C	8300 V	67 V
D	8300 V	8300 V

- 30** An atom has a single valence electron. It has ionization energy of 5.9 eV and excitation energies from the ground state equal to 3.0 eV, 5.0 eV and 5.5 eV.

What is the longest wavelength which you would expect to observe in the emission spectrum?

- A** 2.1×10^{-7} m **B** 4.1×10^{-7} m **C** 4.3×10^{-7} m **D** 2.5×10^{-6} m