HWA CHONG INSTITUTION
JC2 Preliminary Examinations
Higher 1

CANDIDATE NAME		**CT GROUP**	**22S**
CENTRE NUMBER		**INDEX NUMBER**	

PHYSICS

8867/01

Paper 1 Multiple Choice

20 September 2023

60 minutes

Additional Materials: Optical Mark Sheet

INSTRUCTIONS TO CANDIDATES

Write in soft pencil.

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

Write your name, CT, NRIC or FIN number on the optical mark sheet (OMS). Shade your NRIC or FIN in the spaces provided.

There are **thirty** questions on this paper. 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 OMS.

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 booklet.

The use of an approved scientific calculator is expected, where appropriate.

Data

speed of light in free space,
$c = 3.00 \times 10^{8}\ \text{m s}^{-1}$

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

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

the Avogadro constant,
$N_A = 6.02 \times 10^{23}\ \text{mol}^{-1}$

gravitational constant,
$G = 6.67 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2}$

acceleration of free fall,
$g = 9.81\ \text{m s}^{-2}$

Formulae

uniformly accelerated motion

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

resistors in series

$$R = R_1 + R_2 + \ldots$$

resistors in parallel

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

1 The SI unit of magnetic flux density is the tesla, T.

What are the base SI units of the tesla?

A kg s^{-2} A^{-1} **B** kg m s^{-2} A^{-1} **C** kg s^{2} A^{-1} **D** kg m^{2} s^{-2} A^{-1}

2 A point source is emitting a steady sound wave uniformly in all directions.

A sound intensity meter placed at a distance (2.0 ± 0.1) m away from the source detects an intensity of (0.25 ± 0.05) Wm^{-2}.

The equation to determine the intensity I of the light at distance r is given by

$$I = \frac{P}{4\pi r^2}$$, where P is the power of the source.

What is the uncertainty of the power of the source?

A 0.1 W **B** 0.3 W **C** 3 W **D** 4 W

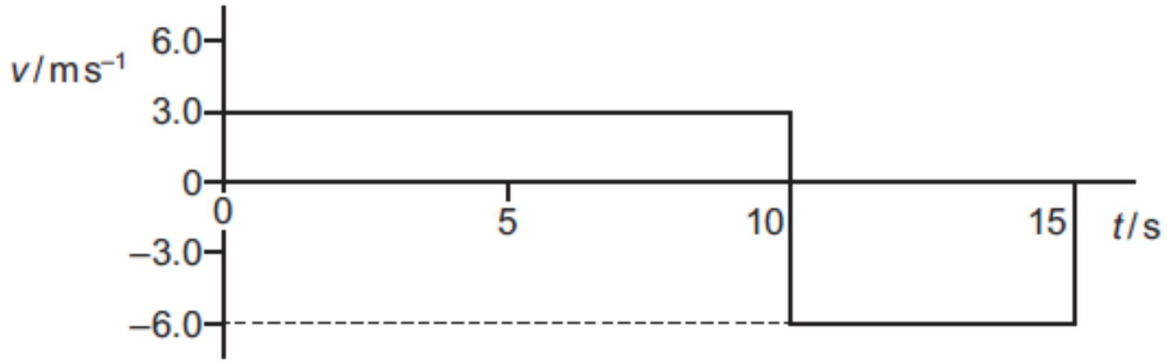
3 Four students measured and calculated the electronic charge, e. Their results are presented in the table as shown below.

Which student obtained a set of results that were accurate but least precise?

Student	electronic charge, e / x 10^{-19} C				
A	1.62	1.59	1.59	1.61	1.60
B	1.57	1.63	1.64	1.58	1.59
C	1.59	1.60	1.58	1.57	1.57
D	1.58	1.62	1.65	1.59	1.66

4 A radio-controlled toy car travels along a straight line for a time of 15 s.

The variation with time t of the velocity v of the car is shown.



What is the average velocity of the toy car for the journey shown by the graph?

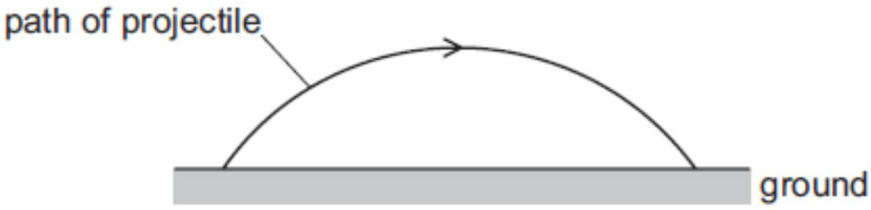
A -1.5 m s^{-1} **B** 0.0 m s^{-1} **C** 4.0 m s^{-1} **D** 4.5 m s^{-1}

5 A train, initially at rest at a station, has a uniform acceleration of 0.20 m s^{-2} until it reaches a speed of 20 m s^{-1}. It travels for a time at this constant speed and then has a uniform deceleration of 0.40 m s^{-2} until it comes to rest at the next station. The distance between the two stations is 3000 m.

What is the time taken by the train to travel between the two stations?

A 75 s **B** 150 s **C** 230 s **D** 300 s

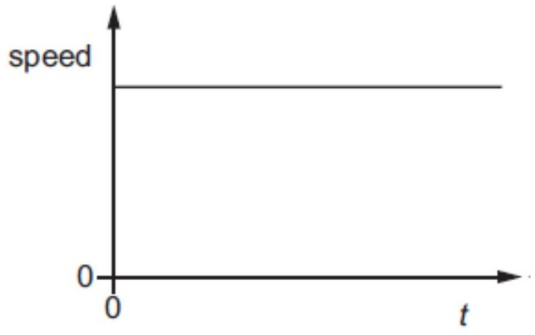
6 A projectile is launched at an angle to the horizontal at time $t = 0$. It travels over horizontal ground, as shown.



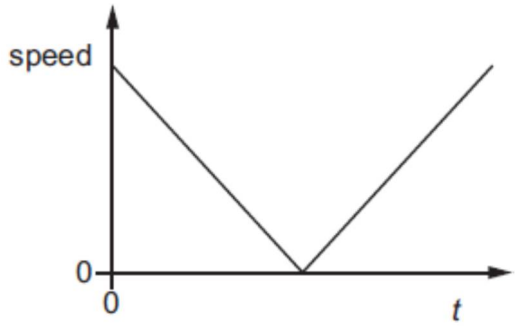
Air resistance is negligible.

Which graph best shows the variation with t of the speed of the projectile from when it is launched to when it lands on the ground?

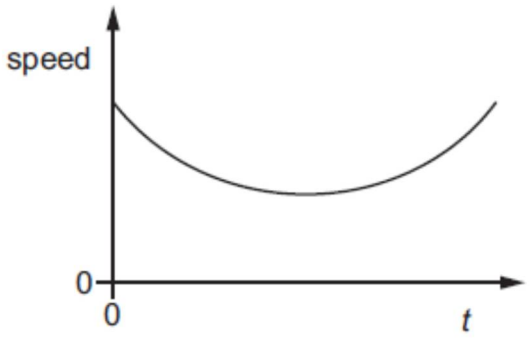
A



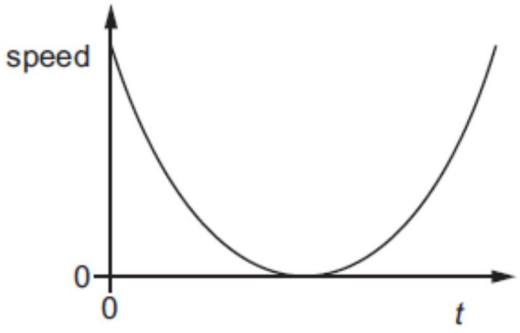
B



C



D



7 A block is placed on the floor in an ascending lift.

When the lift is slowing down, the magnitude of the force exerted on the block by the floor is always

A equal to the magnitude of its weight.

B less than the magnitude of its weight.

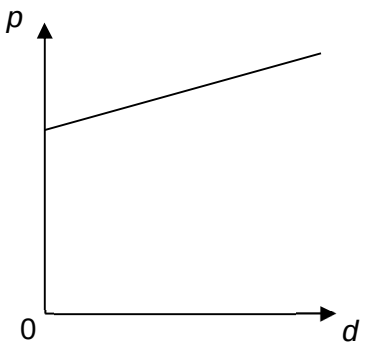
C greater than the magnitude of its weight.

D different from the magnitude of the force exerted on the lift floor by the block.

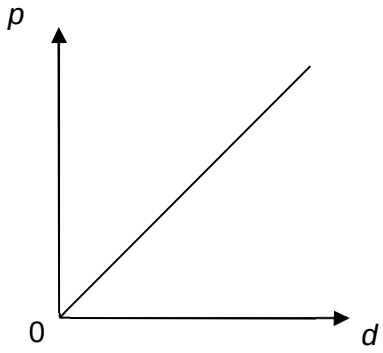
8 A particle is accelerated from rest by a constant force.

Which of the following graphs best represents the momentum p of the particle as a function of distance d travelled?

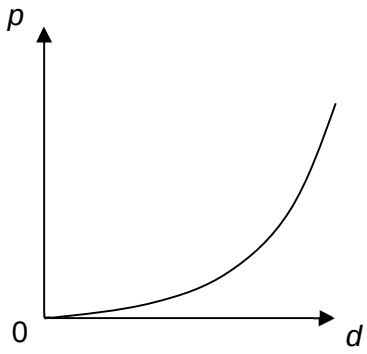
A



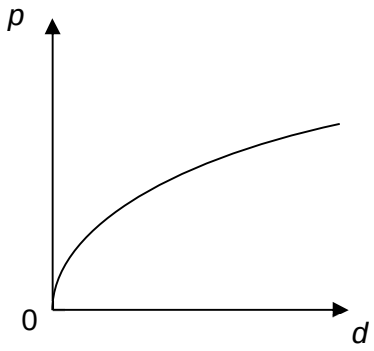
B



C



D

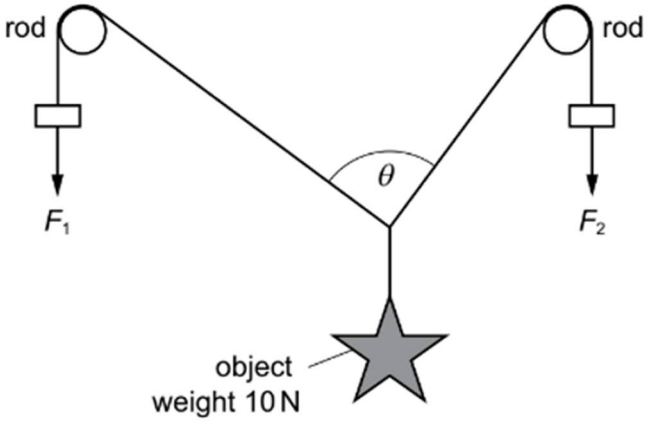


9 A hose directs a stream of water of speed travelling horizontally at 8.0 m s^{-1} onto a wall. The water flows vertically down the wall without splashing after the impact.

What is the pressure exerted on the wall by the water? (density of water = 1000 kg m^{-3})

A 8.0 kPa **B** 64 kPa **C** 128 kPa **D** 256 kPa

10 An object hangs by means of two cords around two rods, as shown in diagram below.



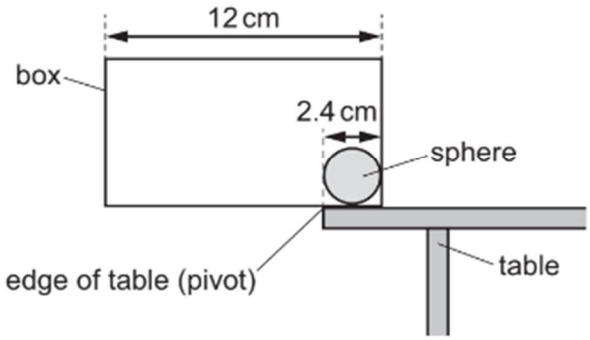
The object is held in equilibrium by the forces F_1 and F_2. The object weights 10 N. There is negligible friction between the rods and cords.

Which row of the table gives an angle θ of 90°?

	F_1 / N	F_2 / N
A	4.0	6.0
B	6.0	4.0
C	6.0	8.0
D	8.0	6.0

11 A box of length 12 cm and weight 0.43 N is placed on a horizontal table, with the greater part of its length overhanging the edge of the table. The edge of the table acts as a pivot. The centre of gravity of the box is at its geometric centre.

To balance the box, a uniform sphere of diameter 2.4 cm is placed inside the box, touching one end, as shown.

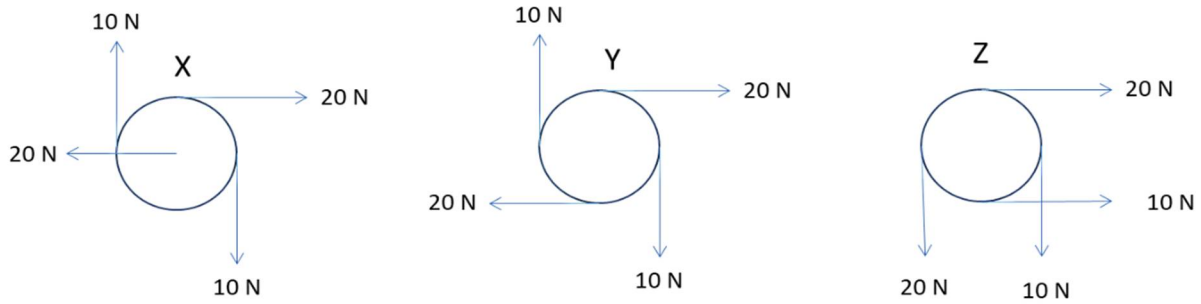


Assume that the forces acting on the box are in the plane of the diagram.

What is the minimum mass of the sphere that is needed to maintain the system in equilibrium?

A 0.066 kg **B** 0.13 kg **C** 0.22 kg **D** 1.3 kg

12 The diagrams show four forces applied to each of the 3 circular discs, X, Y and Z.



Which of the disc(s) will experience a resultant torque and no resultant force?

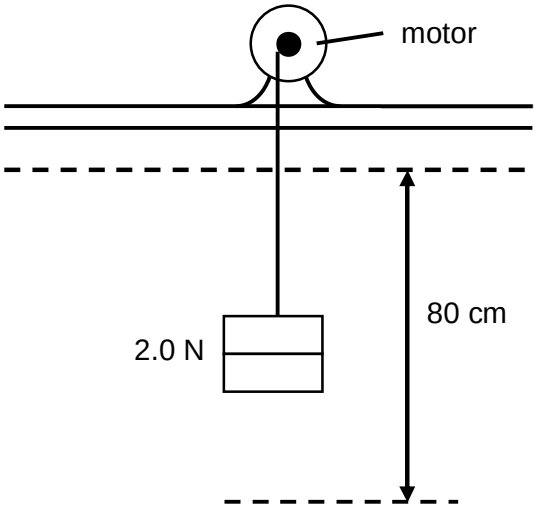
A X only.

B Y only.

C X and Y only.

D X, Y and Z.

13 A small electric motor is used to raise a weight of 2.0 N at constant speed through a vertical height of 80 cm in 4.0 s.

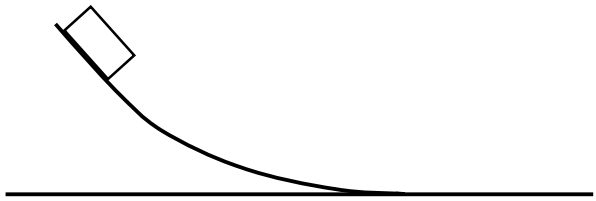


The efficiency of the motor is 20 %.

What is the electrical power supplied to the motor?

A 0.080 W **B** 0.80 W **C** 2.0 W **D** 200 W

14 A 50 kg block is released from rest at a height of 5.00 m above the ground. It then travels a distance of 10.0 m along a curved slope to the ground as shown in the figure below. The final speed of the block at the end of the slope is only 4.90 m s^{-1} because a constant resistive force acts on it during the descent.



What is the resistive force acting on the block?

A 185 N

B 600 N

C 2450 N

D 22500 N

15 Which word equation is **not** required to derive power as the product of force and velocity?

A force = mass × acceleration

B $\text{power} = \frac{\text{work done}}{\text{time}}$

C $\text{velocity} = \frac{\text{displacement}}{\text{time}}$

D work done = force × displacement in the direction of the force

16 What is the angular speed of a point on the Earth's equator as a result of the Earth's rotation about its axis? (radius of the Earth = 6.38×10^6 m)

A 3.4×10^{-10} rad s^{-1}

B 6.8×10^{-10} rad s^{-1}

C 3.6×10^{-5} rad s^{-1}

D 7.3×10^{-5} rad s^{-1}

17 A body is undergoing uniform circular motion with linear speed v and angular speed ω.

What are the magnitudes of the radius of the circular motion r, the time to complete one revolution T, and the acceleration a?

	radius r	period T	acceleration a
A	$\frac{\omega}{v}$	$\frac{2\pi}{\omega}$	$v\omega$
B	$\frac{v}{\omega}$	$\frac{1}{\omega}$	$v\omega$
C	$\frac{v}{\omega}$	$\frac{2\pi}{\omega}$	$\frac{v^3}{\omega}$
D	$\frac{v}{\omega}$	$\frac{2\pi}{\omega}$	$v\omega$

18 Io is one of Jupiter's four Galilean satellites, so called as they were discovered by Galileo Galilei. The radius of the Io's orbit about Jupiter is 4.22×10^8 m. Io takes 1.77 Earth days to orbit Juptier.

What is the mass of Jupiter?

A 6.1×10^{26} kg

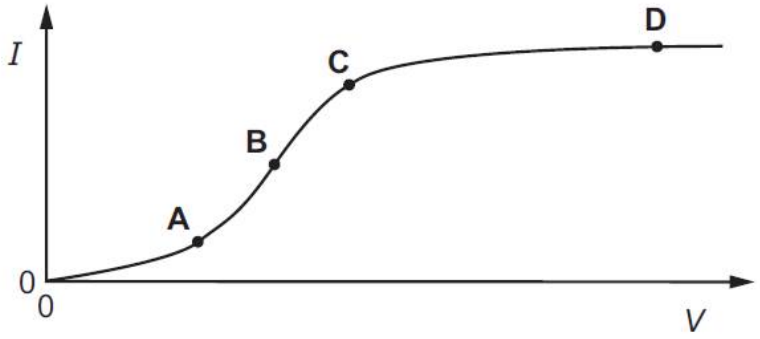
B 1.9×10^{27} kg

C 1.1×10^{30} kg

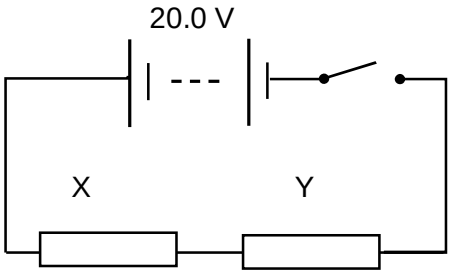
D 3.1×10^{30} kg

19 The graph shows how the electric current I through a conducting liquid varies with the potential difference V across it.

At which point on the graph does the liquid have the smallest resistance?



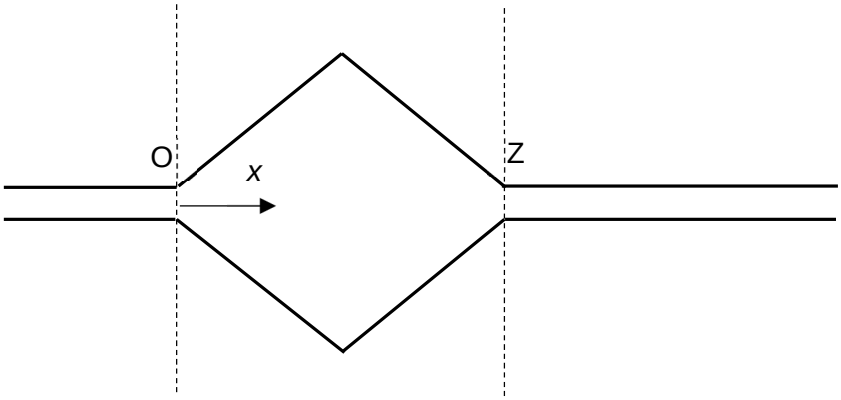
20 When fixed resistors X and Y are connected separately to a potential difference of 10.0 V, the power dissipated in them are 100 W and 50 W respectively.
Two resistors are connected in series to a 20.0 V power supply with negligible internal resistance.



Which of the following best describes the power dissipated in the resistors when the switch is closed?

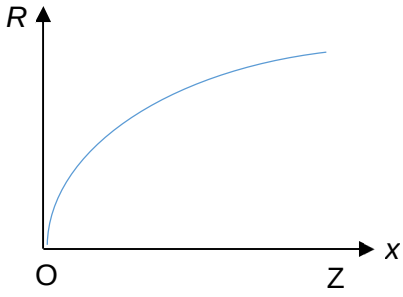
	power dissipated in resistor X	power dissipated in resistor Y
A	greater than 100 W	smaller than 50 W
B	greater than 100 W	greater than 50 W
C	smaller than 100 W	greater than 50 W
D	smaller than 100 W	smaller than 50 W

21 A flat conductor of uniform thickness and resistivity, has the shape shown below.

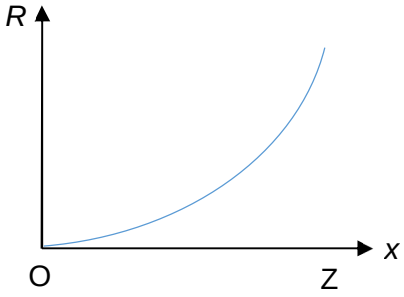


Which of the following graphs best represents the variation of the resistance *R* with the distance x between OZ?

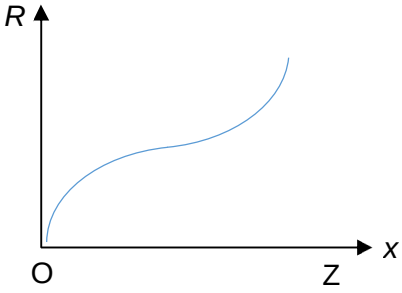
A



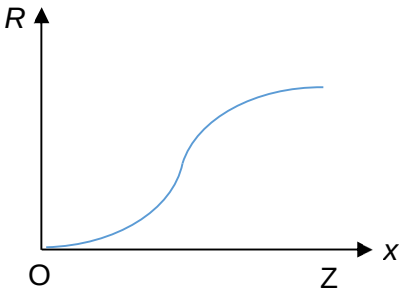
B



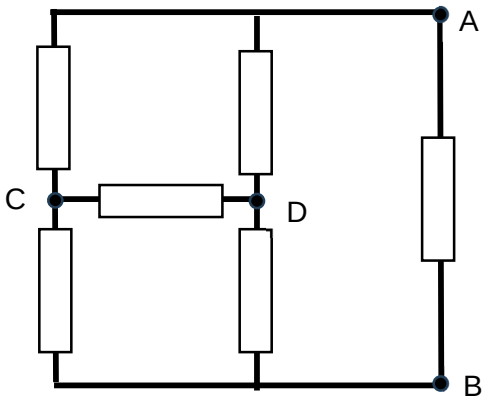
C



D



22 Six identical resistors are arranged in a circuit as shown below. Each resistor has a resistance of 6.0 Ω.



What is the effective resistance between points A and B?

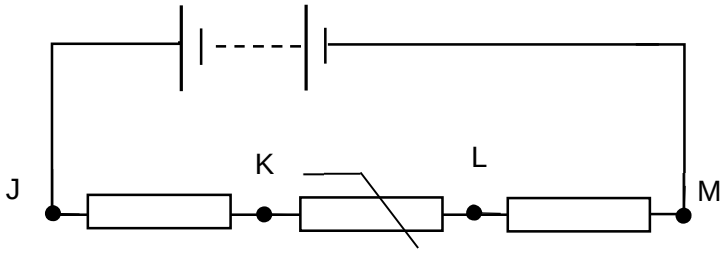
A 2.0 Ω

B 3.0 Ω

C 4.0 Ω

D 6.0 Ω

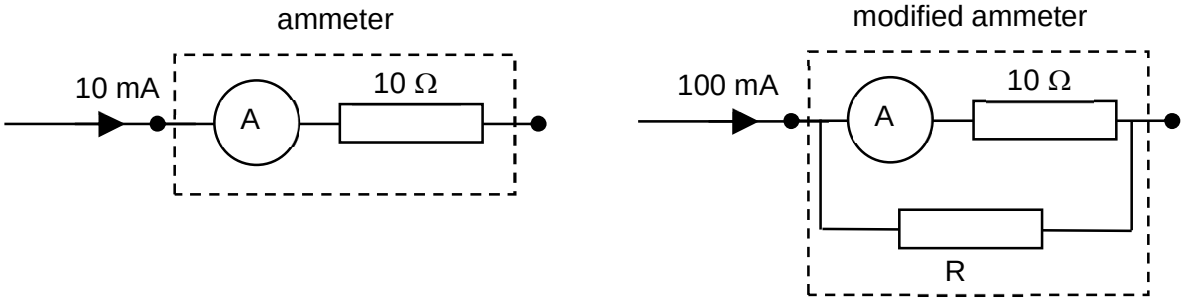
23 Two fixed resistors and a negative-thermal-coefficient (NTC) thermistor are connected in series to a power supply with negligible internal resistance.



Which of the following best describes the potential differences between the points J & K and J & L when the temperature of the thermistor increases?

	potential difference between the points J & K	potential difference between the points J & L
A	increases	increases
B	increases	decreases
C	decreases	decreases
D	decreases	increases

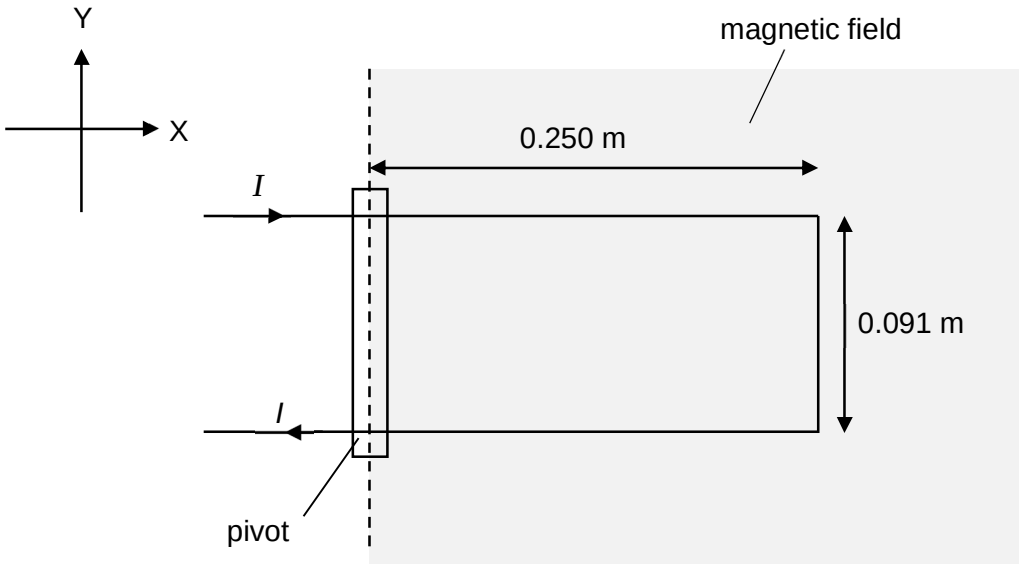
24 An analogue milliameter of resistance 10 Ω, which gives a full-scale deflection when a current of 10 mA flows through in a circuit as shown on the left diagram. It can be modified to gives a full-scale deflection when a current of 100 mA flows in another circuit when it has a resistor in parallel to itself as shown on the right diagram.



What is the resistance R of the added resistor?

A 0.9 Ω **B** 1.0 Ω **C** 1.1 Ω **D** 1.2 Ω

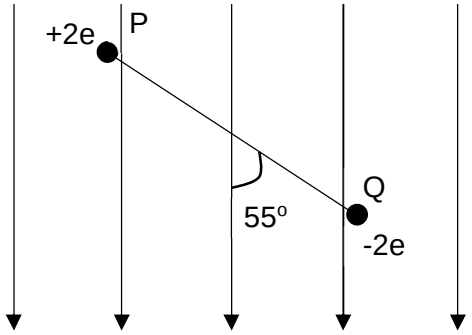
25 A current balance is used to determine the magnetic flux density of a uniform magnetic field.
The U-shaped wire has length of 0.250 m and the arms are 0.091 m apart, as shown in the diagram below.
When a current I of 1.60 A passed through the current balance, the U-shaped wire experiences a turning moment of value 7.2 x 10^{-3} N m about the pivot.



What is the magnitude and direction of the magnetic flux density?

	Magnitude	Direction
A	0.072 T	parallel to X
B	0.198 T	parallel to X
C	0.072 T	parallel to Y
D	0.198 T	parallel to Y

26 Two ions P and Q are linked to form a molecule and are situated in a uniform electric field, as shown in the figure below.



electric field

The electric field strength is 1.5 x 10^5 V m^{-1}. The line joining P and Q is at an angle of 55° to the direction of the electric field.

The distance between P and Q is 4.0 x 10^{-12} m. The charge on P is +2e and the charge on Q is -2e. The resultant torque acting on the molecule PQ is

	Magnitude	**Direction**
A	1.1 x 10^{-25} N	clockwise
B	1.6 x 10^{-25} N	clockwise
C	1.1 x 10^{-25} N	anti-clockwise
D	1.6 x 10^{-25} N	anti-clockwise

27 An electron of mass *m* and charge *e*, moving with uniform speed *v* at right angles to a magnetic field of flux density *B* will move in a circular trajectory with radius given by

A $\frac{Be}{mv}$ **B** $\frac{mv}{Be}$ **C** $\frac{mv^2}{Be}$ **D** $\frac{1}{2}\frac{mv}{Be}$

28 In an experiment to learn more about the structure of the atom, Geiger and Marsden fired α-particles at a thin sheet of gold foil. They found that most of the α-particles passed through the gold foil with no significant deviation, although a very tiny minority were deflected through large angles, and some were even back-scattered (deflected by more than 90°).

The experiment is repeated with a foil made from a heavier isotope of gold.

How would the results be different?

A A much greater proportion of the α-particles would be back-scattered.

B A much greater proportion of the α-particles would deflect through a large angle.

C A greater proportion of the α-particles would pass through with no significant deviation.

D There would be no significant change.

29 Fig. 29 is a graph for a group of naturally-occurring nuclides.

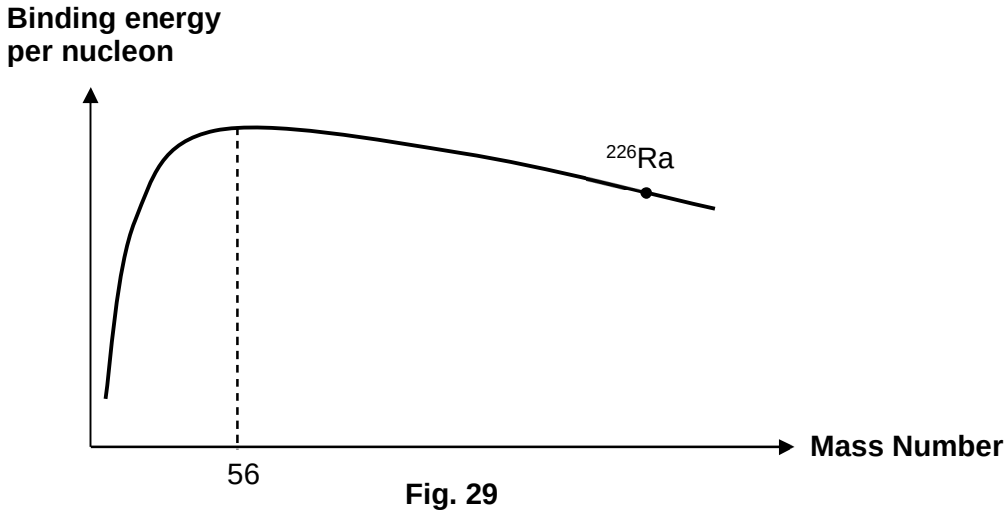


Fig. 29

Which of the following statements is correct?

A Nuclei with high mass numbers undergo fusion with release of energy.

B When a nucleus of mass number 56 is formed, it releases the greatest amount of binding energy compared to the formation of nuclei of other mass numbers.

C When the nuclide ^{226}Ra undergoes fission, the binding energy per nucleon is reduced.

D When small nuclei undergo fusion, the products have higher binding energy per nucleon.

30 A sample of material contains 64 μg of a radioactive isotope. After 60 minutes, 2.0 μg of this isotope remains. Calculate the half-life of this isotope.

A 20 min **B** 15 min **C** 12 min **D** 10 min

END OF PAPER