NAME: _____ CLASS: _____ INDEX: _____

CATHOLIC JUNIOR COLLEGE
JC2 Preliminary EXAMINATIONS
Higher 1

PHYSICS

8866/01
Paper 1
1 September 2015
60 min

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, tutorial group and index number on this cover page.

Write and/or shade your name, NRIC / FIN number and HT group on the Answer Sheet (OMR sheet), unless this has been done for you.
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are a total of **30 Multiple Choice Questions (MCQs)** in 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 Answer Sheet (OMR sheet) provided.

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 booklet.
Calculators may be used.

This document consists of **14** printed pages.

PHYSICS DATA:

speed of light in free space,	c	=	3.00×10^{8} m s^{-1}
permeability of free space,	μ_o	=	$4\pi \times 10^{-7}$ H m^{-1}
elementary charge,	e	=	1.60×10^{-19} C
the Planck constant,	h	=	6.63×10^{-34} J s
unified atomic mass constant,	u	=	1.66×10^{-27} kg
rest mass of electron,	m_e	=	9.11×10^{-31} kg
rest mass of proton,	m_p	=	1.67×10^{-27} kg
acceleration of free fall,	g	=	9.81 m s^{-2}

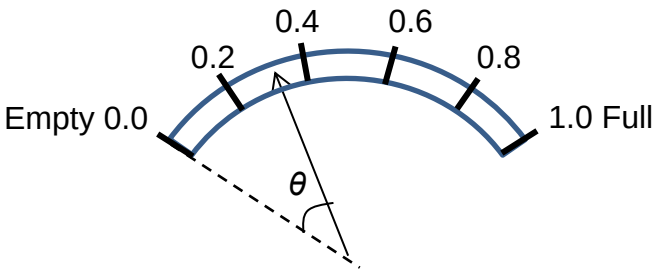
PHYSICS FORMULAE:

uniformly accelerated motion,	s	=	$u\,t + \frac{1}{2} a\,t^2$
	v^2	=	$u^2 + 2\,a\,s$
work done on / by a gas,	W	=	$p\,\Delta V$
Hydrostatic pressure	p	=	$\rho\,g\,h$
resistors in series,	R	=	$R_1 + R_2 + \ldots$
resistors in parallel,	$\frac{1}{R}$	=	$\frac{1}{R_1} + \frac{1}{R_2} + \ldots$

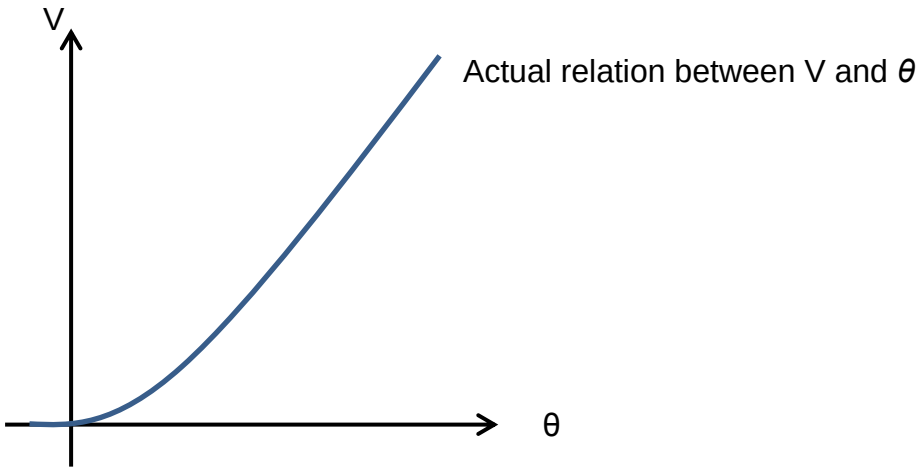
1 Estimate the time taken for a laser beam to travel from a laser gun at the grandstand to the goalkeeper.

A 3 ns **B** 300 ns **C** 3 ps **D** 300 ps

2 A petrol gauge in a car indicates the volume *V* of fuel in the tank. *V* is given by the angular deflection *θ* of the pointer on a dial such that the scale is linear.



The graph below shows the actual variation of the volume *V* of fuel with the angular deflection *θ*.

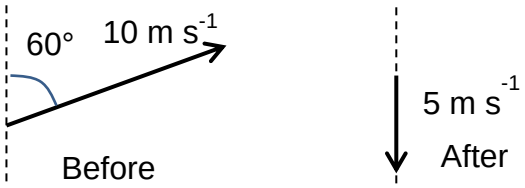


Which of the following statements are **not** correct?

P: The petrol gauge is most sensitive when the tank has low fuel level.
Q: The petrol gauge is most sensitive when the tank has high fuel level.
R: The readings of V from the scale results in a random error.
S: The readings of V from the scale results in a systematic error

A P & R **B** P & S **C** Q & R **D** Q & S

3 Figure below shows the movement of a vehicle. It is initially moving at 10 m s^{-1} with a bearing of 60° and after 2 seconds it moves in the bearing of 180° at 5 m s^{-1}.



What is the direction and magnitude of the change in velocity?

	Direction	Magnitude/ m s^{-1}
A	180°	5.0
B	90°	8.7
C	123°	11
D	221°	13

4 A ball, dropped from a building, is timed to take (4.5 ± 0.1) s to fall to the ground. If the acceleration of free fall is taken to be 10 m s^{-2}, the calculated height of the building should be quoted as

A (101 $\pm$ 2) m

B (101 $\pm$ 5) m

C (101.3 $\pm$ 2.3) m

D (101.3 $\pm$ 4.5) m

5 A body is thrown vertically upwards in a medium in which the viscous drag cannot be neglected. If the times of flight for the upward motion t_u and the downward motion t_d (to return to the same level) are compared, then

A $t_d < t_u$, because the average speed is smaller during its downward motion as compared to its upwards motion.

B $t_d < t_u$, because the net accelerating force during its downward motion is greater than the net decelerating force during upwards motion.

C $t_d > t_u$, because the viscous force is greater in the downward motion as compared to its upwards motion.

D $t_d > t_u$, because the net accelerating force during its downward motion is smaller than the net decelerating force during upwards motion.

6 When a man is standing in an ascending lift that has a constant upward acceleration, the magnitude of the force exerted on the man's feet by the floor is always

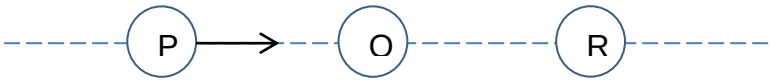
A equal to the magnitude of his weight.

B less than the magnitude of his weight.

C greater than the magnitude of his weight.

D greater than his weight only when the acceleration is greater than g.

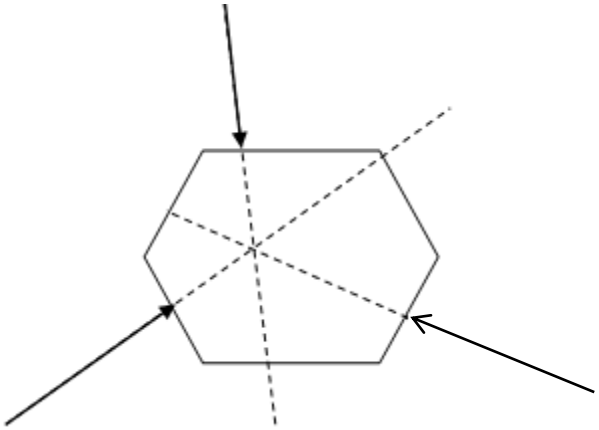
7 Three identical stationary discs, P, Q and R are placed in a line on a horizontal, flat and frictionless surface. Disc P is projected straight towards disc Q.



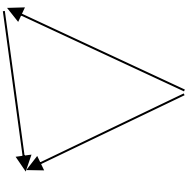
If all consequent collisions are perfectly elastic, what will be the final motion of the three spheres?

	P	Q	R
A	stationary	stationary	moving right
B	moving left	moving left	moving right
C	moving left	stationary	moving right
D	moving right	moving right	stationary

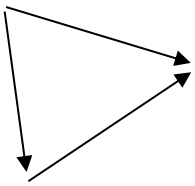
8 Three forces act on different parts of a rigid body as shown in the diagram below. Which of the following vector diagram represents the body in equilibrium?



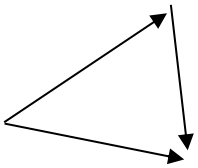
A



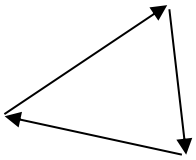
B



C



D



9 A smooth uniform rod of weight W rests on the rim of a smooth, hemispherical bowl as shown in the diagram below. What is the magnitude of the normal contact force by the rim of the bowl on the rod?

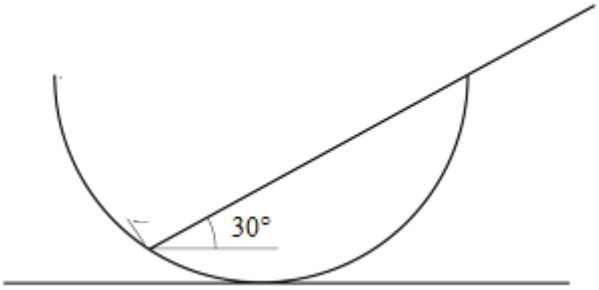
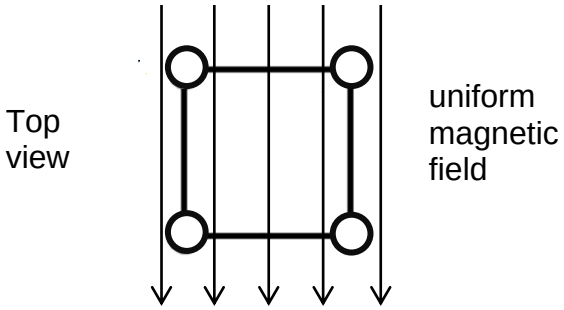


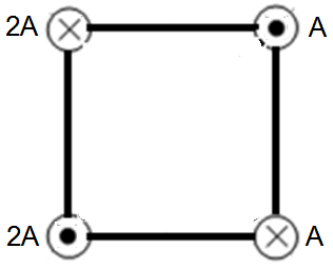
Diagram is drawn to scale

A 0.4 W **B** 0.6 W **C** 0.9 W **D** W

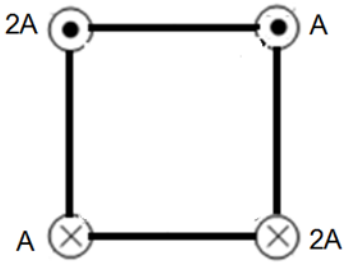
10 Four long straight vertical wires carry currents are attached to the corners of a rigid square. A uniform magnetic field is applied in the direction as shown. Which of the following configurations is in equilibrium?



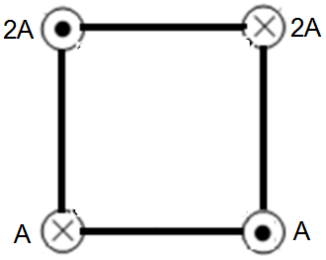
A



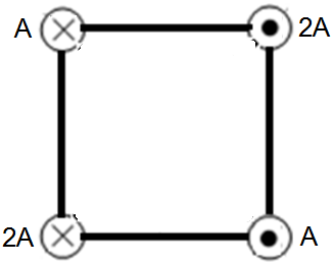
B



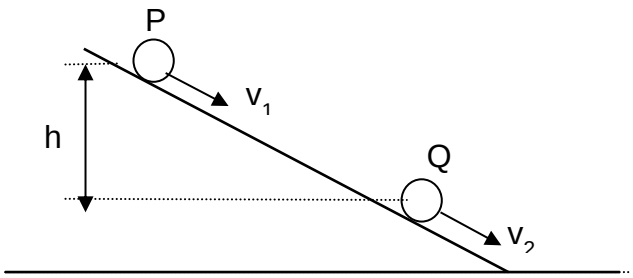
C



D



11 A particle of mass m is moving down a rough incline. At position P, its velocity is v_1 while at position Q, a vertical distance h down the incline, its velocity is v_2. What is the work done against friction in going from P to Q? (Take g to be acceleration due to gravity.)



A $\frac{1}{2} m v_2^2 - \frac{1}{2} m v_1^2$

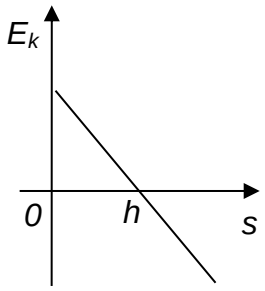
B mgh

C $mgh - (\frac{1}{2} mv_2^2 - \frac{1}{2} m v_1^2)$

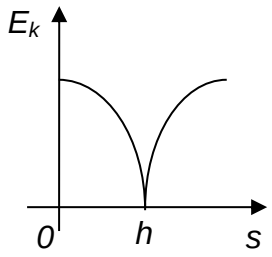
D $mgh - \frac{1}{2} mv_1^2$

12 A ball, thrown vertically upwards, rises to a height *h* and then falls to its starting point. Air resistance may be taken as negligible. Which graph best shows the variation of kinetic energy E_k of the ball with the distance *s* traveled?

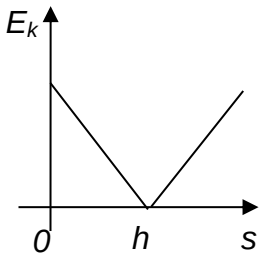
A



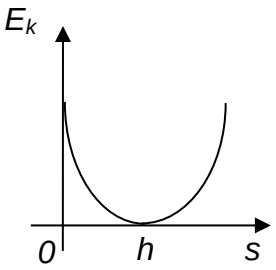
B



C



D



13 An electric motor is used to haul a cage of mass 100 kg up a mine shaft through a vertical height of 1000 m in 90 s. What will be the electrical power required if the overall efficient is 70 %?

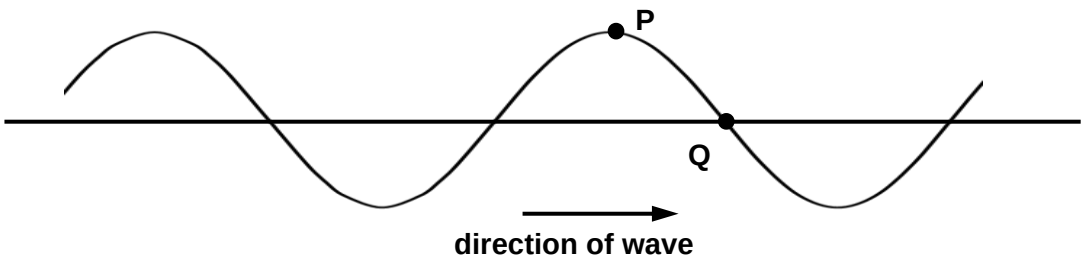
A 1.6 kW

B 7.8 kW

C 15.6 kW

D 952 kW

14 The diagram below shows a transverse wave on a rope. The wave is travelling from left to right. At the instant shown, the points **P** and **Q** have maximum and zero displacement respectively.



Which of the following describes the direction of motion of the points **P** and **Q** at *this instant*?

	point **P**	*point* **Q**
A	downwards	stationary
B	upwards	stationary
C	stationary	downwards
D	stationary	upwards

15 A plane wave of amplitude A is incident on a surface of area S placed so that it is perpendicular to the direction of travel of the wave. The energy per unit time intercepted by the surface is E.

The amplitude of the wave is doubled and the area of the surface is reduced by half.

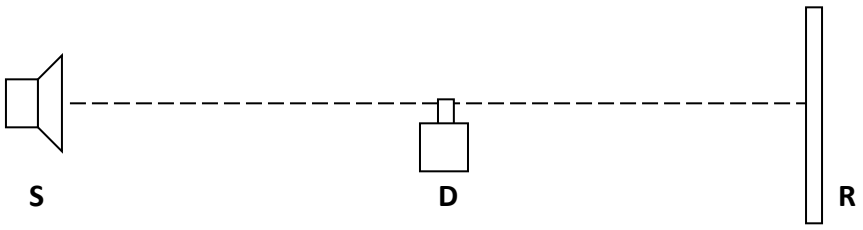
How much energy per unit time is intercepted by this smaller surface?

A $4E$ **B** $2E$ **C** E **D** $E/2$

16 Plane waves of wavelength λ in a ripple tank approach a straight barrier parallel to the wave crests. There is a gap of width w in the middle of the barrier. Which of the following λ and w will produce the largest diffraction?

	λ / cm	w / cm
A	0.5	2.0
B	0.5	4.0
C	1.5	2.0
D	1.5	4.0

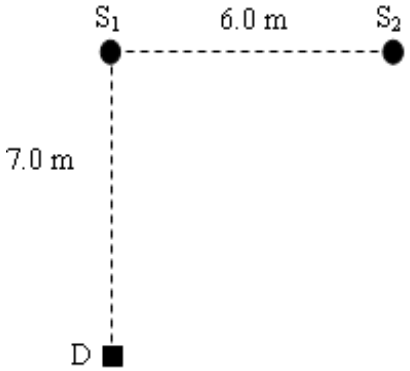
17 A microwave source **S** is placed in front of a detector **D**, and a metal reflecting screen **R** is placed beyond **D** such that its plane is perpendicular to the line joining **S** to **D**.
As the detector is moved slowly away from the source, it registers a series of maxima and minima.



It is observed that the detector moved through a distance of 5.6 cm between the first and fifth minimum. What is the frequency of the microwaves in GHz?

A 5.4 **B** 10.7 **C** 13.4 **D** 27.5

18 Two wave generators S_1 and S_2 produce water waves of wavelength 2.0 m. They are placed 6.0 m apart as shown and are operated in phase. A sensor D which measures the amplitude of water waves is 7.0 m away from S_1 as shown in the diagram below.



The shortest distance D could be moved along the straight line S_1D in order to detect large amplitude of the resultant wave motion is

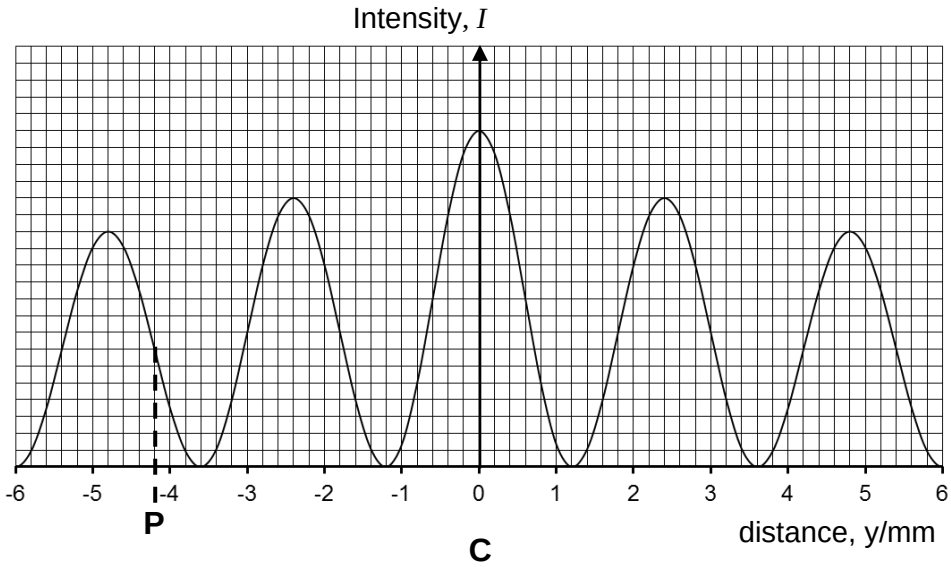
A 1.0 m away from S_1

B 3.0 m away from S_1

C 1.0 m towards S_1

D 3.0 m towards S_1

19 In a Young double slit experiment, coherent monochromatic light is incident normally on a double slit. The figure bellows shows the variation with distance from **C** of the intensity I of the light on the screen, where **C** is the central bright fringe on the screen.



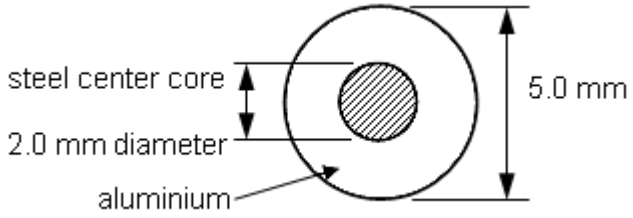
If **P** is a point on the screen and its position is indicated in the figure above, what is the phase angle between the waves from the double slit when the waves meet at **P**?

A $\frac{\pi}{2}$ **B** $\frac{3}{4}\pi$ **C** $\frac{5}{4}\pi$ **D** $\frac{3}{2}\pi$

20 A heater of resistance 5.0 Ω dissipates 125 W when current flows through it. The amount of energy converted to heat when 0.4 C of charge passes through it is

A 2 J **B** 10 J **C** 50 J **D** 625 J

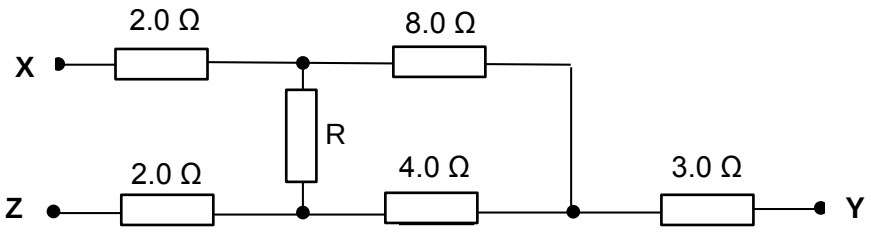
21 A 5.0 mm thick wire comprises a steel core of diameter 2.0 mm surrounded by a coating of aluminium as shown in the figure below.



The resistivity of steel and aluminium are 1.0 x 10^{-7} Ω m and 2.8 x 10^{-8} Ω respectively. What is the resistance of a length of 1.0 m of such a wire?

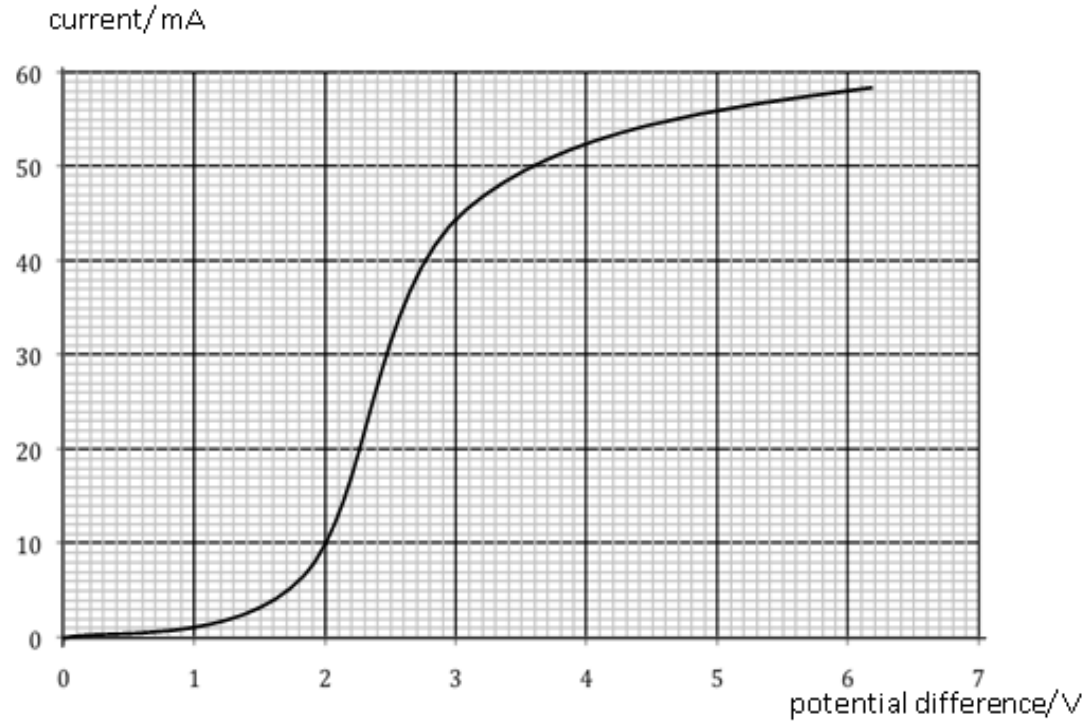
A 0.88 mΩ **B** 1.6 mΩ **C** 3.5 mΩ **D** 34 mΩ

22 The diagram shows a network of six resistors. A multi-meter measures the resistance between X and Z as 8.0 Ω. What is the value of resistance R?



A 2.0 Ω **B** 4.0 Ω **C** 6.0 Ω **D** 8.0 Ω

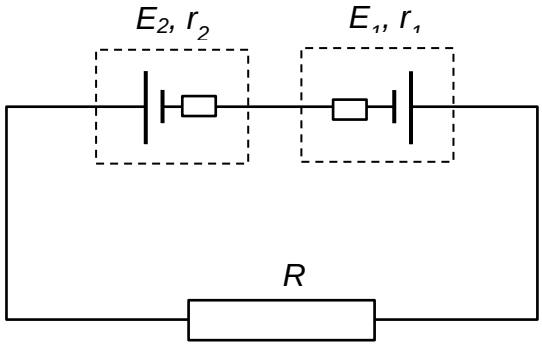
23 A graph of current against potential difference for a component is given below.



What is the potential difference across the component when its resistance is at its lowest?

A 0.90 V **B** 2.50 V **C** 3.00 V **D** 5.00 V

24 Two cells of emfs E_1 and E_2 , and internal resistances r_1 and r_2 , are connected to a load resistance R in the circuit shown.

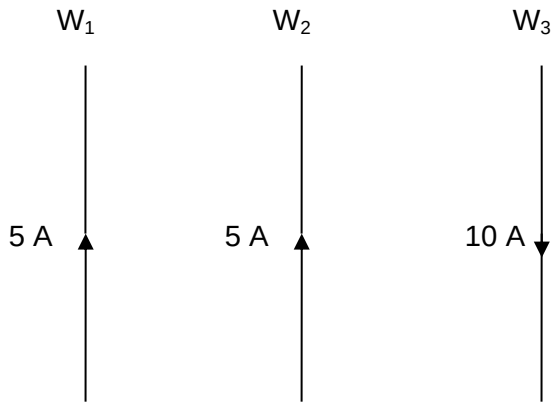


If the current flowing in the circuit is I and $E_1 < E_2$, what is the magnitude of the terminal p.d. across the cell ***E₁***?

A $E_1 - Ir_1$ **B** $E_1 + Ir_1$

C $E_2 - I(r_1 + r_2 + R)$ **D** $E_2 + Ir_2 - IR$

25 W_1, W_2 and W_3 are three long parallel wires carrying currents in a vertical plane as shown.



The resultant force on wire W_2 is

A zero

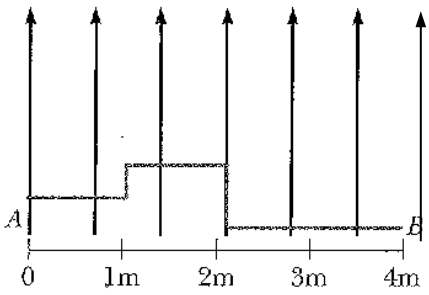
B perpendicular to the plane of the paper

C towards W_1

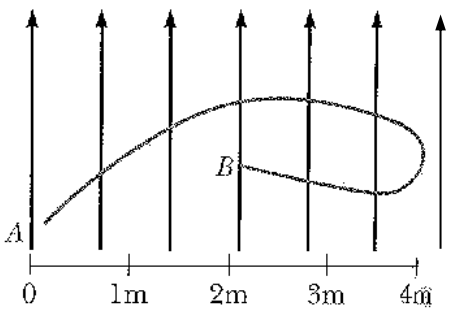
D towards W_3

26 The four wires shown in the diagrams below all carry the same current from point **A** to point **B** through the same magnetic field as indicated by the arrows.
Which wire experiences the greatest magnetic force?

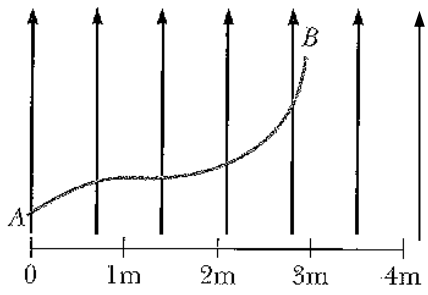
A



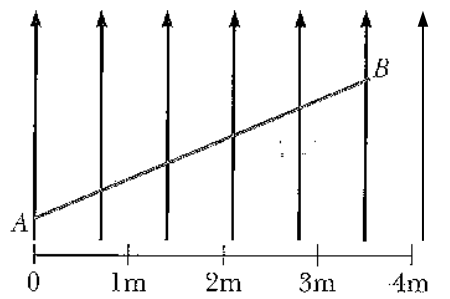
B



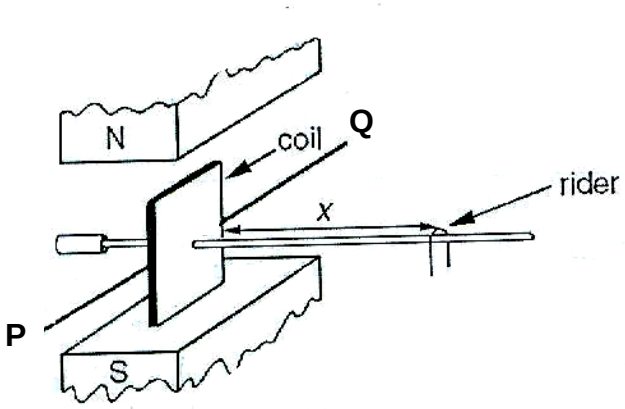
C



D



27 A small square coil of *N* turns has sides of length *L* and is mounted so that it can pivot freely about a horizontal axis **PQ**, parallel to one pair of sides of the coil, through its centre as shown in the diagram above. The coil is situated between the poles of a magnet which produces a uniform magnetic field of flux density *B*.



The coil is maintained in a vertical plane by moving a rider of mass *M* along a horizontal beam attached to the coil. When a current I flows through the coil, equilibrium is restored by placing the rider a distance *x* along the beam from the coil.
What is the expression for *B*?

A $\frac{Mg}{ILN}$ **B** $\frac{Mgx}{2IL^2N}$ **C** $\frac{Mgx}{IL^2N}$ **D** $\frac{2Mgx}{IL^2N}$

28 The wave nature of electrons is suggested by experiments on

A line spectra of atoms
B measuring maximum kinetic energy of emitted electrons
C the photoelectric effect
D electron diffraction by a crystalline material

29 Transitions between three energy levels in a particular atom give rise to three spectra lines of wavelengths in decreasing magnitudes, λ_1, λ_2 and λ_3.
Which one of the following equations correctly relates λ_1, λ_2 and λ_3?

A $\frac{1}{\lambda_3}=\frac{1}{\lambda_2}-\frac{1}{\lambda_1}$ **B** $\frac{1}{\lambda_3}=\frac{1}{\lambda_2}+\frac{1}{\lambda_1}$ **C** $\frac{1}{\lambda_3}=\frac{1}{\lambda_1}-\frac{1}{\lambda_2}$ **D** $\lambda_1=\lambda_2+\lambda_3$

30 What is the de Broglie wavelength of a particle of mass m and kinetic energy E? [h is the Planck constant]

A $h\sqrt{2mE}$ **B** $\frac{\sqrt{2mE}}{h}$ **C** $\frac{h}{\sqrt{2mE}}$ **D** $\frac{h}{\sqrt{mE}}$

End of Paper -