H

NATIONAL JUNIOR COLLEGE

PRELIMINARY EXAMINATIONS

Higher **1**

CANDIDATE NAME

SUBJECT CLASS

REGISTRATION NUMBER

PHYSICS

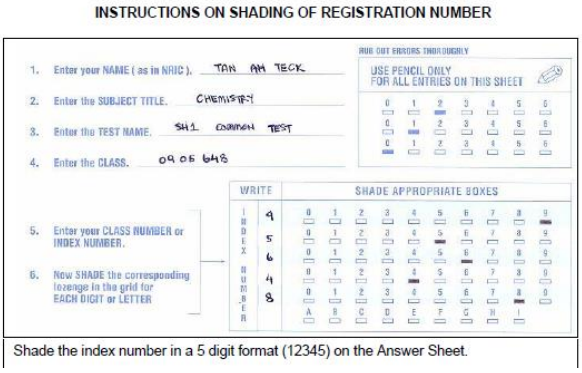
8866/01

Paper 1 Multiple Choice

31 August 2016

Additional Materials: Multiple Choice Answer Sheet

1 hour



OAS index number is in 5-digit format.

5 digit format: **2nd digit** and the **last four digits** of the Reg Number.

READ THE INSTRUCTION FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, Centre number and index number on the Answer Sheet in the spaces provided unless this has been done for you.

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 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 booklet.

This document consists of 14 printed pages.

Data

speed of light in free space,	c	$= 3.00 \times 10^{8}$ m s^{-1}
elementary charge,	e	$= 1.60 \times 10^{-19}$ C
the Planck constant,	h	$= 6.63 \times 10^{-34}$ J s
unified atomic mass constant,	u	$= 1.66 \times 10^{-27}$ kg
rest mass of electron,	m_e	$= 9.11 \times 10^{-31}$ kg
rest mass of proton,	m_p	$= 1.67 \times 10^{-27}$ kg
acceleration of free fall,	g	$= 9.81$ 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	$= \rho gh$
resistors in series,	R	$= R_1 + R_2 + \ldots$
resistors in parallel,	$1/R$	$= 1/R_1 + 1/R_2 + \ldots$

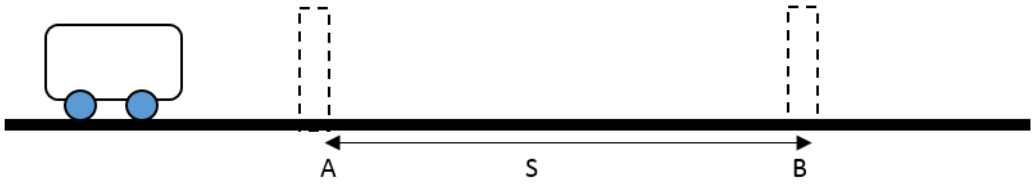
1. The volume of liquid flowing per second is called the volume flowrate Q and has the unit $m^3\ s^{-1}$. The flowrate through a hypodermic needle during an injection can be estimated with the following equation:

$$Q = \frac{\pi R^n (P_2 - P_1)}{8\eta L}$$

The length and radius of the needle are L and R, respectively. The pressure at opposite ends of the needle are P_2 and P_1. The viscosity of the liquid is given by η which has the unit kg $m^{-1}\ s^{-1}$. The value of n is

A 2 **B** 3 **C** 4 **D** 8

2. In an experiment to find the constant acceleration of a toy car, the speed of the toy car was captured using speed meters placed at 2 different locations, **A** and **B** respectively.



The distance between **A** and **B** is measured as S.

Distance S = 1.400 m ± 0.002 m

The manufacturer for the speed meter quoted an uncertainty of 1 % for their instrument.

Speed measured at A = 2.50 m s^{-1}

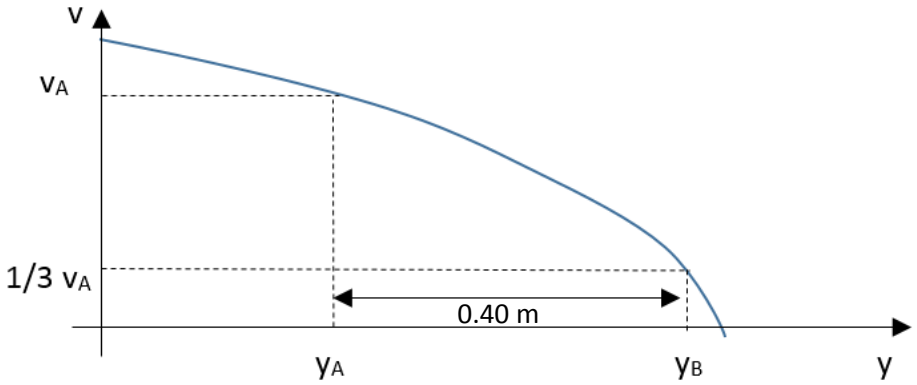
Speed measured at B = 4.65 m s^{-1}

The correct acceleration of the toy car is

A (5.49 ± 0.04) m s^{-2} **B** (5.50 ± 0.04) m s^{-2}

C (5.5 ± 0.4) m s^{-2} **D** (5.5 ± 0.2) m s^{-2}

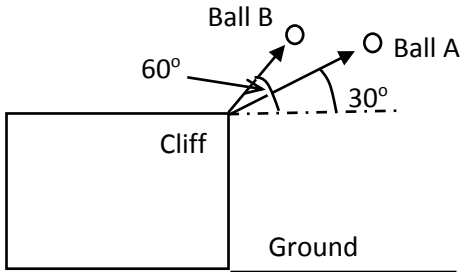
3. The figure below shows the speed v versus vertical height y of a ball tossed directly upward. The speed at height y_A is v_A. The speed at height y_B is 1/3 v_A. What is the speed v_A?



A 2.10 m s^{-1} **B** 2.97 m s^{-1}

C 6.98 m s^{-1} **D** 9.40 m s^{-1}

4. Two similar balls **A** and **B** were fired at different angles but with the same vertical velocity from the edge of a cliff. Which of the following statements is false?



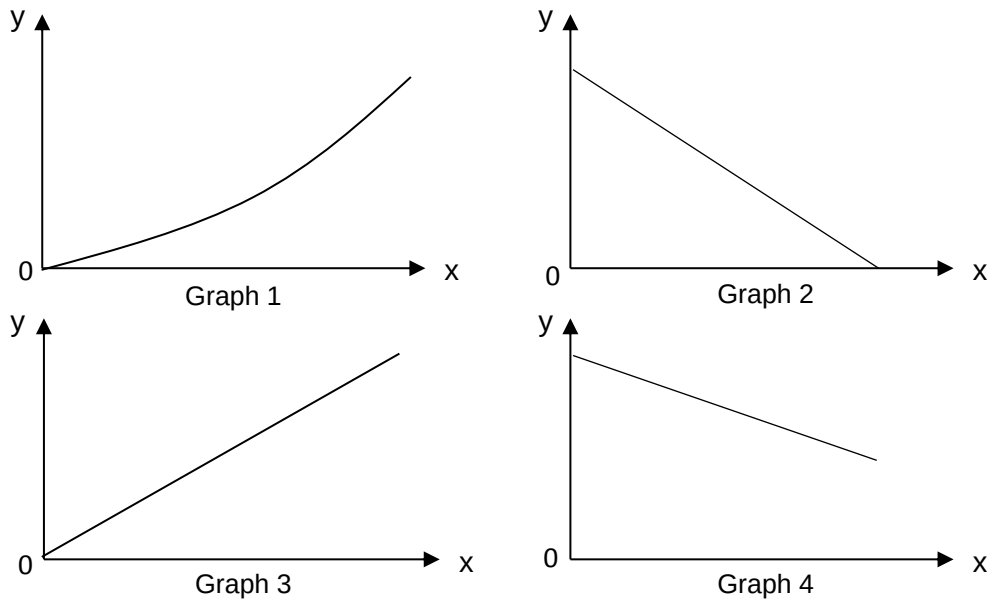
A Both balls will hit the ground at the same time.

B The change in momentum of both balls are the same.

C The ratio of the horizontal velocity of ball **A** to the horizontal velocity of ball **B** is a constant value of $1/\sqrt{3}$.

D The kinetic energy of ball **A**, just before impact with the ground**,** is greater than ball **B**.

5. An object is projected with a certain velocity at an angle from a flat surface. Which of the following graphs correctly shows the variation of the horizontal displacement with time, and the variation of the kinetic energy with vertical displacement of the object?



	Horizontal displacement vs time	Kinetic energy vs vertical displacement
A	Graph 1	Graph 2
B	Graph 1	Graph 4
C	Graph 3	Graph 2
D	Graph 3	Graph 4

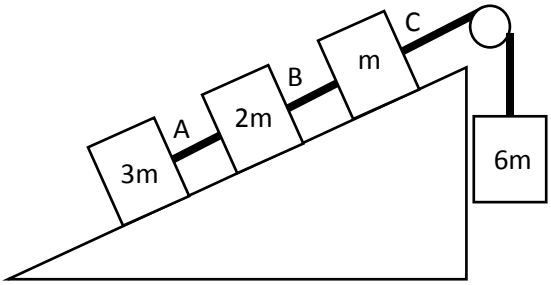
6. Consider two laboratory carts of different masses but both possess identical kinetic energy. Which of the following statements must be correct?

(1) The one with the greatest mass has the greatest momentum
(2) The same impulse was required to accelerate each cart from rest
(3) Both can do the same amount of work as they come to a stop
(4) The same amount of force was required to accelerate each cart from rest

A (1), (4) **B** (2), (3)

C (3), (4) **D** (1), (3)

7. Three blocks of masses 3m, 2m and m are connected to strings **A**, **B** and **C** as shown below. The blocks are placed on a smooth slope surface and attached to a block of mass 6m by string **C**. Assuming that the pulley is smooth, which string must be the strongest in order not to break when the block of mass 6m is released?



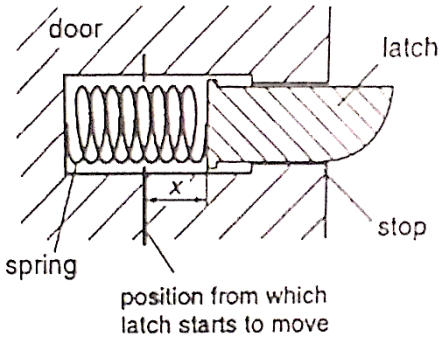
A A

B B

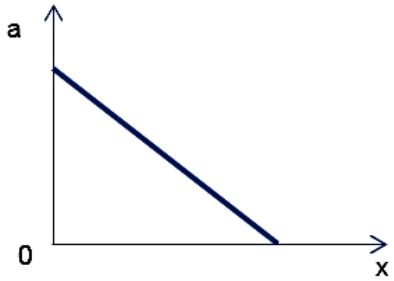
C C

D They must all be the same strength.

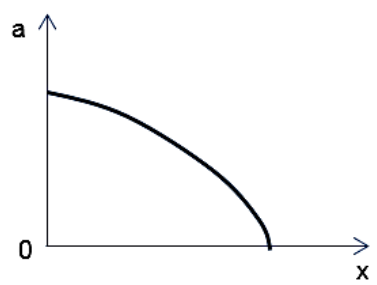
8. A door is fitted with a spring-operated latch as shown. When the latch is pushed in, the spring becomes compressed but remains within its elastic limit. The latch is suddenly released.
Which graph best shows how the acceleration ***a*** of the latch varies with distance ***x*** it moves before it stopped? Ignore friction.



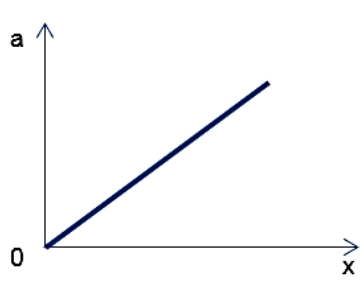
A



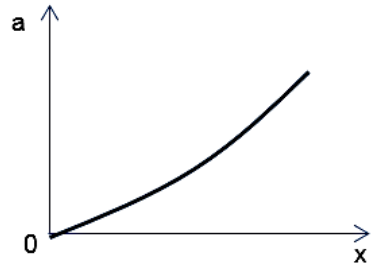
B



C



D

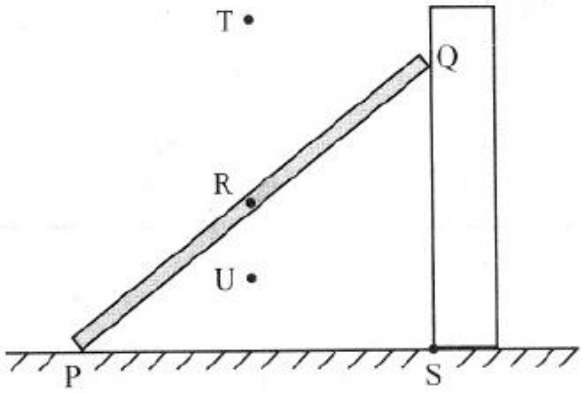


9. A child drinks a liquid of density ρ through a vertical straw. Atmospheric pressure is p_o and the child is capable of lowering the pressure at the top of the straw by 10 %. What is the maximum length of straw above the liquid that would enable the child to drink the liquid?

A $\frac{p_O}{10\rho g}$ **B** $\frac{p_O}{\rho g}$

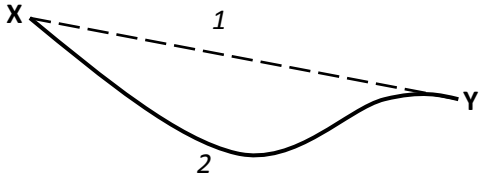
C $\frac{9p_O}{10\rho g}$ **D** $\frac{10p_O}{\rho g}$

10. The figure below shows a ladder PQ with a centre of mass *R*, resting a rough wall QS. The resultant forces at P and Q are F_P and F_Q respectively. If the ladder is in equilibrium, F_P and F_Q must act through point



A R **B** S **C** T **D** U

11. Two identical balls were released simultaneously from rest at **X** and made their way to **Y** along two different tracks on the same vertical plane as shown below. Ball 1 travels along a straight down-slope track while ball 2 travels along a curve down-slope followed by an up-slope track. Ball 2 reaches **Y** first.

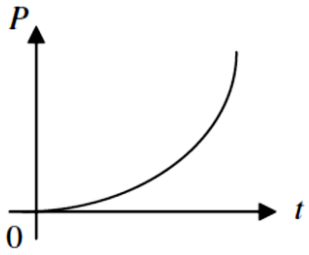


Neglecting all resistive forces, what can be said of the final energy and the average rate of energy conversion for the two balls?

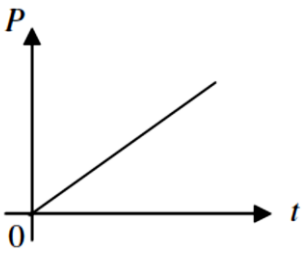
	Final total energy of	Higher average rate of energy conversion
A	Both balls are the same	Ball 2
B	Ball 2 is higher	Ball 1
C	Ball 2 is higher	Ball 2
D	Both balls are the same	Ball 1

12. An object resting on a horizontal frictionless surface is accelerated from rest by a constant force from a motor. Which of the following graphs shows the variation of the motor power *P* with time *t* ?

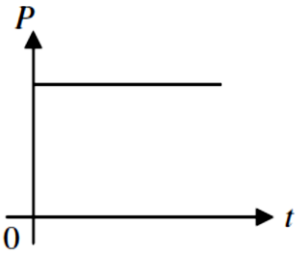
A



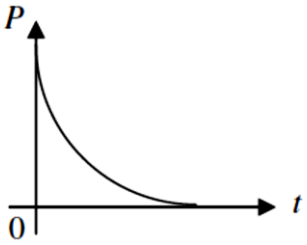
B



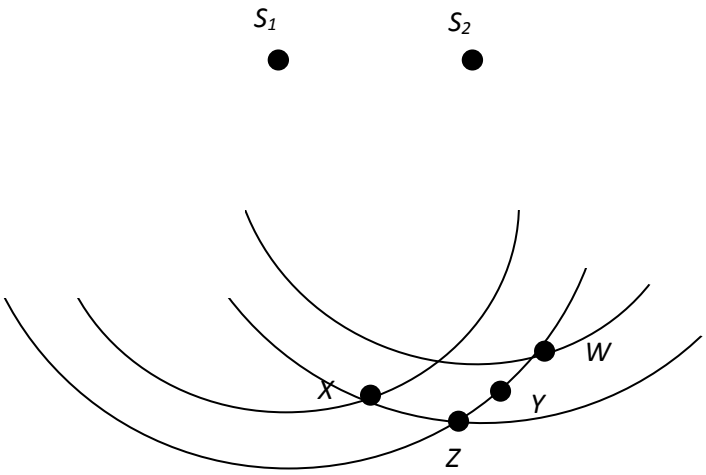
C



D



13. S_1 and S_2 are two identical sources of waves that are in phase. The instantaneous positions of two wave crests from each source are shown below.



Which of the following is true?

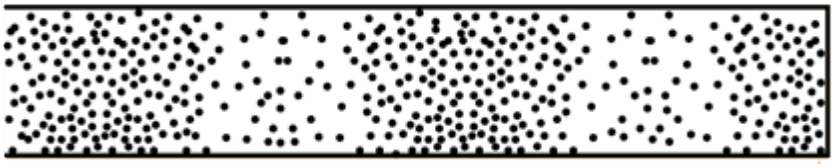
A *X* is a point where the 2 crests have a phase difference of $2n\pi$ where n is an integer.

B *W* is a point of destructive interference.

C $S_1Y - S_2Y = n\,\lambda$ where *n* is an integer.

D $S_1Z - S_2Z = (2n - 1)\,\lambda/2$ where *n* is an integer.

14. The diagram below shows the positions of the air particles for an open-closed tube at the instant when time t = 0 s.



Which of the following statements is NOT correct?

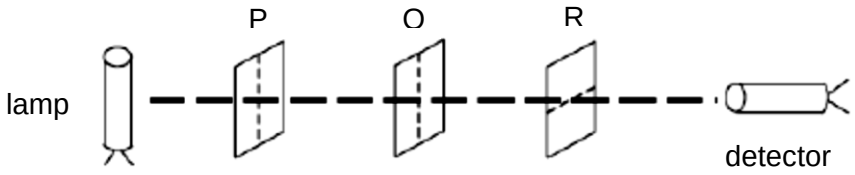
A At the instant t = 0 s, the air pressure variation is maximum but the air velocity is zero at the closed end.

B There will always be more than 2 complete wavelengths in the tube at any instant in time.

C At the instant t = T/4, the air pressure variation is zero but the air acceleration is maximum at the open end.

D The frequency of the air particles is 9 times the value of the fundamental frequency.

15. Three polaroid sheets P, Q and R are placed along a straight line with a lamp and a detector as shown below.



Initially, the directions of polarisation of P and Q are parallel but are normal to that of R. What happens to the intensity I recorded by the detector when P is being rotated slowly through 90^o until its direction of polarisation is parallel to that of R?

A I increases throughout.

B I decreases and then increases back to original value.

C I remains unchanged.

D I increases then decreases back to original value.

16. A loudspeaker emits a sound wave of amplitude *A* and intensity *I*. After some time, the intensity increased by 8.00 %. The corresponding change in amplitude is

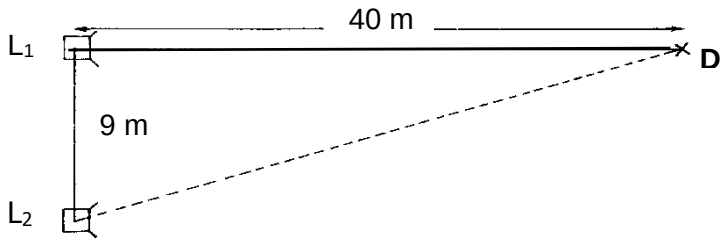
A 3.92 %

B 16.6 %

C 104 %

D 108 %

17. Two loudspeakers L_1 and L_2, driven by a common oscillator and amplifier, are set up as shown. As the frequency of the oscillator increases from zero, the detector at **D** recorded a series of maximum and minimum signals. At what frequency is the first **minimum** observed?
(Speed of sound = 330 m s^{-1})



A 165 Hz

B 330 Hz

C 495 Hz

D 660 Hz

18. In a Young's double slit experiment, a small detector measures an intensity of illumination of **I** units at the centre of the fringe pattern. What will be the measured intensity if one of the two (identical) slits is now covered?

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

19. Which of the following statement best describes the electric potential difference between two points in a wire that carries a current?

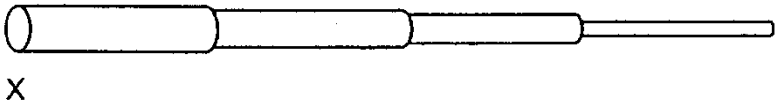
A the ratio of the power dissipated between the points to the charge moved.

B the ratio of the power dissipated between the points to the current.

C the force required to move a unit positive charge between the points.

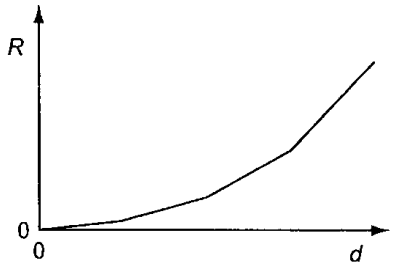
D the ratio of the energy dissipated between the points to the current.

20. A composite wire is made by connecting in series four uniform wires made of the same material but having different diameters.

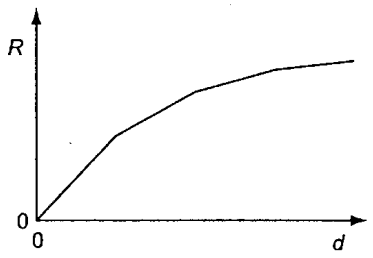


The resistance *R* of this composite wire is measured between X and other points on the wire at distances *d* from *X*.
hich graph best represents the relationship between *R* and *d*?

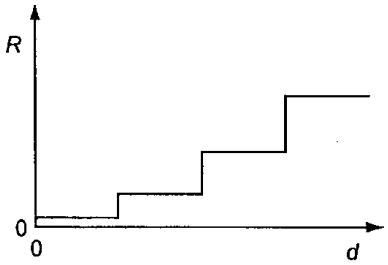
A



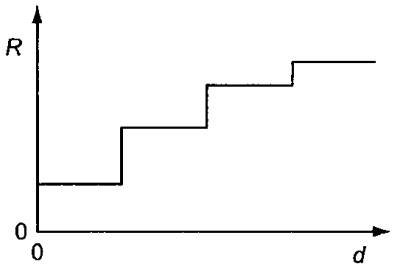
B



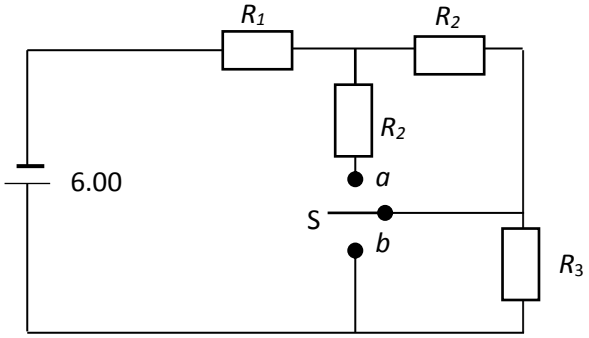
C



D

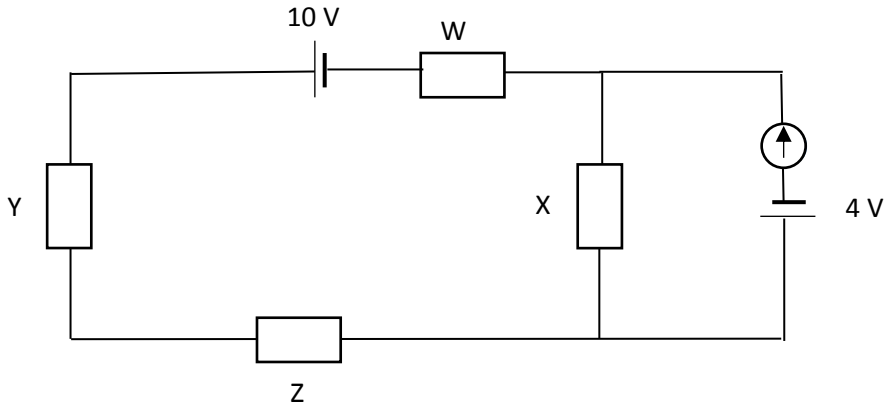


21. A 6.00 V battery supplies current to the circuit shown in the figure below. When the double-throw switch **S** is open as shown in the figure, the current in the battery is 1.00 mA. When the switch is closed in position *a*, the current in the battery is 1.20 mA. When the switch is closed in the position *b*, the current in the battery is 2.00 mA. The resistances of R_1, R_2, R_3 are



	R_1/ Ω	R_2/ Ω	R_3/ Ω
A	2000	1000	3000
B	1000	2000	3000
C	3000	1000	2000
D	3000	2000	1000

22. Resistors can be connected at the four positions as shown in the circuit below. Which of the arrangements would result in a null deflection in the galvanometer?

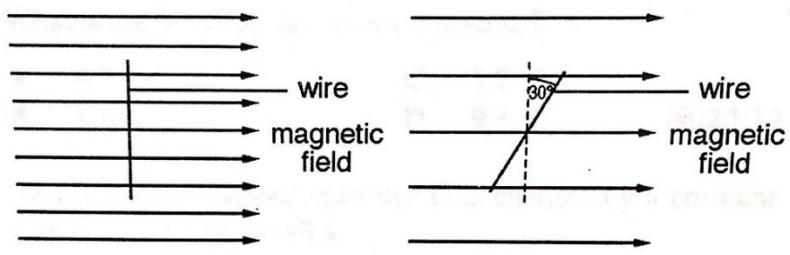


	W	X	Y	Z
A	1 Ω	2 Ω	4 Ω	3 Ω
B	6 Ω	8 Ω	4 Ω	2 Ω
C	3 Ω	5 Ω	4 Ω	2 Ω
D	2 Ω	1 Ω	5 Ω	4 Ω

23. A battery of e.m.f. 1.50 V has a terminal p.d. of 1.25 V when a resistor of 25 Ω is joined to it. What is the current flowing when a resistor of 10 Ω replaces the 25 Ω resistor?

A 0.01 A **B** 0.10 A **C** 1.0 A **D** 10 A

24. A straight, horizontal, current-carrying wire lies at right angles to a horizontal magnetic field. The field exerts a vertical force of 10 mN on the wire.
The wire is rotated, in its horizontal plane, through 30° as shown. The flux density of the magnetic field is halved.

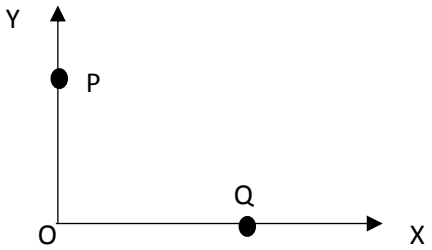


What is the vertical force on the wire?

A 2.50 mN **B** 4.33 mN

C 5.00 mN **D** 8.66 mN

25. The diagram shows a flat surface with lines OX and OY at right angles to each other.



Which current in a straight conductor will produce a magnetic field at O in the direction of OY?

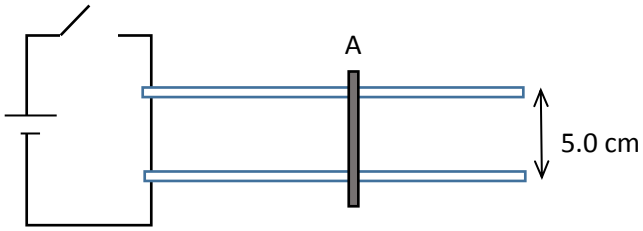
A at P into the plane of the diagram.

B at P out of the plane of the diagram.

C at Q into the plane of the diagram.

D at Q out of the plane of the diagram.

26. The figure below shows a cylindrical aluminium bar **A** of mass 5.0 g resting on two horizontal aluminium rails which can be connected to a battery to drive a current of 4.0 A through **A**. A magnetic field, of flux density 0.10 T acts perpendicularly to the paper and into it.



What is the angle to the horizontal to which the rail must be tilted to keep **A** stationary?

A 2.33^{o} **B** 22.2^{o}

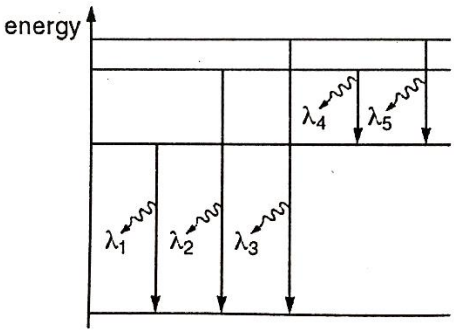
C 32.2^{o} **D** 76.2^{o}

27. The atomic spacing in a thin metal film is of the order 10^{-10}m. For diffraction of an electron beam, what order of velocity is required?

A 4×10^{4} m s^{-1} **B** 4×10^{5} m s^{-1}

C 7×10^{6} m s^{-1} **D** 7×10^{7} ms^{-1}

28. An energy level diagram for an atom is shown drawn to scale. The electron transitions give rise to the emissions of a spectrum of lines of wavelength λ_1, λ_2, λ_3, λ_4, λ_5.



What can be deduced from the diagram?

A The transition corresponding to wavelength λ_3 represents the ionisation of the atom.

B $\lambda_2 > \lambda_3$

C $\lambda_4 = \lambda_3 - \lambda_5$

D λ_1 lies in the visible light region

29. Which one of the following has the largest energy content?

A 10^2 photons of wavelength 1 pm (γ-rays)

B 10^5 photons of wavelength 2 nm (X-rays)

C 10^6 photons of wavelength 5 μm (infra-red radiation)

D 10^8 photons of wavelength 600 nm (yellow light)

30. Of the following phenomena, which provides the best evidence that particles can have wave properties?

A The absorption of photons by electrons in an atom.

B The interference pattern produced by neutrons incident on a crystal.

C The production of x-rays by electrons striking a metal target.

D The scattering of photons by electrons at rest.

END of PAPER