H

NATIONAL JUNIOR COLLEGE

PRELIMINARY EXAMINATIONS

Higher 1

CANDIDATE NAME			
SUBJECT CLASS		REGISTRATION NUMBER	

PHYSICS 8866/01

Paper 1 Multiple Choice

18 September 2014

Additional Materials: Multiple Choice Answer Sheet

1 hour

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 **30** 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 contains 12 printed pages, including this cover page.

Data

speed of light in free space,	$c = 3.00 \times 10^{8}$ ms^{-1}
elementary charge,	$e = 1.60 \times 10^{-19}$ C
the Planck constant,	$h = 6.63 \times 10^{-34}$ Js
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 ms^{-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,	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$

1 The speed v of surface waves of wavelength λ on a liquid of density ρ is given by

$$v = \left[\left(\frac{a\lambda}{2\pi}\right) + \left(\frac{2\pi b}{\rho\lambda}\right)\right]^{\frac{1}{2}}$$

where a is a constant and b is a quantity characteristic of the liquid. The dimensions for a and b in SI base units are, respectively,

A $m^{1/2}s^{-1}$ and $kg^{-1/2}m^2s^{-1}$

B ms^{-2} and kgs^{-2}

C m^2s^{-2} and $kg^{-1/2}m^2s^{-1}$

D ms^{-2} and kgm^{-2}

2 Which of the following definition is correct?

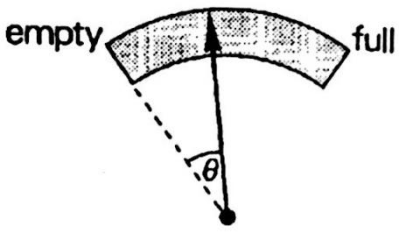
A Density is mass per cubic metre.

B Potential difference is energy per unit current.

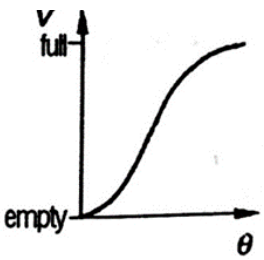
C Pressure is force per unit area.

D Speed is distance travelled per second.

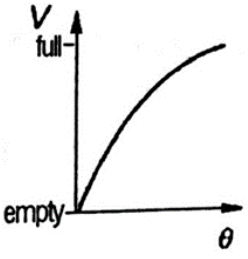
3 A petrol gauge in a car indicates the volume V of the fuel in the tank. V is given by the angular deflection θ of the pointer on a dial. Below are the calibration graphs for 4 different gauges. For low fuel levels in the tank, which gauge would be most sensitive?



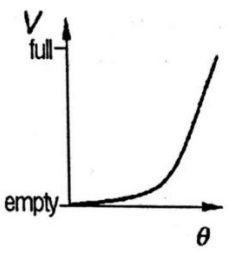
Gauge A



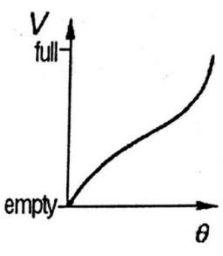
Gauge B



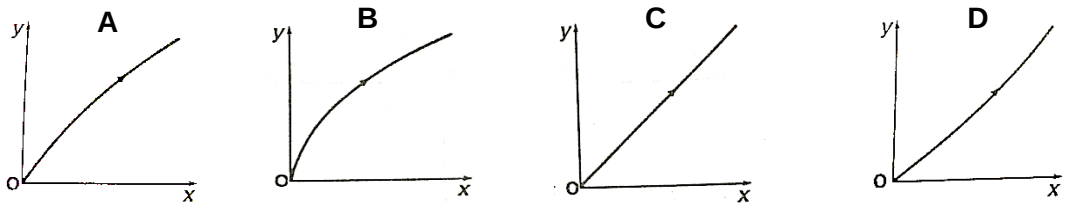
Gauge C



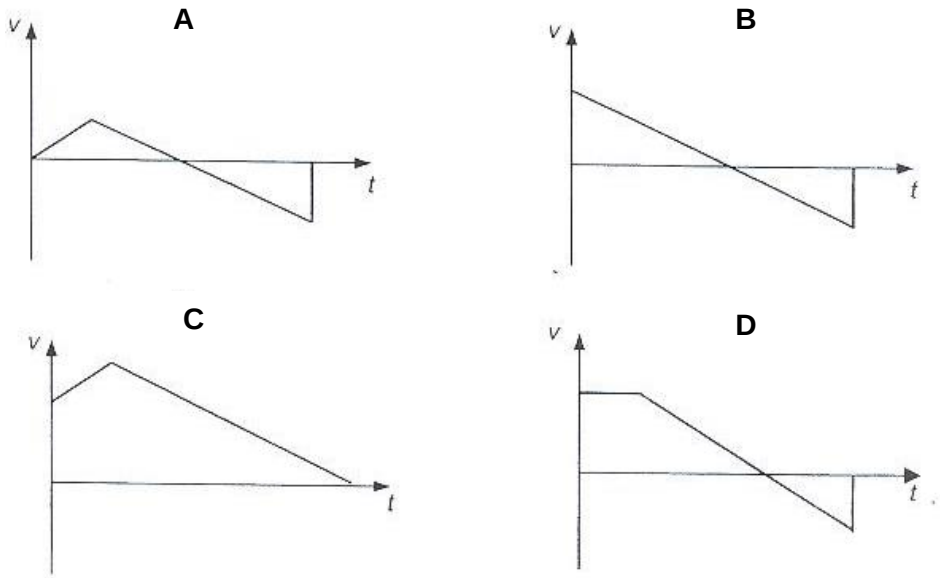
Gauge D



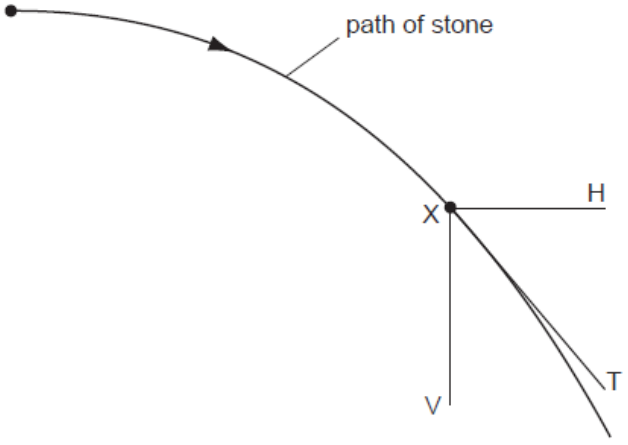
4 A body is moving with constant speed in the y-direction. For positive values of *y*, it experiences a uniform acceleration in the *x*-direction. Which one of the paths A to D does it follow?



5 A toy rocket is launched vertically from Earth with a constant acceleration. After some time, the fuel is used up and the toy rocket falls freely back to Earth. Which one of the velocity-time graphs best represents the journey? Neglect air resistance.



6 A stone is projected horizontally in a vacuum and moves along the path shown.



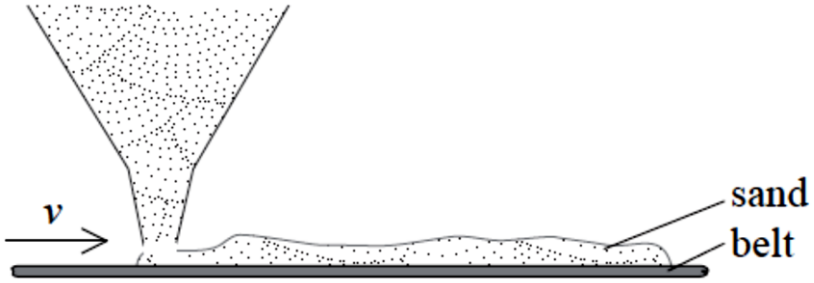
X is a point on this path. XV and XH are vertical and horizontal lines respectively through X. XT is the tangent to the path at X.
Along which directions do forces act on the stone at X?

A XV only **B** XH only **C** XV and XH **D** XT only

7 A rescue plane is flying horizontally with a speed of 30 m s^{-1} and at an altitude of 125 m above the sea when it drops a warning flare. Neglecting air resistance and assuming that the plane does not change its course, speed or altitude, how far from the plane is the flare when it hits the water?

A 125 m **B** 146 m **C** 150 m **D** 195 m

8 Sand falls vertically on a conveyor belt at a rate of m kg s^{-1}.



In order to keep the belt moving at constant speed v the horizontal force that must be exerted on the belt is

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

9 A steel sphere is dropped vertically onto a horizontal metal plate. The sphere hits the plate with a speed u, leaves it at a speed v, and rebounds vertically to half of its original height.

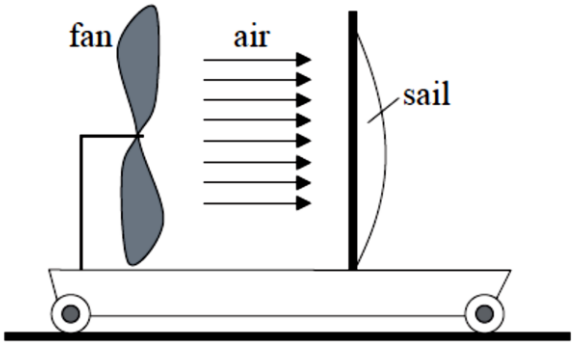
Which expression gives the value of $\frac{v}{u}$?

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

10 A ball is dropped from a window located at the tenth storey of a building. 1.0 second after it is released, the ball is observed to have fallen by exactly 2 storeys. At which storey will the ball be 2.0 seconds after it is released?

A 2nd **B** 4th **C** 6th **D** 8th

11 A fan and a sail are mounted vertically on a cart that is initially at rest on a horizontal table as shown in the diagram below.



When the fan is turned on an air stream is blown towards the right and is incident on the sail. The cart is free to move with negligible resistant forces. After the fan has been turned on the cart will

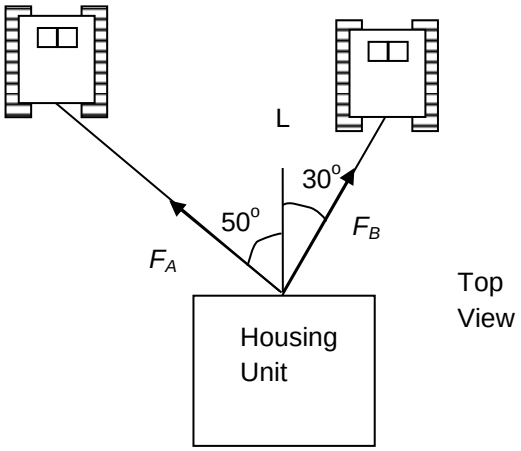
A move to the left and then to the right.

B remain at rest.

C move towards the right.

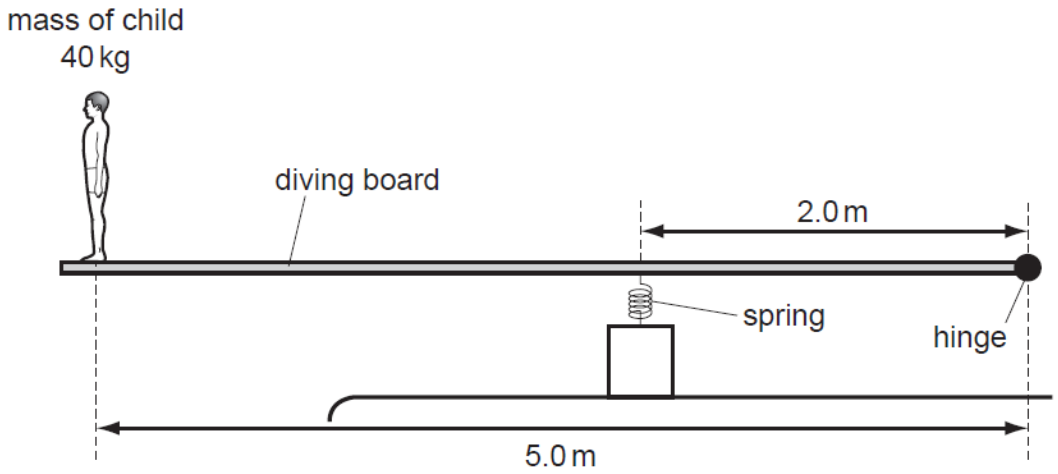
D move towards the left.

12 Two snow-trucks tow a housing unit at constant speed to a new location in the Antarctica as shown below. The sum of forces F_A and F_B exerted on the unit by the horizontal cables is parallel to the line L, and F_A = 4500 N. Determine F_B.



A 1700 N **B** 2500 N **C** 6900 N **D** 9000 N

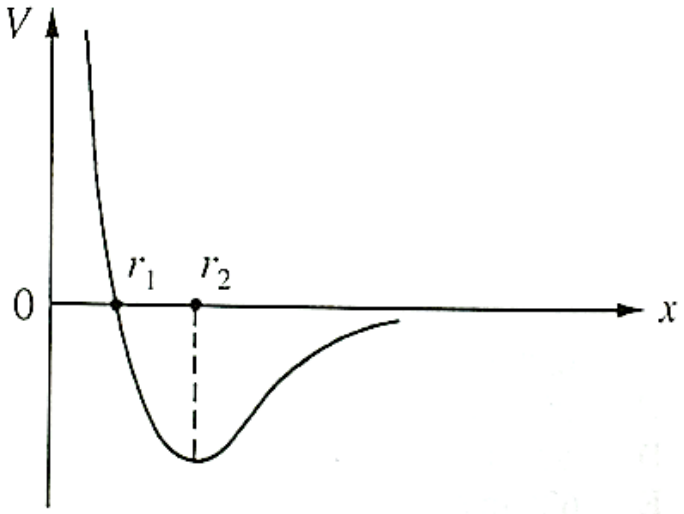
13 An uniform diving board of length 5.0 m and mass 50 kg is hinged at one end and supported 2.0 m from this end by a spring of spring constant 10 kNm^{-1}. A child of mass 40 kg stands at far end of the board.



What is the extra compression of the spring caused by the child standing on the end of the board?

A 1.0 cm **B** 6.1 cm **C** 9.8 cm **D** 16 cm

14 The mutual potential energy V of two molecules separated by distance x is shown in the diagram.



Which of the following correctly describes the force between the molecules?

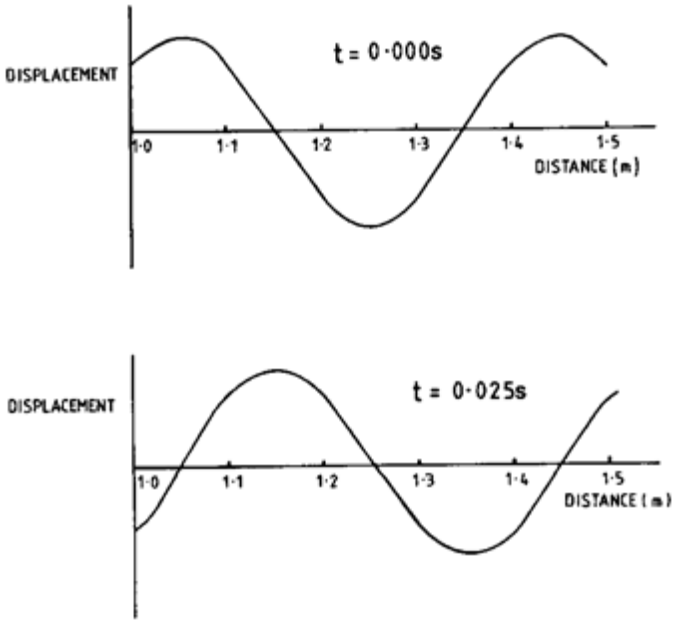
	attractive for	repulsive for
A	$x < r_1$	$x > r_1$
B	$x > r_1$	$x < r_1$
C	$x < r_2$	$x > r_2$
D	$x > r_2$	$x < r_2$

15 A space shuttle of mass m re-enters the Earth's atmosphere at an angle θ to the horizontal. Air resistance acting on the space shuttle causes it to travel at constant speed v.

The heat–shield of the shuttle dissipates heat at a rate of P, so that the mean temperature of the shuttle remains constant. Taking g as the relevant value of acceleration due to free fall, which expression is equal to P?

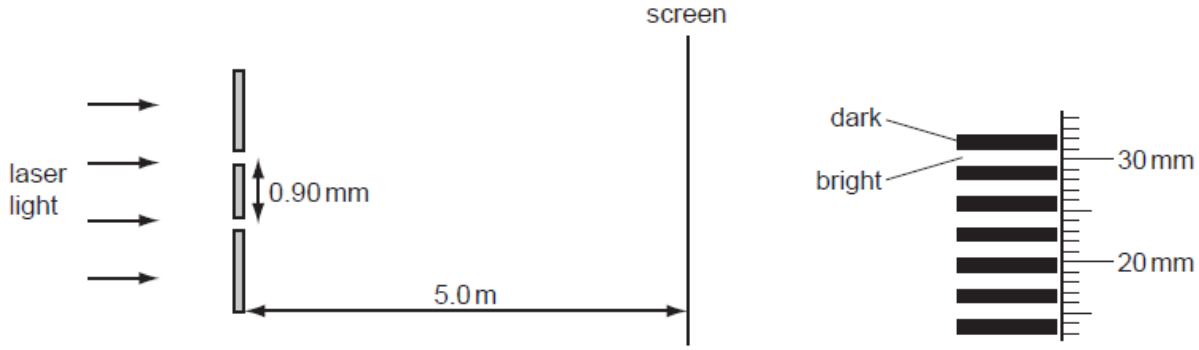
A mgv **B** $mgv\sin\theta$ **C** $\frac{1}{2}mv^2$ **D** $\frac{1}{2}mv^2\sin^2\theta$

16 The diagrams on the right show a wave in the same section of a string at two different times indicated. What is the longest period of the wave consistent with the above information?



A 0.025 s **B** 0.050 s **C** 0.100 s **D** 0.400 s

17 The diagrams show the arrangement of apparatus for a Young's slits experiment and also part of the pattern formed on the screen with a ruler placed next to it.



What is the wavelength of the light?

A 4.8×10^{-7} m **B** 5.4×10^{-7} m **C** 3.2×10^{-6} m **D** 3.4×10^{-6} m

18 Plane sound waves of frequency 100 Hz fall normally on a smooth wall. At what distances from the wall will the air particles have maximum amplitude of vibration. Assume the speed of sound to be 340 ms^{-1}.

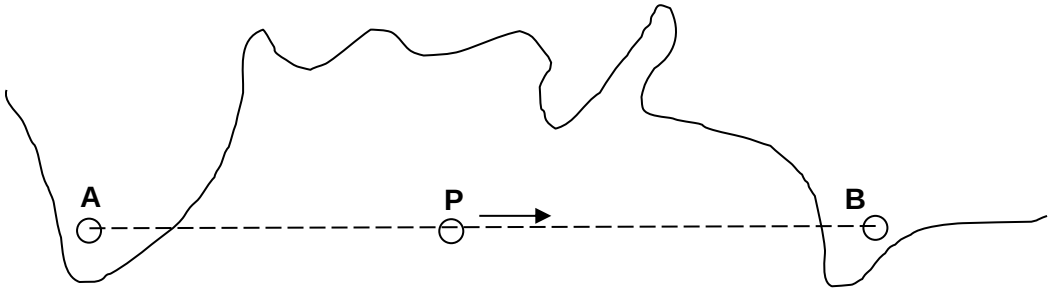
A 0.85 m, 2.55 m, 4.25 m,…

B 1.70 m, 3.40 m, 5.10 m,…

C 2.00 m, 4.00 m, 6.00 m,…

D 2.50 m, 5.00 m, 7.50 m,…

19 The diagram shows a coastline with two radio transmitting stations **A** and **B**. The stations are 100 km apart and each behaves as a point source of e.m waves which radiate as circular wavefronts. Both stations transmit at a frequency of 1.5 MHz and have identical powers.

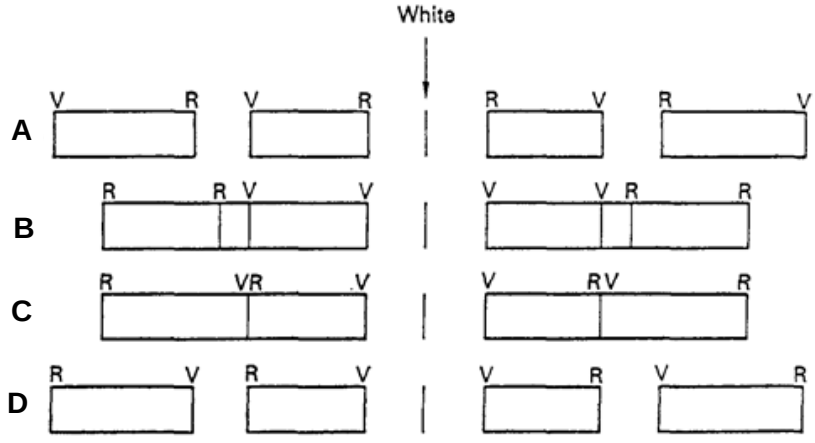


A ship **P**, travels a straight line course between the stations **A** and **B** at a steady speed of 2.0 ms^{-1}. The combined signal received by the ship rises and falls at regular intervals. As the ship passes the point midway between **A** and **B** the amplitude of the combined signal received from both stations is a minimum.

The frequency of the received signal to pass from one minimum to the next is

A 0.01 Hz **B** 0.02 Hz **C** 50 Hz **D** 100 Hz

20 A narrow shaft of white light (from violet 400 nm (V), to red 700 nm (R)) falls with normal incidence on a transmission grating, and produces two orders of spectra on a distant screen. The appearance of these will be as in the diagram.

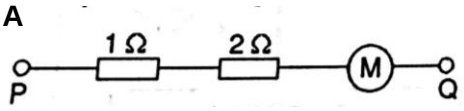


21 A copper wire of cross-sectional area 2.0 mm^2 carries a current of 10 A.
How many electrons pass through a given cross-section of the wire in one second?

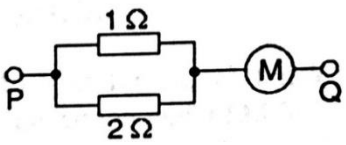
A 1.0×10^{1} **B** 5.0×10^{6} **C** 6.3×10^{19} **D** 3.1×10^{25}

22 In which one of the following arrangements of resistors does the meter **M**, which has a resistance of 2 Ω, give the largest reading when the same potential difference is applied between points **P** and **Q**?

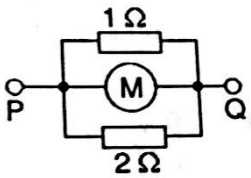
A



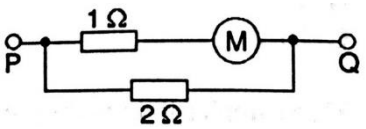
B



C



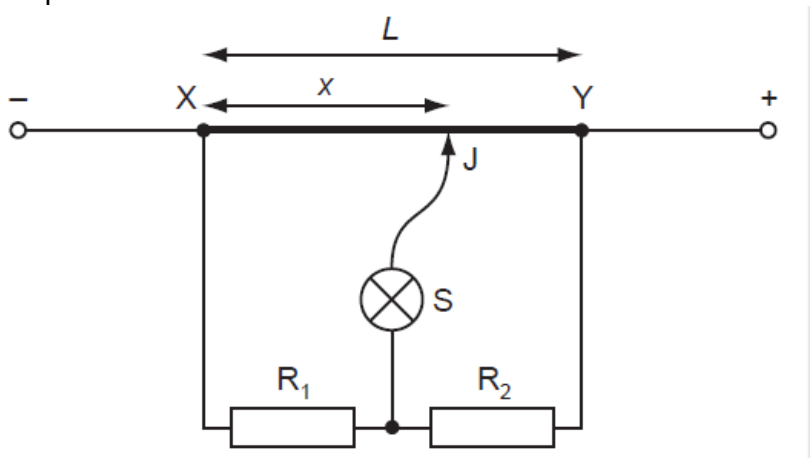
D



23 A battery is connected in series with a resistor ***R***. The battery transfers 2000 C of charge completely round the circuit. During this process, 2500 J of energy is dissipated in the resistor ***R*** and 1500 J is expended in the battery. The e.m.f. of the battery is

A 2.00 V **B** 1.25 V **C** 0.75 V **D** 0.50 V

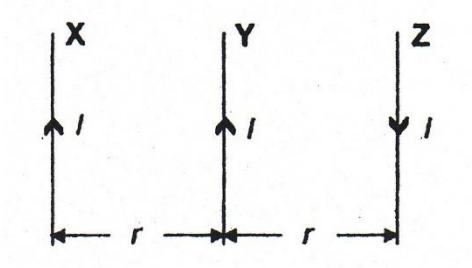
24 In the circuit shown, **XY** is a length L of uniform resistance wire. R_1 and R_2 are unknown resistors. **J** is a sliding contact that joins the junction of R_1 and R_2 to points on **XY** through a small signal lamp **S**.



To determine the ratio $\frac{V_1}{V_2}$ of the potential differences across R_1 and R_2, a point is found on **XY** at which the lamp is off. This point is at a distance x from X.
What is the value of the ratio $\frac{V_1}{V_2}$?

A L / x **B** x / L **C** $(L - x) / x$ **D** $x / (L - x)$

25 The diagram below shows three parallel wires **X**, **Y** and **Z** which carry current I of equal magnitude in the direction shown. The wires are placed at equal distance apart.



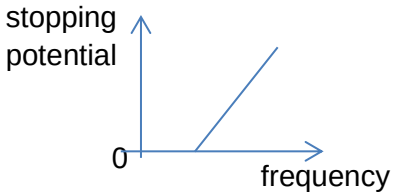
The force on wire Y is

A zero **B** Towards **X** **C** Towards **Z** **D** Along **Y**

26 A proton moves with initial velocity of 10^5 m s^{-1} at an angle of 30^0 to a magnetic field of 1 T. What is the work done by the magnetic field on the proton after 10^{-3} s?

A zero **B** 4.0×10^{-10} J **C** 8.0×10^{-10} J **D** 4.0×10^{-8} J

27 The result of an experiment to investigate the energy of photoelectrons emitted from a metallic surface is shown below.



The gradient of the graph depends on the

A intensity of the incident radiation

B wavelength of the incident radiation

C work function of the irradiated surface

D ratio of Planck's constant to the electronic charge

28 A photon of light enters a block of glass after travelling through vacuum. The energy of the photon on entering the glass block

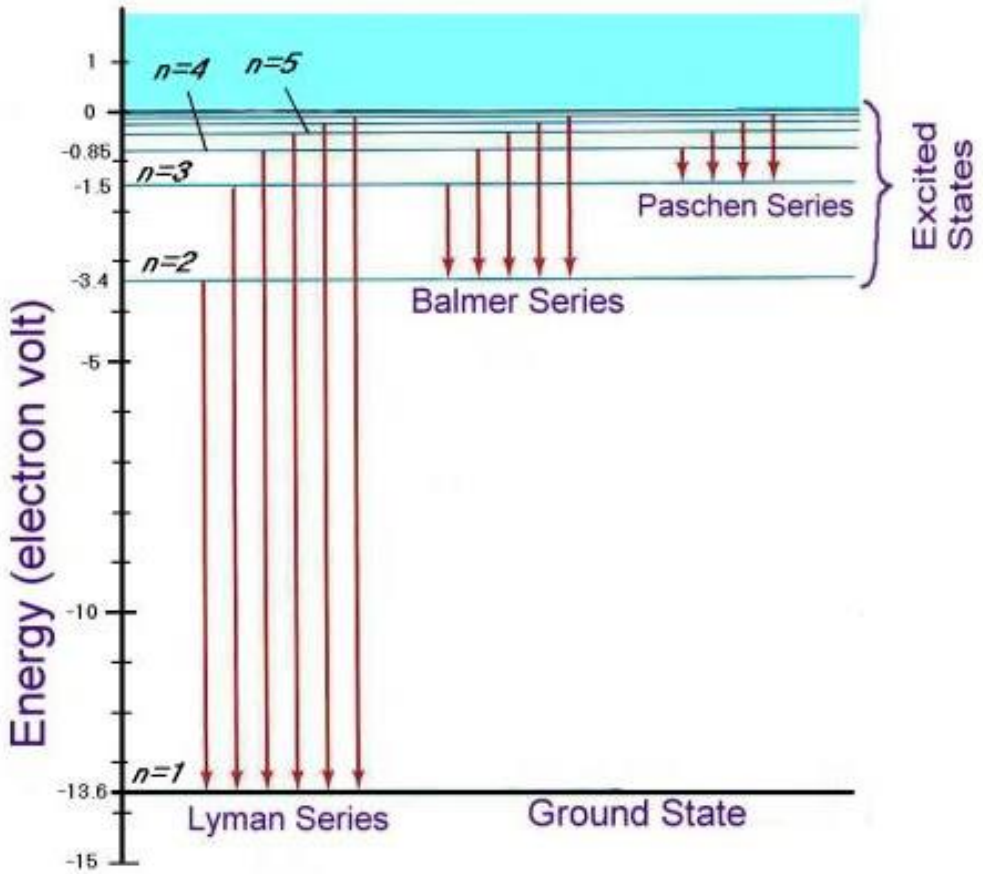
A increases because its associated wavelength decrease.

B decreases because the speed of radiation decreases.

C stay the same because the speed of radiation and associated wavelength do not change.

D stays the same because the frequency of the radiation does not change.

29 The diagram below shows the energy level diagram of hydrogen.



Which one of the following gives the correct region of the electro-magnetic spectrum of the observed spectral lines?

	Lyman Series	**Balmer Series**	**Paschen Series**
A	Infra-red	Infra-red	Visible light
B	Infra-red	Visible light	Ultra-violet
C	Ultra-violet	Visible light	Infra-red
D	Ultra-violet	Ultra-violet	Visible light

30 An excited atom gives up excess energy by emitting a photon of certain frequency. The average period that elapses between the excitation of an atom and the time it radiates is 1.0×10^{-8} s. Find the inherent uncertainty in the frequency of the photon.

A 4.0×10^{6} Hz **B** 8.0×10^{6} Hz **C** 18×10^{6} Hz **D** 28×10^{6} Hz

----------END of PAPER----------