VICTORIA JUNIOR COLLEGE
2015 JC2 PRELIMINARY EXAMINATIONS

PHYSICS
Higher 1

Paper 1 Multiple Choice

8866/01
23 Sep 2015
WEDNESDAY
2 pm to 3 pm
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, CT group and index number on the Multiple Choice Answer Sheet 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 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.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **16** 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,	$p = h\rho g$
resistors in series,	$R = R_1 + R_2 + \ldots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \ldots$

1 Planck's Law of black body radiation is given by

$$R = \frac{2h(D)^3}{c^2} \times \frac{1}{e^{\left(\frac{hf}{kT}\right)} - 1}$$

where R is power per unit area per unit frequency,
h is Planck's constant,
c is the speed of light in a vacuum,
f is frequency of electromagnetic radiation,
k is Boltzmann's constant,
T is the thermodynamic temperature,
and D is an unknown physical quantity.

Which of the following shows the correct units for D ?

A kg m s^{-2} **B** s^{-1}
C kg m^2 s^{-2} **D** s^{-3}

2 A force of 5 N and a force of 8 N are applied on an object. Which of the following is not a possible resultant force on the object?

A 12 N **B** 8 N **C** 5 N **D** 2 N

3 Which of the following is the closest estimate for the number of water molecules in a 500 ml bottle fully filled with water ?

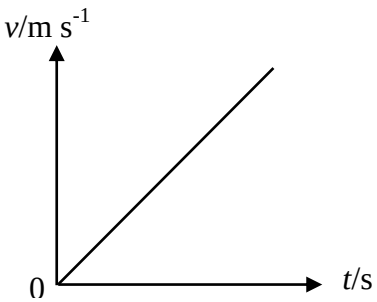
A 10^{25} **B** 10^{23} **C** 10^{27} **D** 10^{22}

4 A hollow plastic ball is cut into half and the external and internal diameters are measured. The external diameter of the plastic ball is 95.0 ± 0.1 mm and the internal diameter is given by 87.0 ± 0.1 mm The mean wall thickness should be quoted as

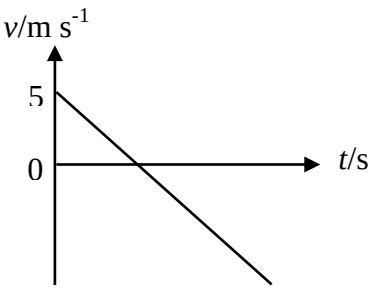
A 4.0 ± 0.2 mm **B** 8.0 ± 0.2 mm **C** 4.0 ± 0.1 mm **D** 8.0 ± 0.1 mm

5 A hot air balloon is ascending at a velocity of 5.0 m s^{-1}. A sandbag is released from the hot air balloon when it is 10 m above the ground. Which of the following graphs best shows how the sandbag's velocity will vary with time?

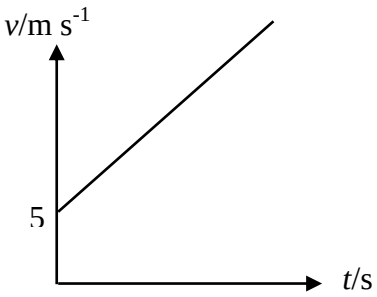
A



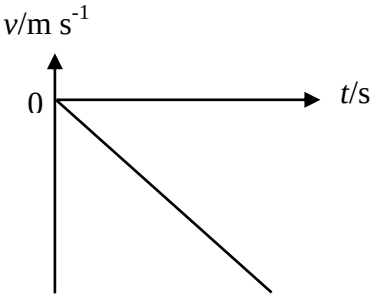
C



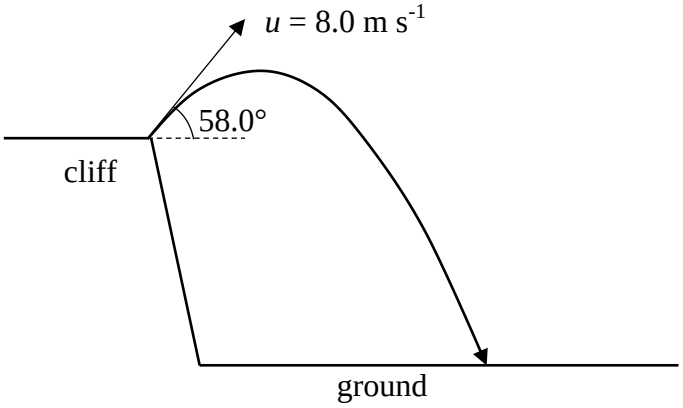
B



D



6 A stone is thrown upwards with an initial velocity u of 8.0 m s^{-1} from a point at the edge of a cliff at an angle of 58.0° above the horizontal. The time taken between the stone passing the edge of the cliff on its way down and hitting the ground at the bottom of the cliff is 1.5 s. What is the height of the cliff? Take air resistance to be negligible.

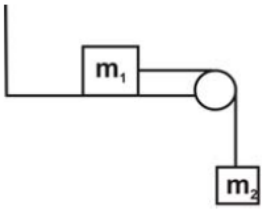


A 15 m **B** 17 m **C** 21 m **D** 23 m

7 What is the average horizontal force acting on a ball when it elastically bounces off a wall, assuming the collision time is 0.10 s and the momentum of the ball before the bounce was 2 .0 kg m s^{-1}, perpendicular to the wall?

A 0.20 N **B** 20 N **C** 0.40 N **D** 40 N

8



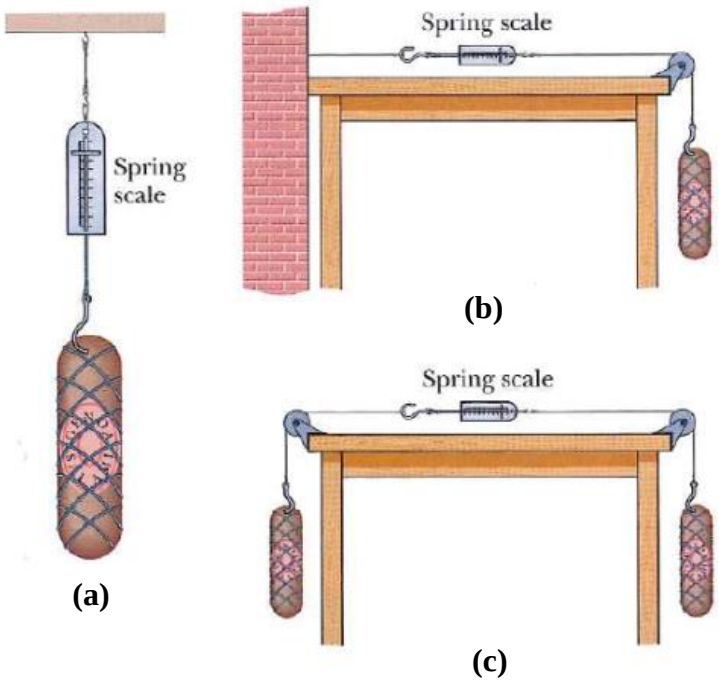
A mass m_1 rests on a frictionless surface. It is attached to mass m_2 by a light string which passes over a massless, frictionless pulley, as shown in the figure above. The system is released from rest. The initial acceleration a of m_2 is given by

A $a = g$ **B** $a = \dfrac{m_2 g}{m_1 + m_2}$ **C** $a = (m_2 - m_1)g$ **D** $a = \dfrac{m_1 g}{m_1 + m_2}$

9 A 250 g block is placed on top of a vertical spring that has a spring constant of 2.5 N cm^{-1}. The block causes the spring to be compressed. What is the strain energy stored in the spring?

A 0.0120 J **B** 0.245 J **C** 1.20 J **D** 2.41 J

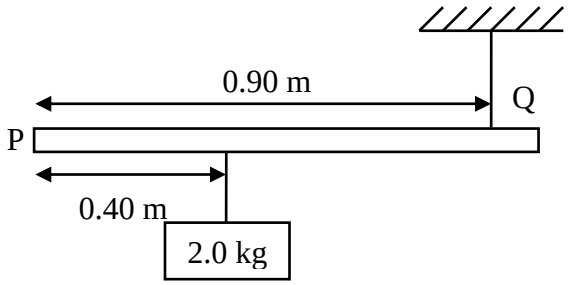
10 A spring scale reads 110 N when a load is supported by a cord and hung vertically on it as shown in Figure (a). In Figures (b) and (c), the load is supported by a cord that runs around a frictionless pulley and to the spring scale. What are the readings on the spring scale for Figures (b) and (c)?



(a) **(b)** **(c)**

	Figure (b)	**Figure (c)**
A	55 N	220 N
B	110 N	220 N
C	55 N	110 N
D	110 N	110 N

11



A horizontal uniform rod 1.00 m long and of mass 2.0 kg is pivoted at P. A 2.0 kg mass is hung 0.40 m from P and the rod is supported horizontally by a string Q which is 0.90 m from P. Which of the following is correct?

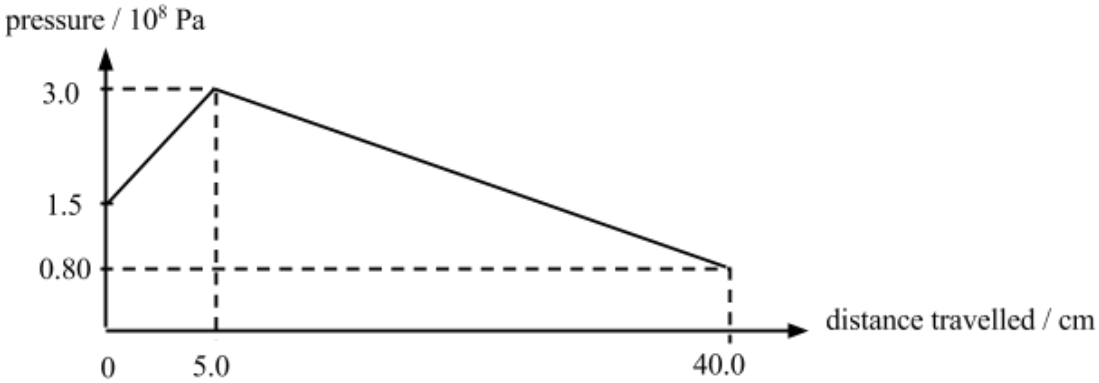
A Force exerted by string Q is 2.0 N upwards.

B Force exerted by string Q is 20 N upwards.

C Force exerted on the rod at P is 2.0 N downwards.

D Force exerted on the rod at P is 20 N downwards.

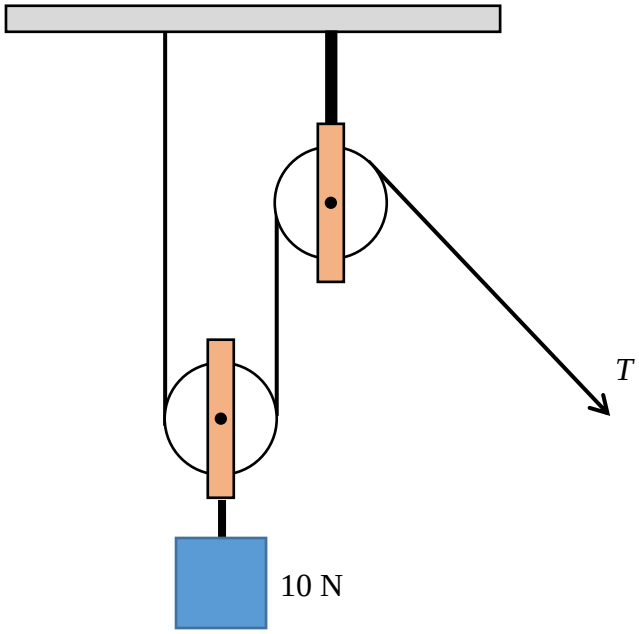
12 In a rifle, the explosive combustion of a propellant produces gas within the gun chamber with a very high pressure which propels the bullet out of the gun via the barrel. The following graph shows how the gas pressure within the gun chamber varies with the distance travelled by the bullet, up to the instant when the bullet exits the barrel of the gun.



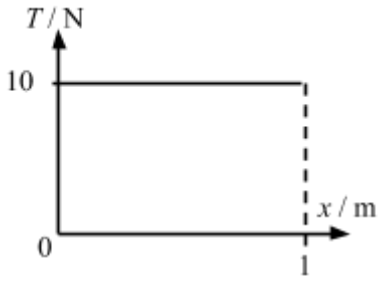
Assuming that the gun barrel is smooth, *estimate* the speed of the bullet when it exits the gun barrel.
The bullet has a cross-sectional area of 2.5×10^{-5} m^2 and a mass of 4.0 g.

A 100 m s^{-1} **B** 500 m s^{-1} **C** 1000 m s^{-1} **D** 2000 m s^{-1}

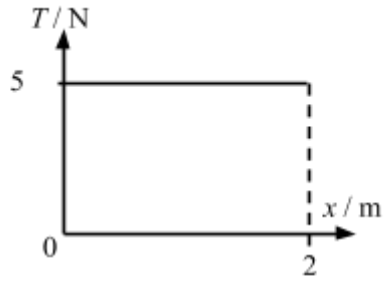
13 A simple compound pulley is used to lift a 10 N load through a vertical distance of 1.0 m at a constant speed.



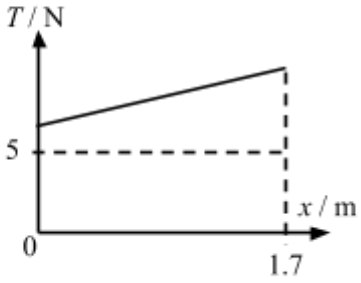
Which of the following graphs shows the variation of the tension *T* in the rope with the distance *x* moved by the rope in the direction of the tension *T*? Disregard frictional effects.



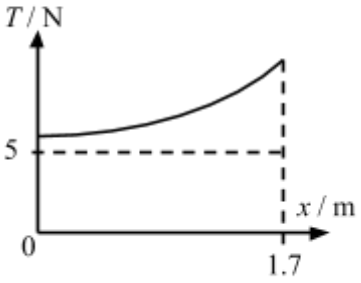
A



B

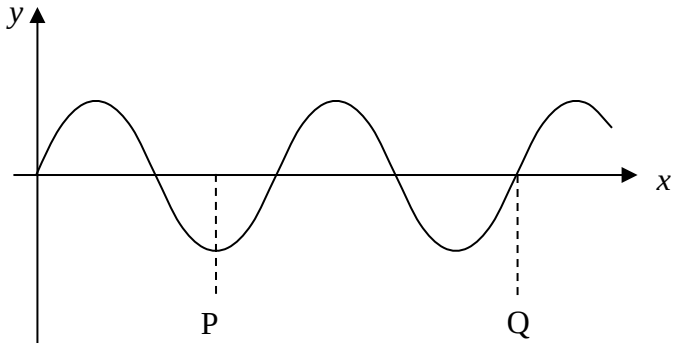


C



D

14 The graph below represents the displacement y at different points along a transverse wave travelling in the $+x$ direction at a particular instant of time. P and Q are two points along the wave.



Which of the following statements is **false**?

A P and Q have a phase difference of $\pi/2$ rad.

B The energy of P and Q is entirely in the form of potential and kinetic respectively at this instant.

C Both P and Q will start to move upwards after this instant.

D P and Q have the same amplitude.

15 An electromagnetic wave has a frequency of 10^{14} Hz. It is a

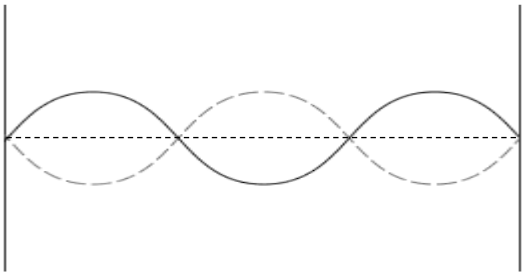
A Radio wave

B Ultraviolet wave

C Infra-red wave

D Visible light wave

16 A stretched string fixed at two ends is plucked in air and vibrates between two extreme positions as shown by the bold and the dotted curves. The horizontal dotted line is the equilibrium level.



Which statement is **false**?

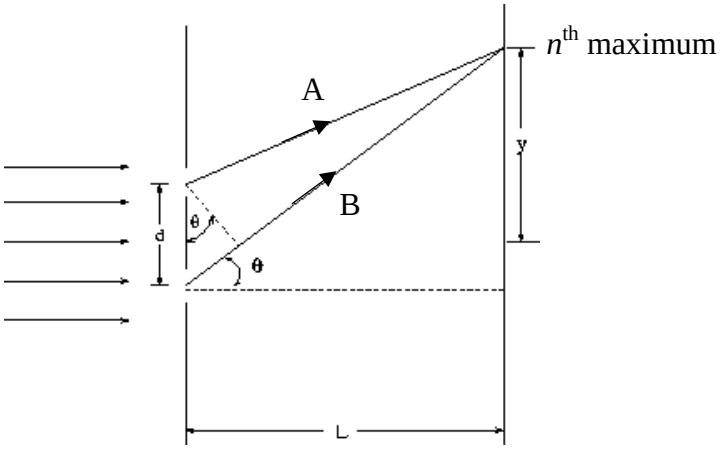
A A transverse stationary wave is formed.

B This mode of vibration is the third lowest frequency.

C There are four displacement nodes and three displacement anti-nodes in the diagram.

D The sound generated by the vibration is a standing longitudinal wave.

17 The diagram below shows the apparatus for Young's Double Slit Experiment. λ is the wavelength of the light used. The diagram is not drawn to scale.
When the angle θ is small, the difference in the lengths of the paths A and B is



A d

B $d \sin \theta$

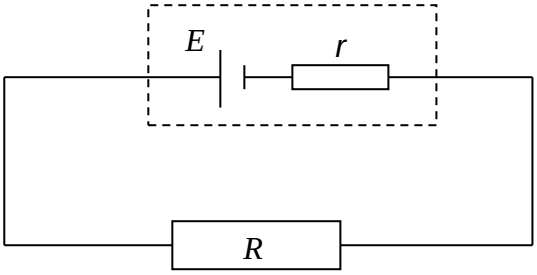
C $d \cos \theta$

D $y \sin \theta$

18 Two wires **P** and **Q**, each of the same length and the same material, are connected in parallel to a battery. The diameter of **P** is half that of **Q**. What fraction of the total current passes through **P** ?

A 0.20 **B** 0.25 **C** 0.33 **D** 0.50

19 A cell of e.m.f. *E* is connected in series with a resistor *R*.

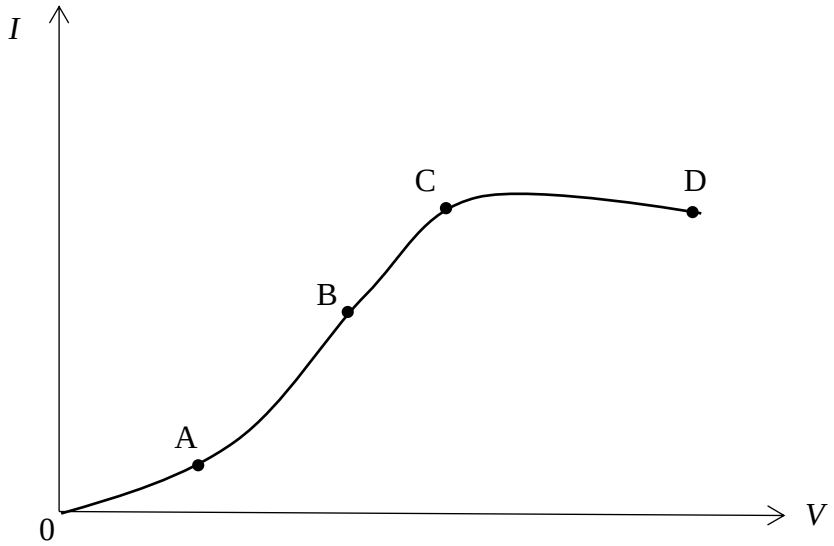


The potential difference across *R* is V_R. The potential difference across the internal resistance *r* of the cell is V_r.

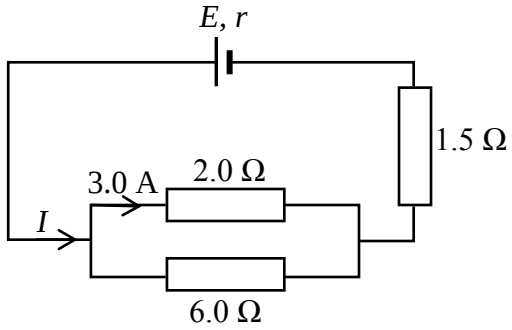
What is the energy developed across the resistor *R* in driving unit charge across it?

A $V_R - V_r$ **B** V_R **C** Er **D** ER

20 The diagram below shows the relation between the direct current *I* in a certain conductor and the potential difference *V* across it. Which point A, B, C and D does the conductor have the greatest resistance?



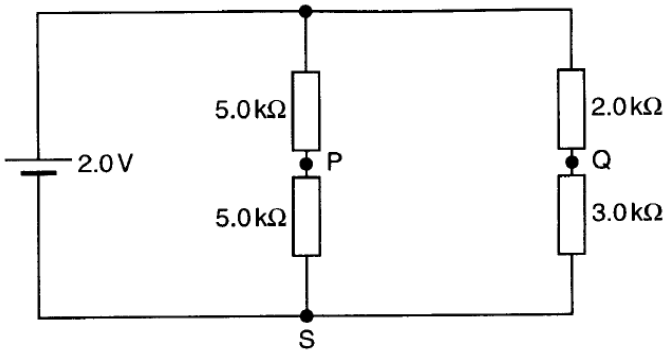
21 In the circuit shown, there is a current of 3.0 A in the 2.0 Ω resistor.



It is known that the source of e.m.f. E with internal resistance r has an output efficiency of 90 % in its power delivery to the external circuit. What are the values of the current I delivered by the source and its e.m.f. E ?

	***I* / A**	***E* / V**
A	3.0	12.0
B	4.0	10.8
C	4.0	13.3
D	12	18.0

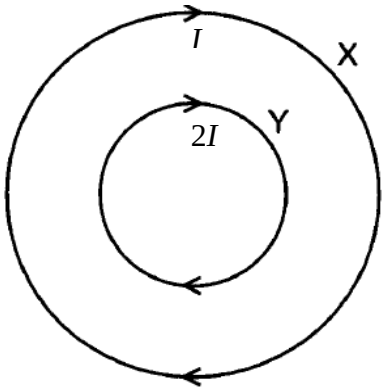
22 A cell of e.m.f. 2.0 V and negligible internal resistance is connected to the network of resistors as shown below.



V_1 is the potential difference between P and S. V_2 is the potential difference between Q and S. What is the value of $V_2 - V_1$?

A 0.50 V **B** 0.20 V **C** 0.10 V **D** 0 V

23 Two concentric coils X and Y each carries a current in the same direction as shown below.



Which of the following statements is correct?

A Force due to current in Y on X is twice that due to X on Y and is inward on X.

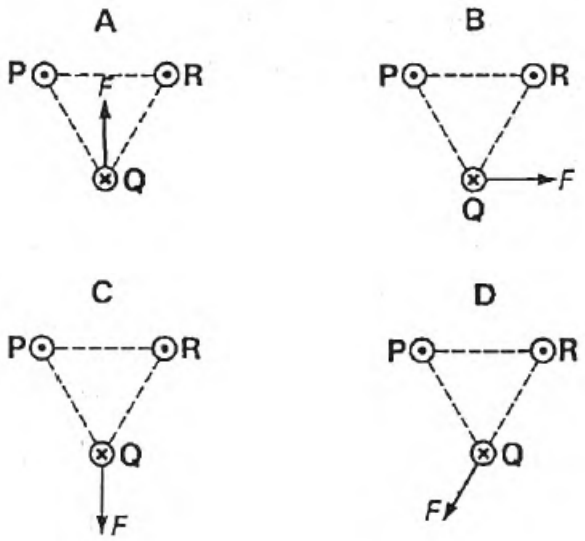
B Force due to current in Y on X is twice that due to X on Y and is perpendicular to the plane of the coil X.

C The direction of the force acting on every point of Y is radially inwards, towards the centre of Y.

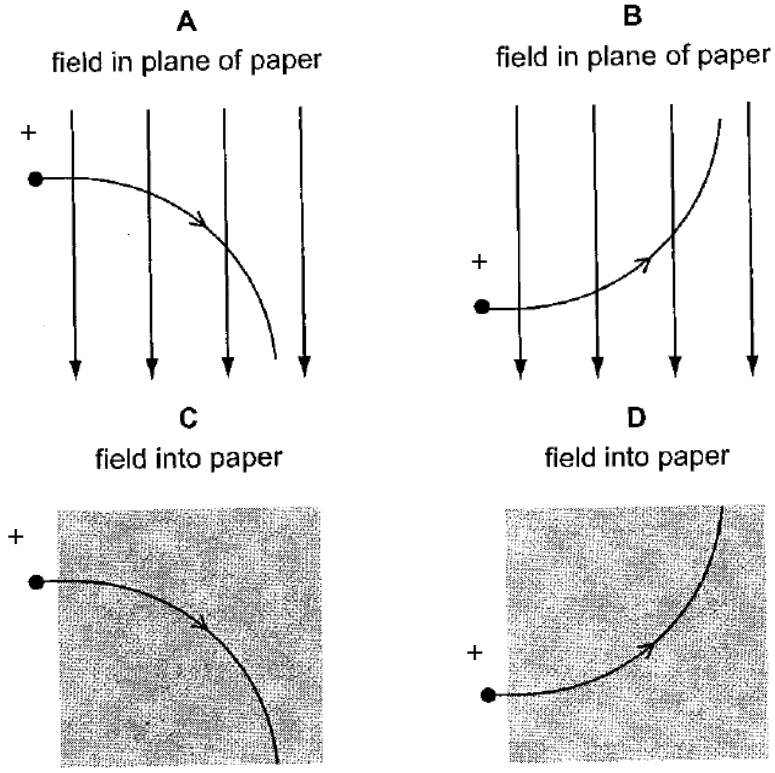
D The direction of the force acting on every point of Y is radially outwards, away from the centre of Y.

24 Three long vertical wires pass through the corners of an equilateral triangle PQR. They carry equal currents into or out of the paper in the directions shown in the diagram.

Which diagram shows the resultant force *F* on wire Q?



25 A positively charged particle enters a uniform magnetic field. Which diagram represents the path of the particle in the magnetic field?



26 In experiments on the photoelectric effect, different metals were illuminated with light from various monochromatic sources of different frequencies and variable intensities. It was found that, for a given metal, frequency and intensity, electrons were emitted with a spread of kinetic energies up to a maximum value. On what does this maximum kinetic energy depend?

	Type of metal	**Frequency of light**	**Intensity of light**
A	x	√	√
B	√	√	x
C	√	x	√
D	√	√	√

27 Which of the following statements referring to photoelectric emission is always true?

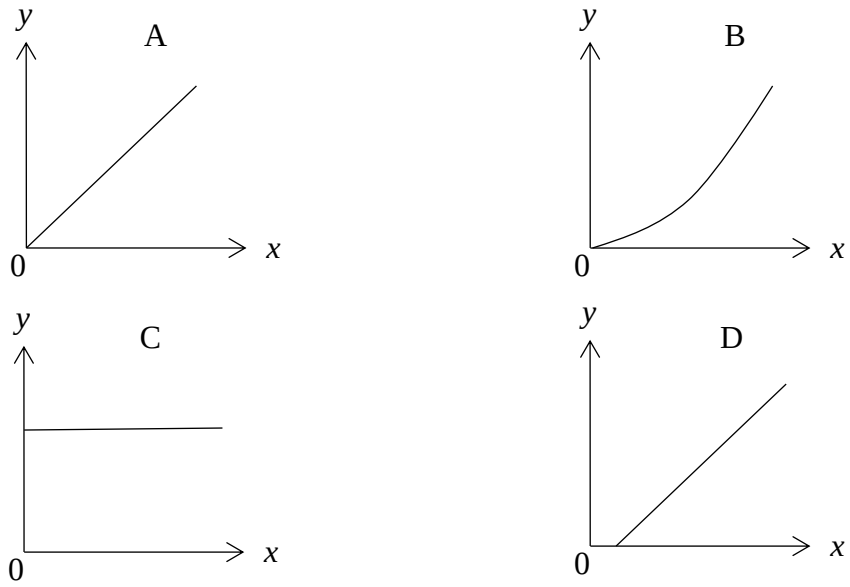
A No emission of electrons occurs for very low intensity illumination

B For a given metal, there is a minimum frequency of radiation below which no emission of electrons occurs.

C The number of electrons emitted per second is independent of the intensity of the incident radiation.

D The number of electrons emitted per second is proportional to the frequency of the incident light.

28 In an experiment on the photoelectric effect, an evacuated photocell with a pure metal cathode is used. Which graph best represents the variation of *y*, the minimum potential difference needed to prevent current from flowing, when *x*, the frequency of the incident light, is varied ?



29 What is the de Broglie wavelength of a particle of mass, *m* and kinetic energy, *E*?

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

30 When an atom absorbs radiation of wavelength λ_1, it makes a transition from its ground state of energy E_1 to an excited state of energy E_3. Then it makes a second transition to a state of lower energy E_2, emitting radiation of wavelength λ_2.
What is the wavelength of the radiation emitted by the atom when it makes a third transition back to the ground state?

A $\lambda_1 - \lambda_2$ **B** $\lambda_2 - \lambda_1$ **C** $\frac{\lambda_1\lambda_2}{\lambda_1 - \lambda_2}$ **D** $\frac{\lambda_1\lambda_2}{\lambda_2 - \lambda_1}$

End of paper