

Class	Index Number	Name
13		

ST. ANDREW'S JUNIOR COLLEGE
JC 2 2014
Preliminary Examinations

PHYSICS, Higher 1
Paper 1 Multiple Choice

8866 / 01
18 Sept 2014
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, index number and Civics Group on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** questions 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 separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully. A mark will not be deducted for a wrong answer.

Any 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 including this page.

Data

speed of light in free space,	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
elementary charge,	$e = 1.60 \times 10^{-19} \text{ C}$
the Planck constant,	$h = 6.63 \times 10^{-34} \text{ J s}$
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,	$m_p = 1.67 \times 10^{-27} \text{ kg}$
acceleration of free fall.	$g = 9.81 \text{ m s}^{-2}$

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
hydrostatic pressure,	$p = \rho gh$
resistors in series,	$R = R_1 + R_2 + \dots$
resistors in parallel.	$1/R = 1/R_1 + 1/R_2 + \dots$

- 1 Which of the following correctly expresses the volt in terms of SI base units?

A $\text{kg m}^2 \text{s}^{-3} \text{A}^{-1}$

B $\text{kg m}^2 \text{s}^{-1} \text{A}^{-1}$

C W A^{-1}

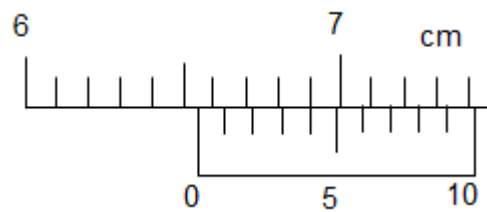
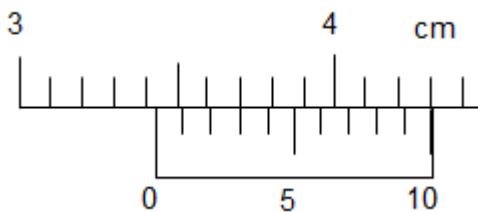
D $\text{A } \Omega$

- 2 Four students each made a series of measurements of the acceleration of free fall g . The table shows the results obtained.

Which set of results could be described as precise but not accurate?

	$g / \text{m s}^{-2}$			
A	9.81	9.79	9.84	9.83
B	9.81	10.12	9.89	8.94
C	9.45	9.21	8.99	8.76
D	8.45	8.46	8.50	8.41

- 3 The diagrams show the scale readings of a travelling microscope focused on each of the ends of a short rod.



On reading the vernier scale, an error of one division either way may be made. What is the length of the rod and the associated error in the measurement?

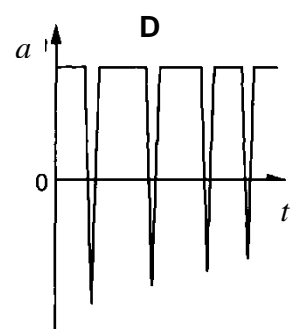
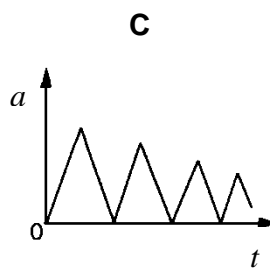
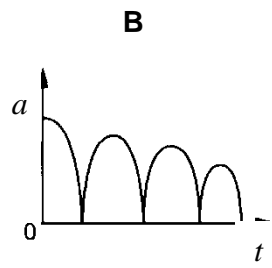
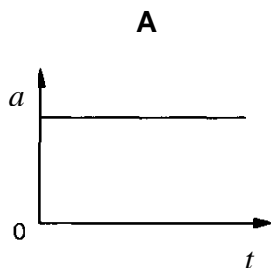
A $(3.11 \pm 0.01) \text{ cm}$

B $(3.11 \pm 0.02) \text{ cm}$

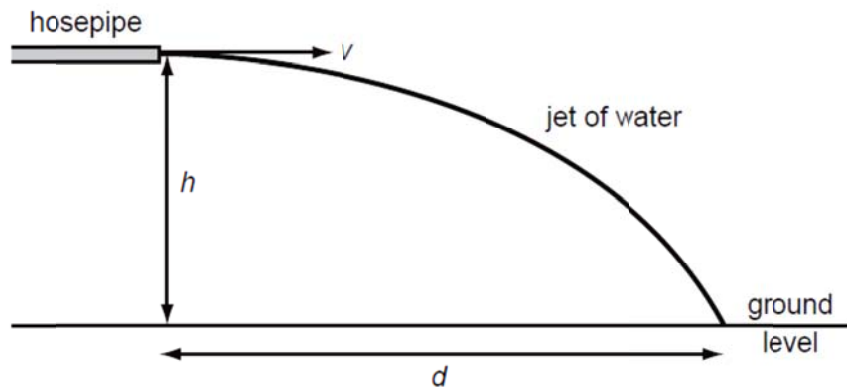
C $(3.21 \pm 0.01) \text{ cm}$

D $(3.21 \pm 0.02) \text{ cm}$

- 4 A steel ball held above a horizontal table is released so that it falls on the table and rebounds several times. If the collisions are inelastic, which graph best represents the acceleration a of the ball with time, t ? Effects of air resistance may be neglected.



- 5 A hosepipe is fixed as shown.



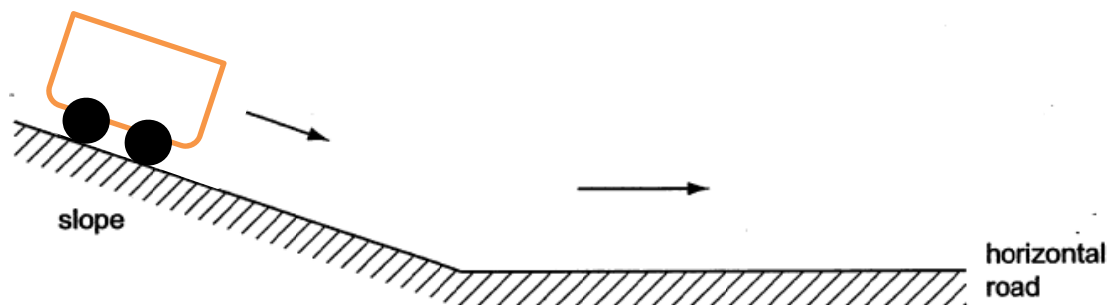
The jet of water emerges with a horizontal velocity v . The hosepipe is fixed at a height h above the ground. The water jet hits the floor at a horizontal distance d from the nozzle tip. The acceleration due to gravity is g . What is the expression for distance d ? (Ignore air resistance.)

- | | | | |
|----------|----------------------------|----------|----------------------------|
| A | $d = \frac{vg}{2h}$ | B | $d = \frac{2vh}{g}$ |
| C | $d = v\sqrt{\frac{2h}{g}}$ | D | $d = v\sqrt{\frac{g}{2h}}$ |

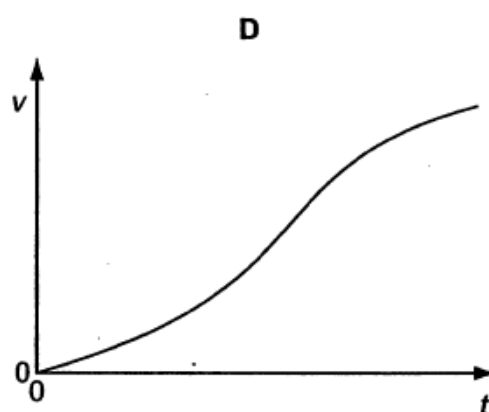
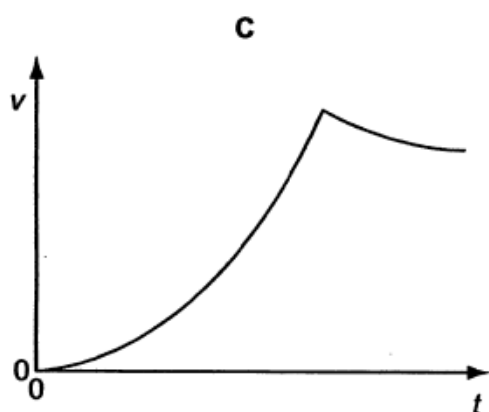
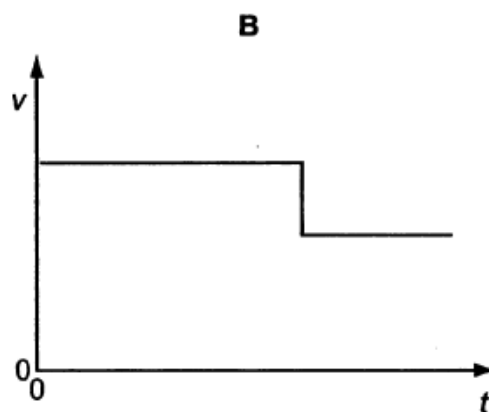
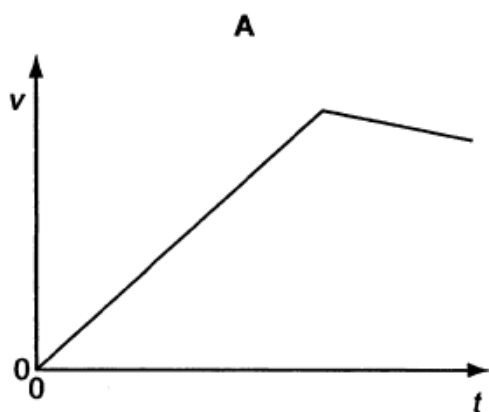
- 6 As a space rocket takes off and flies vertically with a constant speed of 10 m s^{-1} , a loose bolt detaches from the rocket when its height is 120 m from the ground. How long does it take for the bolt to strike the ground?

- | | | | |
|----------|-----------------|----------|-----------------|
| A | 4.0 s | B | 5.4 s |
| C | 5.9 s | D | 6.1 s |

- 7 A trolley with wheels is initially at rest on a downward slope which leads to a horizontal road. The trolley is then allowed to roll freely down the slope. There is a constant frictional force acting on the trolley on the slope and the road.



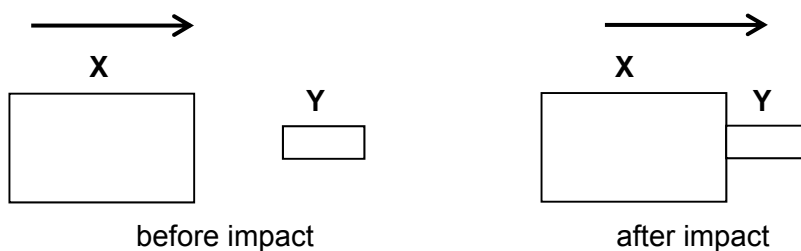
Which graph best represents the way in which the trolley's velocity v varies with time t ?



- 8 An object of mass m is hanging by a string from the roof of a lift. The lift is moving upwards but is slowing down. The tension in the string is

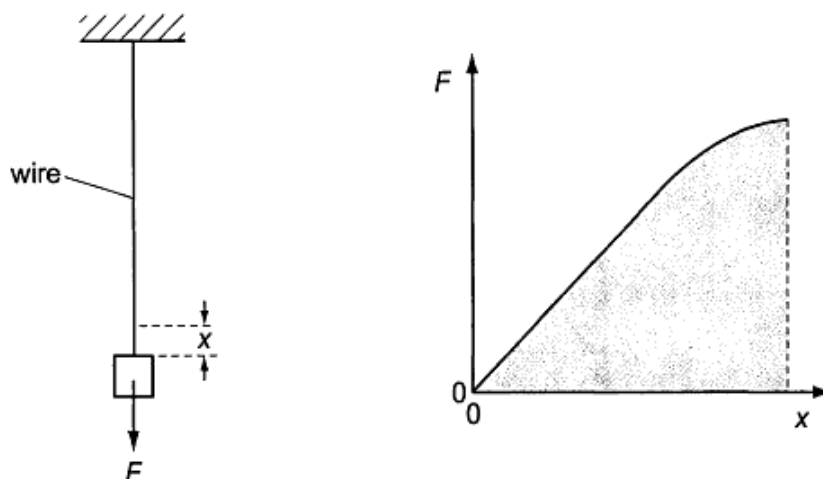
- | | | | |
|----------|-------------------|----------|--------------|
| A | less than mg | B | exactly mg |
| C | greater than mg | D | zero |

- 9 A body **X** collides with a body **Y**. The two bodies stick together on impact and then move together.



Which statement is correct?

- A All of **X**'s momentum becomes kinetic energy of **Y**.
 B Some of **X**'s momentum is lost as heat.
 C The momentum of the system is reduced by the forces during impact.
 D **X** transfers some of its momentum to **Y**.
- 10 A wire, fixed at its upper end, is subjected to an increasing load F by increasing the mass attached to its lower end. A graph of F against the extension x of the wire is shown.

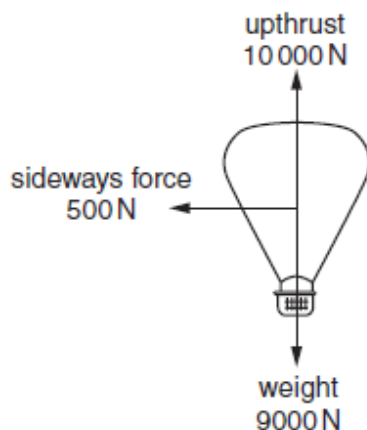


The wire is stretched beyond its elastic limit.

What does the shaded area on the graph represent?

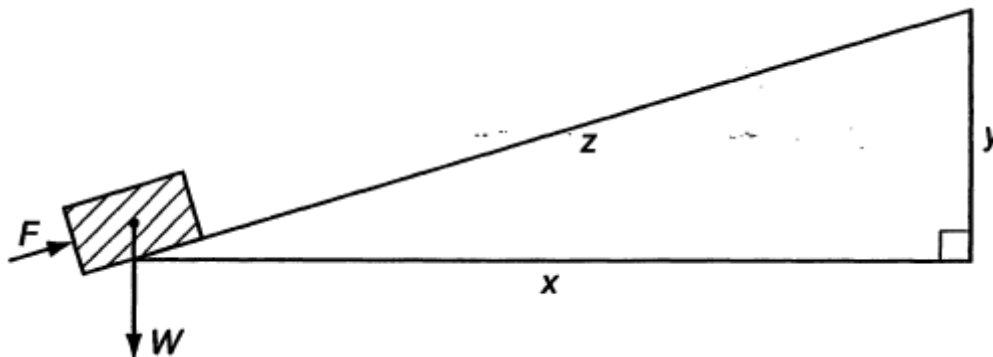
- A the amount of elastic potential energy stored in the wire
 B the amount of heat produced in the wire
 C the loss of gravitational potential energy of the mass
 D the work done by F on the wire

- 11 A balloon is acted upon by three forces, weight, upthrust and sideways force due to the wind, as shown below.



What is the vertical component of the resultant force on the balloon?

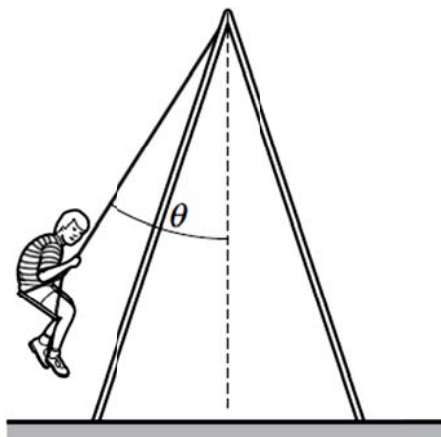
- | | | | |
|----------|----------|----------|----------|
| A | 500 N | B | 1000 N |
| C | 10 000 N | D | 10 500 N |
- 12 A stationary crate of weight W is pushed by a man all the way up a rough slope. The slope has dimensions x , y , z as shown below. The force exerted by the man is F . The crate finishes at the top of the slope at rest.



How much work is done by the man?

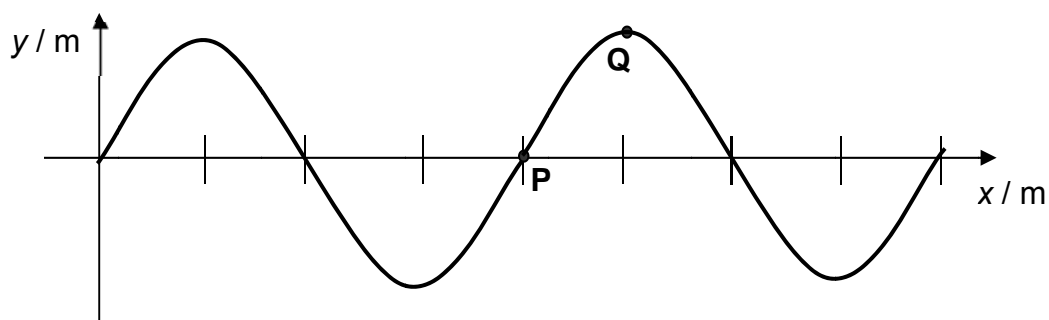
- | | | | |
|----------|------|----------|-----------|
| A | Fz | B | Wz |
| C | Wy | D | $Wy + Fz$ |

- 13** A child of mass 50 kg is on a swing which is suspended by 4.0 m ropes from a rigid support. The horizontal speed of the swing as it passes through the lowest point is 3.0 m s^{-1} .



What is the angle θ that the ropes make with the vertical when the swing is at its highest point?

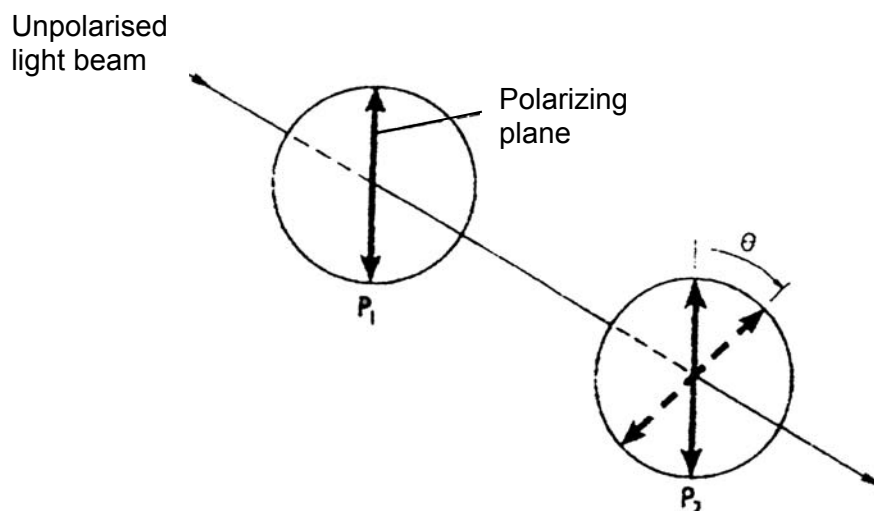
- A** 28° **B** 40° **C** 42° **D** 62°
- 14** Which of the following quantities will be conserved during a collision between a proton and an electron?
- A** Energy only
B Momentum only
C Energy and momentum
D Neither energy nor momentum
- 15** The diagram shows a transverse wave at a particular instant. The wave is travelling to the right at a frequency of 12.5 Hz.



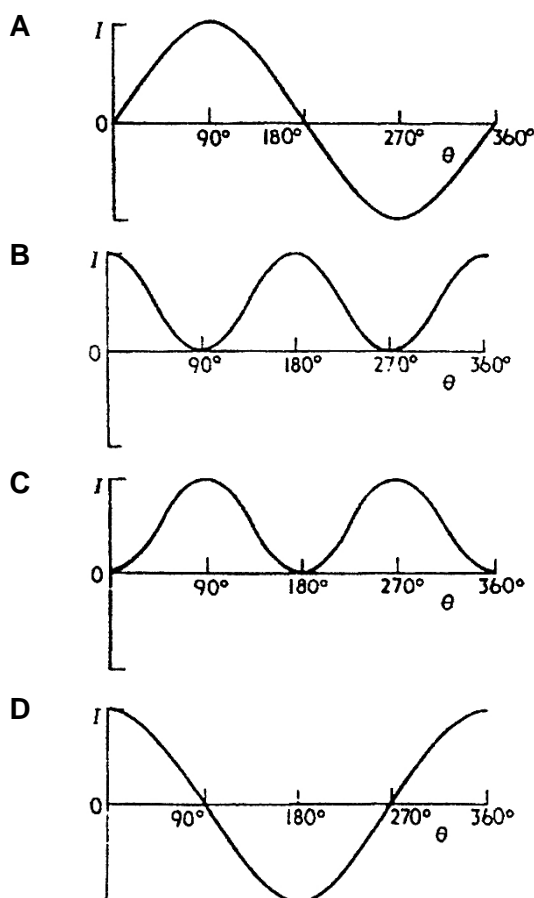
At the instant shown, the displacement at point **P** is zero. What is the possible time interval that would elapse before the displacement is zero at point **Q**?

- A** 0.01 s **B** 0.02 s
C 0.04 s **D** 0.07 s

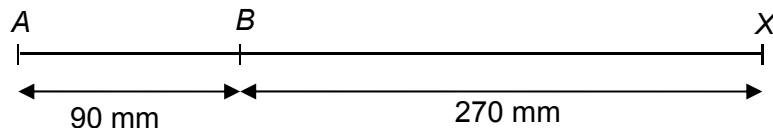
- 16 A beam of unpolarised light passes in turn through polaroids P_1 and P_2 as illustrated in the figure below. The polarising plane of the polaroids are indicated by arrows. Polaroid P_1 is fixed while Polaroid P_2 is rotated through 360° from the position where $\theta = 0^\circ$.



Which of the following graphs best shows how the intensity I of the emergent beam varies with the angle of rotation θ ?



17



A and B are two coherent sound sources which are in phase. Point X shows permanent zero displacement. From the options given below, choose the sound wave with the maximum wavelength that can satisfy this condition.

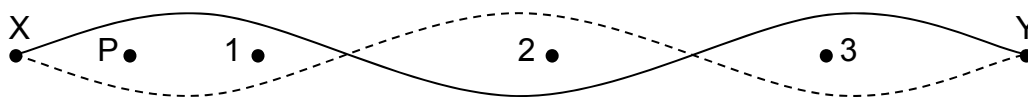
A 180 mm

B 90 mm

C 60 mm

D 45 mm

18 A standing wave is set up on a stretched string XY as shown in the diagram.



At which point(s) will the oscillation be exactly in phase with that at point P ?

A 1 and 3 only

B 2 and 3 only

C 1 only

D 2 only

19 If two waves of the same frequency are superposed in phase, the intensity of the resultant wave is proportional to

A the sum of the intensities of the two waves

B the square of the mean value of the two amplitudes

C the square of the difference of the two amplitudes

D the square of the sum of the two amplitudes

20 When four identical lamps P , Q , R and S are connected as shown in diagram 1, they have normal brightness.

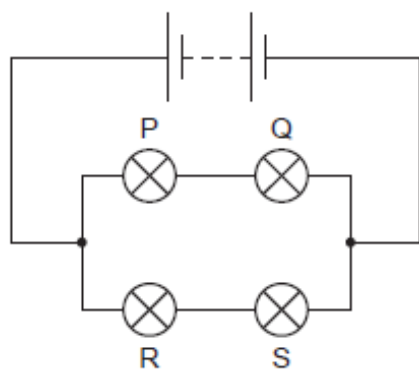


diagram 1

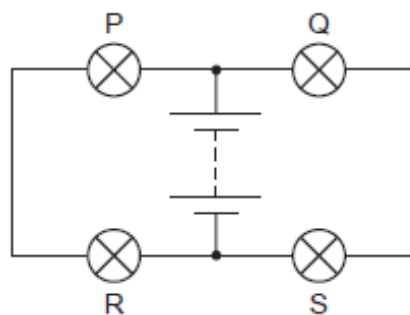
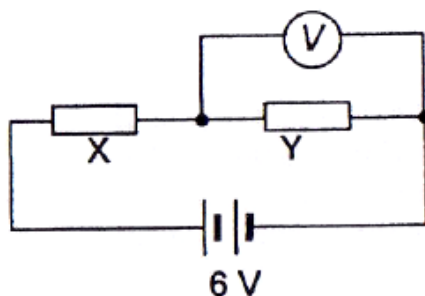


diagram 2

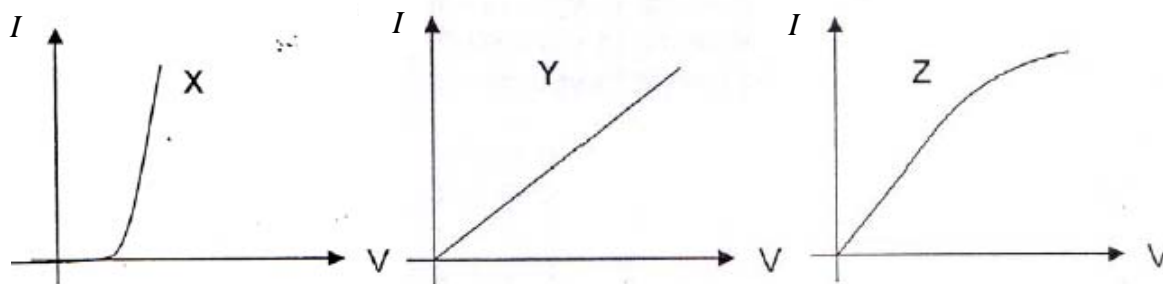
The four lamps and the battery are then connected as shown in diagram 2.
Which statement is correct?

- A** The lamps do not light.
- B** The lamps are less bright than normal.
- C** The lamps have normal brightness.
- D** The lamps are brighter than normal.

- 21** In the circuit below, resistors X and Y, of resistances R and $4R$ respectively, are connected to a 6 V battery of negligible internal resistance. When a non-ideal voltmeter of resistance $4R$ is connected across Y, what will be the reading in the voltmeter?

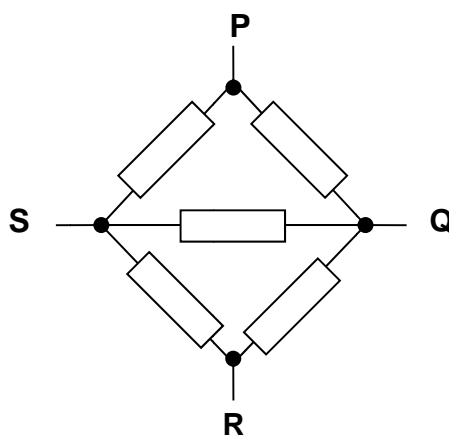


- A** 1 V
 - B** 2 V
 - C** 3 V
 - D** 4 V
- 22** The graphs below show the variation with potential difference V of current I for three circuit elements.



The three circuit elements are a tungsten filament lamp, a metal wire at constant temperature and a semiconductor diode. Which of the following correctly identifies these graphs?

- | | Tungsten filament lamp | metal wire | semiconductor diode |
|----------|------------------------|------------|---------------------|
| A | X | Y | Z |
| B | Y | Z | X |
| C | X | Z | Y |
| D | Z | Y | X |



A	PQ	B	PR
C	PS	D	QS

A	4.5×10^{22}	B	1.3×10^{19}
C	7.2×10^3	D	1.2×10^{-15}

A

2.0 A ↑ 4.0 A ↑

← F_1 F_2 →

$F_1 = 2 F_2$

B

2.0 A ↑ 4.0 A ↑

← F_1 F_2 →

$F_1 = F_2$

C

2.0 A ↑ 4.0 A ↑

→ F_1 F_2 ←

$F_1 = 2 F_2$

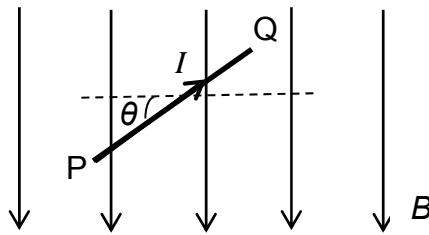
D

2.0 A ↑ 4.0 A ↑

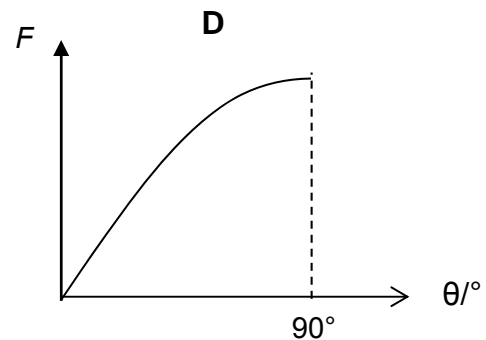
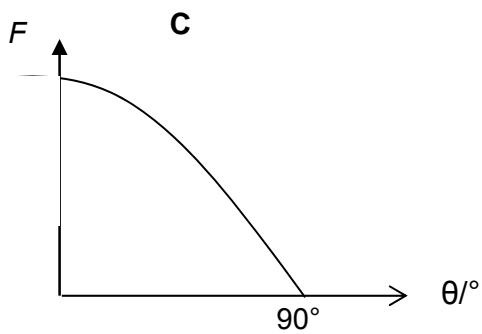
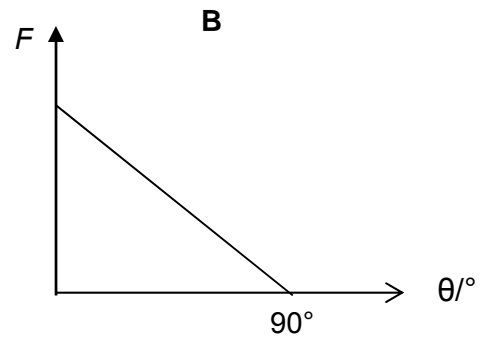
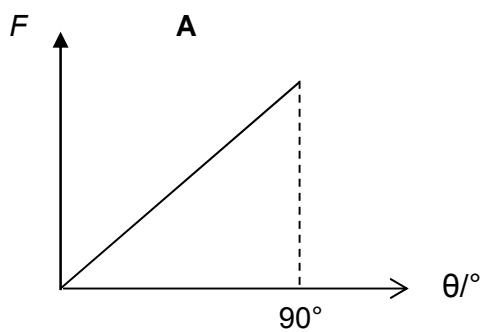
→ F_1 F_2 ←

$F_1 = F_2$

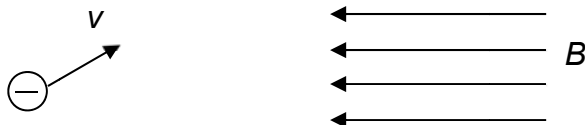
- 26 A straight wire PQ carrying a constant current, I , is placed at right angles to a uniform magnetic field, as shown in the diagram below.



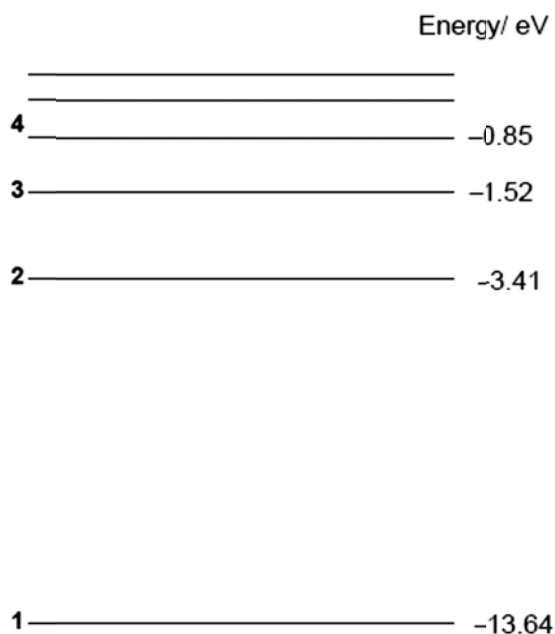
The wire is then rotated through an angle θ about an axis perpendicular to the plane of the diagram. Which graph shows how the magnitude of the magnetic force on the wire varies with θ in the range 0° to 90° ?



- 27 An initially stationary electron in a magnetic field is given a velocity v as shown in the figure below. Which of the following statements about the subsequent motion of the electron is correct?



- A The electron will move in a clockwise circular path in the plane of the paper.
- B The electron will move in an anti-clockwise circular path in the plane of the paper.
- C The electron will move in a helical path towards the left.
- D The electron will move in a helical path towards the right.
- 28 The figure below shows some of the energy levels (in electron-volts) of the hydrogen atom.



Which of the following gives the correct corresponding remaining energies, if separately, an electron and a photon each of energy 12.50 eV is incident on the hydrogen atom?

	Remaining energy of incident electron /eV	Remaining energy of incident photon /eV
A	12.50	0.38
B	0	0.38
C	0.38	12.50
D	0.38	0

- 29** 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 maximum wavelength of radiation above which no emission of electrons occurs.
 - C** The velocity of the emitted electrons is proportional to the intensity of the incident radiation.
 - D** The number of electrons emitted per second is proportional to the frequency of the incident radiation.
- 30** An electron and a proton have the same de Broglie wavelength. Which of the following statements is correct?
- A** The kinetic energy of the proton is smaller than that of the electron.
 - B** The kinetic energy of the proton is greater than that of the electron.
 - C** The momentum of the proton is smaller than that of the electron.
 - D** The momentum of the proton is greater than that of the electron.

End of Paper

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