

# ST. ANDREW'S JUNIOR COLLEGE

## PHYSICS 8866/1 (Higher 1)

Friday

18<sup>th</sup> September 2015

1 hour

### Preliminary Examination Paper 1

#### Instructions to candidates:

1. Write in soft pencil on the OMS.
2. Do not use staples, paper clips, highlighters, glue or correction fluid.
3. Write your name, Civic Group and index number on the separate Optical Mark Sheet (OMS).

There are **thirty** questions in this paper. Answer **all** the questions. For each question there are four possible answers **A, B, C, D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Optical Mark Sheet (OMS).

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

#### Instructions for using the Optical Mark Sheet (OMS)

The diagram shows a portion of an Optical Mark Sheet (OMS). On the left, there is a vertical column labeled 'WRITE' with the words 'INDEX' and 'NUMBER' stacked vertically. To the right of this column is a grid of boxes for shading answers, labeled 'SHADE APPROPRIATE BOXES'. The grid has 10 columns numbered 0 to 9 and 10 rows labeled A to I. A box labeled 'Write your numbers here' has an arrow pointing to the 'WRITE' column. Two ovals highlight specific areas: the top oval is around the first two rows (A and B) and columns 2 and 3, with an arrow pointing to a box labeled 'Class no.'; the bottom oval is around the next two rows (C and D) and columns 2 and 3, with an arrow pointing to a box labeled 'Register no.'.

1. Fill in your class number (e.g. 14S24 = "24", 14A01 = "01") in the first two rows.
2. Fill in your class register number in the next two rows. (e.g. register number 1 is filled in as "01").
3. Write your class and register numbers into the column on the left (ie. 2415)

**The Question Paper consists of 14 printed pages (including this cover sheet).**

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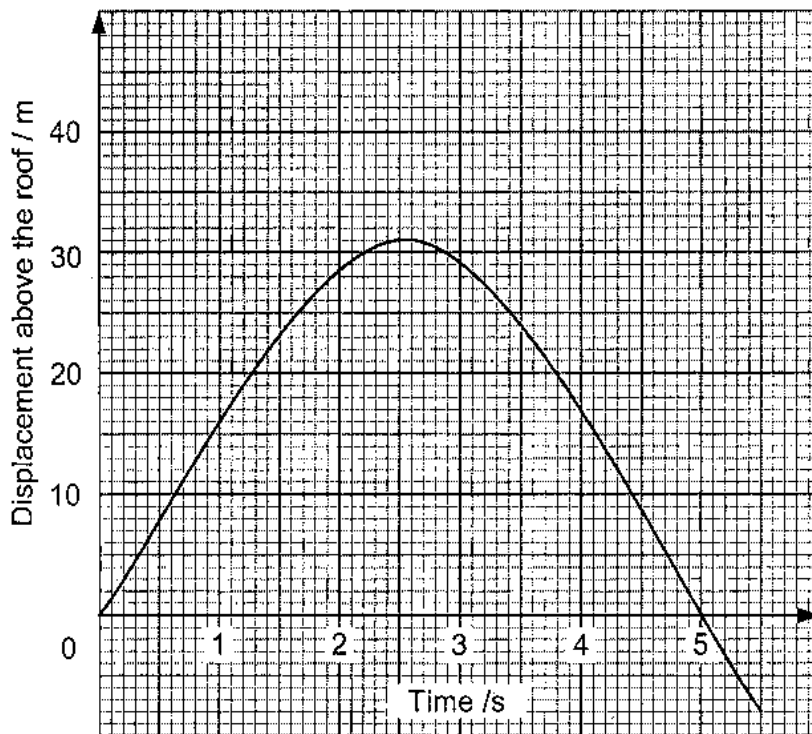
#### Data

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	$h$	=	$6.63 \times 10^{-34} \text{ Js}$
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,	$s$	=	$u t + \frac{1}{2} a t^2$
	$v^2$	=	$u^2 + 2 a s$
work done on/by a gas,	$W$	=	$p \Delta V$
hydrostatic pressure,	$p$	=	$\rho g h$
resistors in series	$R$	=	$R_1 + R_2 + \dots$
resistors in parallel	$1/R$	=	$1/R_1 + 1/R_2 + \dots$

- 1 Which pair of units are both SI base units?
- A ampere, degree celsius  
 B ampere, kelvin  
 C coulomb, degree celsius  
 D coulomb, kelvin
- 2 In an experiment, a radio-controlled car takes  $(2.50 \pm 0.05)$  s to travel  $(40.0 \pm 0.1)$  m. What is the car's average speed and the uncertainty in this value?
- A  $(16 \pm 1) \text{ m s}^{-1}$   
 B  $(16.0 \pm 0.2) \text{ m s}^{-1}$   
 C  $(16.0 \pm 0.4) \text{ m s}^{-1}$   
 D  $(16.00 \pm 0.36) \text{ m s}^{-1}$
- 3 An object is projected vertically up into the air from the edge of a roof top. The displacement time graph for the motion is shown below.



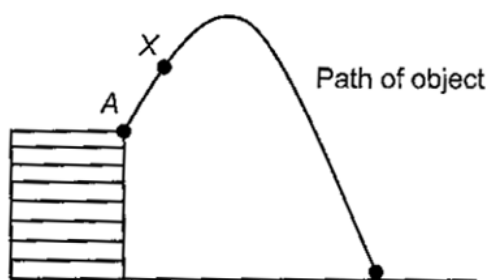
From the graph, it may be concluded that at the time

- A 0 s the speed of the object was  $0 \text{ m s}^{-1}$ .  
 B 2.5 s the speed of the object was  $31 \text{ m s}^{-1}$ .  
 C 2.5 s the acceleration of the object was  $0 \text{ m s}^{-1}$ .  
 D 2.5 s the direction of the velocity of the object was reversed.

- 4 A stone thrown horizontally at a speed of  $24 \text{ m s}^{-1}$  from the top of a cliff takes  $4.0 \text{ s}$  to hit the sea. What is the height of the cliff-top above the sea and the distance from the base of the cliff to the point of impact?

	Height	Distance
<b>A</b>	78 m	96 m
<b>B</b>	78 m	116 m
<b>C</b>	90 m	96 m
<b>D</b>	90 m	116 m

- 5 An object is fired at an angle from point A at the top of a building and follows a free-fall trajectory as shown.



Neglecting air resistance, which vector best represents the direction of the object's acceleration at X?

A



B



C



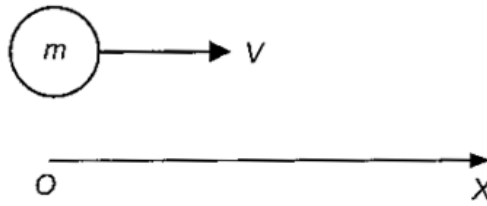
D



- 6 Newton's third law concerns the forces of interaction between two bodies. Which of the following statements relating to the third law is false?

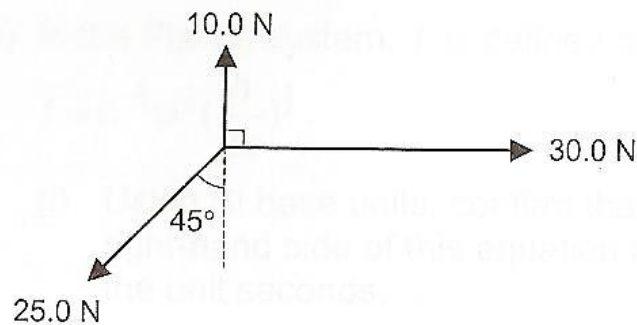
- A** The two forces must act on different bodies.
- B** The two forces are always opposite in direction.
- C** The two forces are equal and opposite so that the bodies are in equilibrium.
- D** The two forces are at all times equal in magnitude.

- 7 A particle of mass  $m$  is traveling with a velocity  $v$  in the direction OX as shown below. At a later time, its velocity is of the same magnitude in the opposite direction XO.

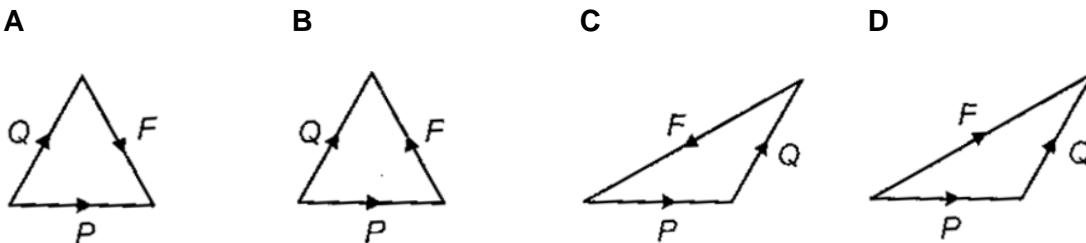


The change of momentum that has taken place in this time interval is

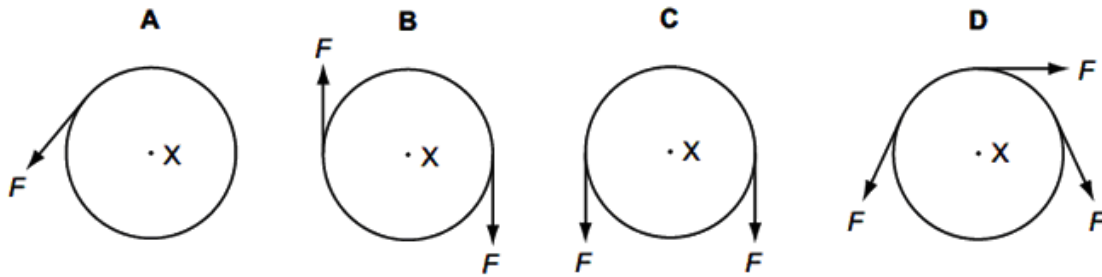
- A  $mv$  in the direction OX.  
 B  $mv$  in the direction XO.  
 C  $2mv$  in the direction of OX.  
 D  $2mv$  in the direction of XO.
- 8 What is the magnitude of the resultant force of the following systems of coplanar forces?



- A 4.62 N      B 12.3 N      C 14.5 N      D 20.0 N
- 9 A body is acted on by two forces, P and Q. A frictional force F holds the body in equilibrium. Which vector triangle could represent the relationship between these forces?

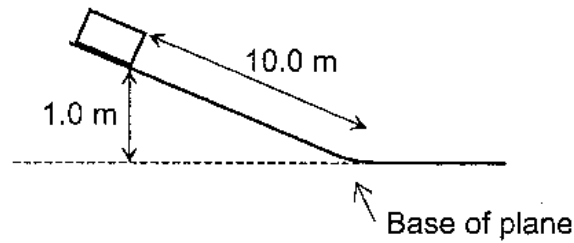


- 10 A rigid circular disc of radius  $r$  has its centre at  $X$ . A number of forces of equal magnitude  $F$  act at the edge of the disc. All the forces are in the plane of the disc.



Which arrangement of forces provides a moment of magnitude  $2Fr$  about  $X$ ?

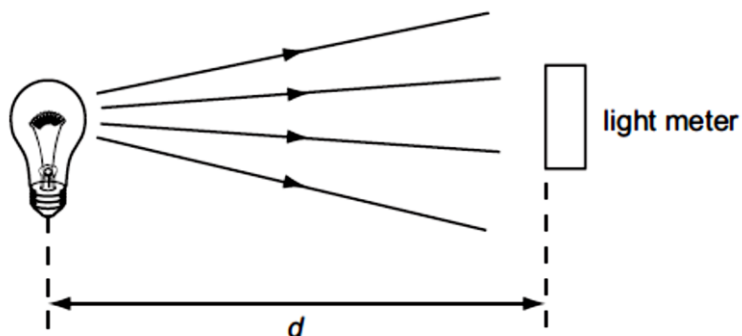
- 11 A body of mass  $1.0\text{ kg}$  initially at rest slides down an inclined plane that is  $1.0\text{ m}$  high and  $10.0\text{ m}$  long as shown in the diagram below.



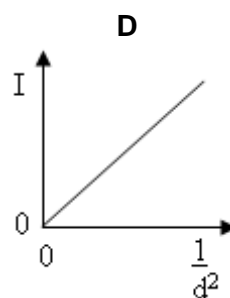
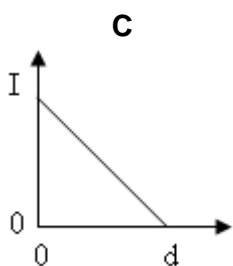
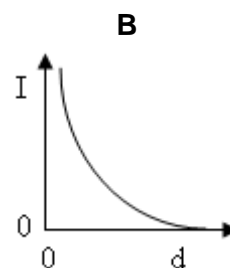
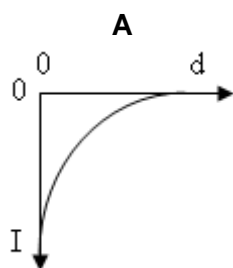
If the body experiences a constant resistive force of  $0.5\text{ N}$  over the slope, what is the kinetic energy of the body at the base of the plane?

- A      $4.81\text{ J}$   
 B      $9.31\text{ J}$   
 C      $10.3\text{ J}$   
 D      $14.8\text{ J}$
- 12 A body of mass  $m$  moves at constant speed  $v$  for a distance  $s$  against a force  $F$ . What is the power required to sustain this motion?
- A      $mv$   
 B      $\frac{1}{2}mv^2$   
 C      $\frac{1}{2}Fs$   
 D      $Fv$

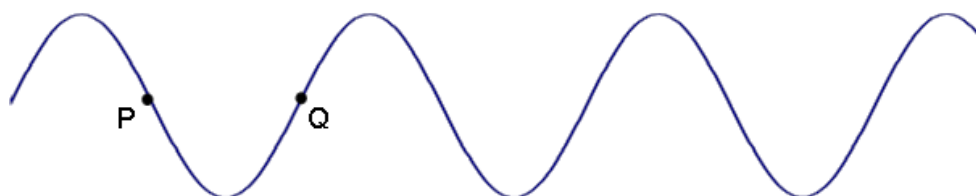
- 13 A light meter measures the intensity  $I$  of the light falling on it. Theory suggests that this varies as the inverse square of the distance  $d$ .



Which graph of the results supports this theory?



- 14 The diagram shows a transverse wave on a rope. The wave is travelling from left to right. The phase difference between P and Q is



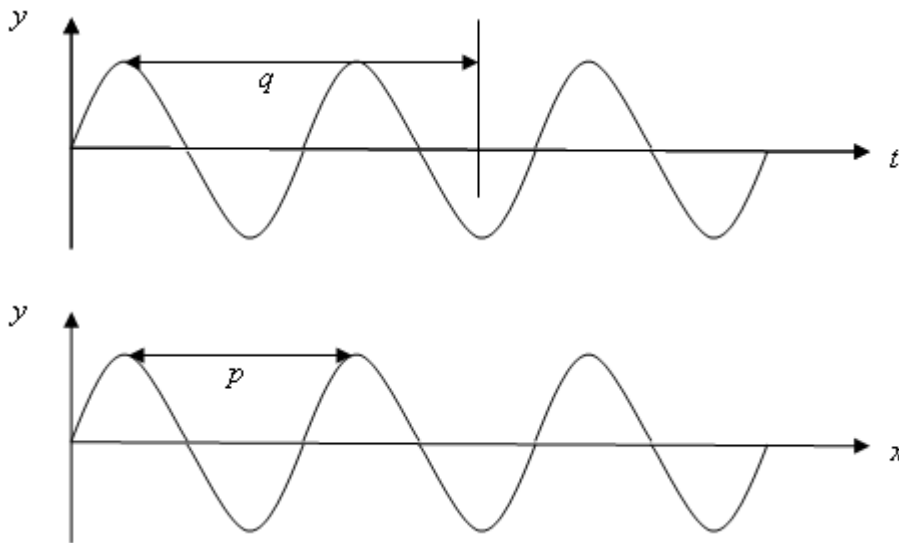
**A**  $\frac{\pi}{4}$

**B**  $\frac{\pi}{2}$

**C**  $\pi$

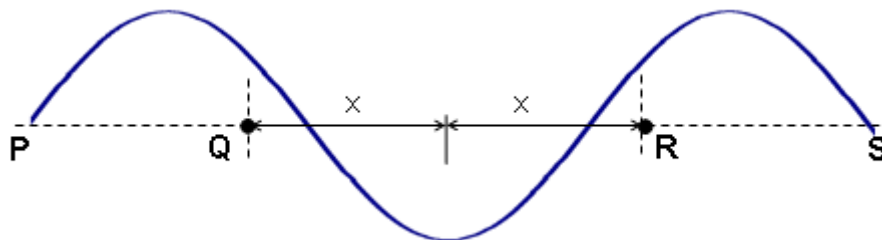
**D**  $2\pi$

- 15 The same progressive wave is represented by the following graphs where  $y$  is the displacement,  $t$  is the time at a fixed position and  $x$  is the position at a certain point of time.



Which of the following gives the speed of the wave?

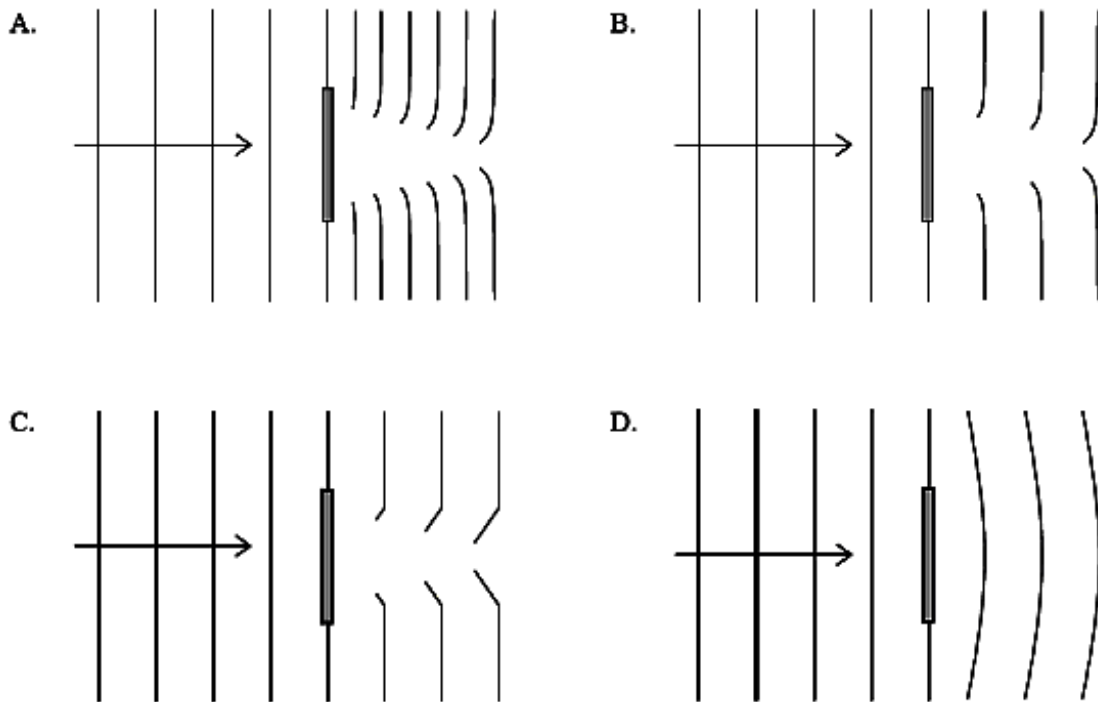
- A  $\frac{q}{p}$                       B  $\frac{p}{q}$                       C  $\frac{2p}{3q}$                       D  $\frac{3p}{2q}$
- 16 A standing wave is set up on a stretched string PS as shown in the diagram.



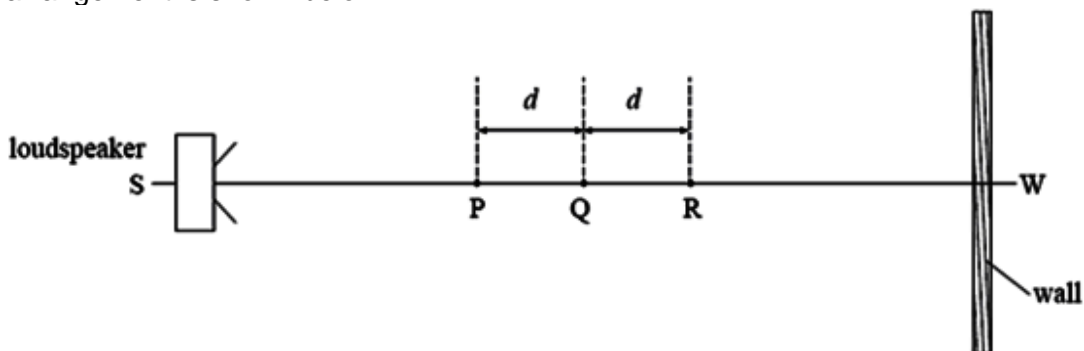
The vibrations of the two points Q and R, shown on the string have

- A different amplitude and are in anti-phase.  
 B different amplitude and are in phase.  
 C the same amplitude and are in anti-phase.  
 D the same amplitude and are in phase.

- 17 Which of the following diagrams best illustrates the diffraction of waves by an obstacle?



- 18 A loudspeaker emits sound of frequency  $f$ . The sound waves are reflected from a wall. The arrangement is shown below.



When a microphone is moved along the line SW, minimum loudness of sound is detected at points P, Q and R. There are no other minima between these points. The separation of the minima is  $d$ . The speed of the sound wave is

- A  $\frac{1}{2}fd$       B  $f/d$       C  $fd$       D  $2fd$

- 19 The potential difference between point P and point Q is 15 V and the current flowing through is 0.025 A. During a period of time  $t$ , the energy of the charge carriers changes by 6 J when moving from P to Q.

What is the value of time  $t$ ?

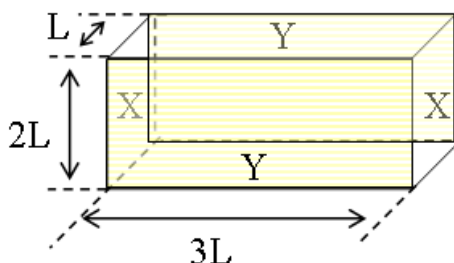
- A 0.010 s
- B 0.063 s
- C 16 s
- D 100 s

- 20 A high potential is applied between the electrodes of a gas discharge tube so that the gas is ionised. The copper conductors to the gas carry a current of 8.16 mA and the number of electrons passing any point in the gas per unit time is  $2.58 \times 10^{16} \text{ s}^{-1}$ .

If the charge on each positive particle is  $3.2 \times 10^{-19} \text{ C}$ , what is the number of positively charged particles passing any point in the gas per unit time?

- A  $1.26 \times 10^{16} \text{ s}^{-1}$
- B  $2.58 \times 10^{16} \text{ s}^{-1}$
- C  $3.84 \times 10^{16} \text{ s}^{-1}$
- D  $10.3 \times 10^{16} \text{ s}^{-1}$

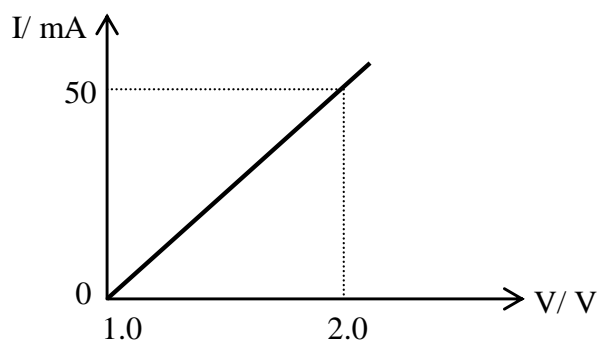
- 21 A conductor has the dimensions given by the figure below.



What is the ratio  $R_X / R_Y$  of the resistance between the opposite faces marked X (left and right faces) and Y (front and rear faces) respectively?

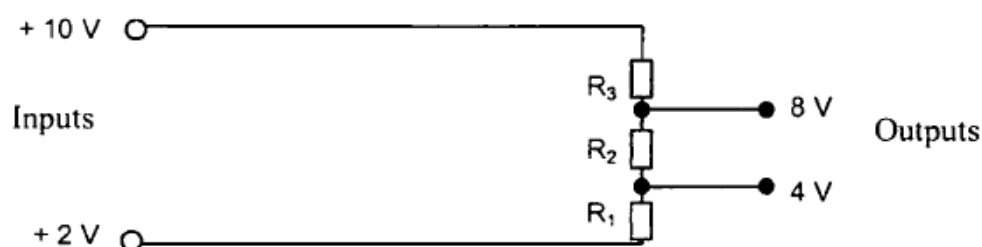
- A  $2/3$
- B  $9/4$
- C  $3/2$
- D  $9/1$

- 22 The graph below shows the relation between the direct current  $I$  in a certain conductor and the potential difference  $V$  across it. When  $V$  is less than 1.0 V, the current is negligible.



Which statement about the conductor is correct?

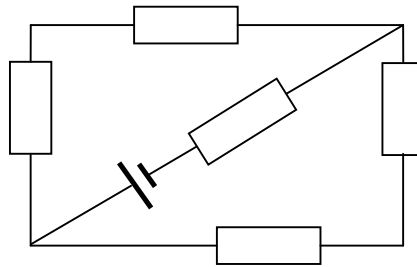
- A It does not obey Ohm's law but when  $V = 1.5$  V, resistance =  $20\ \Omega$   
 B It does not obey Ohm's law but when  $V = 1.5$  V, resistance =  $60\ \Omega$   
 C It obeys Ohm's law and when  $V = 1.5$  V, resistance =  $20\ \Omega$   
 D It obeys Ohm's law and when  $V = 1.5$  V, resistance =  $60\ \Omega$
- 23 The circuit shown below may be used to give output potentials of 4 V and 8 V.



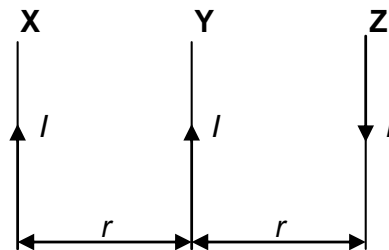
Which of the following is the correct combination of resistances  $R_1$ ,  $R_2$  and  $R_3$ , that gives the required output potentials as shown in the circuit?

	$R_1 / k\Omega$	$R_2 / k\Omega$	$R_3 / k\Omega$
A	2	4	2
B	4	4	2
C	4	2	4
D	2	4	4

- 24 With respect to the figure below, and given that each of the resistor has a resistance of  $2\ \Omega$ , what is the current supplied by a battery of emf  $12.0\text{ V}$ ?



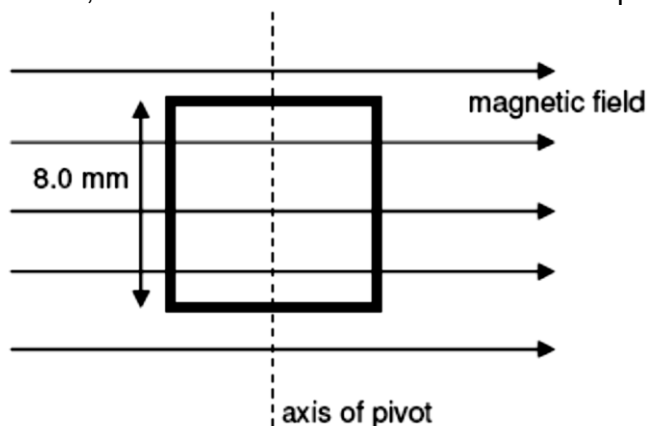
- A 1.2 A                      B 4.0 A                      C 3.0 A                      D 6.0 A
- 25 The figure below shows three parallel wires **X**, **Y** and **Z** which carry currents  $I$  of equal magnitude in the direction shown.



The resultant force experienced by **Y** due to the currents in **X** and **Z** is

- A zero.  
 B towards X.  
 C towards Z.  
 D along Y.

- 26 A 20-turn square coil of side 8.0 mm is pivoted at the centre and placed in a magnetic field of flux density 0.010 T such that two sides of the coil are parallel to the field and two sides are perpendicular to the field, as shown below. A current of 5.0 mA is passed through the coil.



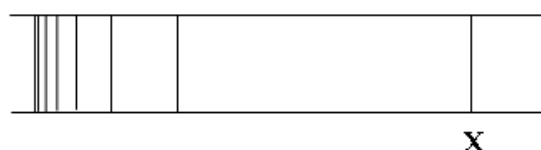
What is the magnitude of the torque acting on the square coil?

- A  $1.6 \times 10^{-9} \text{ N m}$   
 B  $3.2 \times 10^{-8} \text{ N m}$   
 C  $6.4 \times 10^{-8} \text{ N m}$   
 D  $3.2 \times 10^{-5} \text{ N m}$
- 27 An atom emits a spectral line of wavelength  $\lambda$  when an electron makes a transition between levels of energy  $E_1$  and  $E_2$ .

Which expression correctly relates  $\lambda$ ,  $E_1$  and  $E_2$ ?

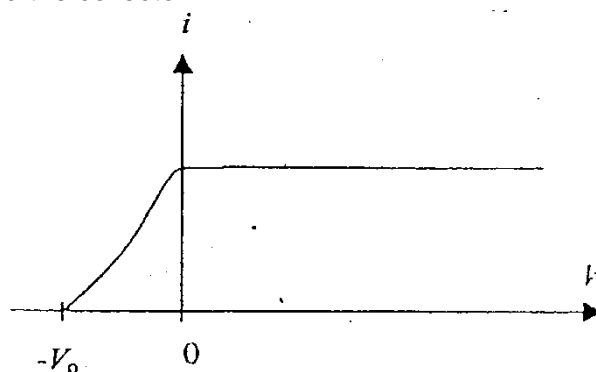
- A  $\lambda = hc(E_1 - E_2)$   
 B  $\lambda = \frac{h}{c}(E_1 - E_2)$   
 C  $\lambda = \frac{c}{h(E_1 - E_2)}$   
 D  $\lambda = \frac{hc}{(E_1 - E_2)}$
- 28 Electrons are accelerated from rest by a potential difference  $V$ . If  $V$  is doubled, the de Broglie wavelength of the electrons is
- A halved.  
 B doubled.  
 C increased by a factor of  $\sqrt{2}$ .  
 D decreased by a factor of  $\sqrt{2}$ .

- 29 The diagram shows part of a typical line emission spectrum. This spectrum extends through the visible region of the electromagnetic spectrum into the ultraviolet region.

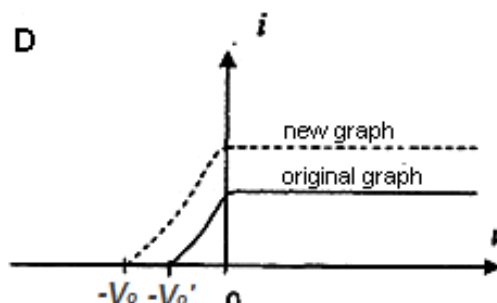
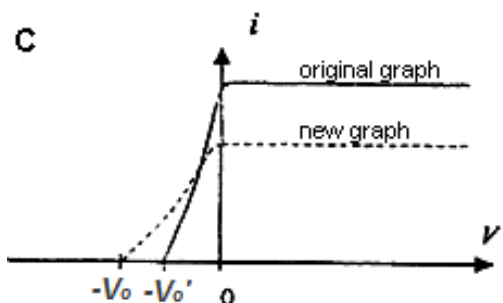
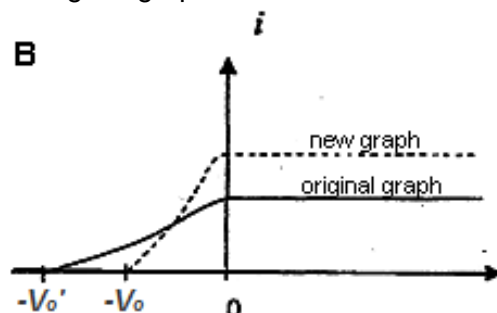
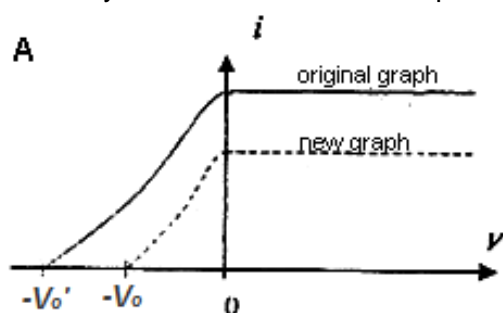


Which statement is true for emission line **X** of the spectrum?

- A It has the shortest wavelength and is at the ultraviolet end of the spectrum.  
 B It has the lowest frequency and is at the ultraviolet end of the spectrum.  
 C It has the longest wavelength and is at the red end of the spectrum.  
 D It has the highest frequency and is at the red end of the spectrum.
- 30 In a typical photoelectric effect experiment, monochromatic light is shone onto a metal surface. The figure below shows how the photocurrent  $i$  varies with the potential difference  $V$  applied across the emitter and the collector.



If the wavelength and the intensity of the incident light are both reduced, which of the following correctly shows the new  $i$ - $V$  comparison with the original graph?



## Answers for H1 Physics Preliminary Exams 2015 Paper 1

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
<b>Ans</b>	B	C	D	A	A	C	D	C	C	B
	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
<b>Ans</b>	A	D	D	C	D	D	B	D	C	A
	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
<b>Ans</b>	B / D	B	A	C	B	C	D	D	C	C