NAME: ____ CLASS: ___________ INDEX: __________

CATHOLIC JUNIOR COLLEGE

JC2 PRELIMINARY EXAMINATIONS
Higher 1

PHYSICS [SOLUTIONS]

8866/1

Paper 1

29 AUGUST 2016
1 h

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, tutorial group and index number on this cover page.

Write and/or shade your name, NRIC / FIN number and HT group on the Answer Sheet (OMR sheet),
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are a total of **30 Multiple Choice Questions (MCQs)** 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 Answer Sheet (OMR sheet) provided.

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.
Calculators may be used.

PHYSICS DATA:

speed of light in free space,	c	=	3.00×10^{8} m s^{-1}
permeability of free space,	μ_0	=	$4\pi \times 10^{-7}$ H m^{-1}
permittivity of free space,	ε_0	=	8.85×10^{-12} F m^{-1}
			$\approx (1/(36\pi)) \times 10^{-9}$ F m^{-1}
elementary charge,	e	=	1.60×10^{-19} C
the Planck constant,	h	=	6.63×10^{-34} J s
unified atomic mass constant,	u	=	1.66×10^{-27} kg
rest mass of electron,	m_e	=	9.11×10^{-31} kg
rest mass of proton,	m_P	=	1.67×10^{-27} kg
molar gas constant,	R	=	8.31 J K^{-1} mol^{-1}
the Avogadro constant,	N_A	=	6.02×10^{23} mol^{-1}
the Boltzmann constant,	k	=	1.38×10^{-23} mol^{-1}
gravitational constant,	G	=	6.67×10^{-11} N m^{2} kg^{-2}
acceleration of free fall,	g	=	9.81 m s^{-2}

PHYSICS 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	=	$\rho g h$
gravitational potential,	ϕ	=	$-G m / r$
Displacement of particle in s.h.m.	x	=	$x_0 \sin \omega t$
Velocity of particle in s.h.m.	v	=	$v_0 \cos \omega t$
		=	$\pm \omega \sqrt{x_0^{\,2} - x^2}$
resistors in series,	R	=	$R_1 + R_2 + \ldots$
resistors in parallel,	$1/R$	=	$1/R_1 + 1/R_2 + \ldots$
electric potential,	V	=	$Q / 4 \pi \varepsilon_0 r$
alternating current / voltage,	x	=	$x_0 \sin \omega t$
Transmission coefficient	T	=	$\exp(-2kd)$
	where k	=	$\sqrt{\frac{8\pi^2 m(U-E)}{h^2}}$
radioactive decay,	x	=	$x_0 \exp(-\lambda t)$
decay constant,	λ	=	$\frac{0.693}{t_{\frac{1}{2}}}$

1 The Van Der Waal's equation is used to describe the pressure, *P*, volume, *V*, and temperature, *T*, of a real gas,

$$\left(P+\frac{n^2a}{V^2}\right)(V-nb)=nRT$$

where *n* is the number of moles of gas present and *R* is the universal gas constant. *a* and *b* are empirical constants.

What are the units of *a* and *b* respectively?

	Unit of *a*	**Unit of *b***
A	Pa m^6 mol^{-2}	m^3 mol^{-1}
B	mol^2 Pa^{-1} m^{-6}	mol m^{-3}
C	J m^2 mol^{-2}	J m^3 mol^{-1}
D	mol^2 J^{-1} m^{-2}	mol J m^{-3}

Answer: A

As all terms separated with "+" or "-" have the same units,

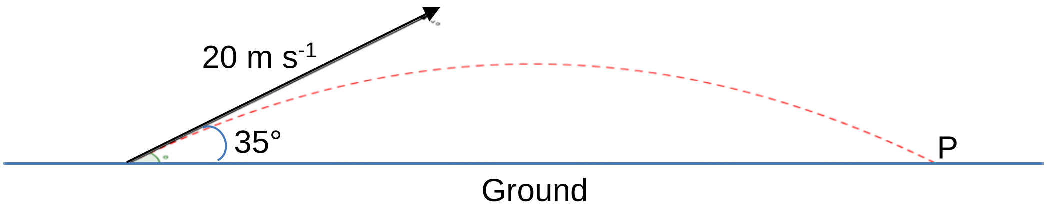
$$[P]=\left[\frac{n^2a}{V^2}\right]$$

$[a]=$ Pa m^6 mol^{-2}

$[V]=[nb]$

$[b]=$ m^3 mol^{-1}

2 A student throws a stone 35° above the ground at an initial speed of 20 m s^{-1}. It travels in a projectile motion until it hits the ground at P.



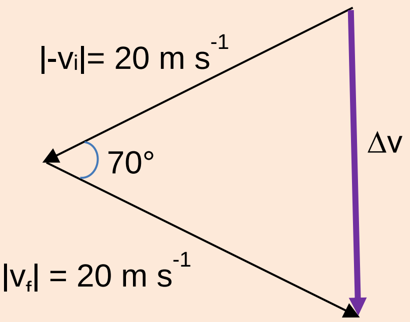
What is the magnitude of the change in velocity of the stone just before hitting the ground at P?

A 0.0 m s^{-1} **B** 20 m s^{-1} **C** 23 m s^{-1} **D** 33 m s^{-1}

Answer: C
Change in velocity,

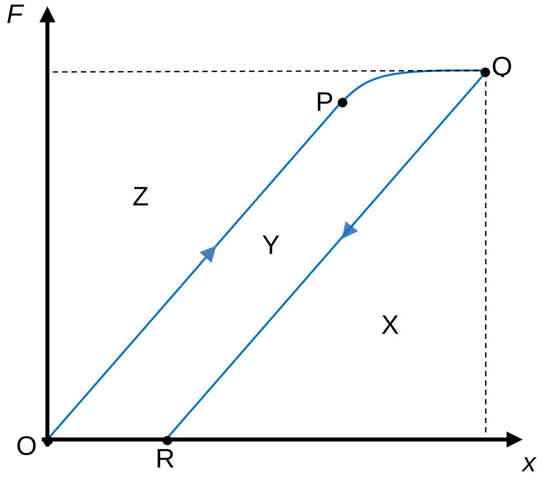
$$\Delta v = v_f - v_i$$

$$\Delta v = v_f + (-v_i)$$



$$\Delta v = \sqrt{(20)^2 + (20)^2 - 2(20)(20)\cos 70°}$$
$$\Delta v = 23 \text{ m s}^{-1}$$

3 A metal wire is stretched by a varying force *F*, causing its extension *x* to increase as shown by the line OPQ on the graph. The force is then gradually reduced to zero and the relation between the force and extension is indicated by line QR.



Which area represents the elastic potential energy stored in the wire at Q?

A X　　**B** Y　　**C** Z　　**D** X + Y

Answer: D

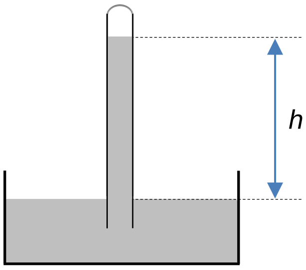
The total elastic potential energy stored at Q before decreasing the force *F* is the total area under the graph X+Y.

Area X is the recoverable energy from the spring.

Area Y is the net work done on the spring when the extension returns to point R.

Area Z has no meaning currently.

4 The figure below shows a simple mercury barometer that registers a height h = 56.0 mm when it is placed at a certain point above sea level. The density of mercury is 1.37×10^4 kg m^{-3}.



(not to scale)

What is the new height h if the mercury is replaced with vegetable oil of density 918 kg m^{-3} at the same point above sea level?

A 3.75 mm **B** 56.0 mm **C** 836 mm **D** 7530 mm

Answer: C

Pressure,

$P = h\rho g$

Since the barometer is placed at the same point above sea level, the pressure is constant. Therefore,

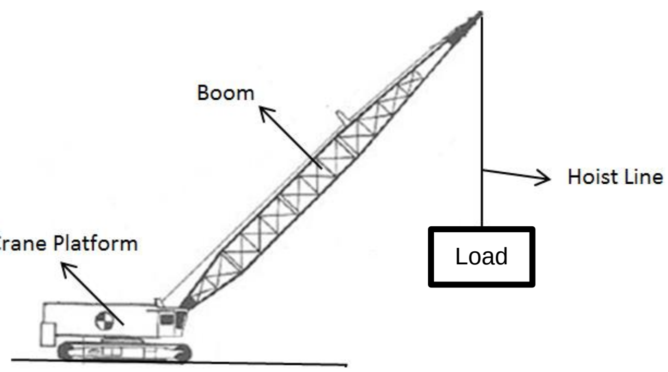
$h_1\rho_1 g = h_2\rho_2 g$

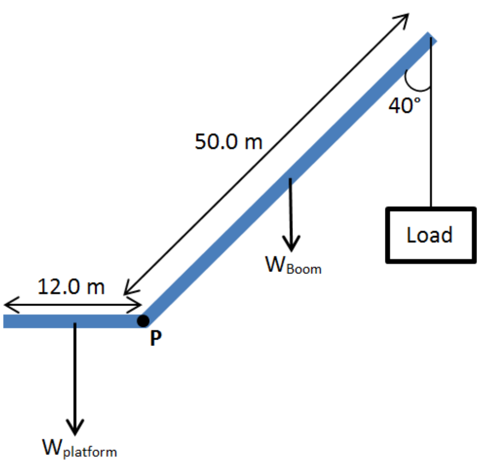
$h_2 = \frac{\rho_1}{\rho_2}h_1$

$h_2 = \frac{1.37\times10^4}{918}(56)$

$h_2 = 836$ mm

5 A crane starts to lift a load of 5.80×10^4 kg load from the ground.





The diagram on the right is a simplified schematic representation of the crane and load on the left.

If the platform has a uniform mass of is 4.00×10^5 kg and the boom has a uniform mass of 4.00×10^4 kg, what is the maximum mass that the crane can lift vertically at constant speed at the end of the boom without the crane toppling over at point P?

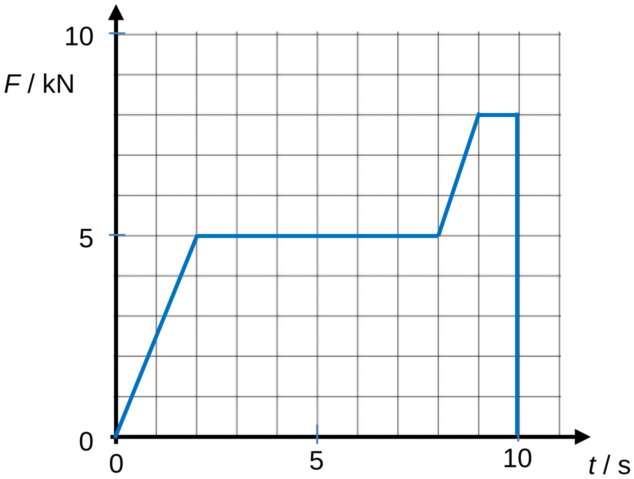
A 2.80×10^4 kg **B** 4.27×10^4 kg **C** 4.40×10^4 kg **D** 5.47×10^4 kg

Answer: D

Maximum weight before toppling over is when the force acting on the crane by the ground is solely acting on point P.

By principle of moments and taking turning point at P,
Clockwise moment = Anticlockwise moment
4.00×10^4×25.0sin 40°× ~~9.81~~+ M_{load} ×50.0sin 40°×~~9.81~~= 4.00×10^5×6×~~9.81~~
M_{load} = 5.467×10^4 = **5.47×10^4 kg**

6 The following graph describes the variation of the resultant force F on an object of mass 2500 kg with time t until 10 s.



If the object is initially at rest when t = 0 s, what is the object's speed at t = 8 s?

A 14 m s^{-1} **B** 16 m s^{-1} **C** 18 m s^{-1} **D** 20 m s^{-1}

Answer: A

The area under an *F*-t graph gives the impulse of the object. Since the value of the impulse is numerically equal to the change in momentum of the object, at *t* = 8 s,

$$\Delta p = p_f - p_i$$

$$p_f - 0 = \Delta p$$

$$v_f = \frac{\frac{1}{2}(2)(5\times10^3)+(6)(5\times10^3)}{2500}$$

$$v_f = 14 \text{ m s}^{-1}$$

7 Object A of mass 6.00 kg has a head-on collision with object B of mass 600 g as shown in the diagram below.

What is the speed of object B immediately after the elastic collision?

A 0.0227 m s^{-1} **B** 0.227 m s^{-1} **C** 4.52 m s^{-1} **D** 5.02 m s^{-1}

Answer: C
By conservation of momentum, taking right as positive,
$m_A u_A + m_B u_B = m_A v_A + m_B v_B$ -- (1)
Since collision is elastic, relative speed of approach = relative speed of separation,
$u_A - u_B = v_B - v_A$
$v_A = v_B - u_A + u_B$
$v_A = v_B - 1.25 + (-2.75)$
$v_A = v_B - 4.00$ --(2)
Sub (2) in (1),
$(6.00)(1.25) + (0.600)(-2.75) = (6.00)(v_B - 4) + (0.600)v_B$
$v_B = 4.52$ m s^{-1}

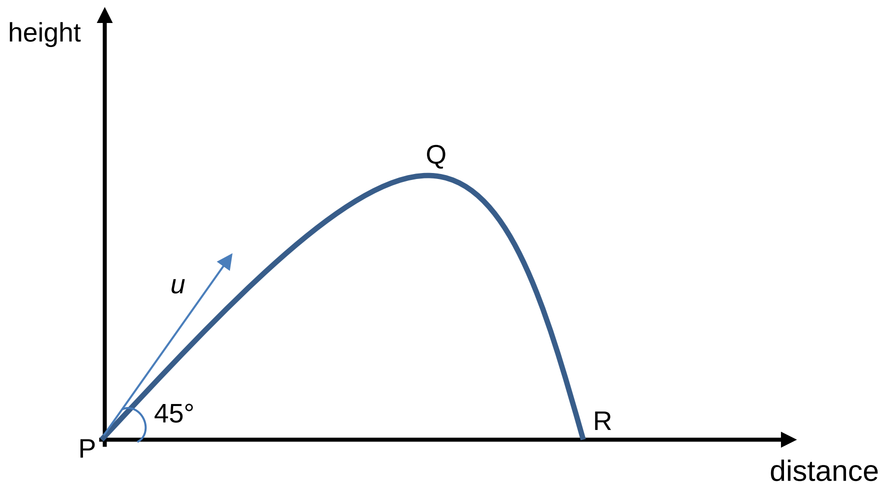
8 An object falls freely from rest vertically to the ground. The effects of air resistance on the coin are negligible.

The object travels 60% of the total vertical distance to the ground in the last second of its fall.

What is the total vertical distance?

A 1.8 m **B** 2.1 m **C** 36 m **D**

9 An object is projected with a certain speed *u* at an angle of 45° to the horizontal from the ground at point P. It travels through air with significant drag force on it, reaches the maximum height at Q, falls and hits the ground at a certain distance away at R.



Which of the following statement is true?

A The time taken for the object to travel from P to Q is more than the time taken for it to travel from Q to R.

B The time taken for the object to travel from P to Q is less than the time taken for it to travel from Q to R.

C The time taken for the object to travel from P to Q is the same as the time taken for it to travel from Q to R.

D The time taken for the object to travel from P to Q can be the same as or more or less than the time taken for it to travel from Q to R, depending on speed *u*.

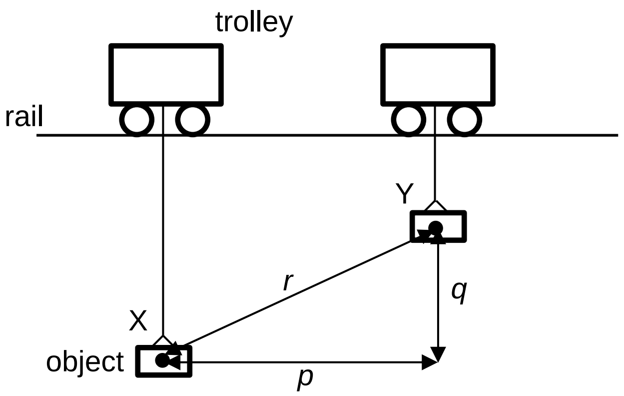
Answer: B

The object moves through with a drag force in both vertical and horizontal direction.

In the horizontal direction, the horizontal velocity will reduce to zero, thus showing the shorter range from Q to R, giving the false impression that the time taken is shorter.

However, when considering the vertical direction, the vertical speed when travelling from P to Q is higher than the vertical speed when travelling from Q to R. Since the vertical distance is the same from P to Q and from Q to R, with larger speed when traveling from P to Q, the time taken for the object to travel from P to Q is lower than the time taken from Q to R.

10 An object of weight *W* hangs from a trolley that runs along a rail. The trolley moves horizontally through a distance *p* and simultaneously raises the object through a height *q*.



As a result, the object moves through a distance *r* from X to Y. It starts and finishes at rest.

Which of the following statements about the object during this process **must** be correct?

A The work done on the object is *Wr*.

B The net work done on the object is 0.

C The gravitational potential energy at Y is *Wq*.

D The increase in kinetic energy of the weight is *W(p + q)*.

Answer: B

By the work-energy theorem the net work done is equals to the change in the kinetic energy of the object.

Since the object starts and ends at rest the change in kinetic energy is zero.

11 The data below are taken from a test of a petrol engine for a motor car.

power output	150 kW
fuel consumption	20 litres per hour
energy content of fuel	40 MJ per litre

Which expression will evaluate the efficiency of the engine?

A $\dfrac{150 \times 10^3}{40 \times 10^6 \times 20 \times 60 \times 60}$

B $\dfrac{150 \times 10^3 \times 60 \times 60}{20 \times 40 \times 10^6}$

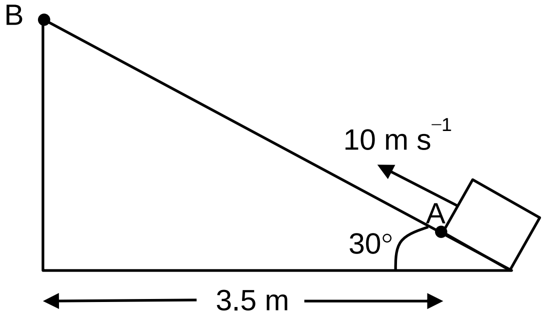
C $\dfrac{150 \times 10^3 \times 40 \times 10^6 \times 20}{60 \times 60}$

D $\dfrac{150 \times 10^3 \times 20}{40 \times 10^3 \times 60 \times 60}$

Answer: B

$$\text{Efficiency} = \frac{P_{output}}{P_{input}} = \frac{150 \times 10^3\ \text{J s}^{-1}}{20\ \text{litres per hour} \times 40 \times 10^6\ \text{J per litre}} = \frac{150 \times 10^3 \times 60 \times 60}{20 \times 40 \times 10^6}$$

12 A box of mass 3.0 kg is projected with an initial speed of 10 m s^{-1} from position A to B up a slope inclined at 30° to the horizontal.



If the box passes point B with a speed of 4.0 m s^{-1}, what is the work done by friction?

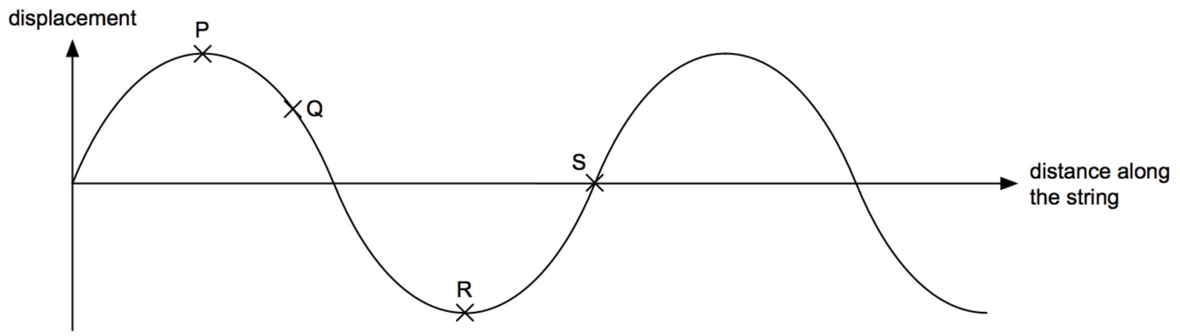
A 18 J **B** 67 J **C** 84 J **D** 150 J

Answer: B

Using the Conservation of Energy,
Energy at A = Energy at B + $W_{friction}$

$$W_{friction} = \frac{1}{2}mv_A^2 - (mgh + \frac{1}{2}mv_B^2)$$
$$= \frac{1}{2}(3)(10)^2 - (3 \times 9.81 \times 3.5\tan 30 + \frac{1}{2} \times 3 \times 4^2)$$
$$= 67 \text{ J}$$

13 The figure shows the shape at a particular instant of part of a transverse wave travelling from left to right along a string.



Which statement about the motion of elements of the string at this instant is correct?

A The speed of Q is higher than S.

B Both Q and S are moving upwards.

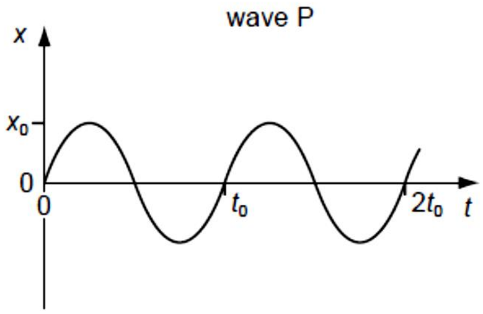
C The energy of P and S is entirely kinetic.

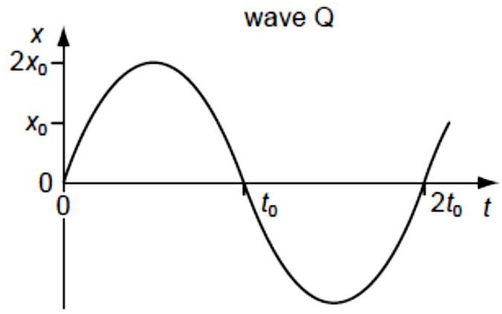
D The acceleration of P and R is a maximum.

Answer: D

Option A is incorrect S should be of higher speed since it is at the equilibrium position.
Option B is incorrect because both should be moving in opposite directions.
Option C is incorrect because kinetic energy of P (being at the amplitude) is 0.
Option D is the answer because acceleration is proportional to displacement from the equilibrium position.

14 The intensity of a wave depends on its amplitude. The intensity is also proportional to the square of the frequency of the wave. The variation with time t of the displacement x of the particles in a medium when two progressive waves P and Q pass separately through the medium are shown in the graphs below.





The intensity of wave P is I_o. What is the intensity of wave Q?

A $0.5I_o$ **B** I_o **C** $4I_o$ **D** $16I_o$

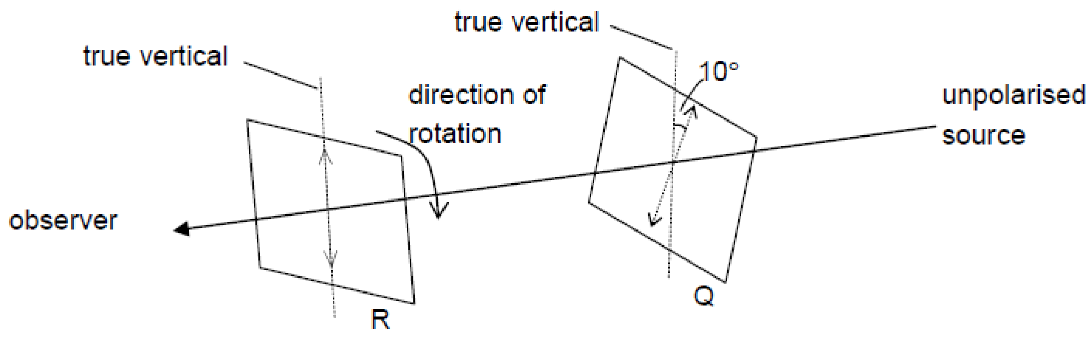
Answer: B

$$\text{Int} \propto A^2 f^2 \propto A^2\left(\frac{1}{T}\right)^2$$

$$\frac{I_Q}{I_P} = \left(\frac{A_Q}{A_P}\right)^2\left(\frac{T_P}{T_Q}\right)^2$$

$$= \left(\frac{2x_o}{x_o}\right)^2\left(\frac{t_o}{2t_o}\right)^2 = 1$$

15 The figure below shows a beam of unpolarised light passing through polaroids Q and R. The polarising axis of each polaroid is shown by the arrow where the axis of R and Q is 10° apart. Polaroid Q is fixed while polaroid R is slowly rotated from the position as shown.



At what angle do the first intensity minima of the emergent light occur?

A 90° **B** 100° **C** 180° **D** 190°

Answer: B

For the first intensity minima the axis of the two polaroids must be at right angles to one another. Polaroid R has to rotate 10 + 90 = 100° in the direction of rotation indicated in the figure.

16 Which one of the following statements correctly describes the relationships between two consecutive antinodes in a standing wave?

A Their oscillations are in phase with each other.

B Both will pass their equilibrium positions with opposite velocities

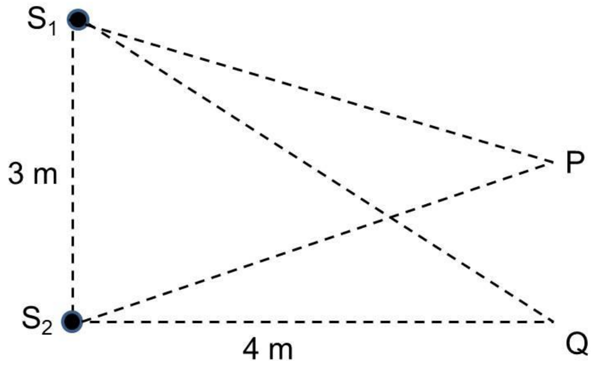
C Both have minimum energy since the amplitude of oscillations is minimal.

D When one has maximum kinetic energy, the other has maximum potential energy.

Answer: B

Option A is incorrect because they should be in antiphase with each other.
Option C is incorrect because their amplitude of oscillations are maximum and hence they should have max energy.
Option D is incorrect because when both are at their max displacements, they both have maximum potential energy and minimum kinetic energy.

17 Two sources of waves, S_1 and S_2, are situated as shown in the figure below. Individually, each source emits waves of intensity I.



Equidistant from S_1 and S_2, a detector at P registers a steady minimum wave intensity. The same detector registers the next steady minimum intensity when it moves to point Q. Which of the following statements is false about the two sources of waves?

A The two sources of waves are coherent.

B The two sources of waves have the same amplitude.

C The two sources of waves have a similar wavelength of 2 m.

D The two sources of waves have a phase difference of π radians.

Answer: C

To obtain a steady interference with minimum intensity at point P, both the sources must be coherent and be out of phase by π radians. Both sources can have same amplitude. The next minimum produced at Q corresponds to a path difference of 1 m and this should be equal to one wavelength. Thus, the wavelength of the waves must be 1 m and not 2 m.

18 In a double-slit experiment, the slit separation is 2.0 mm, and two wavelengths, 750 nm and 900 nm, illuminate the slits. A screen is placed 2.0 m from the slits. At what distance from the central maximum on the screen will a bright fringe from one pattern first coincide with a bright fringe from the other?

A 1.5 mm **B** 3.0 mm **C** 4.5 mm **D** 6.0 mm

Answer: C

$X_{750} = \frac{750 \times 10^{-9} \times 2}{2 \times 10^{-3}} = 7.5 \times 10^{-4}$ m

$X_{900} = \frac{900 \times 10^{-9} \times 2}{2 \times 10^{-3}} = 9.0 \times 10^{-4}$ m

$(n+1)(7.5 \times 10^{-4}) = n\,(9.0 \times 10^{-4})$

$7.5 \times 10^{-4} n + 7.5 \times 10^{-4} = 9.0 \times 10^{-4}\, n$

$n = 5$

distance from central bright $= 5 \times 9.0 \times 10^{-4} = 4.5$ mm

19 The potential difference across an electrical component is 20 V. The time taken for charge carriers to move through this component is 15 s, and, in this time, the energy of the charge carriers changes by 12 J.

What is the electrical resistance of this component?

A 0.04 Ω **B** 0.80 Ω **C** 33.3 Ω **D** 500 Ω

Answer: D

Charge flowing through component $= \frac{W}{V} = \frac{12}{20} = 0.600$ C

Current flowing through $= \frac{Q}{t} = \frac{0.600}{15} = 0.04$ A

Resistance of the component $= \frac{V}{I} = \frac{20}{0.04} = 500\ \Omega$

20 The resistance of wire X of length 1 m and diameter *D* is *R*.

Wire Y, another wire made of the same metal as wire X, is 2 m longer than the first wire. The resistance of the wire Y is 12*R*.

What is the ratio $\frac{\text{diameter of wire X}}{\text{diameter of wire Y}}$?

A 0.50 **B** 2.0 **C** 2.4 **D** 4.0

Answer: B

$R = \frac{\rho L}{A} = \frac{\rho L}{\pi \left(\frac{D}{2}\right)^2} = \frac{4\rho L}{\pi D^2}$

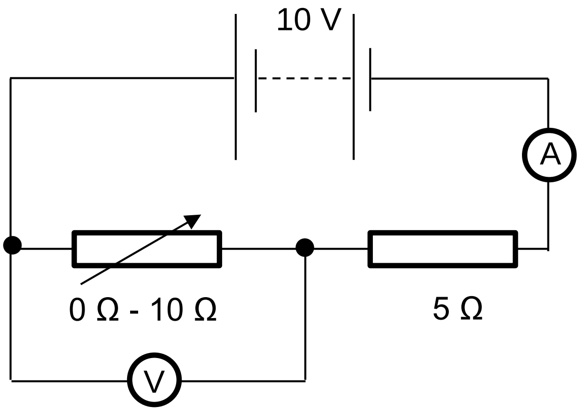
$D = \sqrt{\frac{4\rho L}{\pi R}}$

Since the material is the same, ρ , is a constant thus

$D \propto \sqrt{\frac{L}{R}}$

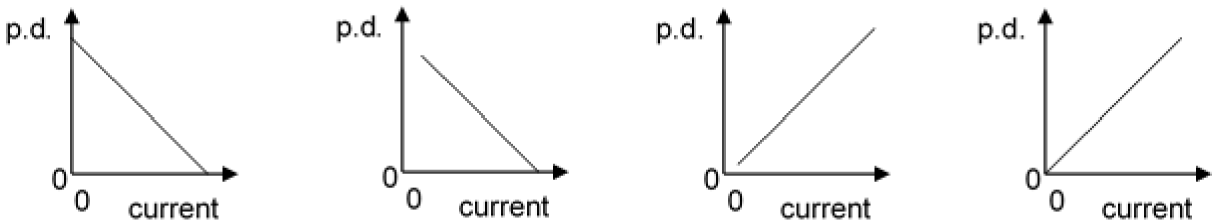
$$\frac{\text{diameter of wire X}}{\text{diameter of wire Y}} = \sqrt{\frac{\frac{L_X}{R_X}}{\frac{L_Y}{R_Y}}} = \sqrt{\frac{L_X}{L_Y} \cdot \frac{R_Y}{R_X}} = \sqrt{\frac{L}{3L} \cdot \frac{12R}{R}} = 2.0$$

21 A 10 V battery is in series with an ammeter, a 5 Ω fixed resistor and a 0 - 10 Ω variable resistor. A high-resistance voltmeter is connected across the variable resistor.



The resistance of the variable resistor is changed from zero to its maximum value.

Which graph shows how the potential difference (p.d.) measured by the voltmeter varies with the current measured by the ammeter?



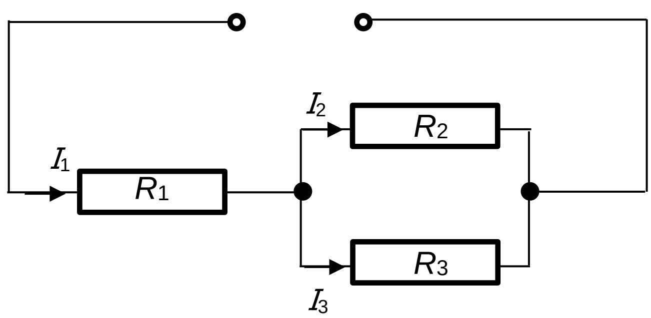
A **B** **C** **D**

Answer: B

When the resistance of the variable resistor is set to its minimum (0 Ω) the p.d. is zero. But that is when the current in the entire circuit is its maximum.

On the other hand when the resistance of the variable to its maximum (10 Ω) the p.d is non-zero while the current is a non-zero minimum.

22 The circuit diagram shows three fixed resistors R_1, R_2 and R_3 connected to a power supply. The currents flowing through each of these resistors are I_1, I_2 and I_3 respectively.



Which of the following expression represents the ratio of $\frac{R_2}{R_3}$?

A $\frac{I_2}{I_3}$

B $\frac{I_1}{I_3} - 1$

C $\frac{I_1}{I_2} - 1$

D $1 + \frac{I_3}{I_2}$

Answer: C

Since R_2 and R_3 are in parallel, the potential difference is equal across both of them.

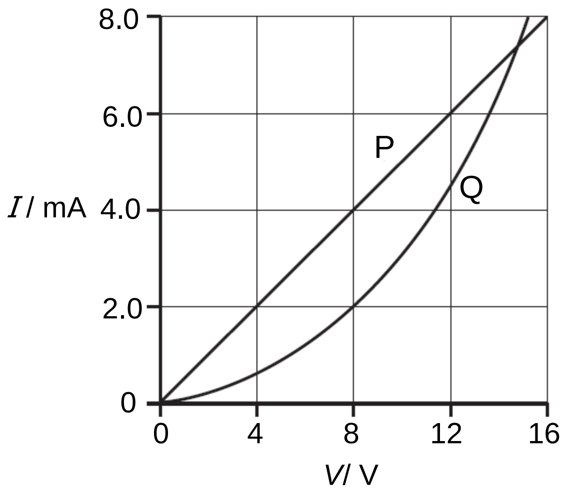
So, $I_2 R_2 = I_3 R_3$,

$$\frac{R_2}{R_3} = \frac{I_3}{I_2}$$

$$= \frac{I_1 - I_2}{I_2}$$

$$= \frac{I_1}{I_2} - 1$$

23 The I-V characteristics of two electrical components P and Q are shown below.



Which statement is correct?

A P is a resistor and Q is a filament lamp.

B The ratio $\frac{\text{resistance of P}}{\text{resistance of Q}}$ is always less than 1.

C At 2.0 mA the power dissipated through Q is always twice that of P.

D At the point where the two lines intersect the resistance of Q is approximately twice that of P.

Answer: C

Option A: P is an ohmic conductor (resistor) while Q is a semiconductor.

Option B: Resistance of P is always smaller than the resistance of Q for values of V to the left of the intersection point. At the intersection point the resistance are equal. While to the right the resistance of P is larger than the resistance of Q.

Option C: The power dissipated in the resistors at 2.0 mA is proportional to $\frac{V^2}{R}$ or (I^2R),

$$\text{So } \frac{\text{Power dissipated through P}}{\text{Power dissipated through Q}} = \frac{V_P^{\ 2}}{R_P} \div \frac{V_Q^{\ 2}}{R_Q}$$

$$= \frac{V_P^{\ 2}}{V_Q^{\ 2}} \times \frac{R_Q}{R_P}$$

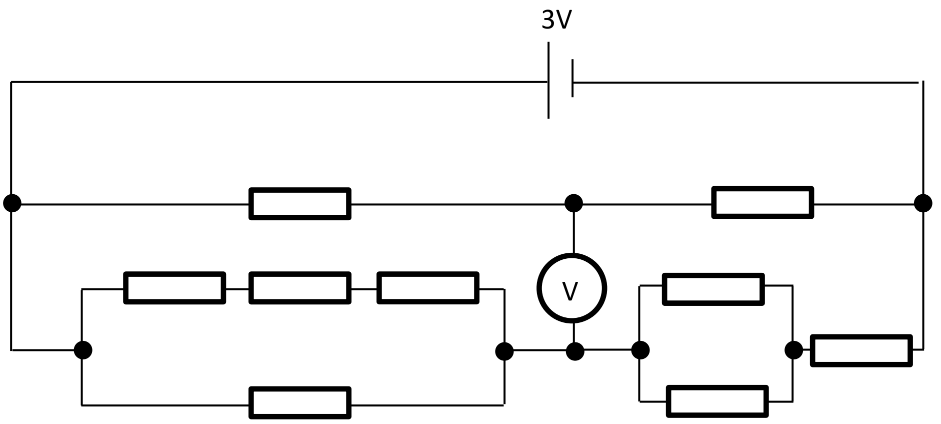
$$= \left(\frac{4}{8}\right)^2 \times \frac{\frac{8}{2\text{x}10^{-3}}}{\frac{4}{2\text{x}10^{-3}}}$$

$$= \frac{1}{2}$$

Option D: At the point of intersection the resistance is equal.

∴ Power dissipated through Q is twice the power dissipated through P.

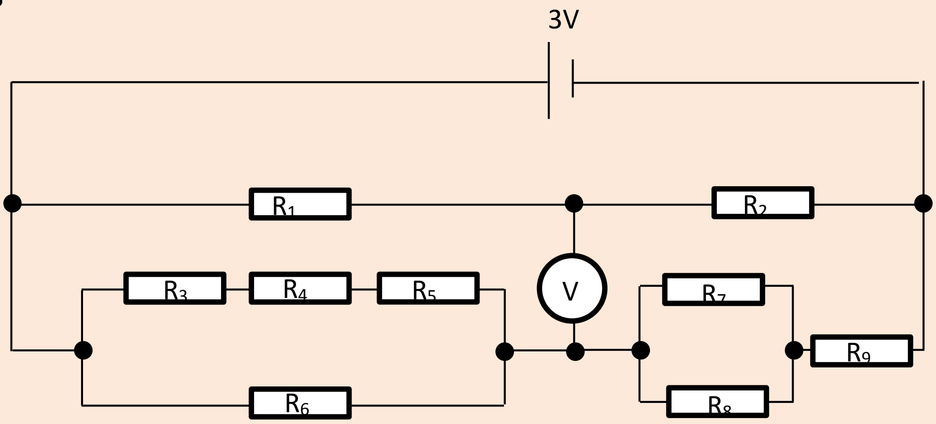
24 A circuit is set up as shown, supplied by a 3V battery. All resistances are 1kΩ.



What will be the reading on the voltmeter?

A 0 **B** 0.5 V **C** 1.0 V **D** 1.5 V

Answer: B



Effective resistance across resistor $R_{3,4,5,6}$ = $\frac{3}{4}\Omega$

Effective resistance across resistor $R_{7,8,9}$ = $\frac{3}{2}\Omega$

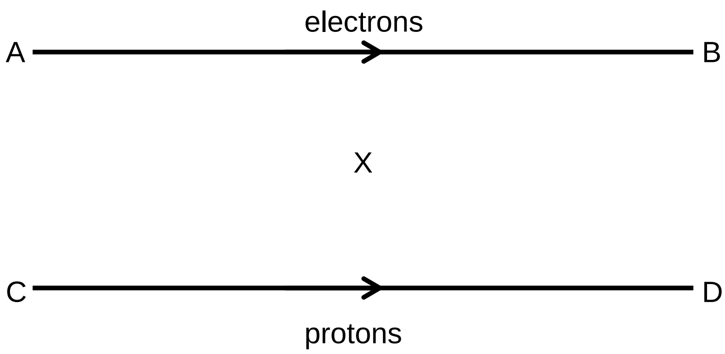
Potential difference across resistor R_1 = 1.5 V

Potential difference across resistor $R_{3,4,5,6}$ = $\frac{0.75}{0.75+1.5}\cdot 3$

= 1.0 V

So, voltmeter reading = 0.5 V

25 A beam of electrons in AB and another made out of protons in CD are parallel to each other.



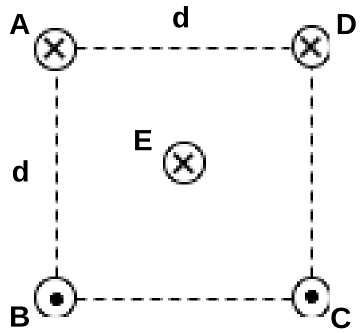
The rate of proton flow in CD is twice that of the electrons in AB. What direction is the magnetic field at point X, which is equidistant from AB and CD?

A Towards AB **B** Towards CD **C** Into the page **D** Out of the page

Answer: D

The current is flowing from B to A and C to D and using the Right Hand Grip Rule, the magnetic field at X is pointing outwards from the paper.

26 Five straight and parallel wires are arranged as shown in the diagram below, and each carries a steady current I.



Which of the following statements incorrectly describes the above scenario?

A The resultant force on wire E due to wires A, B, C and D is pointing towards line AD, perpendicular to AD.
B The resultant force on wire E due to wires B and C is pointing towards line AD, perpendicular to AD.
C The resultant force on wire E due to wires A and D is pointing towards line AD, perpendicular to AD.
D The resultant force on wire E due to wires B and D is pointing towards line AD, perpendicular to AD.

Answer: D

Using FLHR, all scenarios from options A to C are correct, while option D is incorrect.

27 Which of the following is incorrect for a charge in a region where only a magnetic field is present?

A The work done on the charge by the magnetic force is always zero.

B The magnetic force will only act on the charge if it possesses kinetic energy.

C The path taken by the moving charge is exactly that of the magnetic field pattern.

D The force acting on a moving charge in a uniform magnetic field is always perpendicular to the direction of motion.

Answer: C

The field pattern marks out the direction of the flux density of the field at every point (tangential to the curves), The movement of a charge in a magnetic field is determined by the acceleration of the charge, which is then determined by the force acting on the chage.

This force must be perpendicular to the flux density at that point, as well as perpendicular to the velocity of the moving charge.

28 When the frequency of the light incident on the metal in a photoelectric effect experimental setup is increased, which of the following quantities will also increase?
A work function of the target metal

B threshold frequency of the target metal

C stopping potential of the emitted photoelectrons

D number of photoelectrons emitted from the target metal

Answer: C

Increasing the frequency of the light will increase the energy supplied to each photoelectron, and hence increase its maximum kinetic energy. This means that a higher stopping potential is required.

The work function and threshold frequency are properties of the metal itself and does not change. The number of photoelectrons emitted depends on the intensity of the light and not the frequency.

29 Which of the following statements about the wave-particle duality is true?

A The wave-particle duality suggests that every particle will have an associated wavelength when it moves, provided that it is subatomic in size.

B The wave-particle duality suggests that every particle will have an associated wavelength when it moves, regardless of whether it has a mass or not.

C The wave-particle duality suggests that every particle will have an associated wavelength when it moves, provided that they have a non-zero charge.

D The wave-particle duality suggests that every particle will have an associated wavelength when it moves, provided that it is moving at a high velocity.

Answer: B

This principle is applied for all particles, regardless of mass, charge and size.

30 An atom emits a spectral line of wavelength λ when an electron makes a transition between levels of energy E_1 and E_2.

Which equation correctly relates λ, E_1 and E_2?

A $\lambda = \frac{h}{c}(E_1 - E_2)$

B $\lambda = ch(E_1 - E_2)$

C $\lambda = \frac{c}{h(E_1 - E_2)}$

D $\lambda = \frac{ch}{E_1 - E_2}$

Answer: D