

3IB Physics SL + HL. Test 23-10-2008 TM – *include working!*

MC-problems count 1 mark each. Total marks for SL+HL paper: 8+42 = 50.

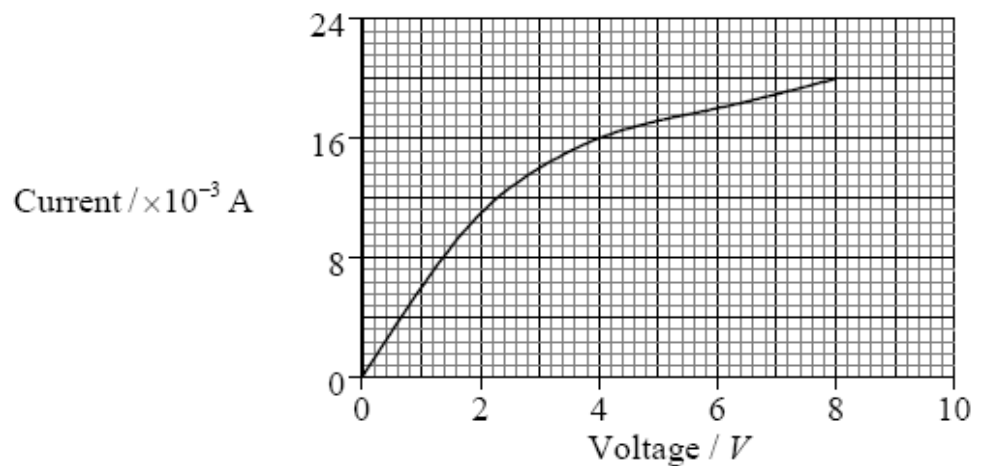
1. M03 S1: 1

When a voltage V of 12.2 V is applied to a DC motor, the current I in the motor is 0.20 A. Which **one** of the following is the output power VI of the motor given to the correct appropriate number of significant digits?

- A. 2 W
- B. 2.4 W
- C. 2.40 W
- D. 2.44 W

2. M03 S1: 23, H1: 25

The graph shows the current/voltage characteristics of a filament lamp.



The resistance of the filament at 4.0 V is

- A. 250 Ω .
- B. 4000 Ω .
- C. 8000 Ω .
- D. 64000 Ω .

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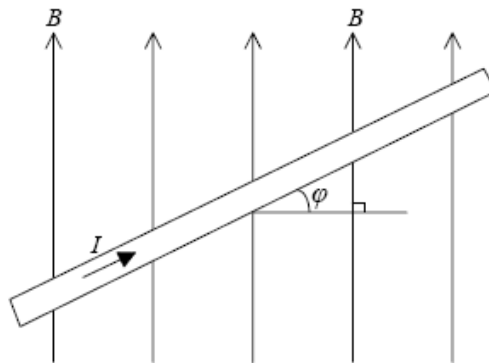
3. M03 S1: 24, H1: 26

An electric motor is used to raise a weight of 2.0 N. When connected to a 4.0 V supply, the current in the motor is 1.5 A. Assuming no energy losses, the best estimate for the maximum steady speed at which the weight can be raised is

- A. 0.3 ms^{-1} .
- B. 3.0 ms^{-1} .
- C. 9.0 ms^{-1} .
- D. 12.0 ms^{-1} .

4. M03 S1: 25

The diagram below shows a current I in a wire placed at an angle ϕ inside a uniform magnetic field of field strength B .



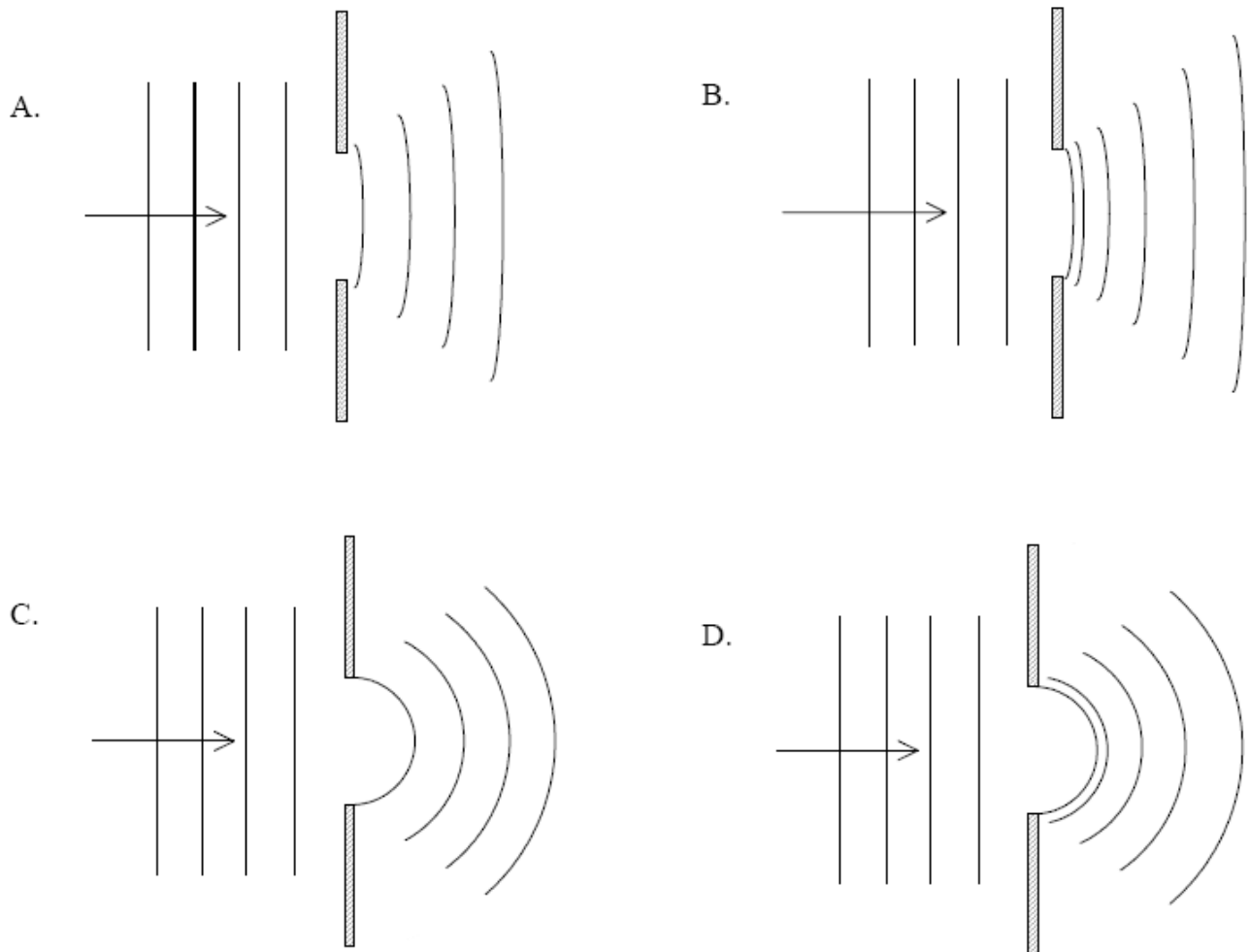
The magnetic force per unit of length of wire is M . The magnetic field strength B is given by

- A. $\frac{M}{I \sin \phi}$.
- B. $\frac{M}{I \cos \phi}$.
- C. $\frac{M \cos \phi}{I}$.
- D. $\frac{M \sin \phi}{I}$.

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5. N03 H1: 23

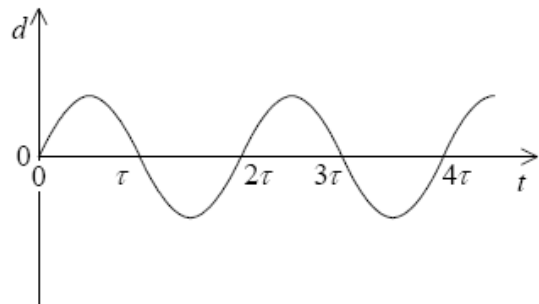
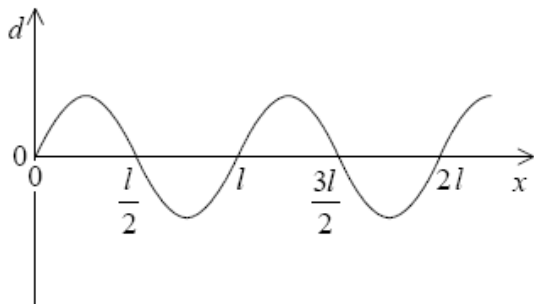
Which diagram best shows diffraction of plane wavefronts at a single slit?



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6. N03 S1: 18

The displacement d of a particle in a wave varies with distance x along a wave and with time t as shown below.



Which expression gives the speed of the wave?

- A. $\frac{l}{4\tau}$
- B. $\frac{l}{2\tau}$
- C. $\frac{l}{\tau}$
- D. $\frac{2l}{\tau}$

7. N03 S1: 22

Two charges of $-e$ and $+4e$ are fixed at the positions shown below. At which position along the line XY is the electric field due to these charges equal to zero?



8. N03 S1: 23

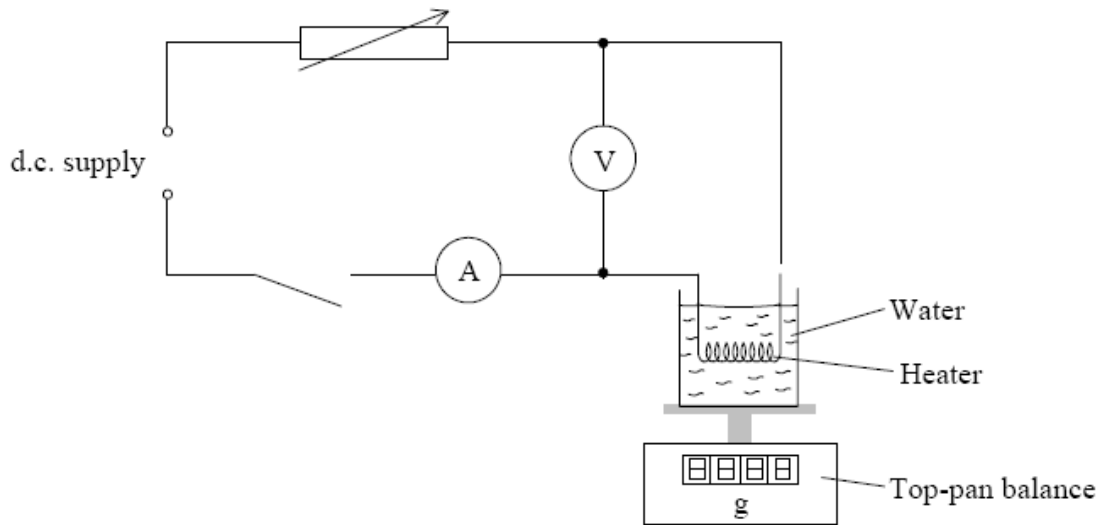
Which **one** of the following is a correct definition of electric potential difference between two points?

- A. The power to move a small positive charge between the two points.
- B. The work done to move a small positive charge between the two points.
- C. The power per unit charge to move a small positive charge between the two points.
- D. The work done per unit charge to move a small positive charge between the two points.

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9. M03 S2/H2: A1 Marks: 12

Some students were asked to design and carry out an experiment to determine the specific latent heat of vaporization of water. They set up the apparatus shown below.



The current was switched on and maintained constant using the variable resistor. The readings of the voltmeter and the ammeter were noted. When the water was boiling steadily, the reading of the top-pan balance was taken and, simultaneously, a stopwatch was started. The reading of the top-pan balance was taken again after 200 seconds and then after a further 200 seconds.

The change in reading of the top-pan balance during each 200 second interval was calculated and an average found. The power of the heater was calculated by multiplying together the readings of the voltmeter and the ammeter.

(a) Suggest how the students would know when the water was boiling steadily. [1]

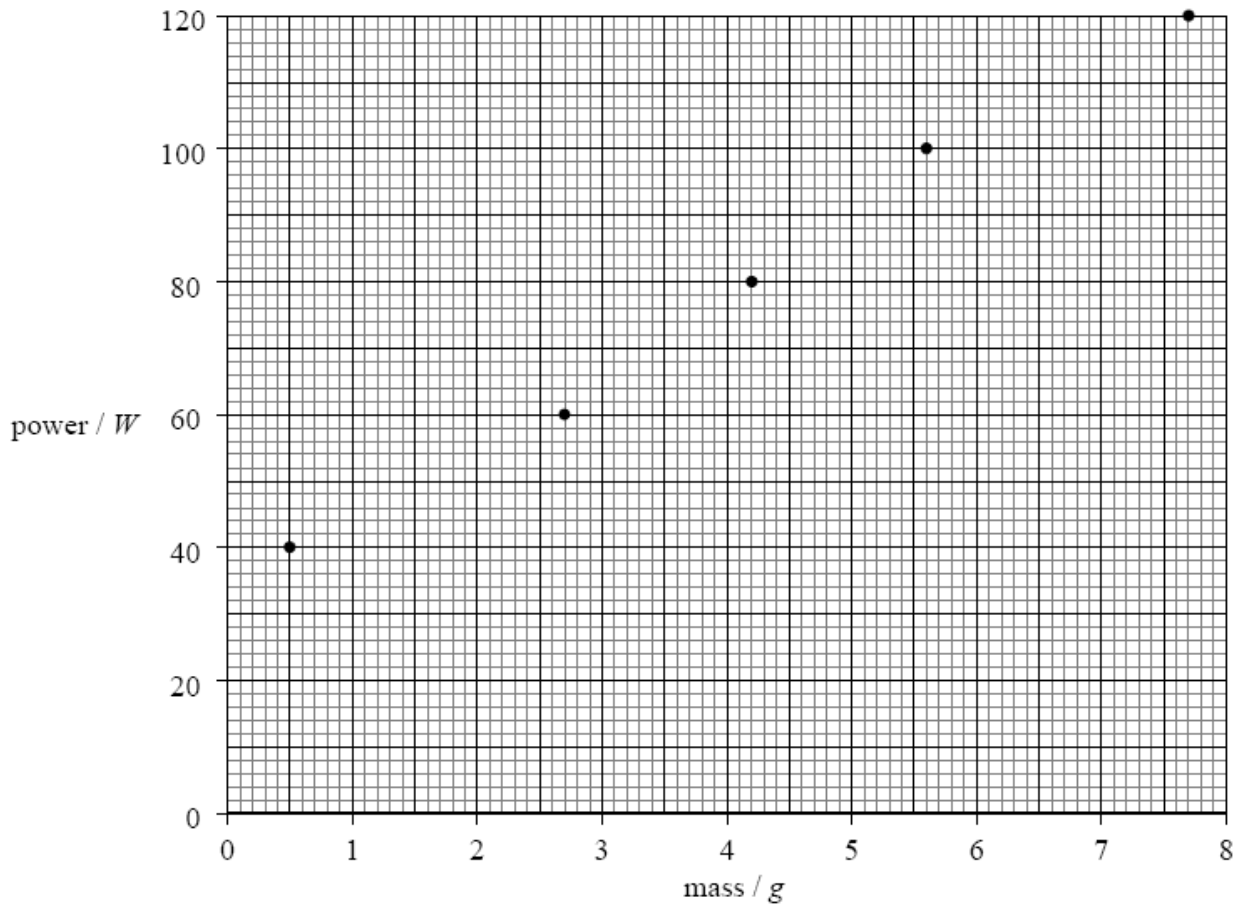
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(b) Explain why a reading of the mass lost in the first 200 seconds and then a reading of the mass lost in the next 200 second interval were taken, rather than one single reading of the mass lost in 400 seconds. [2]

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The students repeated the experiment for different powers supplied to the heater. A graph of the power of the heater against the mass of water lost (the change in balance reading) in 200 seconds was plotted. The results are shown below. (*Error bars showing the uncertainties in the measurements are not shown.*)



- (c) (i) On the graph above, draw the best-fit straight line for the data points. [1]
- (ii) Determine the gradient of the line you have drawn. [3]

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In order to find a value for the specific latent heat of vaporization L , the students used the equation

$$P = mL,$$

where P is the power of the heater and m is the mass of water evaporated **per second**.

- (d) Use your answer for the gradient of the graph to determine a value for the specific latent heat of vaporization of water. [3]

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- (e) The theory of the experiment would suggest that the graph line should pass through the origin. Explain briefly why the graph does not pass through the origin. [2]

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10. M03 S2/(H2): B1 Marks: 25

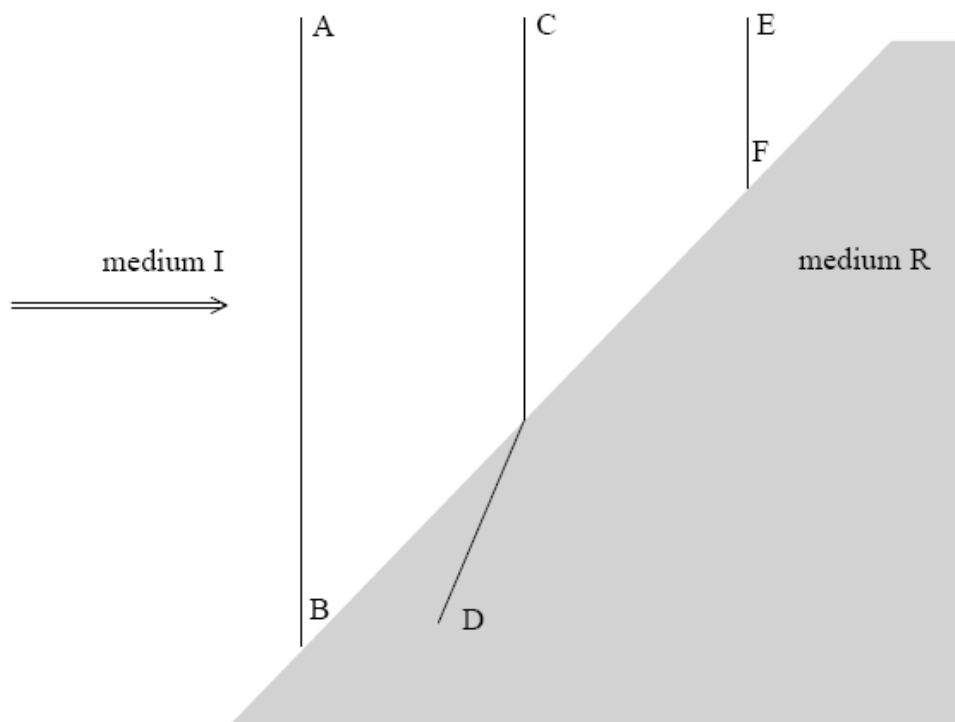
This question is about waves and wave properties.

(a) By making reference to waves, distinguish between a *ray* and a *wavefront*.

[3]

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The diagram below shows three wavefronts incident on a boundary between medium I and medium R. Wavefront CD is shown crossing the boundary. Wavefront EF is incomplete.



(b) (i) On the diagram above, draw a line to complete the wavefront EF.

[1]

(ii) Explain in which medium, I or R, the wave has the higher speed.

[3]

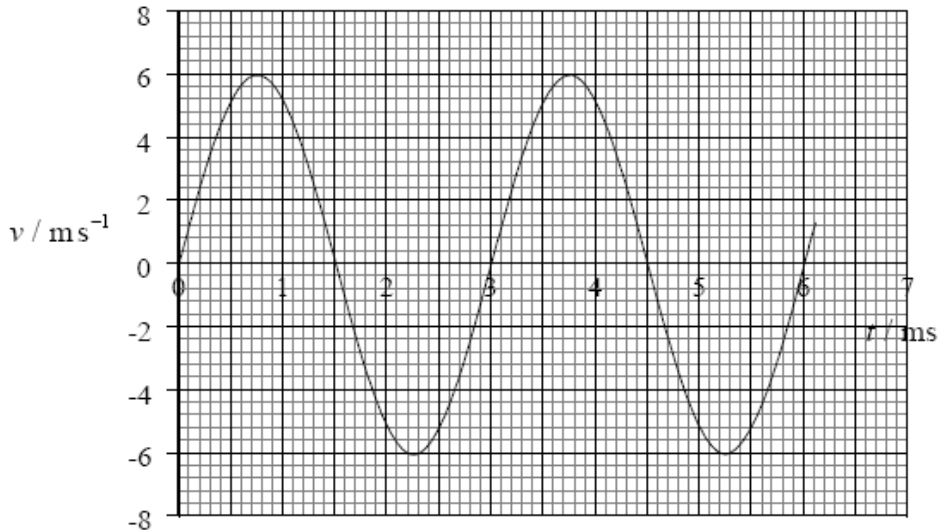
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- (iii) By taking appropriate measurements from the diagram, determine the ratio of the speeds of the wave travelling from medium I to medium R. [2]

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The graph below shows the variation with time t of the velocity v of one particle of the medium through which the wave is travelling.



- (c) (i) Explain how it can be deduced from the graph that the particle is oscillating. [2]

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- (ii) Determine the frequency of oscillation of the particle. [2]

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- (iii) Mark on the graph with the letter M one time at which the particle is at maximum displacement. [1]

- (iv) Estimate the area between the curve and the x-axis from the time $t = 0$ to the time $t = 1.5$ ms. [2]

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(v) Suggest what the area in c (iv) represents.

[1]

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(d) By reference to energy transfer and the amplitude of vibration of particles in a wave, distinguish between a travelling wave and a standing wave.

[4]

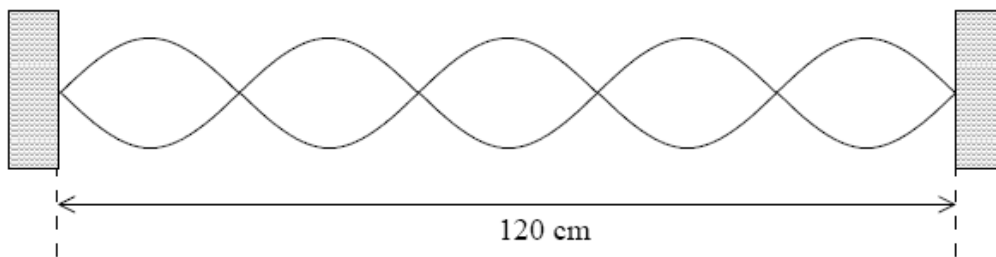
Energy transfer:

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Amplitude:

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A stretched string is fixed at both ends and then plucked at its centre. The diagram below illustrates the vibrating string.



The distance between the fixed points is 120 cm.

(e) (i) Mark on the diagram a distance equal to the wavelength of the standing wave.

[1]

(ii) The frequency of vibration of the string is 250 Hz. Determine the speed of the wave on the string.

[3]

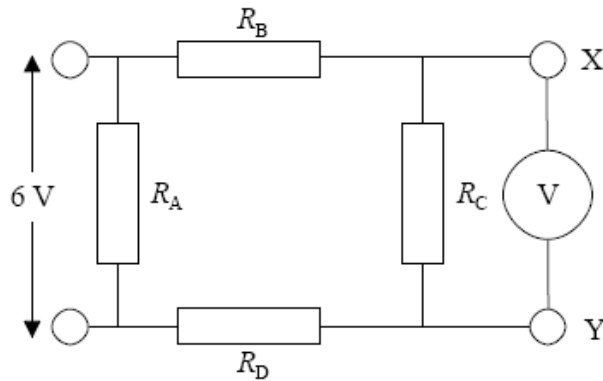
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11. M02 (S2)/H2: A3 Marks: 7

This question is about testing an electrical circuit.

The diagram below shows an electrical circuit consisting of four identical resistors R_A , R_B , R_C , and R_D . The resistance of each resistor is $10\text{ k}\Omega$.



- (a) Commercial resistors sometimes fail in one of two ways. They can go “open-circuit” in which the resistance of the resistor becomes infinite **or** they can go “short-circuit” in which the resistance becomes zero.

In order to test the circuit a technician connects a high resistance voltmeter between the terminals X and Y and applies a potential difference of 6 V across the resistor R_A .

- (i) What voltage will the voltmeter read if all the resistors are functioning normally? [2]

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- (ii) What would the voltmeter read if **either** resistor R_B **or** R_D were to short-circuit? [1]

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- (iii) If the electrician were to note a reading on the voltmeter that suggested **either** R_B **or** R_D had short-circuited how could he test which **one** of these had in fact short-circuited using only the voltmeter? [2]

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- (b) Identify a possible fault with the circuit that would produce a reading of 6 V on the voltmeter when it is connected between X and Y. [1]

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