Physics SL

IB2 Examination

- Paper 2 -

7 IB Questions

Wednesday 17 december 2025

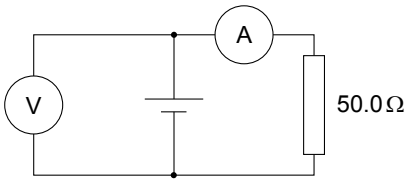
Duration max : 1h 45min.

Name: _____

Tot : / 60 marks

Question 1 [/9 marks]

A 50.0 Ω resistor is connected to a cell of emf 3.00 V. The voltmeter and the ammeter in the circuit are ideal.



(a) The current in the ammeter is 59.0 mA.

Calculate the internal resistance of the cell. [2]

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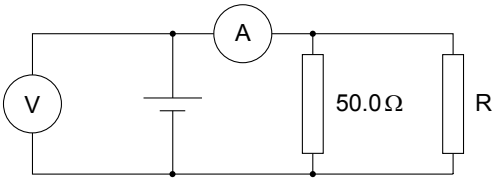
The circuit is changed by connecting another resistor R in parallel to the 50.0 Ω resistor.



(b) Explain the effect of this change on

(i) the reading of the ammeter. [2]

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(Question 1 continuing ...)

(ii) the reading of the voltmeter. [2]

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R is made of a resistive wire of uniform cross-sectional area $3.1 \times 10^{-8}\,m^2$, resistivity $4.9 \times 10^{-7}\,\Omega m$ and length L. The resistance of R is given by the equation

$$R = kL$$

where k is a constant.

(c) Calculate k. State an appropriate unit for your answer. [3]

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Question 2 [/8 marks]

(a) Define *electrical resistance*.

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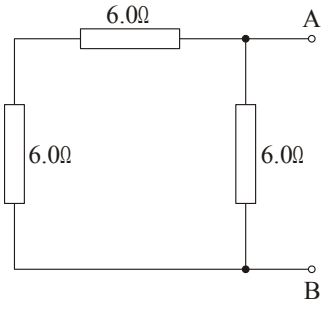
(b) (i) Three resistors, each of resistance 6.0 Ω, are connected as shown below.



Calculate the total resistance between point A and point B of this arrangement.

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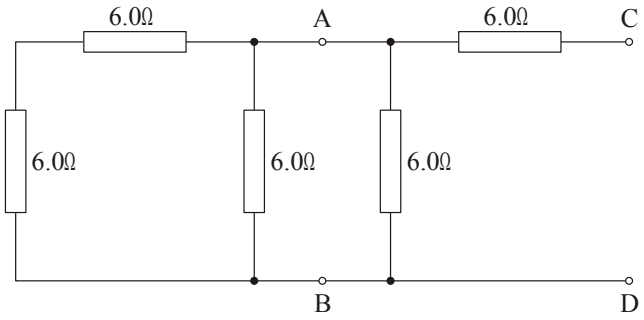
(Question 2 continuing ...)

(ii) The arrangement in (b)(i) is now connected to two more resistors, as shown below. Each resistor is of resistance 6.0 Ω.



Using your answer in (b)(i), deduce that the total resistance between point C and point D is 8.4 Ω.

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(iii) One of the resistors in the arrangement shown in (b)(ii) becomes faulty. The resistance between point C and point D is found to be 6.0 Ω. On the diagram in (b)(ii) above, identify the faulty resistor by drawing a circle around it. Deduce the nature of the fault.

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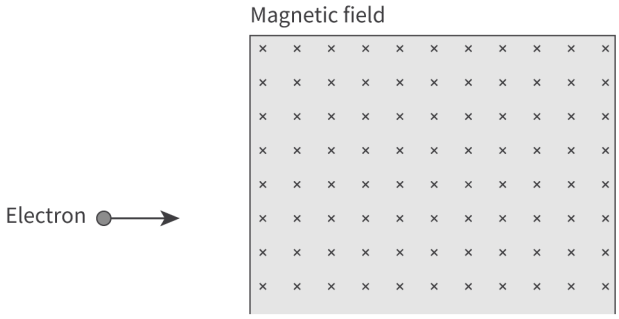
Question 3 [/11 marks]

An electron is moving with a speed of 2.50×10^6 m s^{-1} into a region where a magnetic field with constant magnitude of 0.450 mT. The direction of the magnetic field is into the page and the electron is initially moving rightwards as shown.



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(Question 3 continuing ...)

As the electron enters the region where a magnetic field is present:

(a) State the initial *direction* of the magnetic force. [1]

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(b) Calculate the *magnitude* of the magnetic force. [2]

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(c) Explain why there is *no work* done by the magnetic force on the electron. [2]

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(d) Determine the *radius* of the path that the electron would follow. [2]

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An electric field is also present along with the magnetic field.

(e) State the direction of an electric field that could result in the electron moving with constant velocity through the magnetic field. [2]

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(f) Calculate the magnitude of such an electric field. [2]

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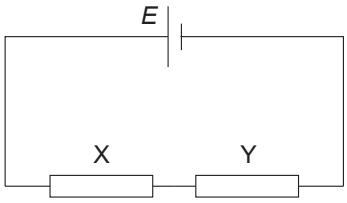
Question 4 [/ 8 marks]

(a) Two resistors, X and Y, are connected in series to a cell of emf *E* and negligible internal resistance. The resistances of X and Y are constant.



The power dissipated in X is greater than that in Y.

State and explain how the resistance of X compares with the resistance of Y. [2]

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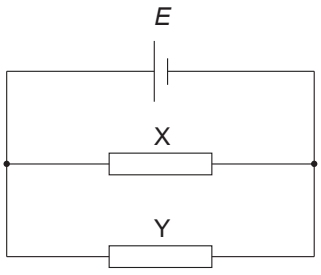
(b) X and Y are now connected in parallel to the same cell.



State and explain which resistor has the greater power dissipation. [2]

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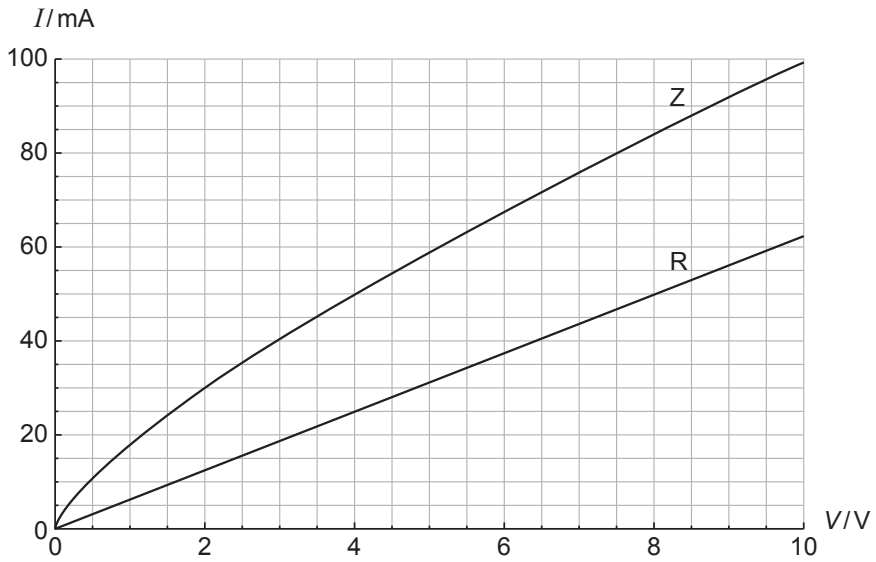
(c) A lamp Z and a resistor R have the I-V characteristics shown in the graph.



(i) Calculate the resistance of R. [1]

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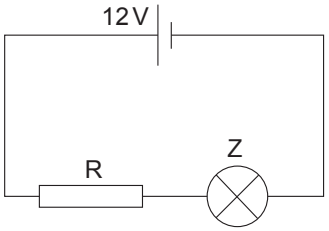
(ii) R and Z are connected in series to a cell of emf 12 V and negligible internal resistance.



Determine, using the graph, the power dissipated in lamp Z. [3]

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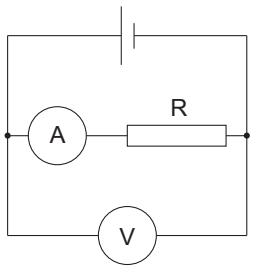
Question 5 [/ 8 marks]

Resistor R is connected in a circuit with a cell that has internal resistance.



The ammeter and the voltmeter are ideal.

(a) State what is meant by an ideal voltmeter. [1]

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(b) The cell has an emf of 1.49 V. The resistance of R is 50.0 Ω. The voltmeter reads 1.47 V.

(i) Show that the internal resistance of the cell is about 0.7 Ω. [2]

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(ii) Determine the total power dissipated in the circuit. [2]

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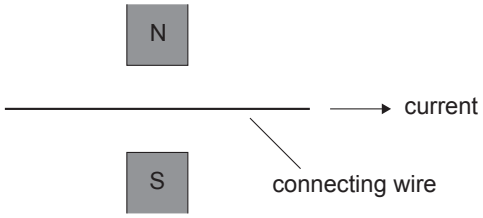
One of the connecting wires is placed in a magnetic field. The direction of the current in the wire is shown.



(c) (i) Explain, by reference to charge carriers in the wire, how the magnetic force on the wire arises. [2]

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(ii) Every current-carrying wire produces a magnetic field.

Describe **one** piece of evidence that supports this statement. [1]

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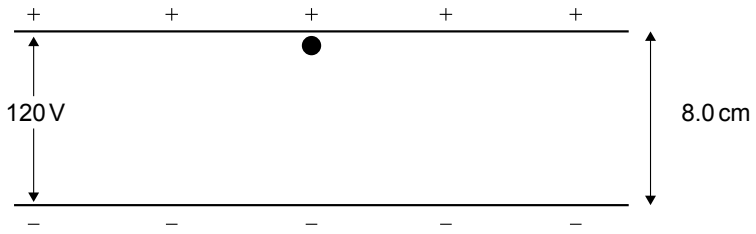
Question 6 [/ 9 marks]

Two oppositely charged parallel plates are a distance 8.0 cm apart. The potential difference between the plates is 120 V. An alpha particle is placed on the positively charged plate and released from rest. Gravity is ignored.



(a) Calculate the electric field between the plates. [1]

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(b) (i) Show that the acceleration of the alpha particle is about $7 \times 10^{10}\,\mathrm{m\,s^{-2}}$. [2]

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(ii) Calculate the time taken for the alpha particle to reach the negative plate. [2]

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(iii) State, in eV, the kinetic energy of the alpha particle when it arrives at the negative plate. [1]

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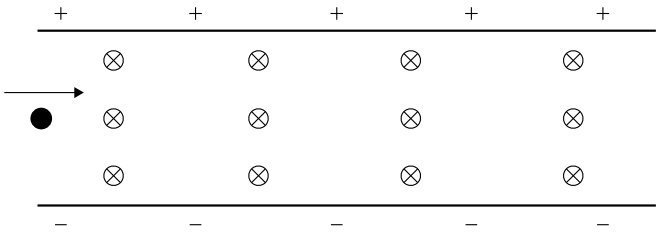
(c) A magnetic field directed into the plane of the page is now established between the plates. An alpha particle enters the region between the plates with a horizontal speed of $5.0 \times 10^5\,\text{m s}^{-1}$. The particle is not deflected.



Calculate the magnitude of the magnetic field. [2]

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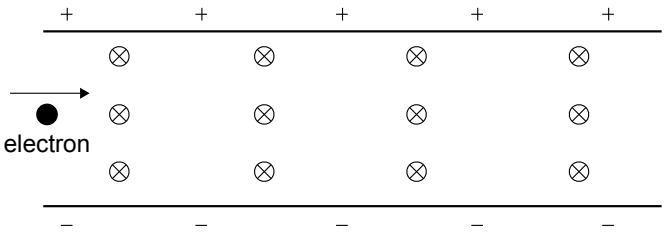
(d) The alpha particle in (c) is replaced by an electron. The electron enters the region between the plates with the same velocity as the alpha particle.

Draw, on the diagram, the path of the electron. [1]



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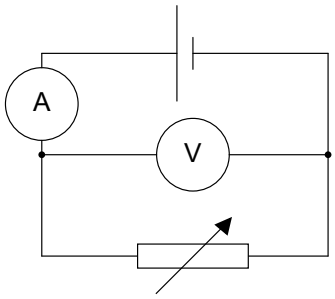
Question 7 [/7 marks]

In an experiment a student constructs the circuit shown in the diagram. The ammeter and the voltmeter are assumed to be ideal.



(a) State what is meant by an ideal voltmeter.

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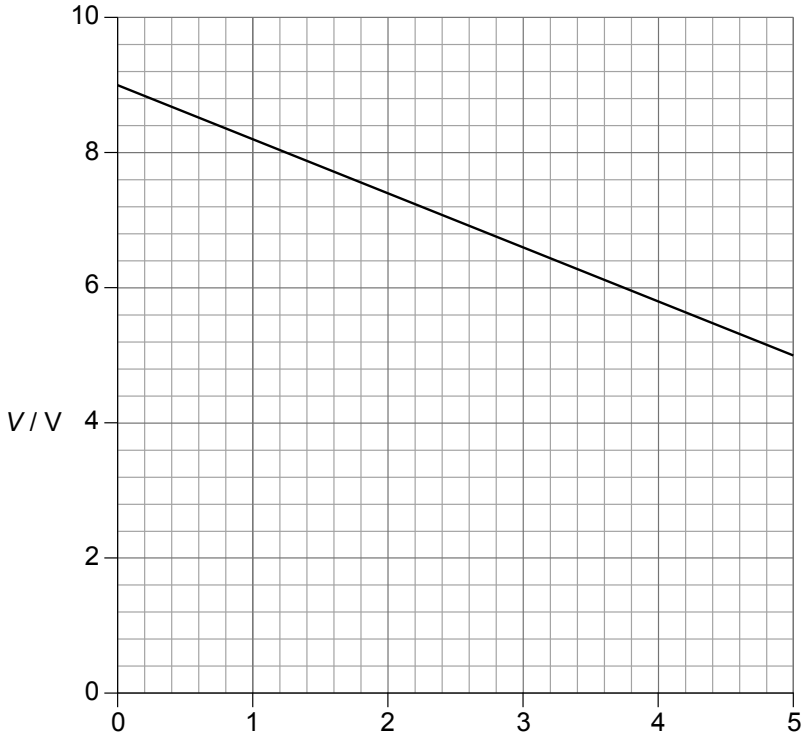
(b) The student adjusts the variable resistor and takes readings from the ammeter and voltmeter. The graph shows the variation of the voltmeter reading V with the ammeter reading I.



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(Question 7 continuing ...)

Use the graph to determine

(i) the electromotive force (emf) of the cell. [1]

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(ii) the internal resistance of the cell. [2]

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(c) A connecting wire in the circuit has a radius of 1.2 mm and the current in it is 3.5 A. The number of electrons per unit volume of the wire is $2.4 \times 10^{28}\,\text{m}^{-3}$. Show that the drift speed of the electrons in the wire is $2.0 \times 10^{-4}\,\text{m s}^{-1}$. [1]

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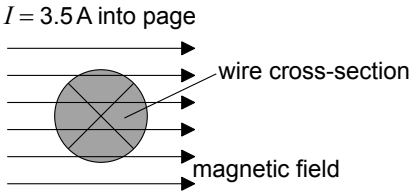
(d) The diagram shows a cross-sectional view of the connecting wire in (c).



The wire which carries a current of 3.5 A into the page, is placed in a region of uniform magnetic field of flux density 0.25 T. The field is directed at right angles to the wire.

Determine the magnitude **and** direction of the magnetic force on one of the charge carriers in the wire. [2]

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End of this exam :)