IB PHYSICS

Name: _____

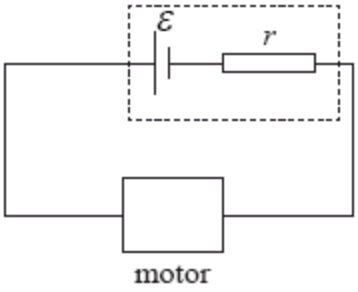
Period: _____ Date: _____

DEVIL PHYSICS

BADDEST CLASS ON CAMPUS

CHAPTER 5 TEST REVIEW

1. A cell of emf ε and internal resistance *r* delivers current to a small electric motor.



450 C of charge flows through the motor and 9000 J of energy are converted in the motor. 1800 J are dissipated in the cell. The emf of the cell is

A. 4.0 V.

B. 16 V.

C. 20 V.

D. 24 V.

(Total 1 mark)

2. A copper wire, of electric resistance *R*, has a length *L* and a cross-section area *S*. Another copper wire has a length 2*L* and a cross-section area of $\frac{S}{2}$. Which of the following is the resistance of this wire?

A. $\frac{R}{4}$

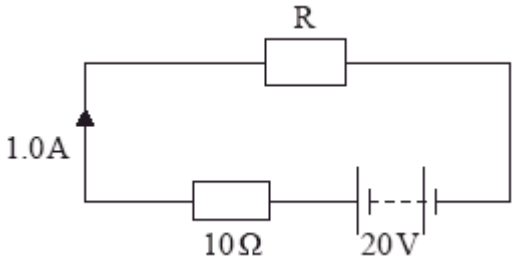
B. $\frac{R}{2}$

C. 2*R*

D. 4*R*

(Total 1 mark)

3. The circuit shows a resistor R connected in series with a battery and a resistor of resistance 10 Ω. The emf of the battery is 20 V and it has negligible internal resistance. The current in the circuit is 1.0 A.



Which of the following is the resistance of R?

A. 1.0 Ω

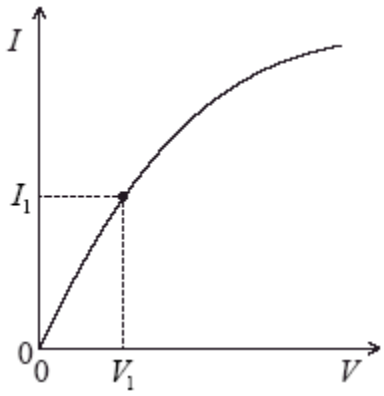
B. 2.0 Ω

C. 10 Ω

D. 20 Ω

(Total 1 mark)

4. The graph shows how the current I in a resistor varies with the voltage V applied across it.



Which of the following gives the resistance of the resistor, when $I = I_1$?

A. $\frac{V_1}{I_1}$

B. The slope of the curve at the point (V_1, I_1)

C. $\frac{I_1}{V_1}$

D. The inverse of the slope of the curve at the point (V_1, I_1)

(Total 1 mark)

5. The tungsten filament of a lamp has a cross-sectional area A and length L. For a potential difference V across the filament, the current in the filament is I. The resistivity of the tungsten equals

A. $\frac{V\,A}{I\,L}$.

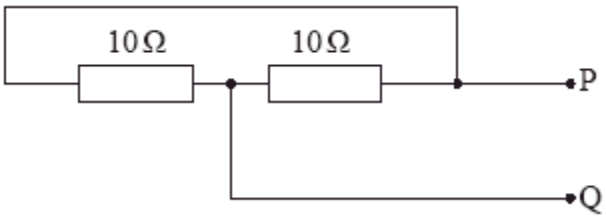
B. $\frac{I\,L}{V\,A}$.

C. $\frac{V\,L}{I\,A}$.

D. $\frac{I\,A}{V\,L}$

(Total 1 mark)

6. Two 10 Ω resistors are connected as shown.



What is the resistance across PQ?

A. 0 Ω

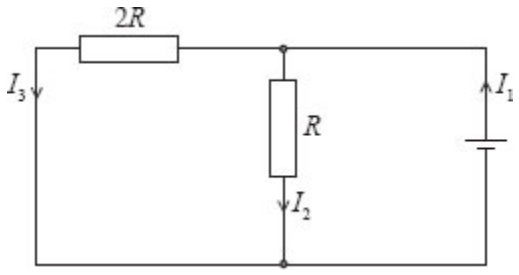
B. 5 Ω

C. 10 Ω

D. 20 Ω

(Total 1 mark)

7. In the circuit shown below, the cell has negligible internal resistance.



Which of the following equations is correct?

A. $I_1 = 2I_2$

B. $I_1 = 2I_3$

C. $I_2 = 2I_3$

D. $I_3 = 2I_1$

(Total 1 mark)

8. A resistor of resistance 12 Ω is connected in series with a cell of negligible internal resistance. The power dissipated in the resistor is *P*. The resistor is replaced with a resistor of resistance 3.0 Ω. What is the power dissipated in this resistor?

A. 0.25 *P*

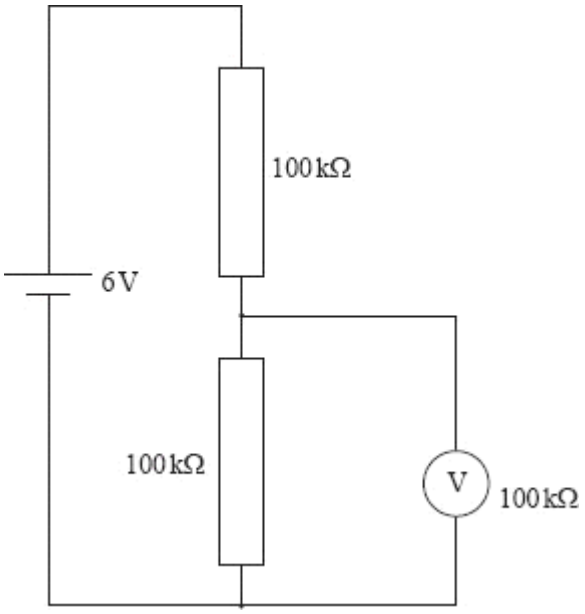
B. *P*

C. 2.0 *P*

D. 4.0 *P*

(Total 1 mark)

9. In the circuit below, the voltmeter has a resistance 100 kΩ. The battery has negligible internal resistance and emf 6 V.



The reading on the voltmeter is

A. 0 V.

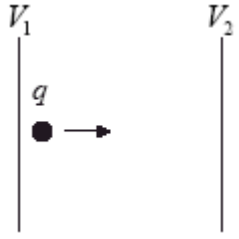
B. 2 V.

C. 3 V.

D. 4 V.

(Total 1 mark)

10. The diagram below shows a particle with positive charge *q* accelerating between two conducting plates at potentials V_1 and V_2.



Which of the following is the kinetic energy gained by the charge in moving between the plates?

A. V_2q

B. V_1q

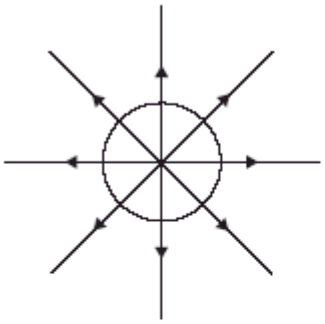
C. $(V_1 - V_2)q$

D. $(V_2 - V_1)q$

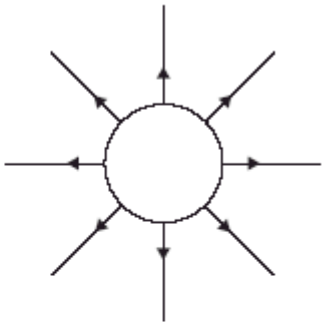
(Total 1 mark)

11. Which diagram best represents the electric field due to a negatively charged conducting sphere?

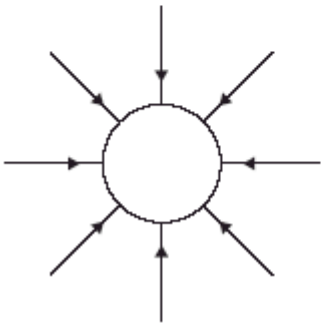
A.



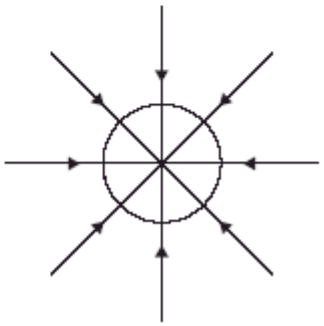
B.



C.



D.



(Total 1 mark)

12. The diagram shows two parallel metal plates X and Y.

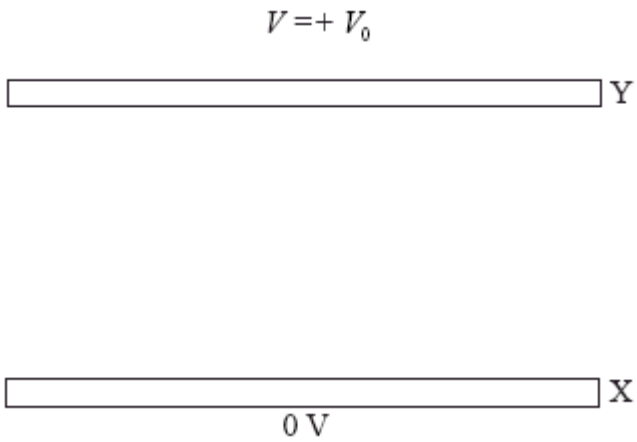


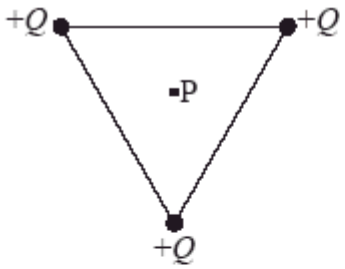
Plate X is at Earth potential (0 V) and the potential of plate Y is V_0.

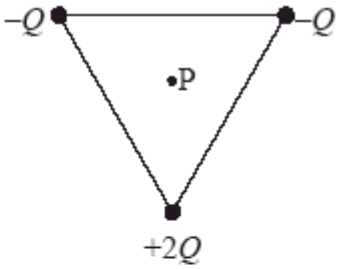
Which of the following is correct in respect of the magnitude and the direction of the electric field between the plates?

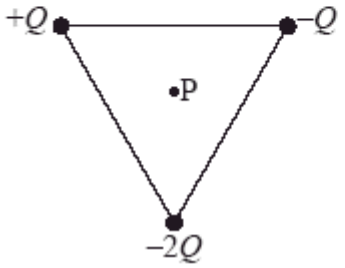
	Magnitude	Direction
A.	constant	X → Y
B.	increasing	Y → X
C.	constant	Y → X
D.	increasing	X → Y

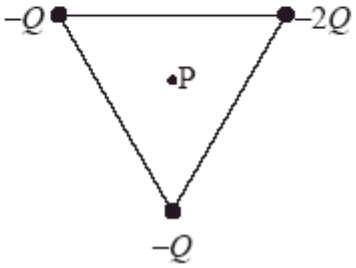
(Total 1 mark)

13. Which arrangement of three point charges at the corner of an equilateral triangle will result in a zero electric field strength at the centre of the triangle, point P?

A. 

B. 

C. 

D. 

(Total 1 mark)

14. An electron travelling in the direction shown by the arrow X, enters a region of uniform magnetic field. It leaves the region of field in the direction shown by the arrow Y.

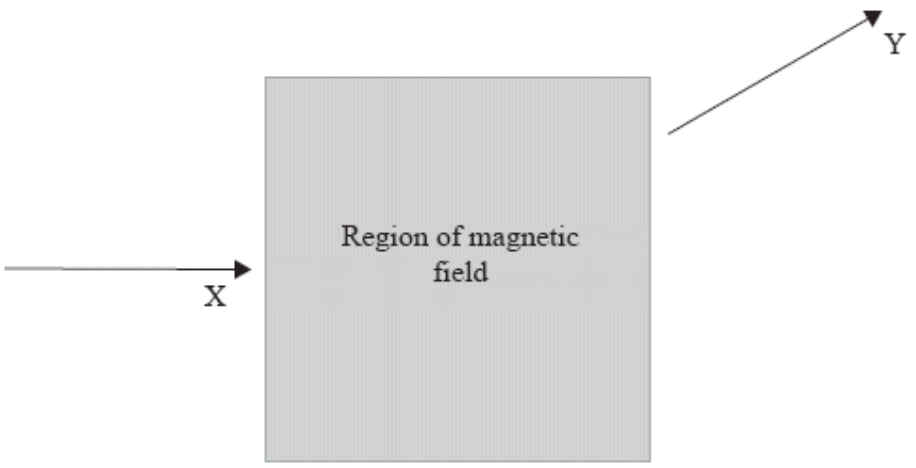
The direction of the magnetic field is

A. in the direction of X.

B. into the plane of the paper.

C. in the opposite direction to X.

D. out of the plane of the paper.



(Total 1 mark)

15. A current is established in a coil of wire in the direction shown.

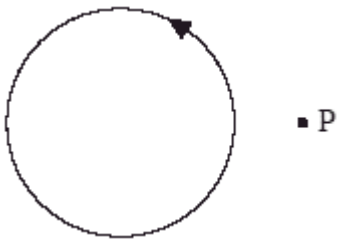
The direction of the magnetic field at point P is

A. out of the plane of the paper.

B. into the plane of the paper.

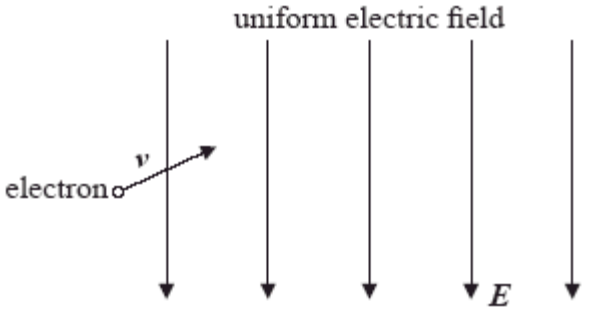
C. to the left.

D. to the right.



(Total 1 mark)

16. The diagram below shows a uniform electric field of strength ***E***. The field is in a vacuum.



An electron enters the field with a velocity ***v*** in the direction shown. The electron is moving in the plane of the paper. The path followed by the electron will be

A. parabolic.

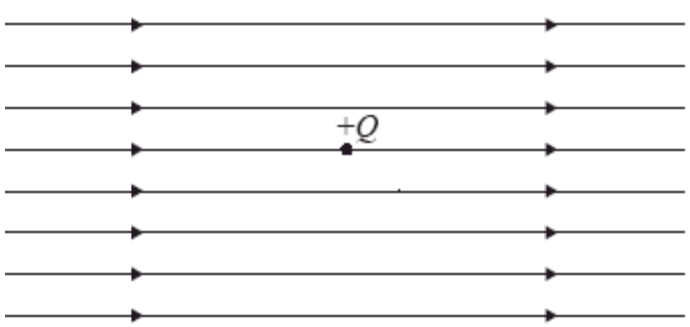
B. in the direction of ***E***.

C. in the direction of ***v***.

D. circular.

(Total 1 mark)

17. A point mass carries a positive charge $+Q$ and is at rest in a magnetic field. The field is in the direction shown.



The magnetic force acting on the charge is

A. from left to right in the plane of the page.

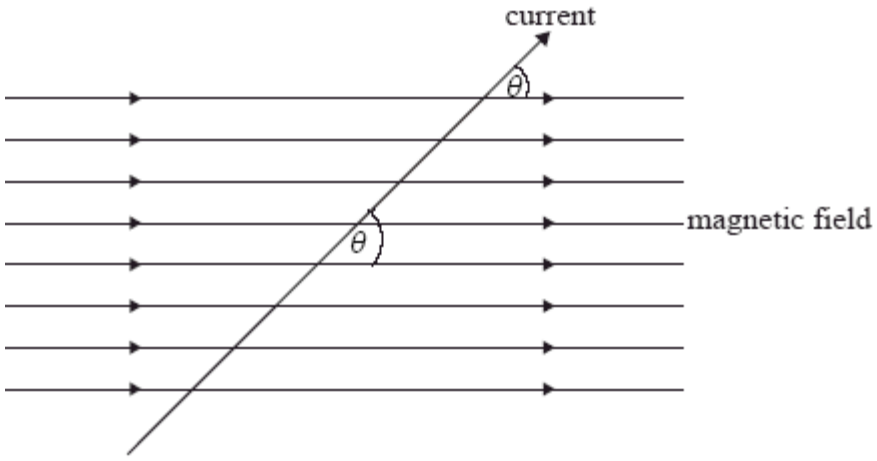
B. from top to bottom in the plane of the page.

C. into the plane of the page.

D. zero.

(Total 1 mark)

18. A current carrying wire is in the same plane as a uniform magnetic field. The angle between the wire and the magnetic field is θ.



The magnetic force on the current carrying wire is

A. zero.

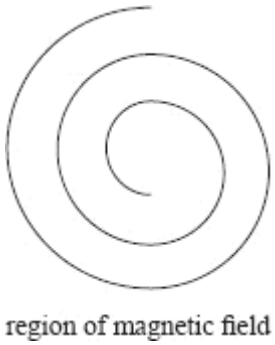
B. into the plane of the paper.

C. out of the plane of the paper.

D. at an angle θ to the direction of the magnetic field.

(Total 1 mark)

19. An electron is moving in air at right angles to a uniform magnetic field. The diagram below shows the path of the electron. The electron is slowing down.



Which of the following correctly gives the direction of motion of the electron and the direction of the magnetic field?

	Direction of motion	Direction of magnetic field
A.	clockwise	into plane of paper
B.	clockwise	out of plane of paper
C.	anti-clockwise	into plane of paper
D.	anti-clockwise	out of plane of paper

(Total 1 mark)

20. This question is about electric circuits.

(a) Define

(i) *electromotive force* (emf) of a battery.

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(1)

(ii) *electrical resistance* of a conductor.

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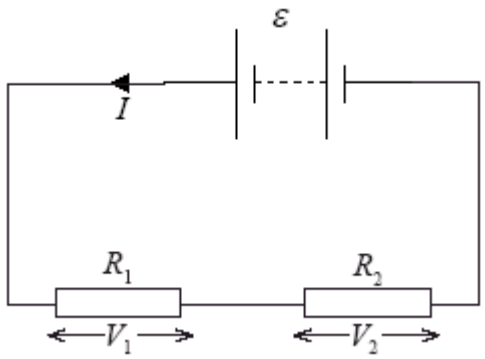
(1)

(b) A battery of emf ε and negligible internal resistance is connected in series to two resistors. The current in the circuit is *I*.



(i) State an equation giving the total power delivered by the battery.

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(1)

(ii) The potential difference across resistor R_1 is V_1 and that across resistor R_2 is V_2. Using the law of the conservation of energy, deduce the equation below.

$$\varepsilon = V_1 + V_2$$

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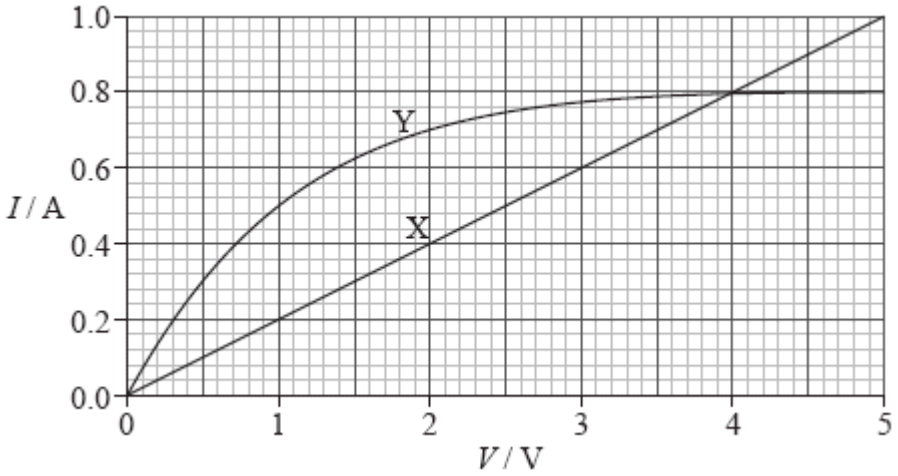
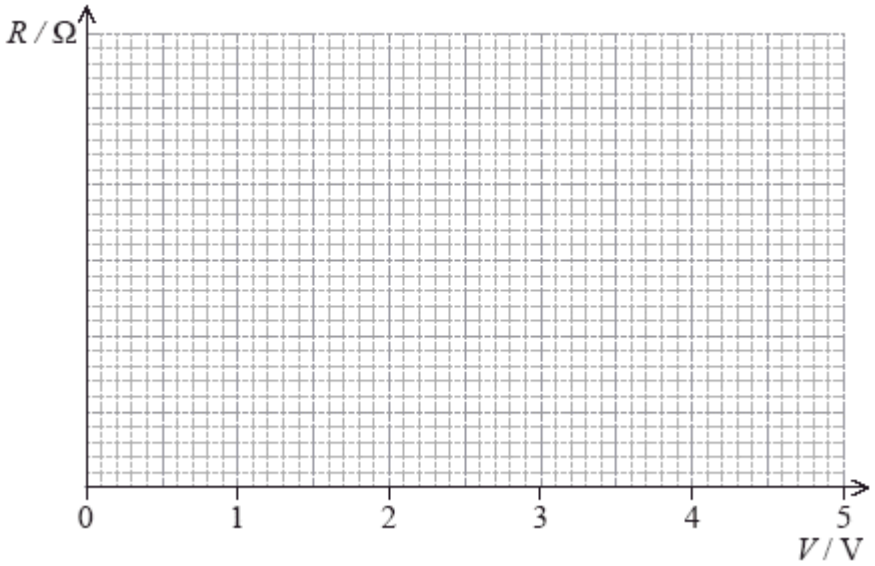
(2)

(c) The graph shows the *I*-*V* characteristics of two conductors, X and Y.

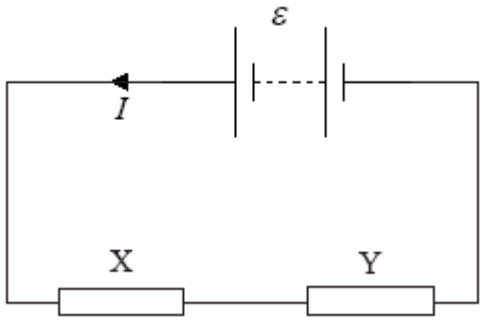


On the axes below, sketch graphs to show the variation with potential difference *V* of the resistance of conductor X (label this graph X) and conductor Y (label this graph Y).
You do not need to put any numbers on the vertical axis.



(3)

(d) The conductors in (c) are connected in series to a battery of emf ε and negligible internal resistance.



The power dissipated in each of the two resistors is the same.

Using the graph given in (c),

(i) determine the emf of the battery.

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(2)

(ii) calculate the total power dissipated in the circuit.

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(2)

(Total 12 marks)

21. This question is about electrical resistance.

(a) A resistor of resistance 1.5 Ω is made from copper wire of radius 0.18 mm. The resistivity of copper is 1.7×10^{-8} Ω m. Determine the length of copper wire used to make the resistor.

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(2)

(b) The manufacturer of the resistor in (a) guarantees that the resistance is within 10 % of 1.5 Ω , provided that the power dissipation in the resistor does not exceed 1.0 W.

(i) Suggest why the resistance of the resistor might be greater than 1.65 Ω if the power dissipation in the resistor is greater than 1.0 W.

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(2)

(ii) Show that, for a power dissipation of 1.0 W, the current in a resistor of resistance 1.5 Ω is 0.82 A.

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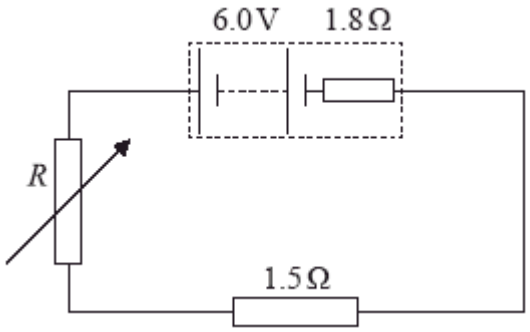
(1)

(iii) The 1.5 Ω resistor is connected in series with a variable resistor and battery of emf 6.0 V and internal resistance 1.8 Ω.



Estimate the resistance *R* of the variable resistor that will limit the current to 0.82 A.

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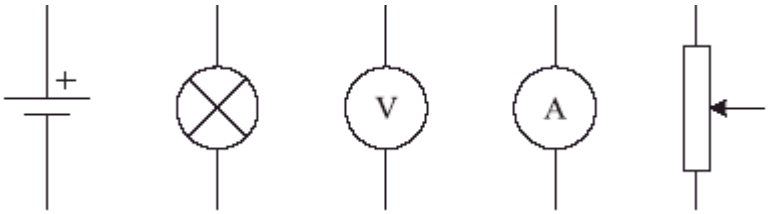
(3)

22. This question is about electric circuits.

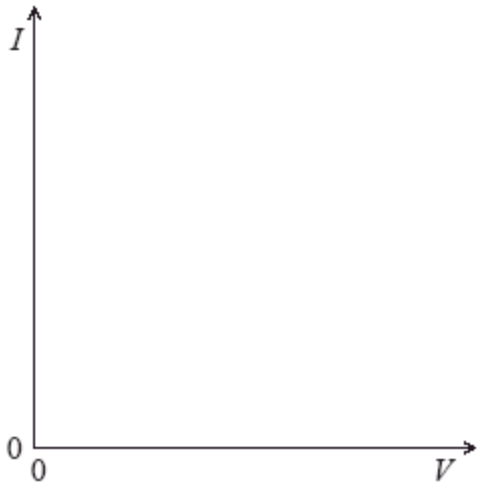
The components shown below are to be connected in a circuit to investigate how the current *I* in a tungsten filament lamp varies with the potential difference *V* across it.



(a) Construct a circuit diagram to show how these components should be connected together in order to obtain as large a range as possible for values of potential difference across the lamp.

(4)

(b) On the axes, sketch a graph of I against V for a filament lamp in the range $V = 0$ to its normal working voltage.



(2)

(c) The lamp is marked with the symbols "1.25 V, 300 mW". Calculate the current in the filament when it is working normally.

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(1)

(d) The resistivity of tungsten at the lamp's working temperature is 4×10^{-7} Ωm. The total length of the tungsten filament is 0.80 m. Estimate the radius of the filament.

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(4)

(e) The cell is connected to two identical lamps connected in parallel. The lamps are rated at 1.25 V, 300 mW. The cell has an emf of 1.5 V and an internal resistance of 1.2 Ω.
Determine whether the lamps will light normally.

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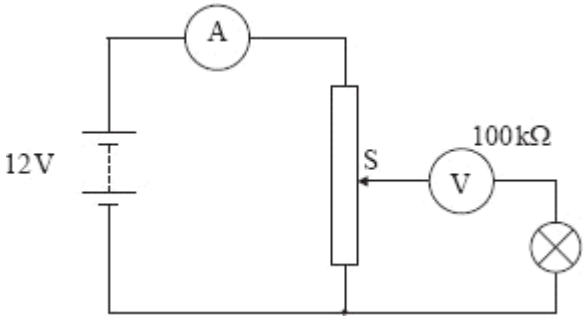
(4)

23. This question is about an electric circuit.

A particular filament lamp is rated at 12 V, 6.0 mA. It just lights when the potential difference across the filament is 6.0 V.

A student sets up an electric circuit to measure the *I-V* characteristic of the filament lamp.

In the circuit, shown below, the student has connected the voltmeter and the ammeter into the circuit **incorrectly**.



The battery has emf 12 V and negligible internal resistance. The ammeter has negligible resistance and the resistance of the voltmeter is 100 kΩ. The maximum resistance of the variable resistor is 15Ω.

(a) Explain, without doing any calculations, whether there is a position of the slide S at which the lamp will be lit.

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(3)

(b) Estimate the maximum reading of the ammeter.

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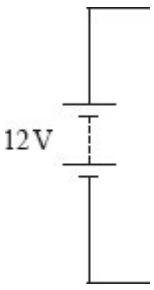
(2)

(c) Complete the circuit diagram below showing the correct position of the voltmeter and of the ammeter in order to determine the *I-V* characteristic of the filament lamp.

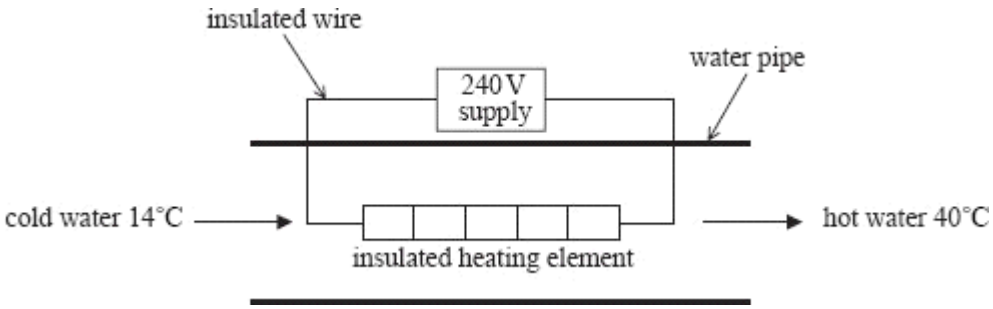


(2)

(Total 7 marks)

24. Domestic shower

(a) The diagram below shows part of the heating circuit of a domestic shower.



Cold water enters the shower unit and flows over an insulated heating element. The heating element is rated at 7.2 kW, 240 V. The water enters at a temperature of 14 °C and leaves at a temperature of 40 °C. The specific heat capacity of water is 4.2×10^3 J kg^{-1} K^{-1}.

(i) Define *specific heat capacity*.

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(1)

(ii) Estimate the flow rate of the water.

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(4)

(iii) Suggest **two** reasons why your answer to (a)(ii) is only an estimate.

1. .....

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2. .....

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(2)

(iv) Calculate the current in the heating element when the element is operating at 7.2 kW.

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(2)

(v) Explain why, when the shower unit is switched on, the initial current in the heating element is greater than the current calculated in (a)(iv).

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(2)

(b) In some countries, shower units are operated from a 110 V supply. A heating element operating with a 240 V supply has resistance R_{240} and an element operating from a 110 V supply has resistance R_{110}.

Show that for heating elements to have identical power outputs

$$\frac{R_{110}}{R_{240}} = 0.21.$$

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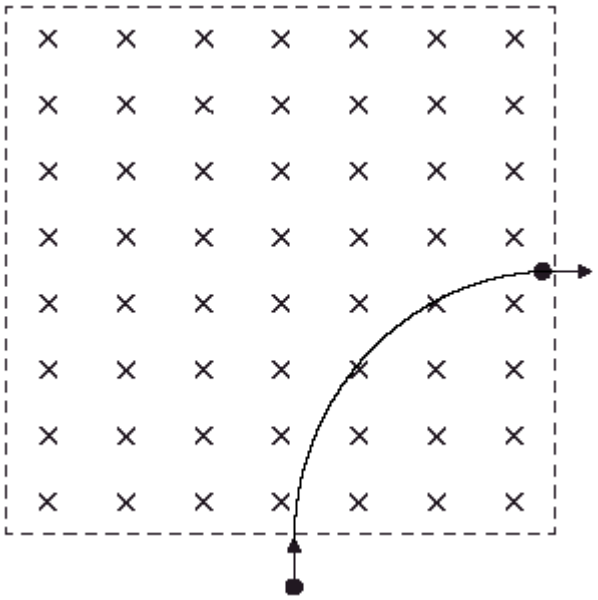
(3)

25. This question is about motion in a magnetic field.

An electron, that has been accelerated from rest by a potential difference of 250 V, enters a region of magnetic field of strength 0.12 T that is directed into the plane of the page.



(a) The electron's path while in the region of magnetic field is a quarter circle. Show that the

(i) speed of the electron after acceleration is 9.4×10^6 m s^{-1}.

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(2)

(ii) radius of the path is 4.5×10^{-4} m.

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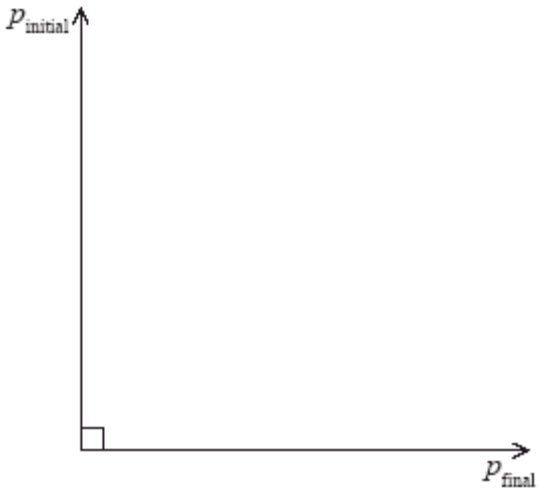
(2)

(b) The diagram below shows the momentum of the electron as it enters and leaves the region of magnetic field. The magnitude of the initial momentum and of the final momentum is 8.6×10^{-24} N s.



(i) On the diagram, draw an arrow to indicate the vector representing the change in the momentum of the electron.

(1)

(ii) Show that the magnitude of the change in the momentum of the electron is 1.2×10^{-23} Ns.

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(1)

(iii) The time the electron spends in the region of magnetic field is 7.4×10^{-11} s. Estimate the magnitude of the average force on the electron.

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(1)