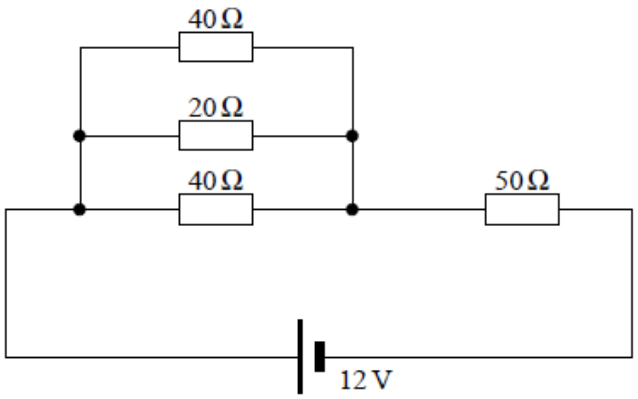
Revision – Electricity (Year 12)

1.

A battery of e.m.f. 12 V and negligible internal resistance is connected to a resistor network as shown in the circuit diagram.



(a) Calculate the total resistance of the circuit.

.....

.....

.....

.....

.....

(3 marks)

(b) Calculate the current through the 50 Ω resistor.

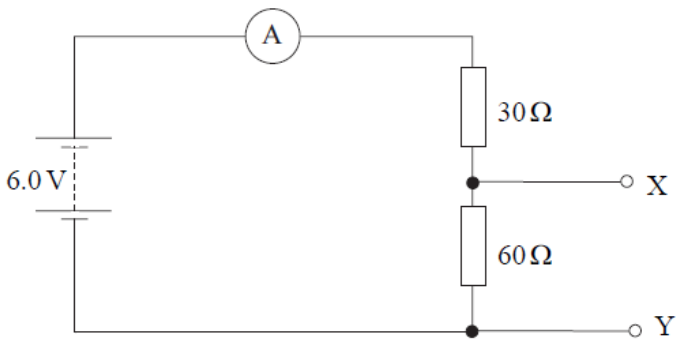
.....

.....

(1 mark)

2.

In the circuit shown, the battery has negligible internal resistance.



Calculate the current in the ammeter when

(a) the terminals X and Y are short-circuited i.e. connected together,

.....

.....

.....

.....

(2 marks)

(b) the terminals X and Y are connected to a 30 Ω resistor.

.....

.....

.....

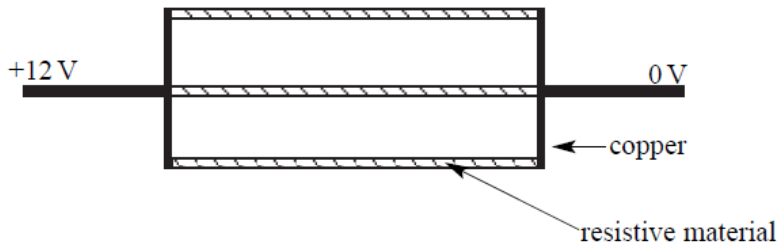
.....

.....

(4 marks)

3.

A heating element, as used on the rear window of a car, consists of three strips of a resistive material, joined, as shown in the diagram, by strips of copper of negligible resistance. The voltage applied to the unit is 12 V and heat is generated at a rate of 40 W.



(a) (i) Calculate the total resistance of the element.

.....

.....

(ii) Hence show that the resistance of a single strip is about 11 Ω.

.....

.....

.....

.....

(5 marks)

(b) If each strip is 2.6 mm wide and 1.1 mm thick, determine the length of each strip.

resistivity of the resistive material = 4.0×10^{-5} Ω m

.....

.....

.....

.....

(3 marks)

4.

The list gives some quantities and units. *Underline* those which are base quantities of the International (SI) System of units.

coulomb force length mole newton temperature interval

(2)

Define the volt.

.....

.....

(2)

Use your definition to express the volt in terms of base units.

.....

.....

.....

(3)

Explain the difference between scalar and vector quantities.

.....

.....

.....

(2)

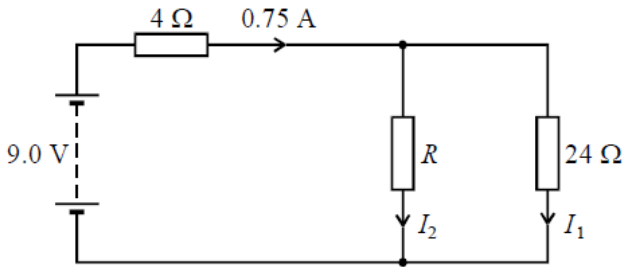
Is potential difference a scalar or vector quantity?

.....

(1)

5.

The circuit shows a battery of negligible internal resistance connected to three resistors.



Calculate current I_1.

.....

.....

.....

I_1 = ...

(3)

Calculate resistance R

.....

.....

R = ...

(2)

6.

(a) (i) Give the equation which relates the *electrical resistivity* of a conducting material to its *resistance*. Define the symbols in the equation.

.....

.....

.....

(ii) A potential difference of 1.5 V exists across the ends of a copper wire of length 2.0 m and uniform radius 0.40 mm. Calculate the current in the wire.

resistivity of copper = $1.7 \times 10^{-8}\ \Omega$ m

.....

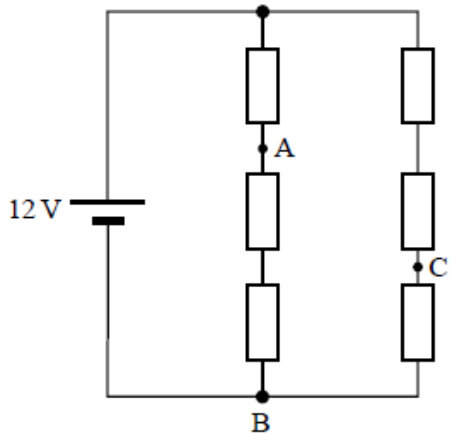
.....

.....

.....

(5 marks)

(b) In the circuit shown, each resistor has the same resistance. The battery has an e.m.f. of 12 V and negligible internal resistance.



(i) Calculate the potential difference between A and B.

.....

.....

(ii) Calculate the potential difference between B and C.

.....

.....

(iii) A high resistance voltmeter is connected between A and C. What is the reading on the voltmeter?

.....

(5 marks)

7.

A cell of negligible internal resistance is connected in series with a microammeter of negligible resistance and two resistors of 10 kΩ and 15 kΩ. The current is 200 μA.

Draw a circuit diagram of the arrangement.

(1)

Calculate the e.m.f. of the cell.

.....

.....

e.m.f. = ...

(2)

Where a voltmeter is connected in parallel with the 15 kΩ resistor, the current in the microammeter increases to 250 μA. Sketch a diagram of the modified circuit.

(1)

Calculate the resistance of the voltmeter.

.....

.....

.....

.....

Resistance = ...

(3)

8.

A battery of e.m.f. $\in$ and internal resistance r is connected in series with a variable resistor R as shown in **Figure 1**. A voltmeter is connected as shown.

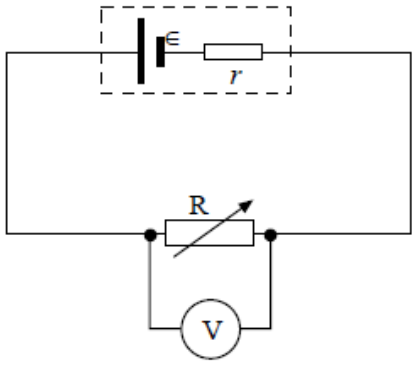


Figure 1

(a) (i) State what is meant by the e.m.f. of a battery.

.....

.....

(ii) The reading V on the voltmeter is the voltage across R.
Why is V less than $\in$?

.....

.....

(3 marks)

(b) In order to measure ϵ and r, an ammeter is used in the circuit, as shown in **Figure 2**.

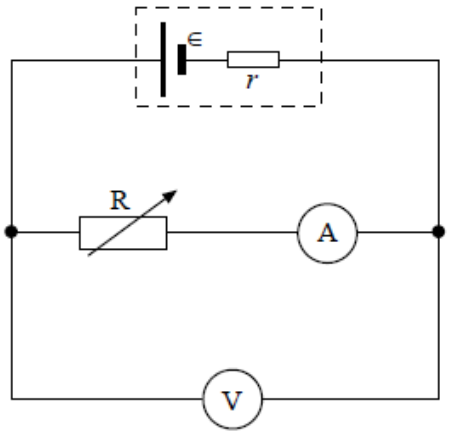


Figure 2

The value of R is decreased in steps and at each step the readings V and I on the voltmeter and ammeter, respectively, are recorded. These are shown in the table.

reading on voltmeter/V	reading on ammeter/A
4.0	0.07
3.0	0.14
2.0	0.21
1.0	0.28

(i) Plot a graph of V (on y axis) against I (on x axis) and draw the best straight line through the points.

The grid to draw the graph is given on the next page.

(ii) Determine the values of ϵ and r from the graph, explaining your method.

.....

.....

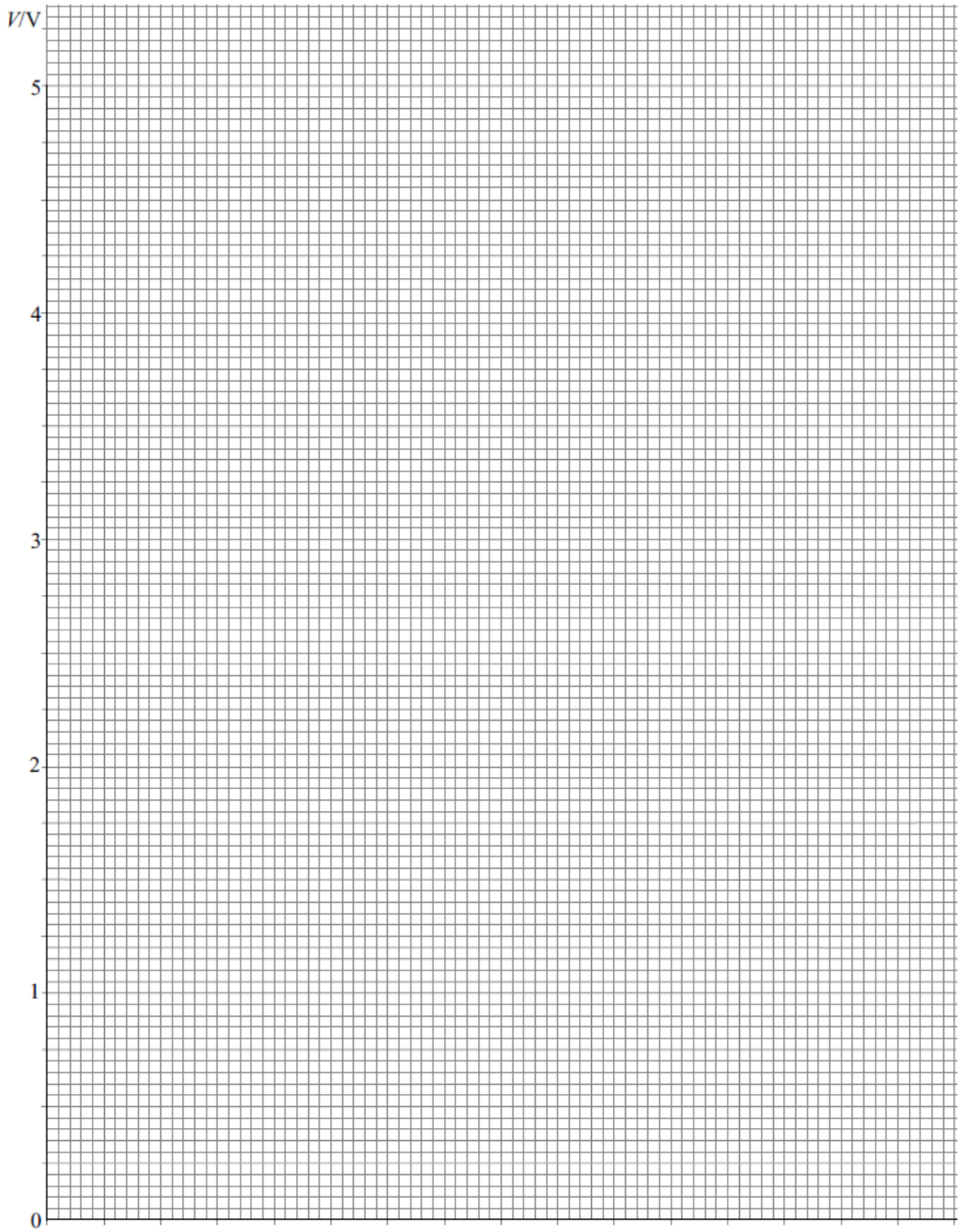
.....

.....

.....

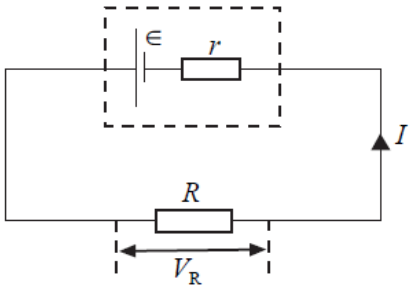
.....

(8 marks)


V/V
5
4
3
2
1
0

9.

(a) A cell of emf $\in$ and internal resistance r is connected in series to a resistor of resistance R as shown. A current I flows in the circuit.



(i) State an expression which gives $\in$ in terms of I, r and R.

.....

(ii) Hence show how V_R, the potential difference across the resistor, is related to $\in$, I and r.

.....

(2 marks)

(b) A lamp, rated at 30 W, is connected to a 120 V supply.

(i) Calculate the current in the lamp.

.....

.....

(ii) If the resistor in part (a) is replaced by the lamp described in part (b), determine how many cells, each of emf 1.5 V and internal resistance 1.2 Ω, would have to be connected in series so that the lamp would operate at its proper power.

.....

.....

.....

.....

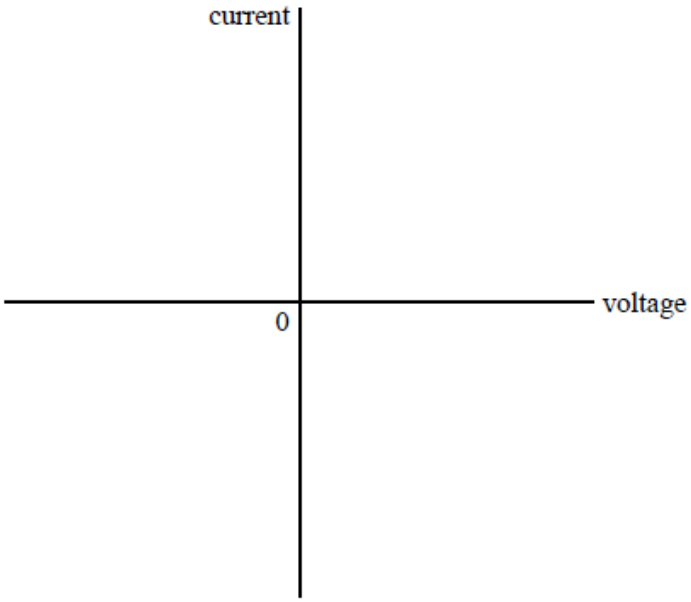
.....

.....

(5 marks)

10.

(a) Draw, on the axes below, the current/voltage characteristic for a filament lamp.
Do **not** insert any values for current or voltage.



(3 marks)

(b) Explain why the characteristic has the shape you have drawn.

.....

.....

.....

.....

.....

(3 marks)

(c) The current/voltage characteristic of a filament lamp is to be determined using a datalogger, the data then being fed into a computer to give a visual display of the characteristic.
Draw the circuit diagram required for such an experiment and state what is varied so as to produce a range of values.

.....

.....

.....

.....

(5 marks)

11.

A light-dependent resistor may be used with additional components to make a light meter.
Sketch a diagram for a suitable circuit.

(2)

Explain how your circuit works

.....

.....

.....

.....

(2)

12.

Define the term *resistivity*.

.....

.....

.....

(2)

The resistivity of copper is 1.7×10^{-8} Ωm. A copper wire is 0.6 m long and has a cross-sectional area of 1mm^2. Calculate its resistance.

.....

.....

.....

Resistance = ...

(3)

Two such wires as used to connect a lamp to a power supply of negligible internal resistance. The potential difference across the lamp is 12 V and its power is 36 W. Calculate the potential difference across each wire.

.....

.....

.....

Potential difference = ...

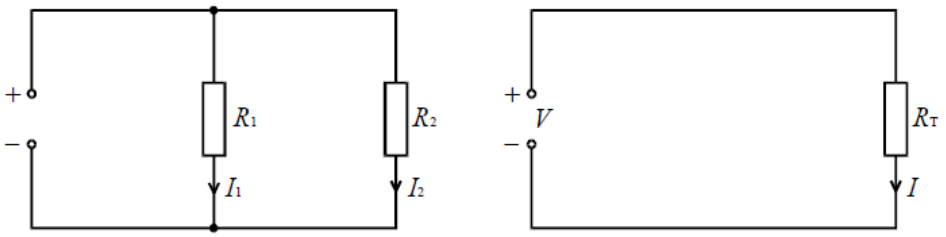
(3)

Draw a circuit diagram of the above arrangement. Label the potential differences across the wires, lamp and power supply.

(3)

13.

The power supplies in the two circuits shown below are identical.



Write down the relationship between I_1, I_2 and I which must hold if the combined resistance of the parallel pair, R_1, and R_2, is to equal R_T.

.....

.....

(1)

Hence derive the formula for the equivalent resistance of two resistors connected in parallel.

.....

.....

.....

.....

.....

(3)

Use your formula to show that the resistance between the terminals of a low-resistance component is hardly changed when a high-resistance voltmeter is connected in parallel with it.

.....

.....

.....

.....

.....

(2)