5 **(a)** State Ohm's law.

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.....

..... [1]

(b) A battery of electromotive force (e.m.f.) 6.2 V and negligible internal resistance is connected in a circuit to a uniform resistance wire, a voltmeter, a fixed resistor and a switch, as shown in Fig. 5.1.

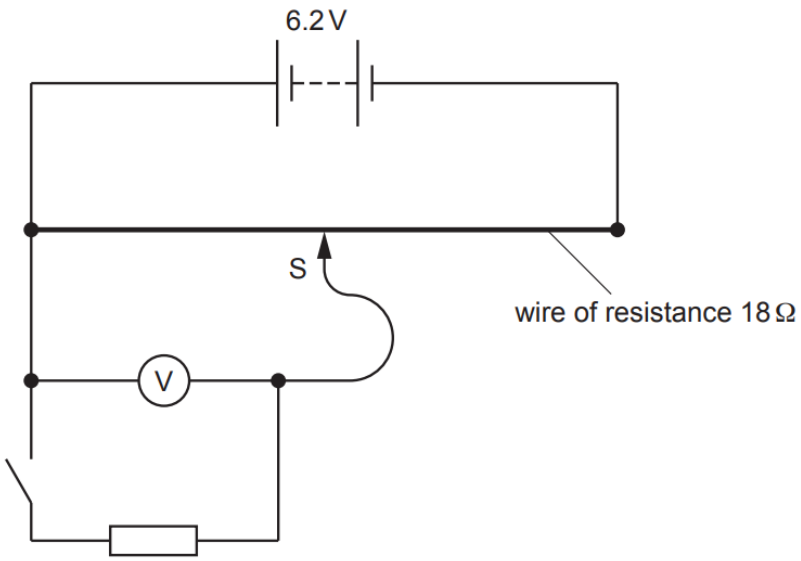

Fig. 5.1

The resistance wire has resistance 18 Ω, length 0.94 m and cross-sectional area 7.2×10^{-8} m^2. The slider S is positioned half-way along the length of the wire.

(i) Calculate the resistivity ρ of the material of the resistance wire.

ρ = ... Ω m [1]

(ii) The switch is now closed.

State whether there is an increase, decrease or no change to:

- the current in the battery

  ……..……..……..

- the voltmeter reading.

  ……..……..
  [2]

(iii) The switch remains closed. The slider S is moved along the resistance wire so that the voltmeter reading is 3.1 V.

On Fig. 5.1, draw a cross (×) on the resistance wire to show a possible new position of the slider. [1]

(c) The circuit in **(b)** is altered by changing the battery for one of a different e.m.f. The switch is open.

A student records the following data for the resistance wire:

current in the wire	0.93 A
mean drift speed of charge carriers	1.3×10^{-3} m s^{-1}
number density of charge carriers	9.0×10^{28} m^{-3}.

(i) Determine the charge q of a charge carrier in the wire suggested by this data.

q = …….. C [1]

(ii) With reference to the value of q, explain why the data recorded by the student cannot be correct.

……..

…..……..[1]

(d) A cell of electromotive force (e.m.f.) 1.8 V and internal resistance r is connected in parallel with a resistor of resistance 6.0 Ω and a filament lamp, as shown in Fig. 5.2.

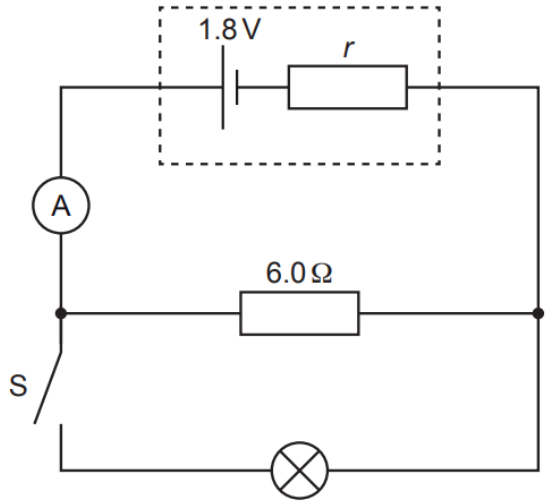

Fig. 5.2

Initially, the switch S is open.

At time t_1 switch S in Fig. 5.2 is closed. Fig. 5.3 shows the variation with time t of the ammeter reading I.

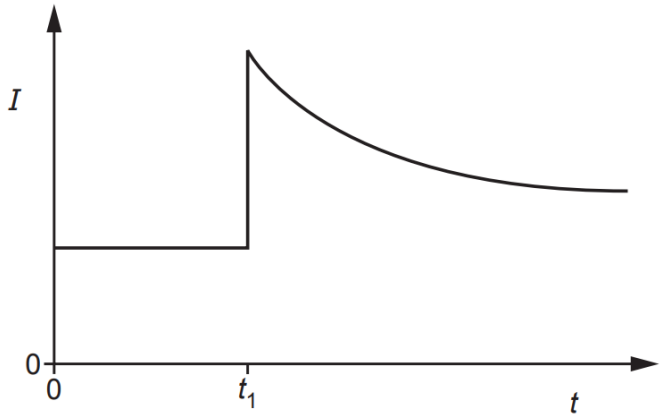

Fig. 5.3

By considering the effect of the lamp on the total resistance of the circuit, explain the variation of the ammeter reading shown in Fig. 5.3.

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..... [3]