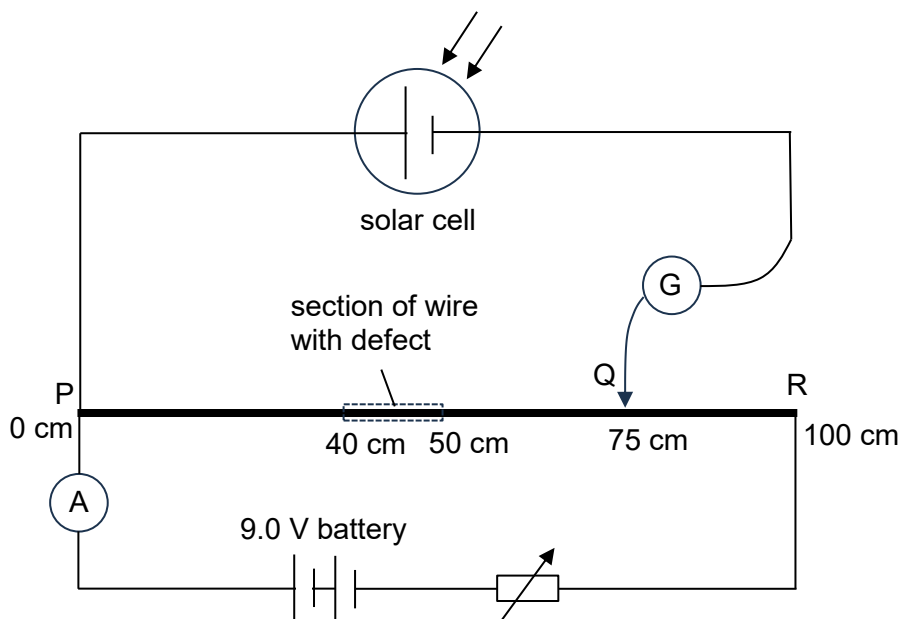**6** A potentiometer wire PR, mounted on a metre rule (not shown), is used to measure the electromotive force (e.m.f.) E of a solar cell with internal resistance as shown in Fig. 6.1.

Fig. 6.1

Points P and R of the wire are at the 0 cm and 100 cm marks on the metre rule respectively. The 9.0 V battery has negligible internal resistance.

The potentiometer wire has a resistivity of 5.0×10^{-7} Ω m. It is found that there is defect in a small section of the wire, from 40 cm to 50 cm marks, where the cross-sectional area is 20% smaller than the rest of the wire which has a cross-sectional area of 5.7×10^{-8} m^2.

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

....

.... [1]

(b) Calculate the resistance of the potentiometer wire PR.

resistance = ... Ω   [2]

(c) When the variable resistor is set to a resistance of 25 Ω, the galvanometer shows no deflection when the jockey Q is in contact with the wire at the 75 cm mark.

(i) Calculate the current I shown on the ammeter.

$I =$ .... A   [2]

(ii) Calculate E.

$E =$ V   [2]

(d) (i) Explain why the internal resistance of the solar cell does not have to be considered in the calculation in (c)(ii).

....

.... [1]

(ii) Explain, without calculation, how the balance length would change if the cross-sectional area of the potentiometer wire is uniform throughout with a value of 5.7×10^{-8} m^2 and the resistance of the variable resistor is unchanged.

....

.... [1]

[Total: 9]