4 A circuit is set up to determine the e.m.f. E and internal resistance r of an unknown cell as shown in Fig. 4.1. Initially, both switch S_1 and switch S_2 are opened.

An accumulator with a negligible internal resistance is connected in series to a resistor R_1 and a resistance wire. The resistance wire AB is 120.0 cm long. Both resistance wire and the external resistor R_1 has the same resistance. When the jockey J is placed at end point B, the potential difference across the resistor R_1 is 4.00 V. The resistance of the fixed resistor R_2 is 12.0 Ω.

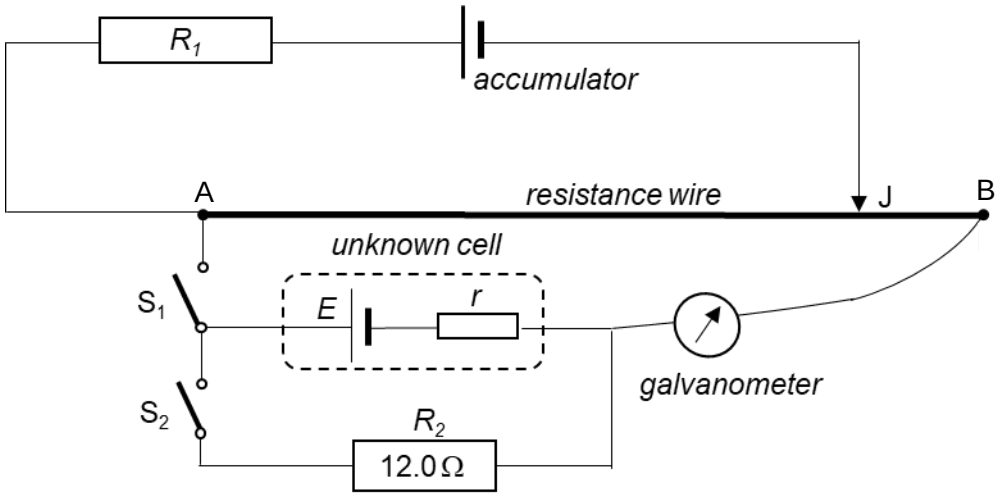

Fig. 4.1

(a) Determine the e.m.f. of the accumulator.

e.m.f. = …….. V [1]

(b) The switch S_1 is closed. When the jockey J touches the point B on the resistance wire, the galvanometer shows null deflection. Determine the e.m.f. E and terminal potential difference of the unknown cell.

terminal potential difference = …….. V

E = …….. V [2]

(c) Both switches S_1 and S_2 are closed. When the jockey J is moved to a new point C on the resistance wire where it is at a distance of 72.0 cm from the point A, the galvanometer shows null deflection. Determine

(i) the potential difference between point A and point C.

potential difference = ……. V [2]

(ii) the potential difference across the fixed resistance R_2.

potential difference = ……. V [1]

(iii) the internal resistance r of the unknown cell.

r = ……. Ω [2]

[Total: 8]