4 **(a)** In a laboratory, a circuit is set up as shown in Fig. 4.1. Cell A has an electromotive force (e.m.f.) of 2.0 V and negligible internal resistance. XY is a uniform wire of length 100.0 cm and resistance 5.0 Ω.

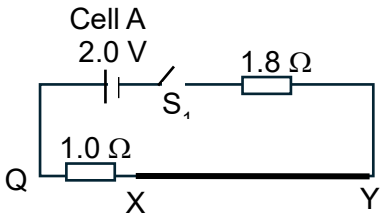

Fig. 4.1

(i) Explain what is meant by *electromotive force* (e.m.f.) of 2.0 V.

.....

.....

.....[1]

(ii) Calculate the current in the 1.0 Ω resistor and wire XY when switch S_1 is closed.

current = ... A [1]

(b) A second circuit which contains Cell B of e.m.f. 1.2 V and negligible resistance is connected to the circuit in **(a)** at Q and P.

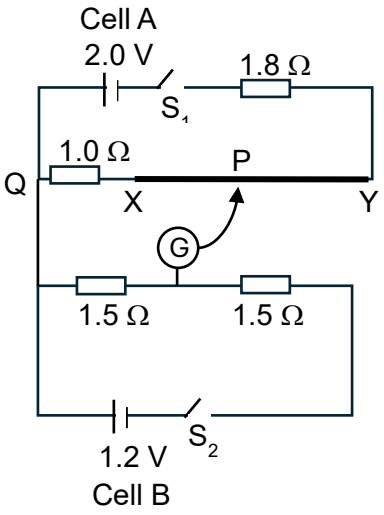

Fig. 4.2

(i) Calculate the balance length XP required to produce a zero deflection on the galvanometer when both switches S_1 and S_2 are closed.

length = ... m [3]

(ii) Describe and explain how the balance length XP will be different if the 1 Ω resistor is replaced with a 1 kΩ resistor.

.....

.....

.....

.....[2]

(iii) If both 1.5 Ω resistors are replaced with identical LDRs, describe and explain how the balance length XP will be different as the light intensity in the laboratory decreases.

.....

.....

.....

.....[2]

[Total: 9]