

(b) Suggest how a big mass damper can help stabilise a building during an earthquake.

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- 4 [2]
 A cell of constant e.m.f. E and internal resistance r is connected to a 100.0 cm length of a high-resistivity wire XY at points X and J, where J is a movable contact. A voltmeter is connected across X and J. The circuit is shown in **Fig. 4.1**. The poorly-constructed voltmeter has a finite resistance R_v . An ammeter with negligible resistance is connected in series with the cell to measure the current I .

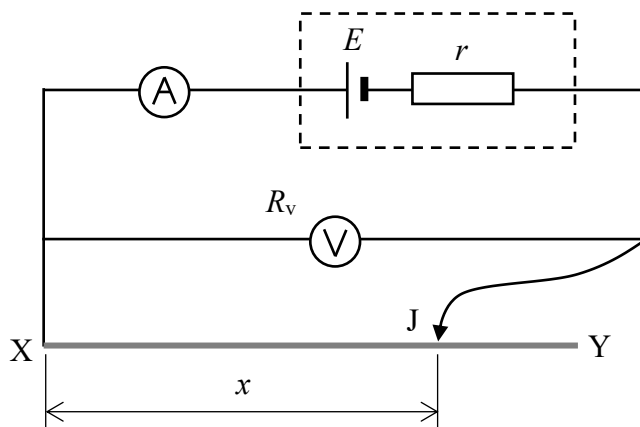


Fig. 4.1

By adjusting the distance x between X and the movable contact J, two sets of data were recorded with high accuracy, as shown in **Fig. 4.2**.

Distance XJ x / cm	Voltmeter reading V / V	Ammeter reading I / A
50.0	5.66	0.724
100.0	5.96	0.405

Fig. 4.2

- (a) Use the data in **Fig. 4.2** to determine the e.m.f. E and internal resistance r of the cell.

$$E = \dots\dots\dots \text{V}$$

$$r = \dots\dots\dots \Omega \text{ [3]}$$

- (b) Determine the effective resistance between points X and J when $x = 100.0 \text{ cm}$.

$$\text{Effective resistance} = \dots\dots\dots \Omega \text{ [1]}$$

- (c) By using the result from (b) and the effective resistance between X and J when $x = 50.0 \text{ cm}$, calculate the resistance R_v of the voltmeter and the resistance R of the wire XY.

$$R_v = \dots\dots\dots \Omega$$

$$R = \dots\dots\dots \Omega [3]$$

The voltmeter is now removed and the ammeter is replaced by a galvanometer.
A second cell of unknown e.m.f. E_c and negligible internal resistance is now connected across the wire XY, as shown in **Fig. 4.3**.

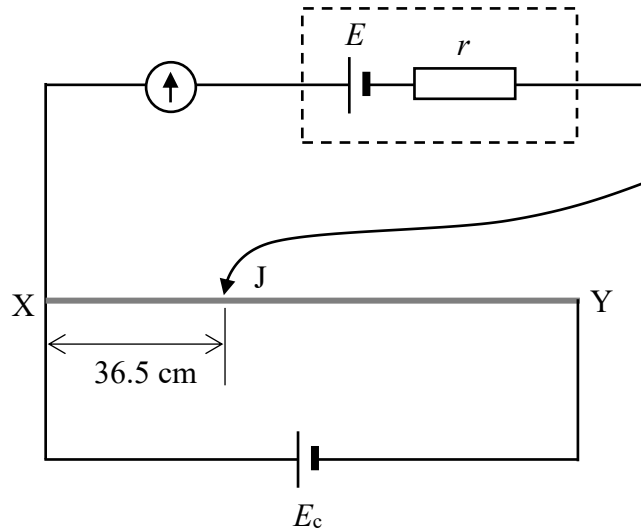


Fig. 4.3

The movable contact J is adjusted and the galvanometer indicates zero current when the length x between X and J is 36.5 cm.

- (d) Determine the e.m.f. E_c of the second cell.

$$E_c = \dots\dots\dots \text{V} [3]$$

