5 (a) Define *potential difference* between two points in a circuit.

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……………………………………………………………….…………………………………..… [1]
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(b) A thermistor and a variable resistor are connected in a potential divider circuit as shown in Fig. 5.1.

The battery has an e.m.f. of E, the thermistor has a resistance R_T and the variable resistor has a resistance R_V.

This circuit is used to activate an alarm system whenever the ambient temperature rises to a certain value. The alarm bell will sound if the potential difference across it increases beyond the pre-set value.

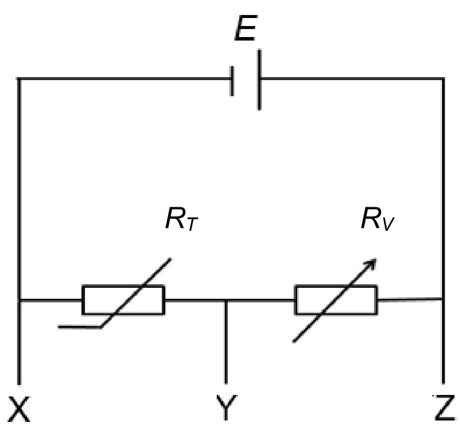

Fig. 5.1

(i) State an expression for the potential difference across the variable resistor in terms of E, R_T and R_V. [1]

(ii) State and explain across which two terminals, XY or YZ, the alarm bell should be connected to the circuit in Fig. 5.1.

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(iii) State and explain the purpose of the variable resistor in the circuit.

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…...…………………………………………………………………………………………… [2]
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(c) Fig. 5.2 shows a potentiometer circuit consisting of a 100 cm length of wire AB and a driver cell E_1 of e.m.f. 2.0 V and of negligible internal resistance.

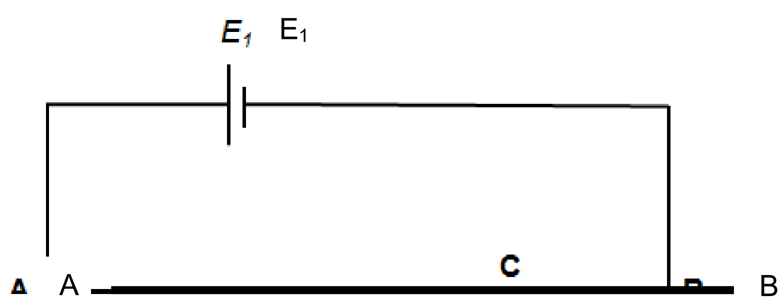

Fig. 5.2

(i) State the value of the potential gradient along AB.

potential gradient = …………………………….. V cm^{-1} [1]

(ii) A circuit consisting of a cell E_2 and a variable resistor R is now connected to the potentiometer as shown in Fig. 5.3.

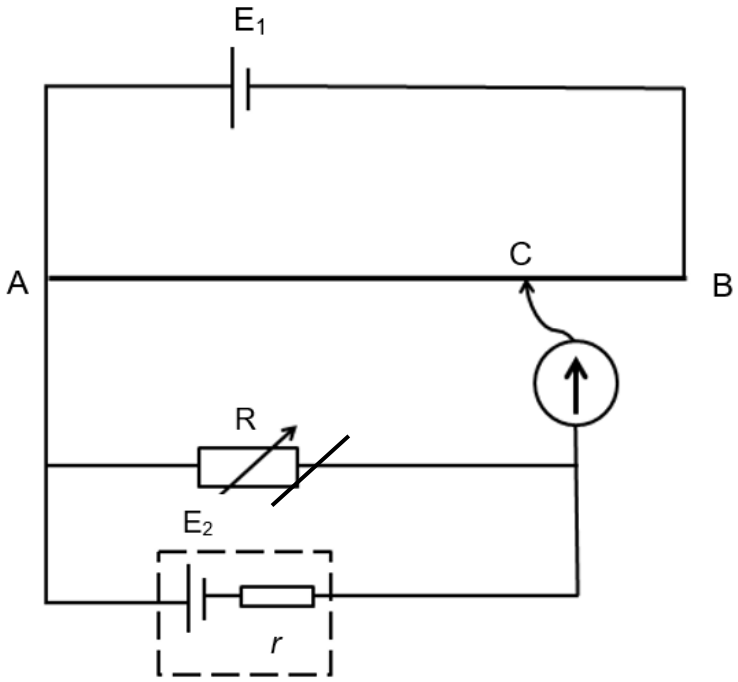

Fig. 5.3

The resistance of R is set to 10.0 Ω and the sliding contact C is adjusted until there is no current flowing in the galvanometer. The length AC is found to be 60.0 cm.

The resistance of R is now set to 3.0 Ω and the experiment is repeated. The length AC is now 54.0 cm.

Calculate the e.m.f. and internal resistance *r* of cell E_2.

e.m.f. of cell E_2 = …….. V

internal resistance of cell E_2 = ……. Ω [5]