2 A student investigates an electric circuit to find the resistance of an unknown resistor Z.

The student sets up the incomplete circuit shown in Fig. 2.1. There is a gap between the points labelled X and Y.

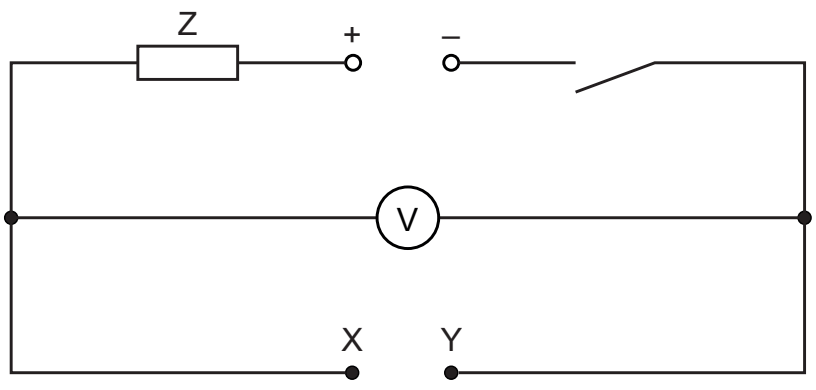

Fig. 2.1

(a) The student:

- closes the switch
- records the voltmeter reading V_0
- opens the switch.

The reading on the voltmeter is shown in Fig. 2.2.
Record the voltmeter reading V_0.

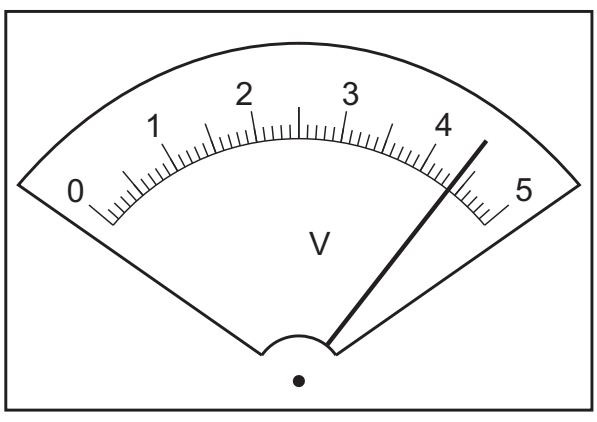

Fig. 2.2

V_0 = ... V [1]

(b) The student:

- connects a 10 Ω resistor between points X and Y
- closes the switch
- records, in Table 2.1, the reading V on the voltmeter
- opens the switch
- repeats this procedure for resistors of resistances R = 22 Ω, 39 Ω, 47 Ω and 68 Ω.

Table 2.1

resistance R/Ω	voltmeter reading V/V	current I/A
10	1.35	
22	2.20	0.10
39	2.85	0.073
47		0.064
68	3.37	0.050

(i) Use the voltmeter reading in Table 2.1 when the 10 Ω resistor is connected between X and Y to calculate the current I in the circuit. Use the equation:

$$I = \frac{V}{R}$$

Record your value of I in Table 2.1 to 2 significant figures. [2]

(ii) The voltmeter reading V for the 47 Ω resistor is missing. Calculate V.

V = ... V

Add your answer to Table 2.1. [1]

(c) Plot a graph of V/V (y-axis) against I/A (x-axis). Start your axes at the origin (0,0).

Draw a best-fit straight line.

[4]

(d) Determine the gradient G of your line. Show all working and indicate on the graph the values you use.

G = ... [2]

(e) The gradient of your line is numerically equal to the resistance R_Z of the unknown resistor Z.

Write down the value of the resistance R_Z.

Record your answer to the nearest ohm.

R_Z = ... Ω [1]

[Total: 11]