

- 4 (a) State what is meant by *resistivity* of a material.

.....
.....
.....

[1]

- (b) A student attempts to measure the resistivity of soil using two parallel copper plates driven into the ground as shown in Fig. 4.1.

Each copper plate has a height of 1.040 m, a width of 0.210 m and a thickness of 0.050 m. The copper plates are driven to a depth of $d = 0.800$ m and separated by a distance $x = 0.900$ m.

When the switch is open, the student obtained a steady voltmeter reading of +0.281 V. When the switch is closed, the student obtained a voltmeter reading of +1.398 V and an ammeter reading of 0.31 mA.

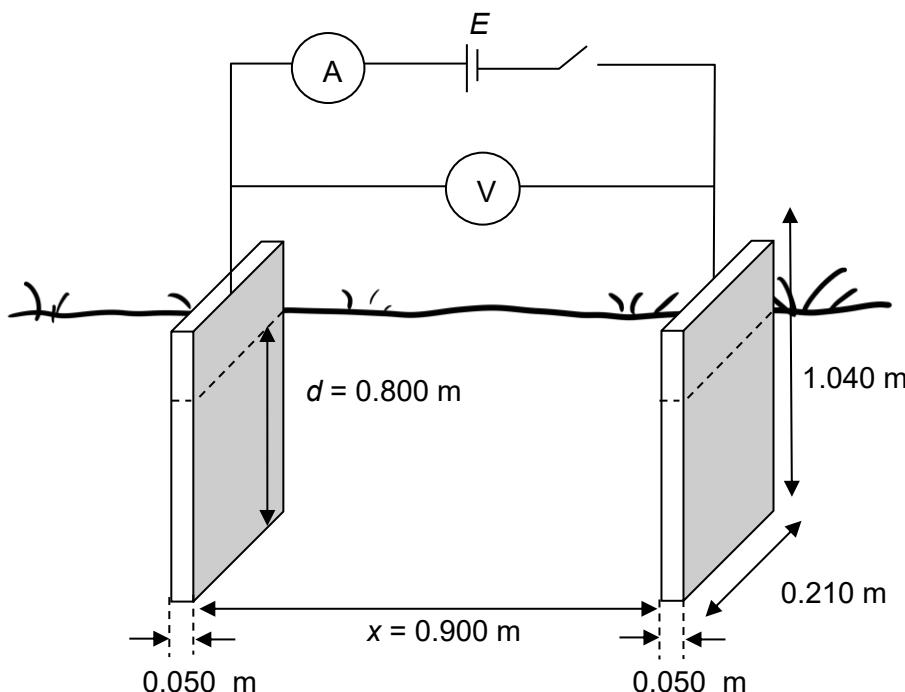


Fig. 4.1

- (i) Show that the resistance of the soil between the copper electrodes is 3.6 k Ω .

[1]

- (ii) Hence, find the resistivity of the soil.

resistivity = Ω m [2]

- (iii) A student suggested using a more precise ammeter to measure the current.

By using the same apparatus, suggest and explain another procedure how the value in (b)(i) could be determined to a higher significant figure.

.....
.....
.....
.....

[2]

- (c) A heating device is designed to operate on an a.c. power supply. The device has a resistance of 6.0Ω .

- (i) Calculate the average power dissipated in the device when operating at an a.c. supply of voltage 12.0 V, 50 Hz.

average power dissipated = W [1]

- (ii) On Fig. 4.2, draw a graph to show the variation with time t of the change in power P dissipated in the device for the a.c. supply in (i). Mark values on both axes.

P / W



Fig. 4.2

[2]

- (iii) The alternating supply of voltage 12.0 V, 50 Hz is derived from the mains supply of voltage 230 V, 50 Hz using a transformer, assuming 30% of the input energy is lost in the transformer.

Calculate the primary r.m.s. current when the heating device is in use.

primary r.m.s. current = A [2]

- (iv) State an advantage of using alternating current for the transmission of electrical energy.

..... [1]