A2-2010 Q1(b) and Q1(e)

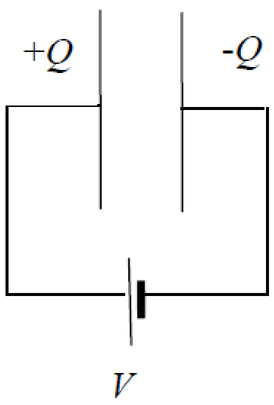
(b) The wires leading from the mains supply in the street into a building have a resistance R of 0.2 Ω. The electrical potential difference of the mains supply in the street is constant and equal to 230 V. The electrical potential difference at the sockets in the building is not to drop below 225 V when electrical power is consumed.

i) Sketch a circuit diagram with the given figures noted on it.
ii) Calculate the maximum current, and hence the maximum power that can be dissipated in the building so that the potential difference at the sockets does not drop below 225 V.

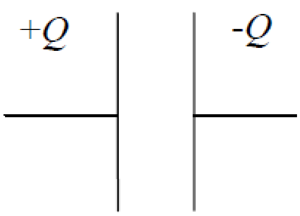
(4 marks)

(e) A pair of plane circular metal plates are connected to a cell of emf V and supported in the position shown in Fig.2 below. The separation of the plates, d, is much less than their diameter so that the field strength between the plates, E, is uniform. The energy stored in the electric field is given by ½QV, where Q is the magnitude of the charge on a plate. The field strength $E = V/d$ and E is proportional to the charge Q on the plates.

When the charged plates are moved apart then work is done on the system (as the charged plates attract each other). In the first case (a), the cell remains connected so that the potential between the plates remains at V as the plate separation is doubled. In the second case (b), the cell is disconnected before the plate separation is doubled. What is the ratio of the final energy stored in (a) to the final energy stored in situation (b)?



(a)



(b)

Fig. 2

(4 marks)

A2-2005 Q1

Figure 1.1 shows a network of resistors, each of resistance R.

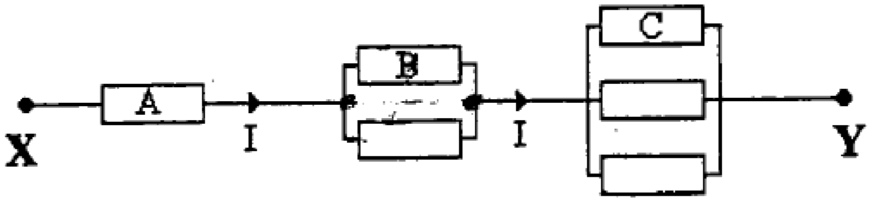


Figure 1.1

(a) The overall resistance, measured between X and Y, is 22 kΩ.
What is the value of R?

(b) The power developed in resistor A, due to the current I, is 1.8 mW.
Calculate the power developed in the resistor

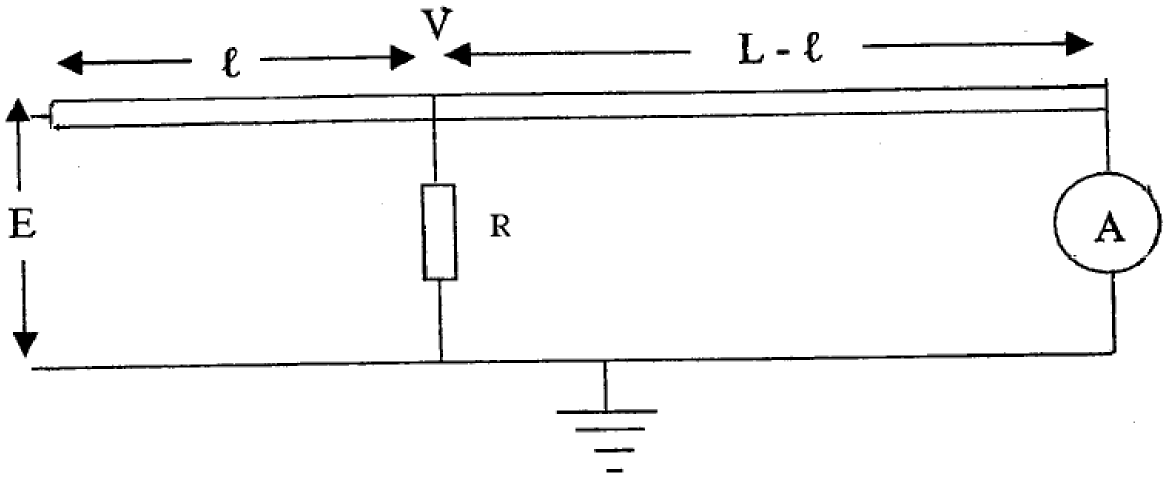
(i) B,

(ii) C.

(10 marks)

A2-2008 Q7

The arrangement of resistances shown in the diagram below, is attached to a constant source of emf E, The resistor at the top consists of a wire of length L and resistance per unit length ρ. The top end of the fixed resistor R can be slid along the wire L. The earthed horizontal wire at the bottom is of negligible resistance and the resistance of the ammeter can also be neglected. V is the potential at the point where resistor R is connected.



You are required to determine the length ℓ for which the current through the ammeter is a maximum.

(a) If the resistance of length ℓ is R_1 and that of L-ℓ is R_2, determine the ratio V/E in terms of R, R_1 and R_2.

(b) The current I through the ammeter is given by V/R_2. Since we want the minimum value of I, we can look for the maximum value of 1/I. Determine an expression for 1/I.

(c) Substitute for R_1 and R_2 in terms of the lengths of the wire and write down an expression for 1/I in terms of L, ℓ, ρ, R and E.

(d) What is the value of ℓ that maximises 1/I?

(10 marks)