5 A capacitor of capacitance 470 μF is connected to a battery of electromotive force (e.m.f.) 24 V in the circuit of Fig. 5.1.

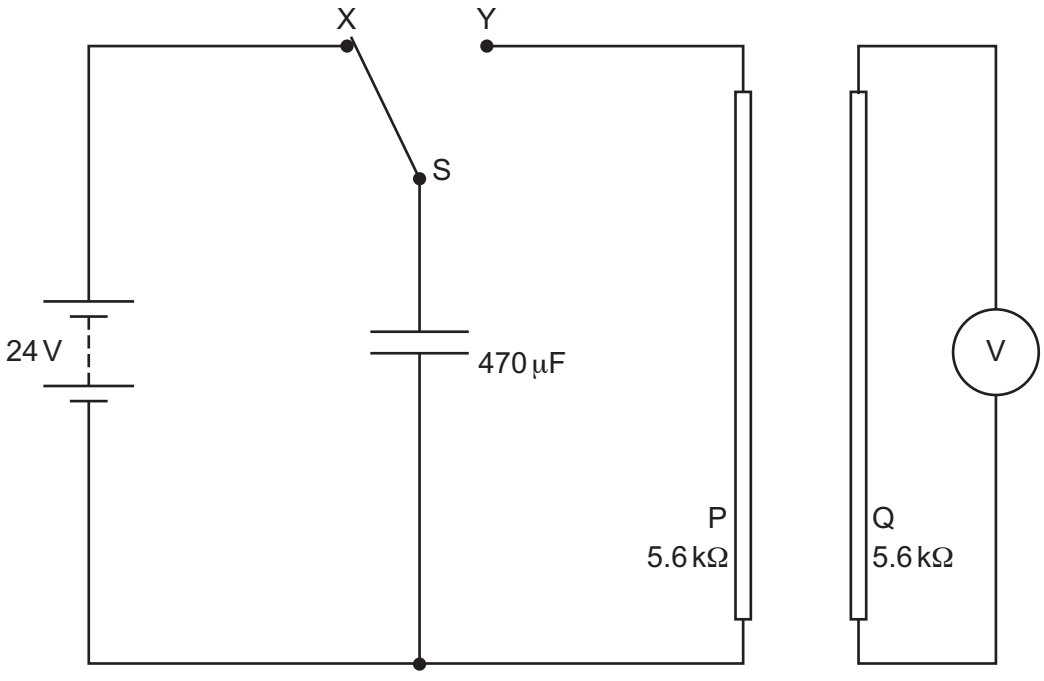

Fig. 5.1

The two-way switch S is initially at position X.

P and Q are identical long straight wires, each with a resistance of 5.6 kΩ. These wires are placed near to, and parallel to, each other. Wire Q is connected to a voltmeter.

At time t = 0, switch S is moved to position Y so that the capacitor discharges through wire P.

(a) (i) Calculate the charge Q_0 on the capacitor at time t = 0.

Q_0 = ... C [2]

(ii) Calculate the current I_0 in wire P at time t = 0.

I_0 = ... A [1]

(iii) Calculate the time constant τ of the discharge circuit.

τ = ... s [2]

(iv) On Fig. 5.2, sketch a line to show the variation with t of the current I in wire P as the capacitor discharges.

Fig. 5.2

[2]

(b) (i) Explain why there is an induced e.m.f. across wire Q during the discharge of the capacitor.

.....

.....

.....

..... [3]

(ii) On Fig. 5.3, sketch a line to suggest the variation with t of the voltmeter reading V.

Fig. 5.3

[1]

[Total: 11]