7 Fig. 7.1 shows a circuit containing a capacitor of capacitance *C* and a resistor of resistance *R*.

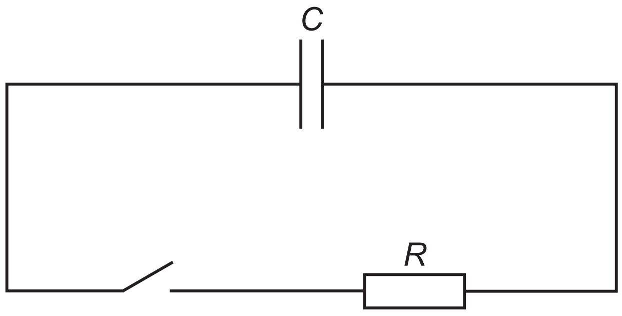

Fig. 7.1

Initially, the switch is open and the potential difference (p.d.) across the capacitor is 12 V.

The switch is closed at time $t = 0$ and the capacitor discharges through the resistor.

Fig. 7.2 shows the variation of the charge Q on the capacitor with the p.d. V_C across the capacitor as the capacitor discharges. Fig. 7.3 shows the variation of the current I in the resistor with the p.d. V_R across the resistor as the capacitor discharges.

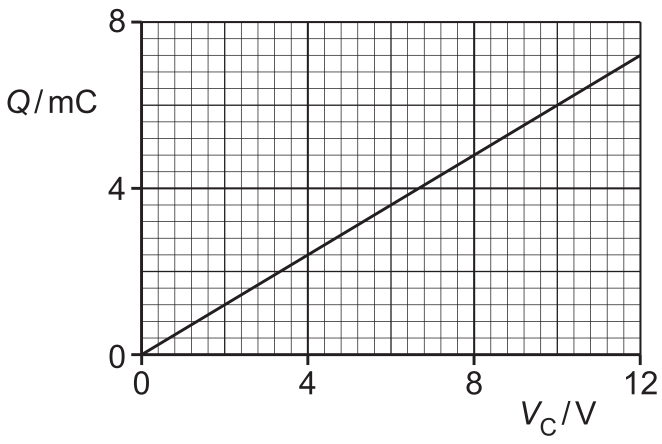

Fig. 7.2

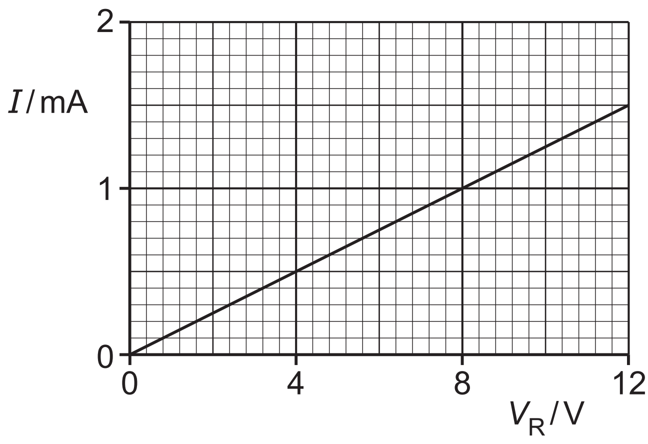

Fig. 7.3

(a) State the relationship between V_C and V_R.

.... [1]

(b) Determine:

(i) the capacitance C, in μF

C = ... μF [2]

(ii) the resistance R, in kΩ

R = ... kΩ [2]

(iii) the time constant τ of the circuit.

τ = ... s [2]

(c) Use Fig. 7.2, Fig. 7.3 and your answer in **(a)** to explain why the variation of Q with t is exponential in nature.

....

....

....

....

.... [3]

[Total: 10]