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

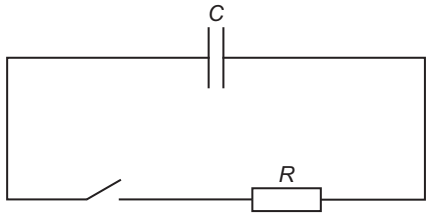

Fig. 7.1

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.

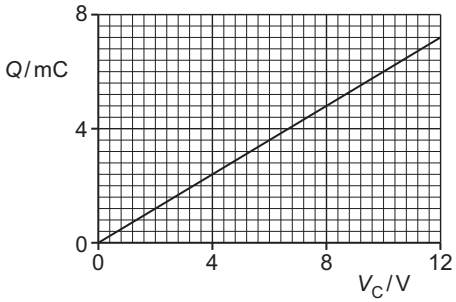

Fig. 7.2

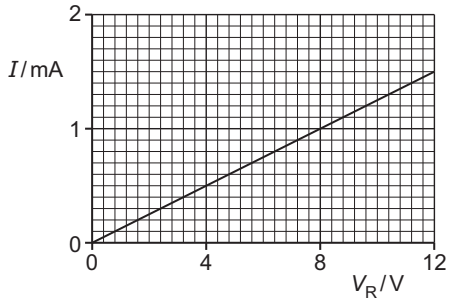

Fig. 7.3

(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]

6 **(a)** **(i)** State what is meant by rectification of an alternating voltage.

.....

..... [1]

(ii) State the difference between half-wave rectification and full-wave rectification.

.....

.....

..... [2]

(b) **(i)** Complete Fig. 6.1 to show a circuit that produces half-wave rectification of an alternating input voltage V_{IN} to produce output voltage V_{OUT} across the resistor R.

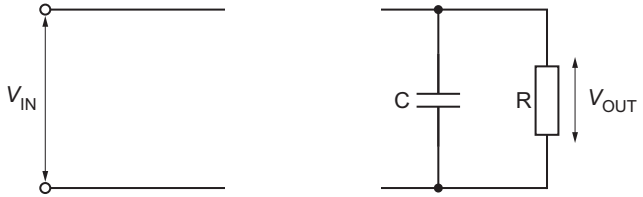

Fig. 6.1

[2]

(ii) State the purpose of the capacitor C in the circuit of Fig. 6.1.

.....

..... [1]

(c) The input voltage V_{IN} in Fig. 6.1 is a square wave. Fig. 6.2 shows the variation of V_{IN} with time t.

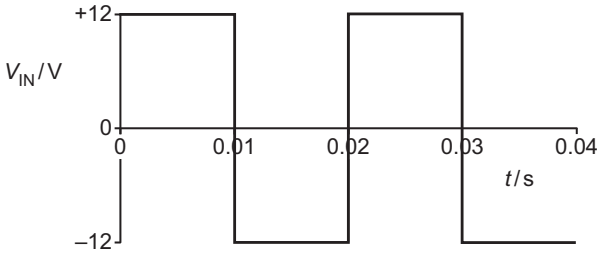

Fig. 6.2

Fig. 6.3 shows the variation of V_{OUT} with t.

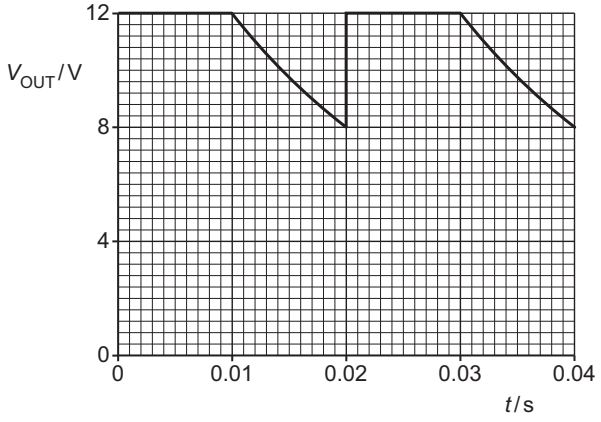

Fig. 6.3

The maximum energy stored in the capacitor is 0.041 J.

(i) Show that the capacitance of C is 570 μF.

[2]

(ii) Determine the resistance of R.

resistance = ... Ω [3]

[Total: 11]

6 Fig. 6.1 shows a capacitor of capacitance C connected in series with a resistor of resistance R.

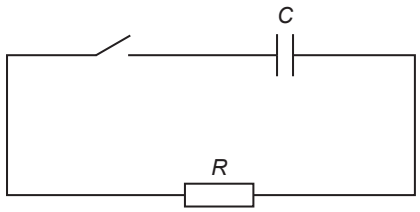

Fig. 6.1

Initially the switch is open and there is a p.d. of 12 V across the capacitor.

At time $t = 0$, the switch is closed so that there is a current I in the resistor.

Fig. 6.2 shows the variation of I with t.

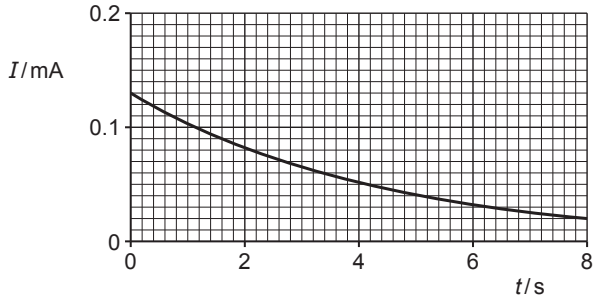

Fig. 6.2

(a) Explain the shape of the line in Fig. 6.2.

.....

.....

.....

.....

..... [3]

(b) Use Fig. 6.2 to determine:

(i) resistance R

R = ... Ω [2]

(ii) the time constant τ of the circuit in Fig. 6.1.

τ = ... s [3]

(c) Use your answers in **(b)** to determine capacitance C.

C = ... F [2]

[Total: 10]

5 Part of an electric circuit is shown in Fig. 5.1.

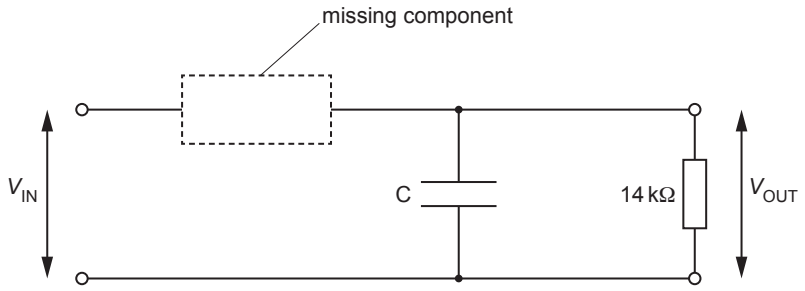

Fig. 5.1

The circuit is used to produce half-wave rectification of an alternating voltage of potential difference (p.d.) V_{IN}.

The output p.d. across the 14 kΩ resistor is V_{OUT}.

(a) (i) A component is missing from the circuit of Fig. 5.1.

Complete the circuit diagram in Fig. 5.1 by adding the circuit symbol for the missing component, correctly connected. [1]

(ii) A capacitor C is shown in the circuit of Fig. 5.1.

State the effect on V_{OUT} of including the capacitor in the circuit.

..... [1]

(b) Fig. 5.2 shows the variation with time t of V_{IN}.

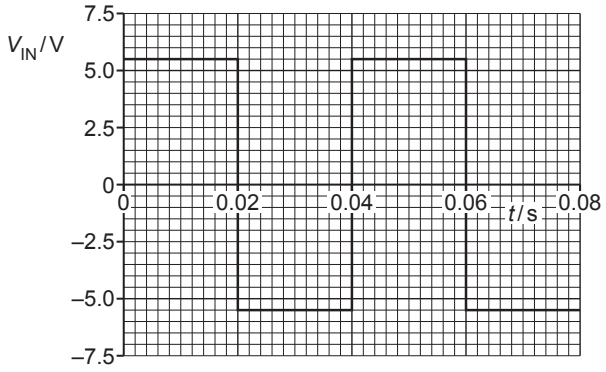

Fig. 5.2

Fig. 5.3 shows the variation with t of V_{OUT}.

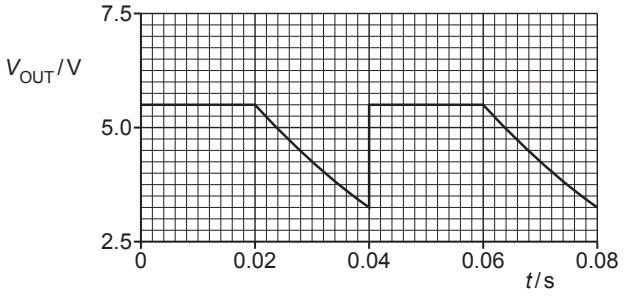

Fig. 5.3

(i) Determine the frequency of V_{IN}.

frequency = ... Hz [1]

(ii) Show that the time constant τ for the discharge of the capacitor through the resistor is 0.038 s.

[2]

(iii) Calculate the capacitance of C. Give a unit with your answer.

capacitance = ... unit ..... [2]

(c) The circuit of Fig. 5.1 is modified so that it produces full-wave rectification of an input voltage.

Suggest, with a reason, how V_{OUT} now varies with time when V_{IN} is as shown in Fig. 5.2.

.....

.....

..... [2]

[Total: 9]