21. Alternating Currents

21.2 Rectification and smoothing

Paper 4

Question Paper

1 A circuit contains a power supply that provides a sinusoidal alternating input voltage V_{IN}. There is an output voltage V_{OUT} across a load resistor R, as shown in Fig. 7.1.

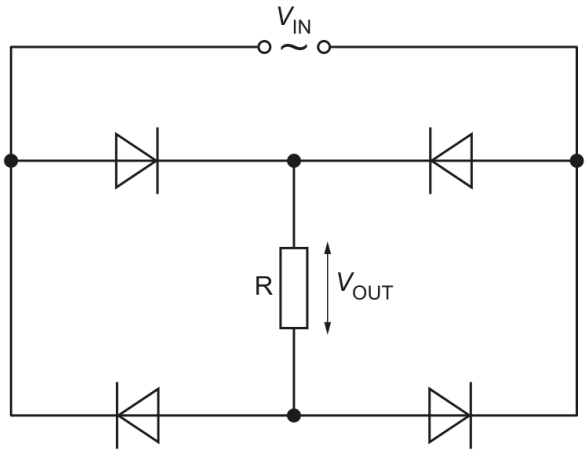


Fig. 7.1

(a) State the purpose of the circuit in Fig. 7.1.

.....

.....

..... [2]

(b) Fig. 7.2 shows the variation of V_{OUT} with time t.

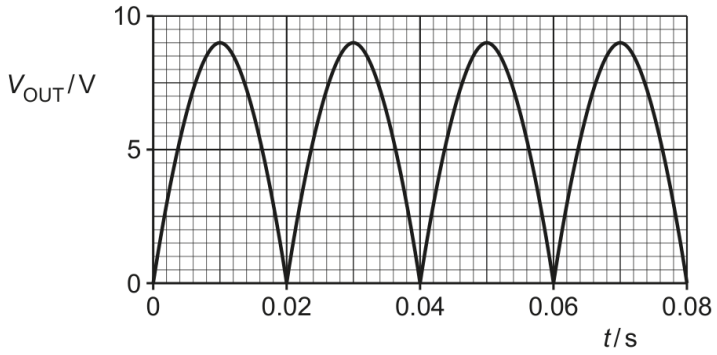


Fig. 7.2

(ii) On Fig. 7.3, sketch the variation with t of the power P dissipated in R.

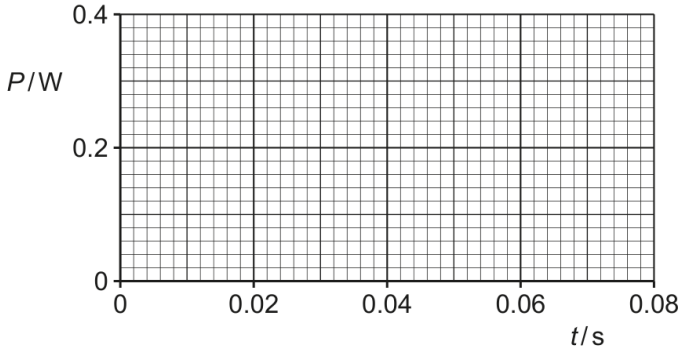


Fig. 7.3

[3]

2 **(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.

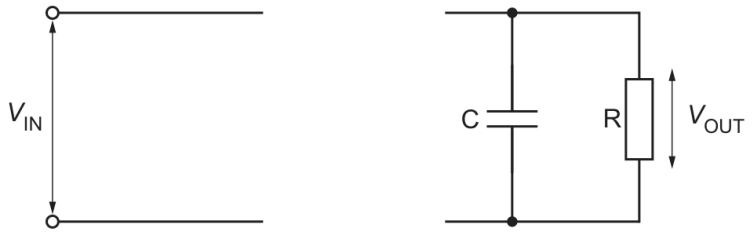


Fig. 6.1

[2]

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

.....

..... [1]

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

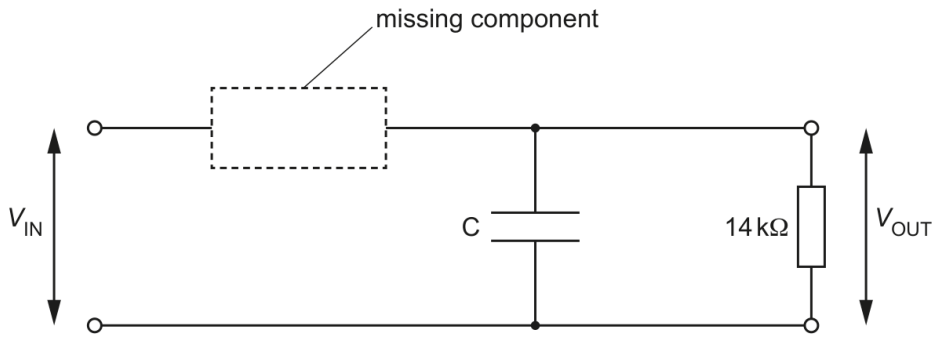


Fig. 5.1

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]

(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]

4 Four diodes are used in a bridge rectifier circuit to produce rectification of a sinusoidal a.c. input voltage V_{IN}.
Fig. 7.1 shows part of the circuit, but three of the diodes are missing.

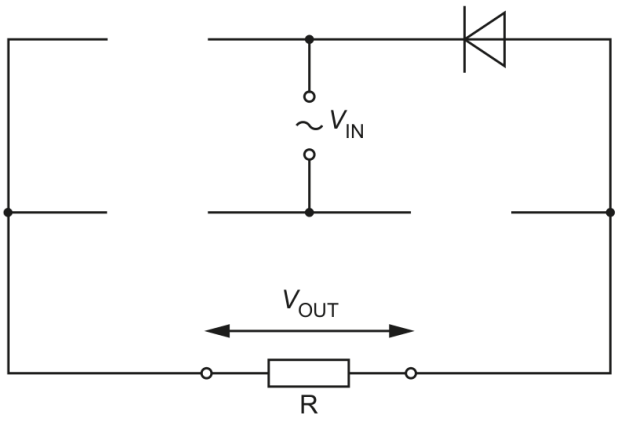


Fig. 7.1

The p.d. across the load resistor R is the output p.d. V_{OUT} of the bridge rectifier.

(a) (i) State the name of the type of rectification produced by a bridge rectifier.

..... [1]

(ii) Complete Fig. 7.1 by drawing the three missing diodes, correctly connected. [2]

(iii) On Fig. 7.1, draw an arrow to indicate the direction of the current in resistor R. [1]

(b) V_{IN} has amplitude V_0 and period T. Fig. 7.2 shows the variation with time t of V_{IN}.

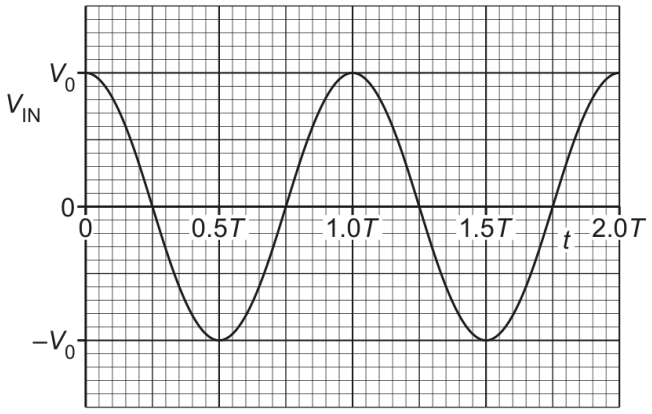


Fig. 7.2

(i) On Fig. 7.3, sketch the variation of V_{OUT} with t between $t = 0$ and $t = 2.0T$.

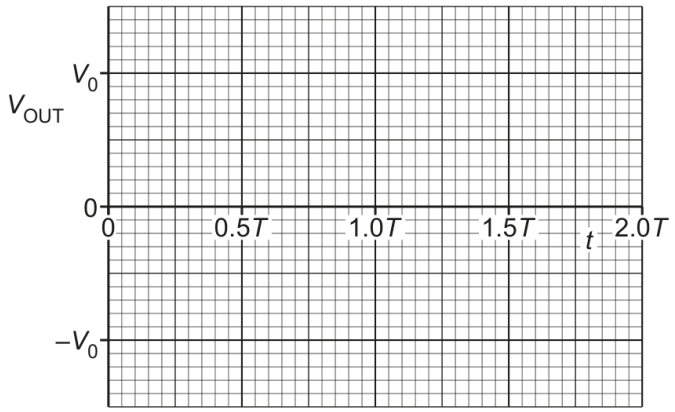


Fig. 7.3

[3]

5 Fig. 5.1 shows four diodes and a load resistor of resistance 1.2 kΩ, connected in a circuit that is used to produce rectification of an alternating voltage.

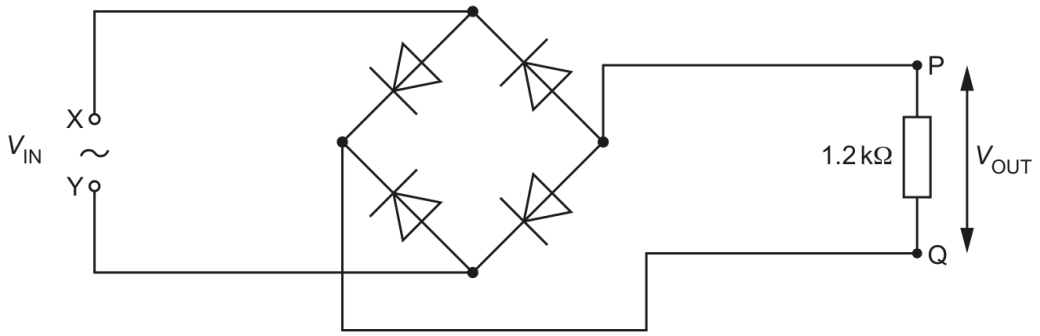


Fig. 5.1

(a) (i) State what is meant by rectification.

.....

..... [1]

(ii) State the type of rectification produced by the circuit in Fig. 5.1.

..... [1]

(b) A sinusoidal alternating voltage V_{IN} is applied across the input terminals X and Y. The variation with time t of V_{IN} is given by the equation

$$V_{IN} = 6.0 \sin 25\pi t$$

where V_{IN} is in volts and t is in seconds.

(i) On Fig. 5.1, label the output terminals P and Q with the appropriate symbols to indicate the polarity of the output voltage V_{OUT}. [1]

(ii) The magnitude of the output voltage V_{OUT} varies with t as shown in Fig. 5.2.

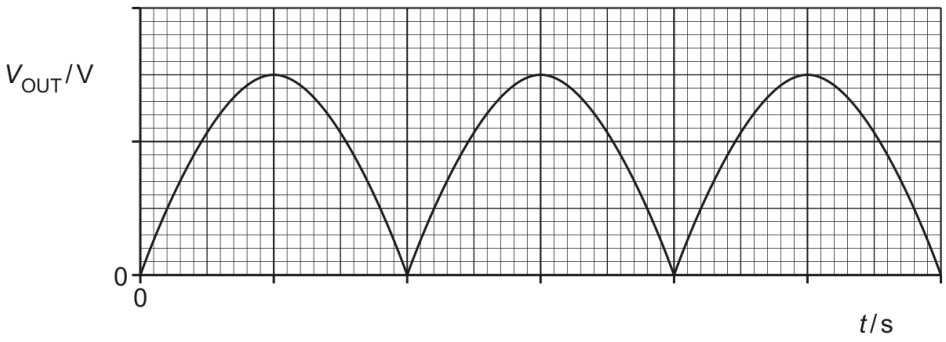


Fig. 5.2

(c) The output voltage in **(b)** is smoothed by adding a capacitor to the circuit in Fig. 5.1.
The difference between the maximum and minimum values of the smoothed output voltage is 10% of the peak voltage.

(i) On Fig. 5.1, draw the circuit symbol for a capacitor showing the capacitor correctly connected into the circuit. [1]

(ii) On Fig. 5.2, sketch the variation with *t* of the smoothed output voltage. [2]

6 A bridge rectifier using four ideal diodes is shown in Fig. 10.1.

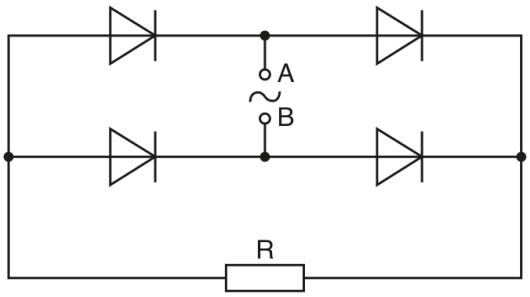


Fig. 10.1

The sinusoidal alternating electromotive force (e.m.f.) applied between points A and B has a root-mean-square (r.m.s.) value of 7.0 V.

(a) (i) On Fig. 10.1, circle the diodes that conduct when point B is positive with respect to point A. [1]

(b) A capacitor is connected into the circuit to produce smoothing of the potential difference across resistor R.

The variation with time *t* of the potential difference *V* across resistor R is shown in Fig. 10.2.

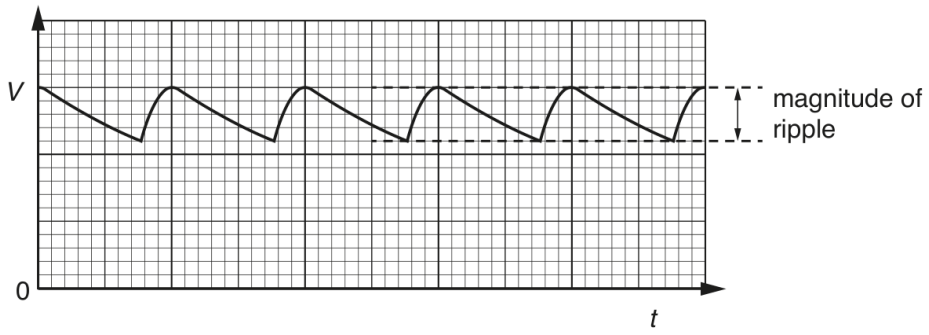


Fig. 10.2

(i) On Fig. 10.1, draw the symbol for a capacitor, connected so as to produce smoothing. [1]

(ii) State the effect, if any, on the magnitude of the ripple on V when, separately:

1. a capacitor of larger capacitance is used

.....

2. the resistor R has a smaller resistance.

.....

[2]