AC

(b) Fig. 6.4 is the circuit of a bridge rectifier.

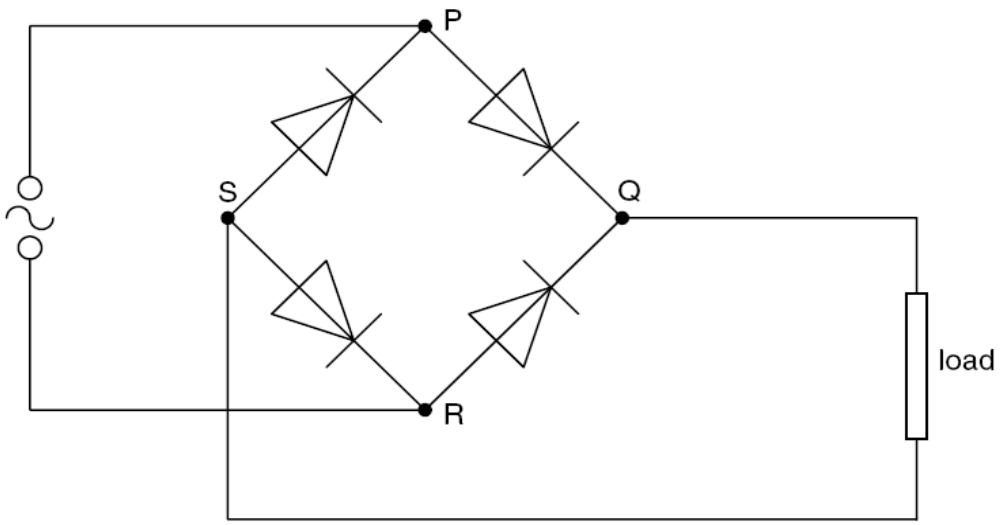

Fig. 6.4

An alternating supply connected across PR has an output of 6.0 V r.m.s.

(i) On Fig. 6.4, circle those diodes that are conducting when R is positive with respect to P. [1]

(ii) Calculate the maximum potential difference between points Q and S, assuming that the diodes are ideal.

potential difference = ... V [2]

(iii) State and explain how a capacitor may be used to smooth the output from the rectifier. You may draw on Fig. 6.4 if you wish.

.....

.....

.....[3]

4 The rectified output of a sinusoidal signal generator is connected across a resistor **R** of resistance 1.5 kΩ, as shown in Fig. 4.1.

Fig. 4.1

The variation with time *t* of the potential difference *V* across **R** is shown in Fig. 4.2.

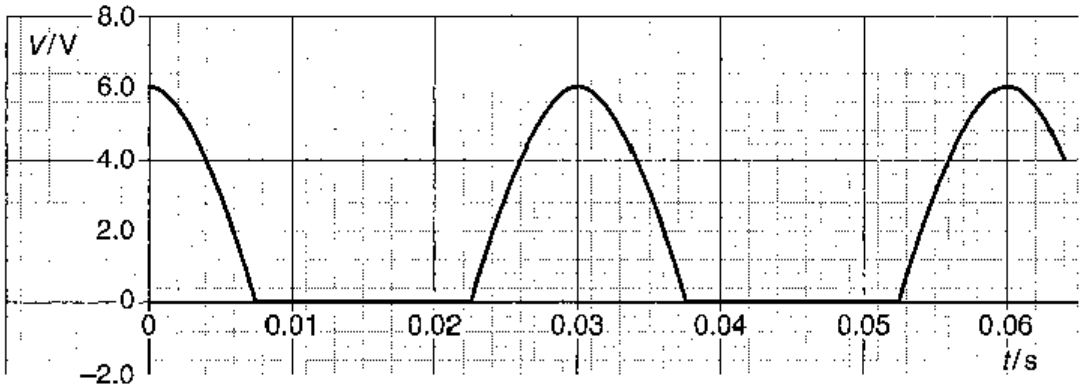

Fig. 4.2

(a) State how the rectification shown in Fig. 4.2 may be achieved.

.....

..... [2]

(b) A capacitor is now connected in parallel with the resistor **R**. The resulting variation with time t of the potential difference V across **R** is shown in Fig. 4.3.

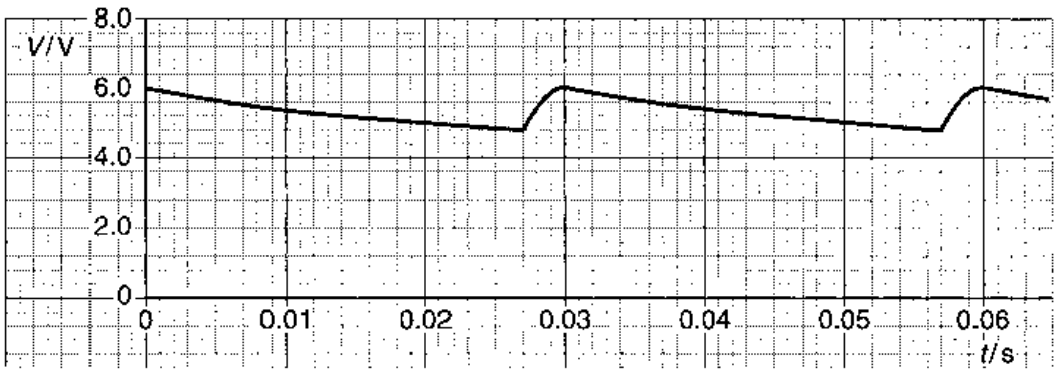

Fig. 4.3

(i) Using Fig. 4.3, determine

1. the mean potential difference across the resistor **R**,

potential difference = ... V

2. the mean current in the resistor,

mean current = ... A

3. the time in each cycle during which the capacitor discharges through the resistor.

time = ... s

[4]

(ii) Using your answers in **(i)**, calculate

1. the charge passing through the resistor during one discharge of the capacitor,

charge = ... C

2. the capacitance of the capacitor.

capacitance = ... F
[4]

(c) A second capacitor is now connected in parallel with the resistor **R** and the first capacitor. On Fig. 4.3, draw a line to show the variation with time t of the potential difference V across the resistor. [1]

5 **(a)** Explain, in terms of heating effect, what is meant by the *root-mean-square (r.m.s.) value* of an alternating current.

.....

.....

..... [2]

(b) State the relation between the peak current I_0 and the r.m.s. current I_{rms} of a sinusoidally-varying current.

..... [1]

(c) The value of a direct current and the peak value of a sinusoidal alternating current are equal.

(i) Determine the ratio

$$\frac{\text{power dissipation in a resistor of resistance } R \text{ by the direct current}}{\text{power dissipation in the resistor of resistance } R \text{ by the alternating current}}.$$

ratio = ... [2]

(ii) State one advantage and one disadvantage of the use of alternating rather than direct current in the home.

advantage .....

.....

disadvantage .....

..... [2]

(d) A current I varies with time t as shown in Fig. 5.1.

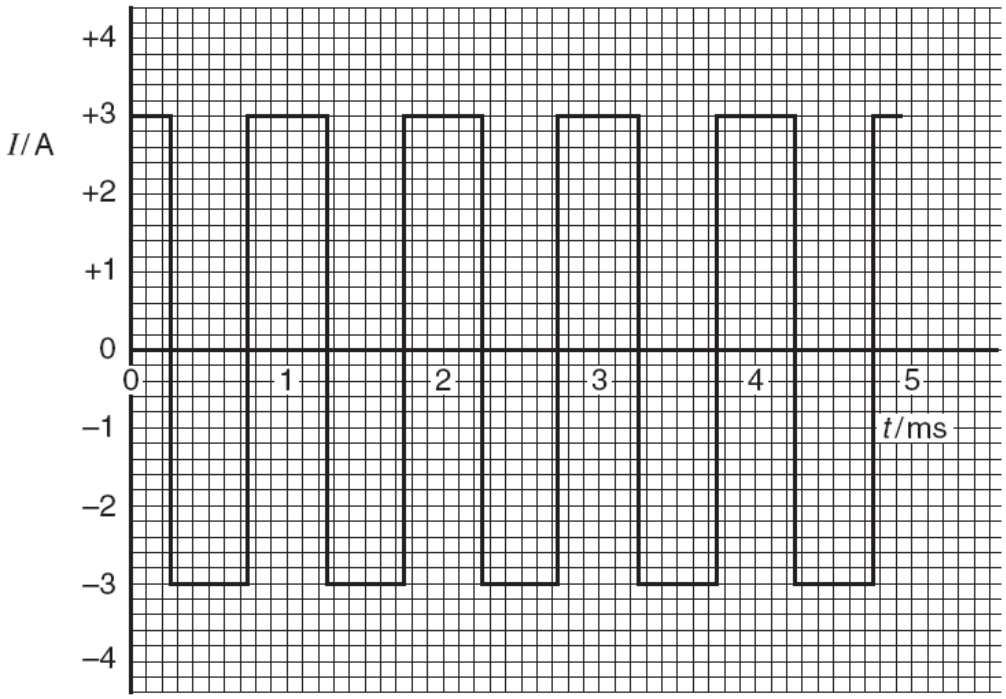

Fig. 5.1

For this varying current, state

(i) the peak value,

peak value = ... A [1]

(ii) the r.m.s. value.

r.m.s. value = ... A [1]

6 An alternating supply of frequency 50 Hz and having an output of 6.0 V r.m.s. is to be rectified so as to provide direct current for a resistor R. The circuit of Fig. 6.1 is used.

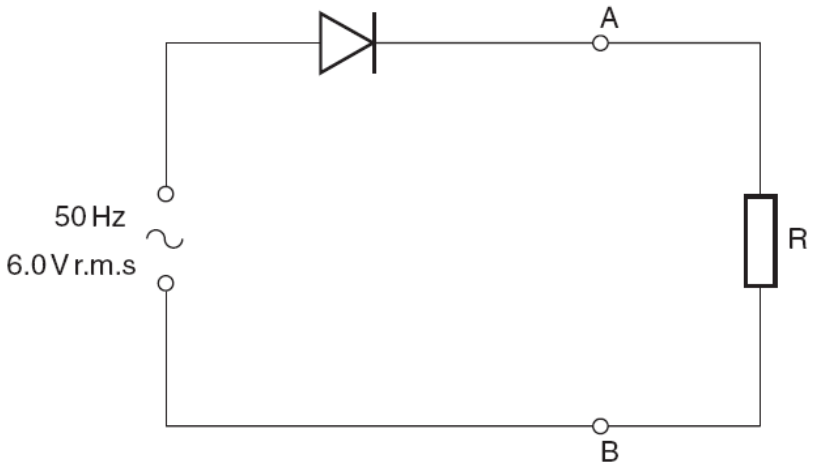

Fig. 6.1

The diode is ideal. The Y-plates of a cathode-ray oscilloscope (c.r.o.) are connected between points A and B.

(a) (i) Calculate the maximum potential difference across the diode during one cycle.

potential difference = ... V [2]

(ii) State the potential difference across R when the diode has maximum potential difference across it. Give a reason for your answer.

.....

..... [1]

(b) The Y-plate sensitivity of the c.r.o. is set at 2.0 V cm^{-1} and the time-base at 5.0 ms cm^{-1}.

On Fig. 6.2, draw the waveform that is seen on the screen of the c.r.o. [3]

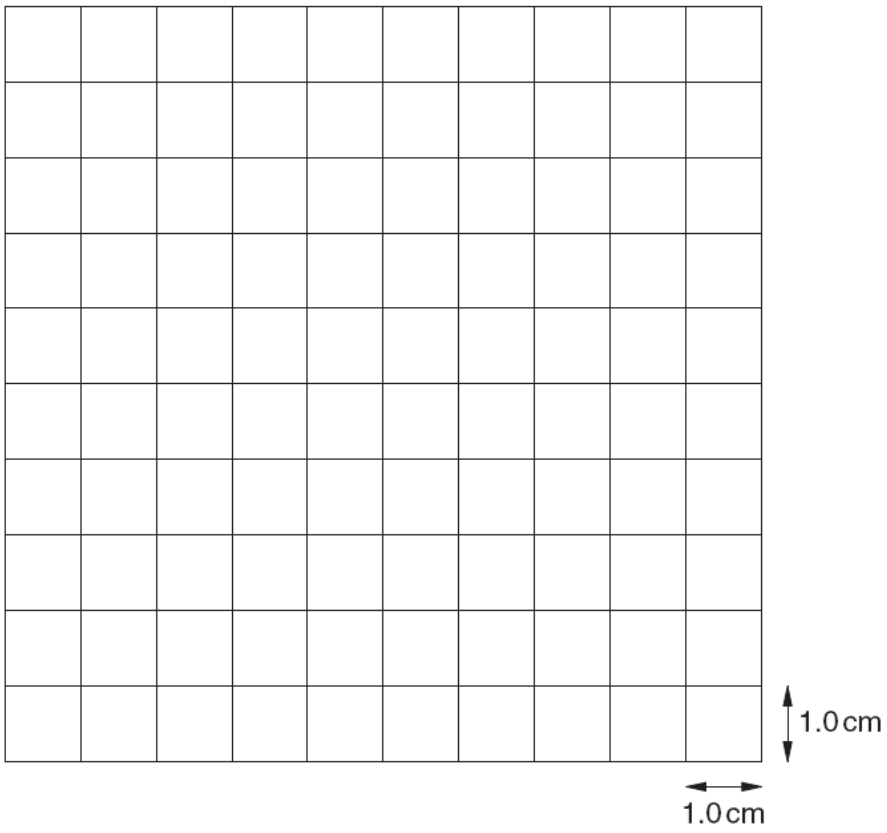

Fig. 6.2

(c) A capacitor of capacitance 180 μF is connected into the circuit to provide smoothing of the potential difference across the resistor R.

(i) On Fig. 6.1, show the position of the capacitor in the circuit. [1]

(ii) Calculate the energy stored in the fully-charged capacitor.

energy = ... J [3]

(iii) During discharge, the potential difference across the capacitor falls to $0.43\,V_0$, where V_0 is the maximum potential difference across the capacitor.

Calculate the fraction of the total energy that remains in the capacitor after the discharge.

fraction = ... [2]

4 An ideal transformer has 5000 turns on its primary coil. It is to be used to convert a mains supply of 230V r.m.s. to an alternating voltage having a peak value of 9.0V.

(a) Calculate the number of turns on the secondary coil.

number = ... [3]

(b) The output from the transformer is to be full-wave rectified. Fig. 4.1 shows part of the rectifier circuit.

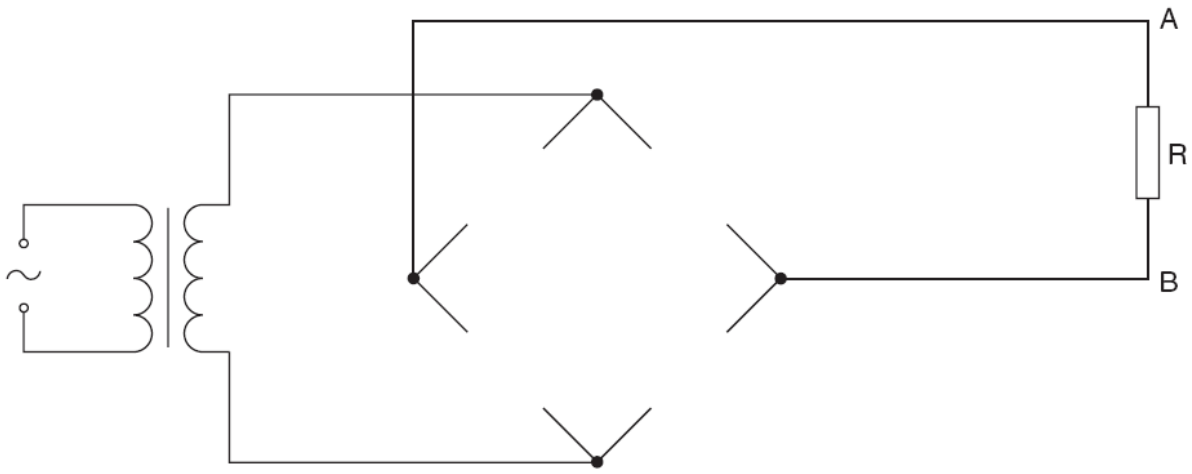

Fig. 4.1

On Fig. 4.1, draw

(i) diode symbols to complete the diagram of the rectifier such that terminal A of the resistor R is positive with respect to terminal B, [2]

(ii) the symbol for a capacitor connected to provide smoothing of the potential difference across the resistor R. [1]

(c) Fig. 4.2 shows the variation with time t of the smoothed potential difference V across the resistor R.

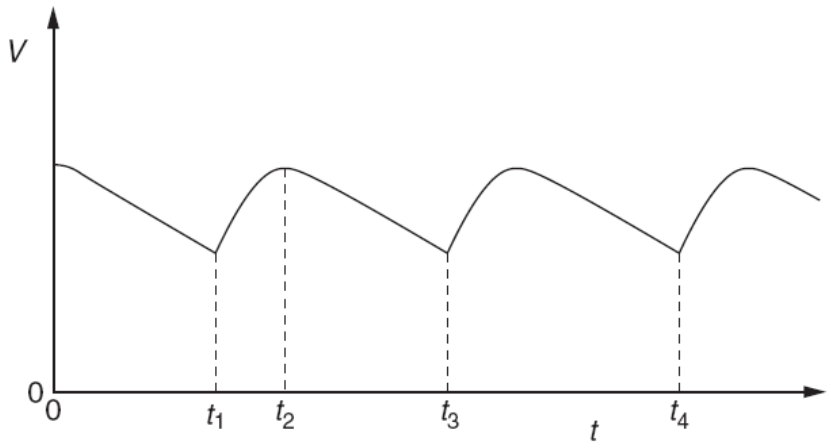

Fig. 4.2

(i) State the interval of time during which the capacitor is being charged from the transformer.

from time ..... to time ..... [1]

(ii) The resistance of the resistor R is doubled. On Fig. 4.2, sketch the variation with time t of the potential difference V across the resistor. [2]