

Easy Questions

1 (a) State the meaning of rectification.

(1 mark)

(b) The graph in Fig. 1.1 shows the voltage output from an alternating current supply.

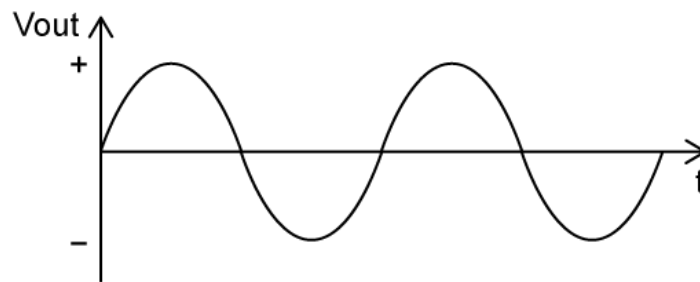


Fig. 1.1

Sketch the variation with time t of the output voltage when the following are applied:

(i) Half-wave rectification



[2]

(ii) Full-wave rectification



[2]

(4 marks)

- (c) In rectification, a smoothing capacitor is often necessary. The resulting graph of the output current against time gives a 'ripple' shape, as shown in Fig. 1.2.



Fig. 1.2

State how the 'ripples' in the graph can be reduced.

(2 marks)

- (d) The circuit in Fig. 1.3 shows a diode bridge rectifier connected to an alternating power supply.

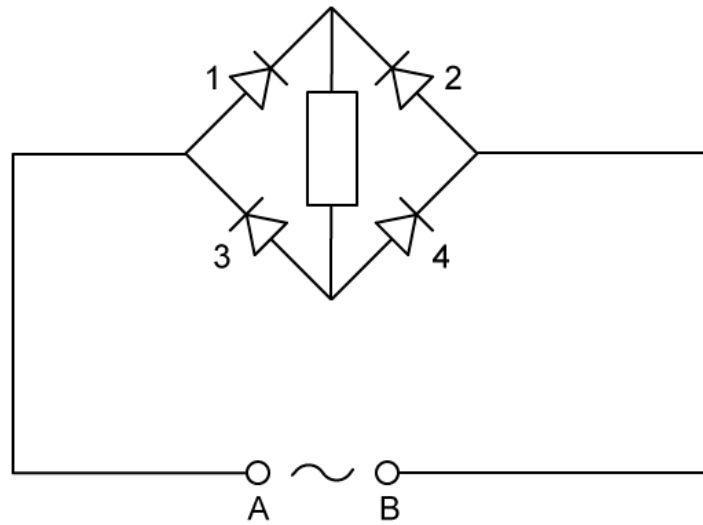


Fig. 1.3

State the diodes that will conduct when

(i) A is positive

[1]

(ii) B is positive.

[1]

(2 marks)

- 2 (a)** Alternating current (a.c.) is converted into direct current (d.c.) using a full-wave rectification circuit. Fig. 1.1. shows part of this circuit.

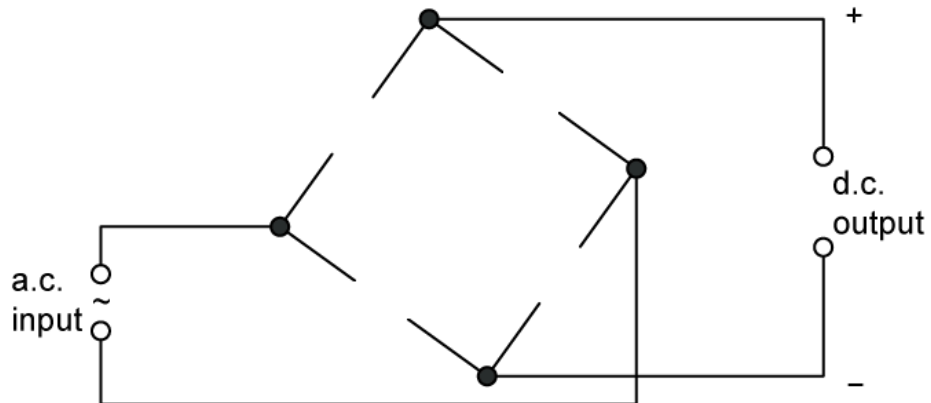


Fig. 1.1

On Fig. 1.1, draw the missing diode symbols that would produce the polarity across the d.c. output as shown on the diagram.

(2 marks)

- (b)** The polarity of the d.c. output is reversed, as shown in Fig. 1.2.

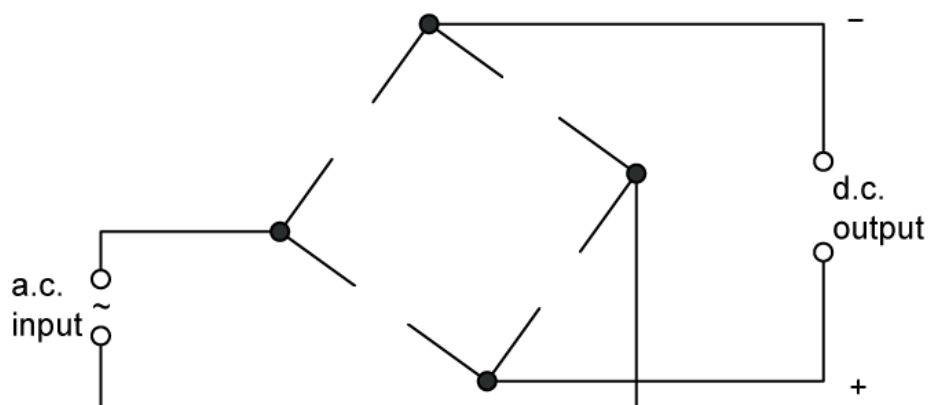


Fig. 1.2

On Fig. 1.2, draw the missing diode symbols that would produce the polarity across the d.c. output as shown on the diagram.

(2 marks)

(c) (i) State what is meant by smoothing.

[1]

(ii) On Fig. 1.2, draw the symbol for a capacitor connected to provide smoothing of the potential difference across the d.c. output.

[1]

(2 marks)

(d) Fig. 1.3 shows the variation with time t of the smoothed potential difference V across the d.c. output.

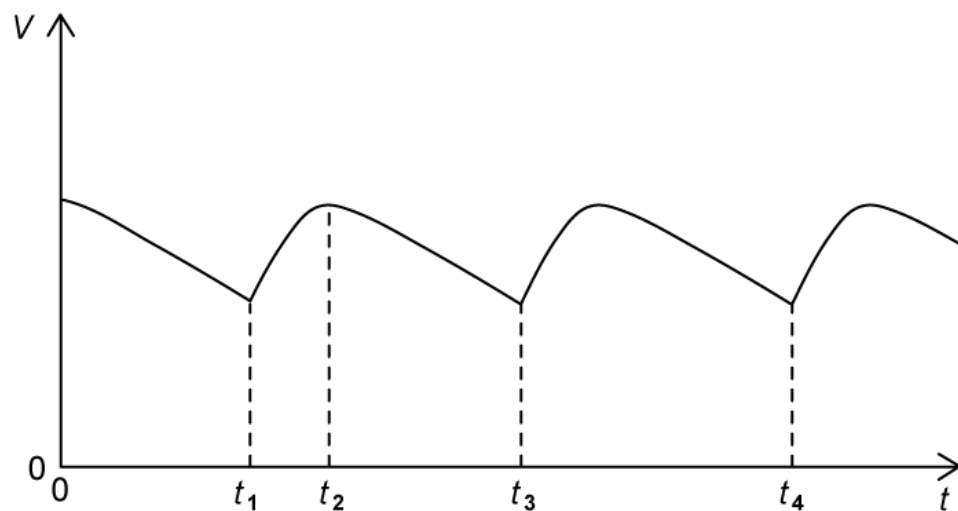


Fig. 1.3

Using Fig. 1.3, state the interval of time during which the capacitor is being charged.

(1 mark)

Medium Questions

- 1 (a)** Fig. 1.1 shows four diodes and a load resistor of resistance, $2.4\text{ k}\Omega$, connected in a circuit that is used to produce rectification of an alternating voltage.

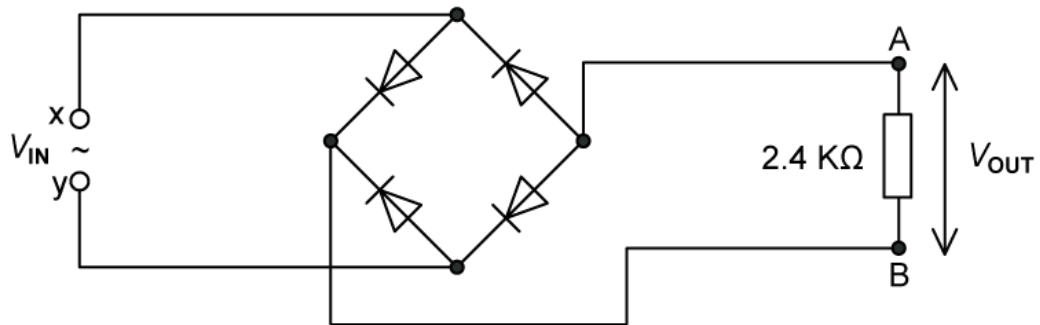


Fig. 1.1

- (i) State what is meant by rectification.

[1]

- (ii) State the type of rectification produced by the circuit in Fig. 1.1

[1]

(2 marks)

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

$$V_{IN} = 3.0 \sin(20\pi t)$$

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

- (i) Label the output terminals A and B, on Fig. 1.1, 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. 1.2

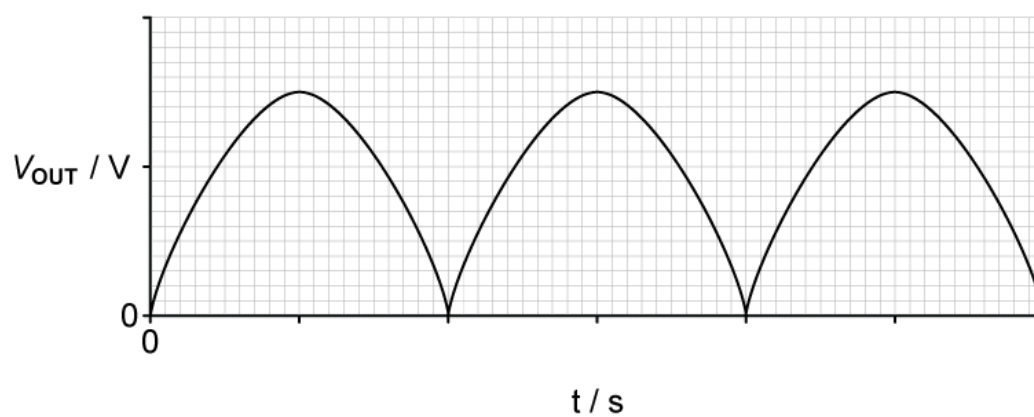


Fig. 1.2

Label both the axis with the correct scales on Fig. 1.2. Use the space below for any working that you need.

[3]

(4 marks)

(c) The output voltage in **(b)** is smoothed by adding a capacitor to the circuit in Fig. 1.1.

The difference between the maximum and minimum values of the smoothed output voltage is 15% of the peak voltage.

(i) On Fig. 1.1, draw the circuit symbol for a capacitor showing the capacitor correctly connected into the circuit.

[1]

(ii) On Fig. 1.2, sketch the variation with t of the smoothed output voltage.

[2]

(3 marks)

- 2 (a)** A sinusoidal alternating potential difference (p.d.) from a supply is rectified using a single diode. The variation with time t of the rectified potential difference V is shown in Fig. 5.1.

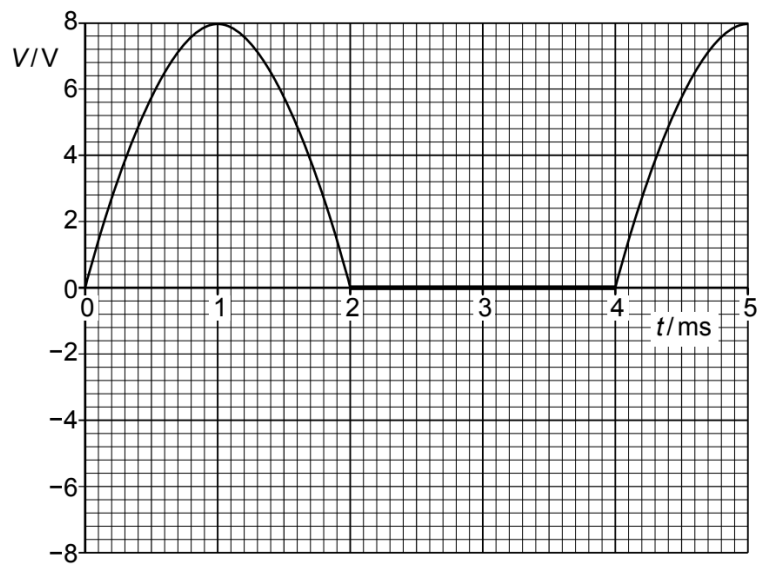


Fig. 5.1

- (i) Determine the root-mean-square (r.m.s.) value of the supply potential difference before rectification.

r.m.s. potential difference = V [2]

- (ii) State the type of rectification shown in Fig. 5.1.

[1]

(3 marks)

(b) The alternating potential difference is rectified and smoothed using the circuit in Fig. 5.2.

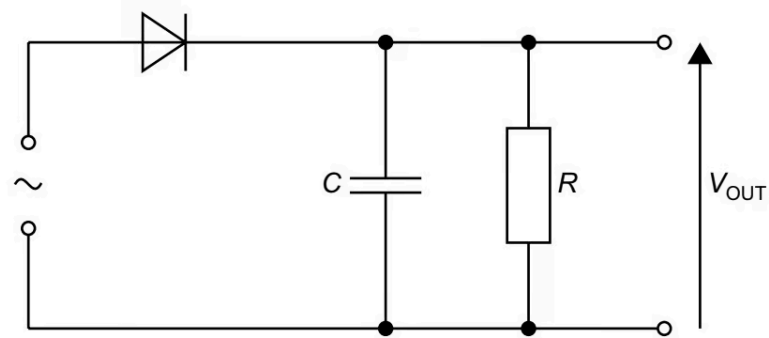


Fig. 5.2

The capacitor has capacitance C of $85\ \mu\text{F}$ and the resistor has resistance R .

The effect of the capacitor and the resistor is to produce a smoothed output potential difference V_{OUT} . The difference between maximum and minimum values of V_{OUT} is $2.0\ \text{V}$.

(i) On Fig. 5.1, draw a line to show V_{OUT} between times $t = 1.0\ \text{ms}$ and $t = 5.0\ \text{ms}$.

[3]

(ii) Determine the time, in s , for which the capacitor is discharging between times $t = 1.0\ \text{ms}$ and $t = 5.0\ \text{ms}$.

time = s [1]

(iii) Use your answers in (b)(i) and (b)(ii) to calculate the resistance R .

$R = \dots\dots\dots\ \Omega$ [2]

(6 marks)

3 (a) An investigation into rectification used the circuit shown in Fig. 1.1.

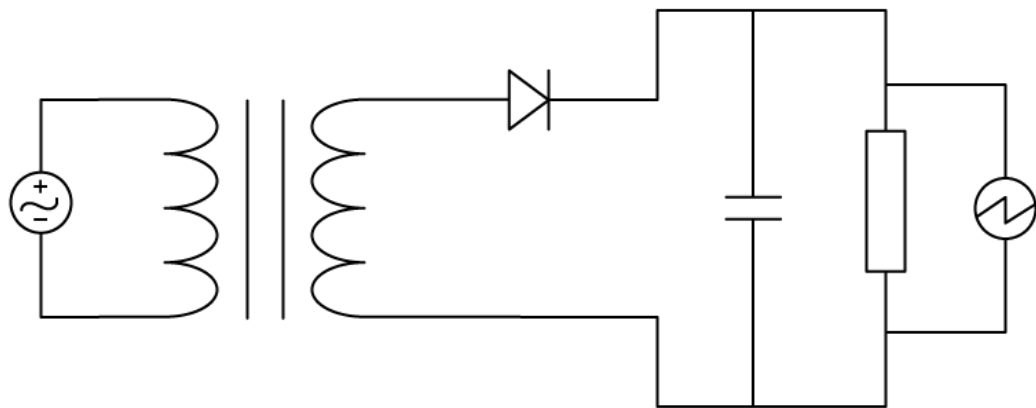


Fig. 1.1

Sketch the expected variation of the output voltage with time for the circuit in Fig. 1.1.

(2 marks)

(b) A modification is made to the circuit to include a bridge rectifier, as shown in Fig. 1.2.

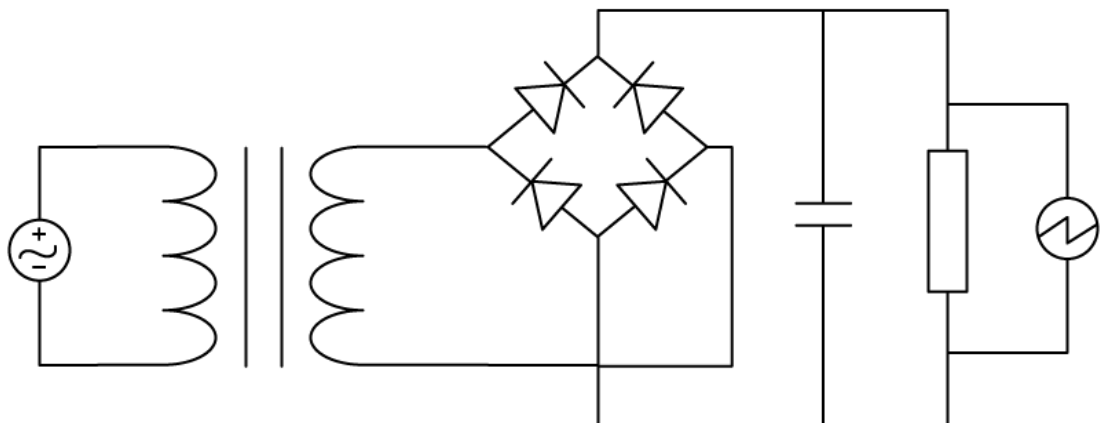


Fig. 1.2

Sketch the expected variation of the output voltage with time for the circuit in Fig. 1.2.

(3 marks)

- (c) A bridge rectifier consists of four ideal diodes, A, B, C and D, connected to an ac generator between the terminals X and Y, as shown in Fig. 1.3.

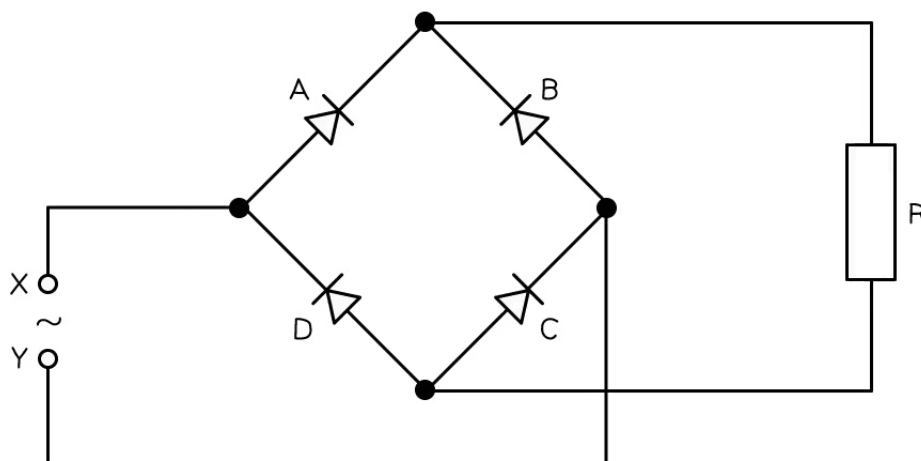


Fig. 1.3

On Fig. 1.3

- (i) label the positive (+) and negative (–) connections to the load resistor R

[1]

- (ii) circle the diodes which are conducting when the polarity of terminal X is negative.

[1]

(2 marks)

- (d) The graph in Fig. 1.4 shows the output of an ac generator after undergoing half-wave

rectification.

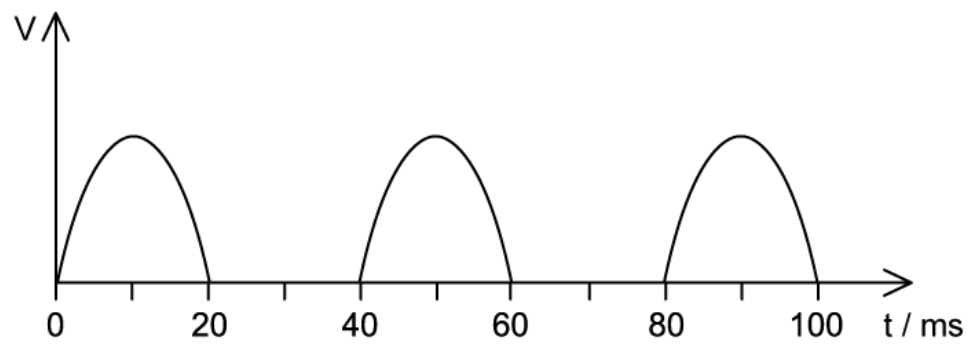


Fig. 1.4.

The load resistor has a resistance of $3.6 \text{ k}\Omega$. Capacitors of capacitance 360 nF and $60 \text{ }\mu\text{F}$ are available.

Determine which of the capacitors would be the most appropriate to smooth the output in Fig. 1.4.

(3 marks)

Hard Questions

- 1 (a)** Complete the circuit diagram in Fig. 1.1 such that it shows a full-wave rectifier where the bottom of the load resistor is positive and the top is negative.

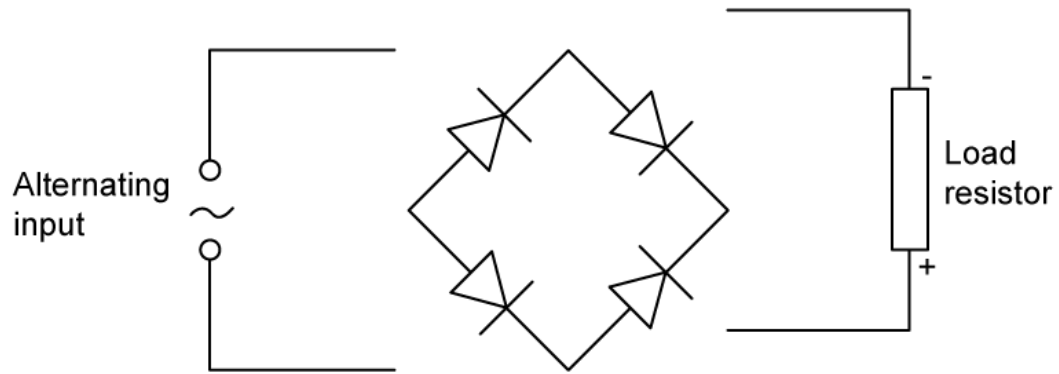


Fig. 1.1

(2 marks)

- (b)** The root-mean-square input potential difference to the full-wave rectifier is 14.1 V.

The frequency of the input potential difference is 40 Hz.

On Fig. 1.2, draw a graph of the potential difference across the load resistor for 2.5 periods, choosing a sensible scale for the y axis.

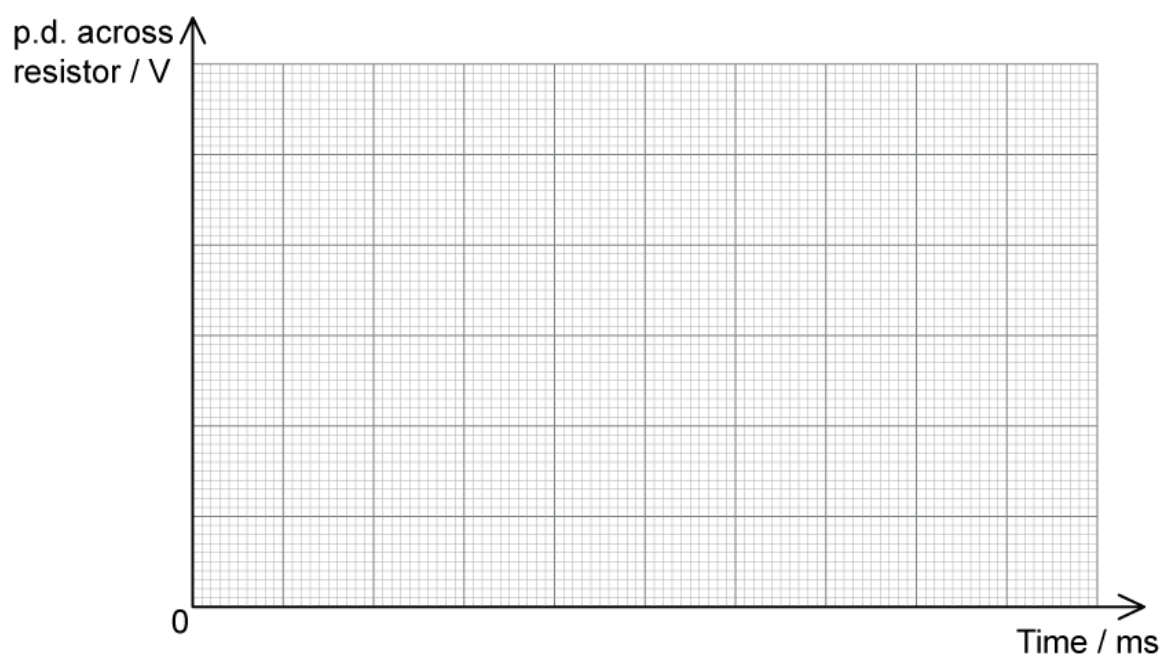


Fig. 1.2

(3 marks)

- (c) The circuit in Fig. 1.1 is then modified by two students. One student adds a single capacitor, as shown in Fig. 1.3. The other adds two capacitors in series, as shown in Fig.

1.4.

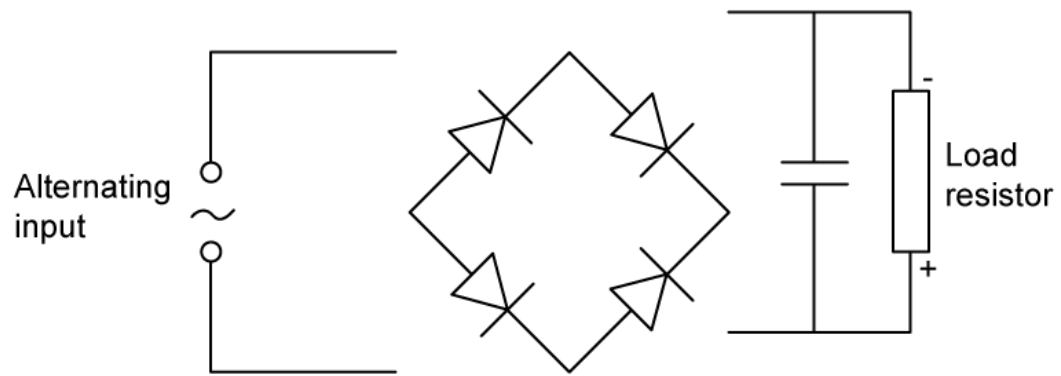


Fig. 1.3

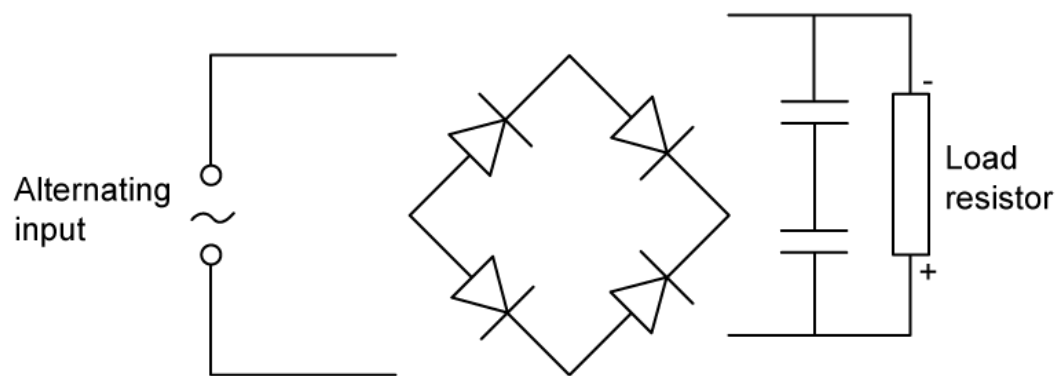


Fig. 1.4

Compare the effects of each modification on the graph you drew on Fig. 1.2, when both circuits are completed to form full-wave rectifiers. Explain any differences.

(5 marks)

2 (a) A technician is testing different bulbs using the half-wave rectifier in Fig. 1.1.

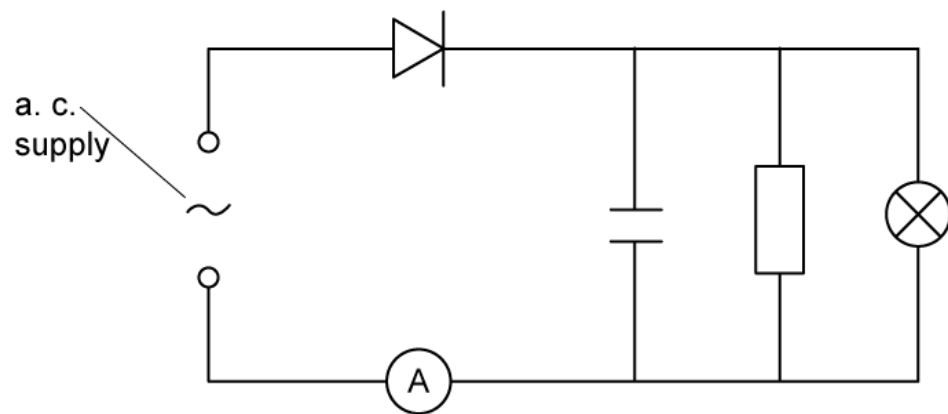


Fig. 1.1

The current I passing through the ammeter in Fig. 1.1 varies with time t according to the following equation:

$$I = 6.0\sin(6250\pi t)$$

The technician has the choice of three combinations (A, B, or C) of capacitors and resistors, as shown in Table 1.1:

Table 1.1

Combination	A	B	C
Resistance / Ω	120	20	10
Capacitance / μF	1.2	8.0	4.0

After using one particular combination, she notices the bulb being used is flickering. She recognises that this is a result of a highly fluctuating input current.

State which combination she used and explain your answer.

.....

(5 marks)

- (b)** The technician attaches an older lightbulb to the same combination as she used in part (a).

This older lightbulb operates by heating a tungsten filament, which then emits light as a result of its high temperature.

She notices this lightbulb flickers less than the previous, more modern lightbulb.

Suggest why the old lightbulb flickers less.

(2 marks)

- (c)** The mean power supplied by the source of a.c. is 36 W.

Calculate the peak voltage across the bulb.

(1 mark)

- (d)** The next day, the technician sets up the equipment in Fig. 1.1 using resistor and capacitor combination B.

Calculate the potential difference across the plates of the capacitor, 0.20 ms after the potential difference across the bulb reaches its maximum value.

(2 marks)