7 An alternating voltage V varies with time t according to

$$V = 18\cos 40\pi t$$

where V is in V and t is in s.

(a) For the alternating voltage:

(i) show that the period is 0.050 s

[1]

(ii) determine the root-mean-square (r.m.s.) voltage.

r.m.s. voltage = ... V [1]

(b) On Fig. 7.1, sketch the variation of V with t for values of t from $t = 0$ to $t = 100$ ms.

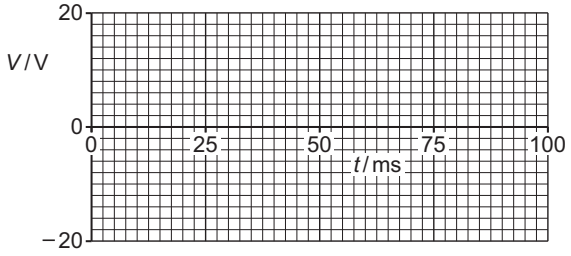

Fig. 7.1

[3]

(c) The alternating voltage is rectified to produce an output voltage across a load resistor R, as shown in Fig. 7.2.

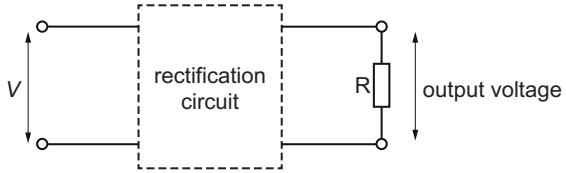

Fig. 7.2

Fig. 7.3 shows the variation with t of the power P in the load resistor.

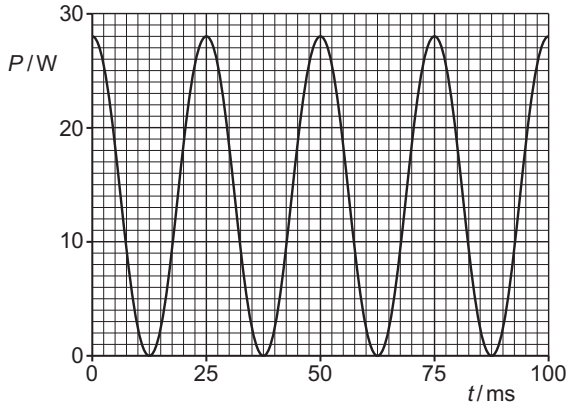

Fig. 7.3

State **three** conclusions that can be drawn from Fig. 7.3. The conclusions may be qualitative or quantitative. Use the space for any working.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

[Total: 8]

6 Fig. 6.1 shows part of a bridge rectifier circuit that can be used for rectification of an alternating input voltage V_{IN}.

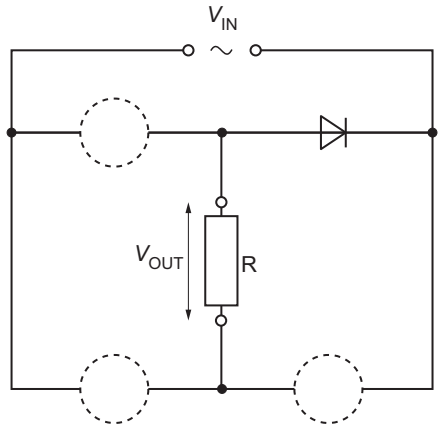

Fig. 6.1

The circuit contains four diodes, one of which is shown.
The rectified output voltage V_{OUT} is applied across load resistor R.

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

.....

..... [1]

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

..... [1]

(iii) Complete the circuit in Fig. 6.1 by drawing the three missing diodes inside the dashed circles. [2]

(b) The input voltage varies with time t according to the equation

$$V_{IN} = 34 \sin 18t$$

where V_{IN} is in V and t is in s.

(i) Show that the period of the input voltage is 0.35 s.

[2]

(ii) Calculate the root-mean-square (r.m.s.) input voltage.

r.m.s. voltage = ... V [1]

(iii) On Fig. 6.2, sketch the variation of V_{OUT} with t from $t = 0$ to $t = 0.35$ s.

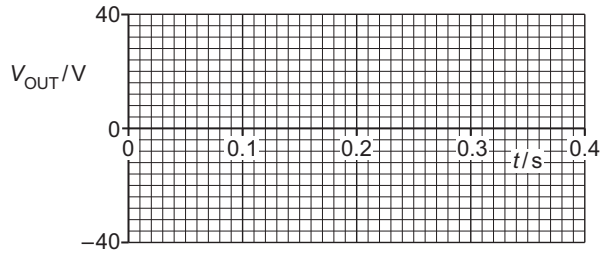

Fig. 6.2

[3]

(c) Resistor R has a resistance of 56 kΩ. A capacitor of capacitance 12 μF is connected into the circuit of Fig. 6.1 in order to smooth the output voltage.

(i) On Fig. 6.1, draw the capacitor correctly connected into the circuit. [1]

(ii) Calculate the time constant of the smoothing circuit.

time constant = ... s [2]

(iii) During each discharge cycle, the time for which the capacitor is discharging is 0.14 s.

Determine the minimum value of the smoothed output voltage.

minimum voltage = ... V [2]

[Total: 15]

8 An incomplete circuit diagram of a bridge rectifier is shown in Fig. 8.1.

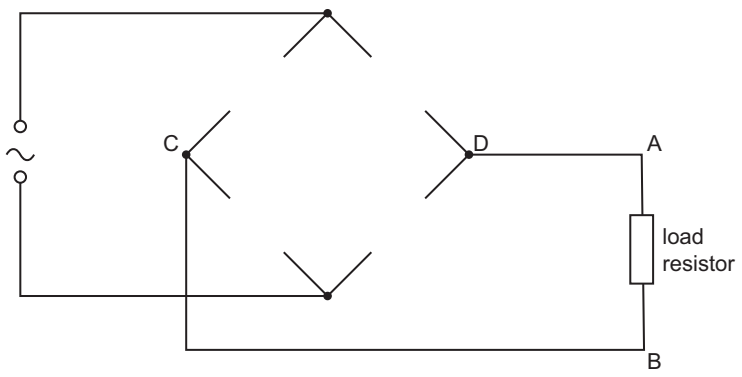

Fig. 8.1

(a) Complete Fig. 8.1 for the bridge rectifier such that the point A is at a positive potential with respect to point B. [2]

(b) The variation with time t of the potential difference (p.d.) V across the load resistor is shown in Fig. 8.2.

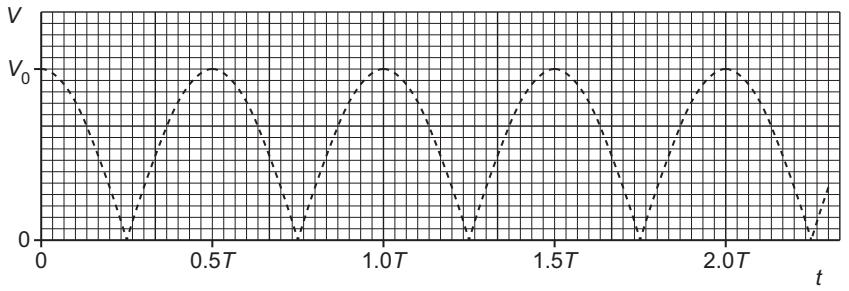

Fig. 8.2

A capacitor is now connected between points C and D of the bridge rectifier. This results in smoothing of the p.d. across the load resistor. The difference between the maximum and minimum values of the smoothed p.d. is 33% of the peak p.d. V_0.

(i) On Fig. 8.2, draw a line to show the variation of the potential difference V across the load resistor with time t. Your line should extend from $t = 0.5T$ to $t = 2.0T$. [3]

(ii) Use your line in **(b)(i)** to determine, in terms of T, the time constant of the smoothing circuit.

time constant = ... T [3]

(iii) The resistance of the load resistor is now increased. The capacitance of the capacitor is unchanged.

State and explain the effect of this change on the smoothed output p.d.

.....

.....

..... [2]

[Total: 10]

1 Fig. 1.1 shows a thin coil of cross-sectional area A and length l connected to a resistor of resistance S and two terminals.

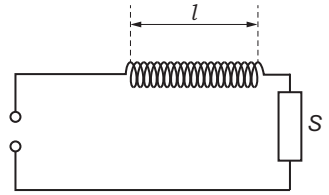

Fig. 1.1

An alternating voltage is applied to the terminals. The peak value of the alternating voltage is E and the frequency is f. The peak value of the potential difference V across the resistor is determined using an oscilloscope.

It is suggested that V is related to f by the relationship

$$\frac{ES}{V} = \frac{KAN^2f}{l}$$

where N is the number of turns on the coil and K is a constant.

Plan a laboratory experiment to test the relationship between V and f.

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine a value for K.

In your plan you should include:

- the procedure to be followed
- the measurements to be taken
- the control of variables
- the analysis of the data
- any safety precautions to be taken.

Diagram

[15]