14 Power supplies provide either alternating or direct currents and potential differences.

(a) A power supply produces an alternating potential difference (p.d.). The p.d. has a period of 0.02 s and a peak value of 4.0 V.

(i) Calculate the frequency of the supply.

(1)

Frequency = ...

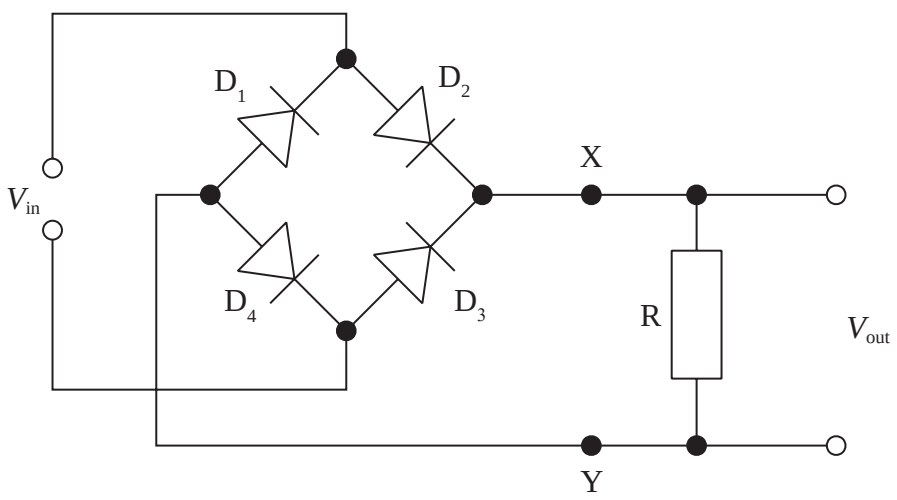
(ii) Calculate the root-mean-square p.d.

(1)

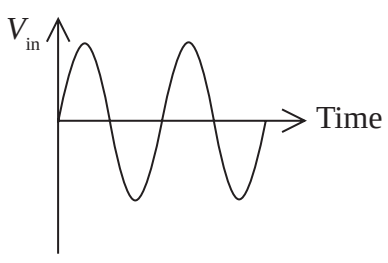
Root-mean-square p.d. = ...

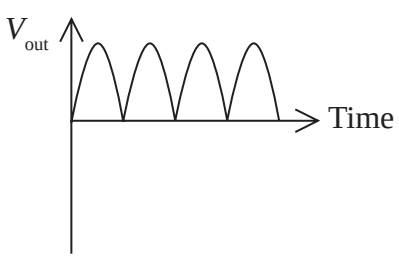
(b) It is possible to convert alternating currents and p.d.s, to direct currents and p.d.s using diodes.

The power supply provides an input V_{in} to the circuit shown. The circuit includes four diodes D_1, D_2, D_3 and D_4 and a resistor R. The circuit produces an output potential difference V_{out}.



A graph of V_{in} against time and a corresponding graph of V_{out} against time are shown below.



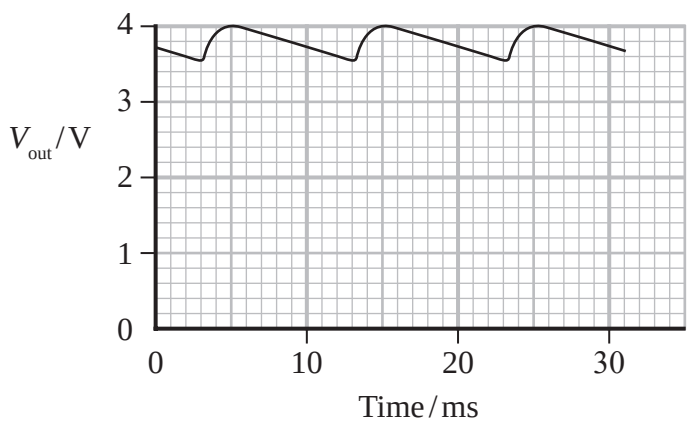


(i) Explain the operation of this circuit. Your answer should refer to D_1, D_2, D_3 and D_4.

(3)

(ii) A capacitor is added between points X and Y in the circuit.

The new graph of V_{out} against time is shown below.



Determine a value for the capacitance of the capacitor.

resistance of R = 2.2 kΩ

(3)

Capacitance = ...

(Total for Question 14 = 8 marks)