PROSPERITY ACADEMY

A2 PHYSCIS 9702

Crash Course

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ALTERNATING CURRENTS

COMPLETE NOTES

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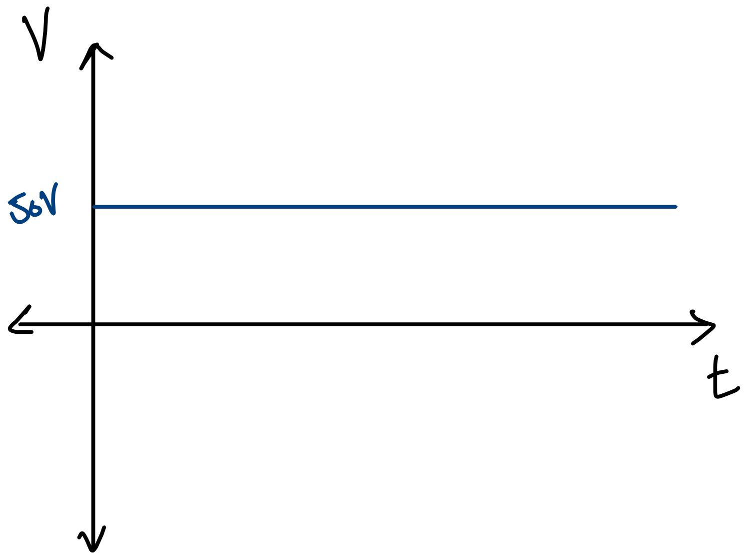
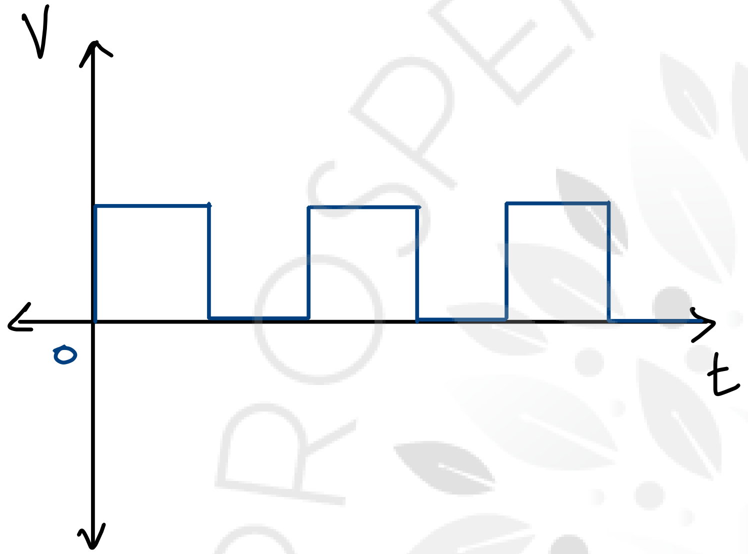
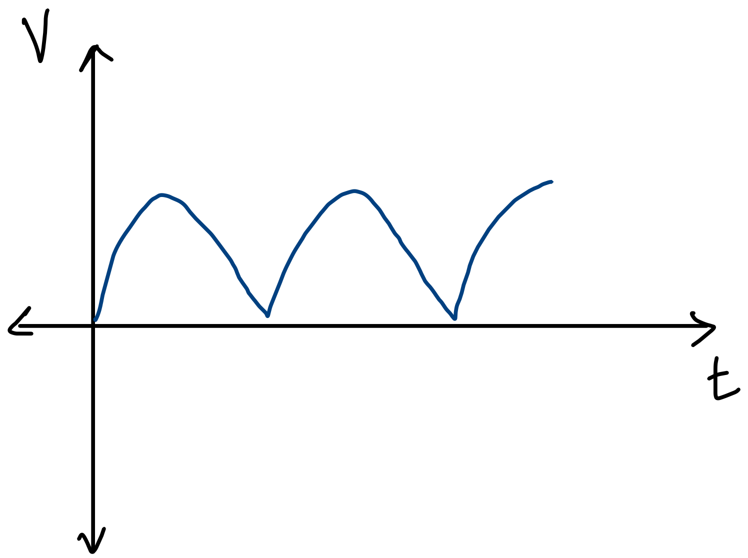
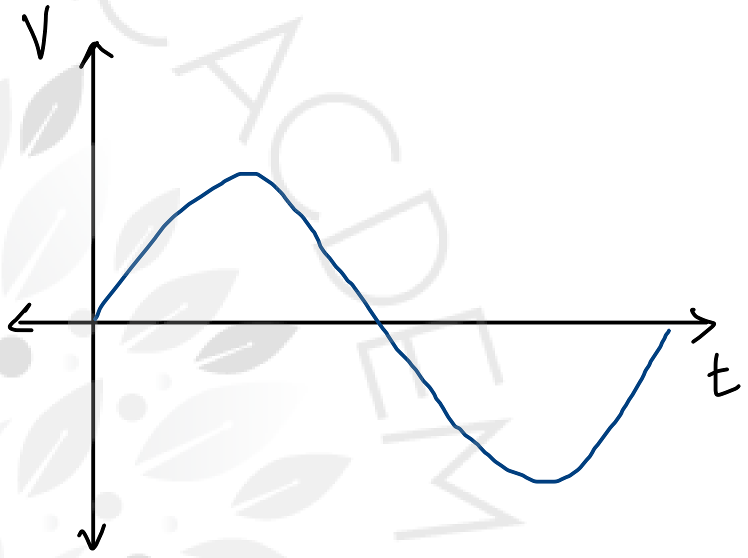
Direct Current:- The current is always in one direction

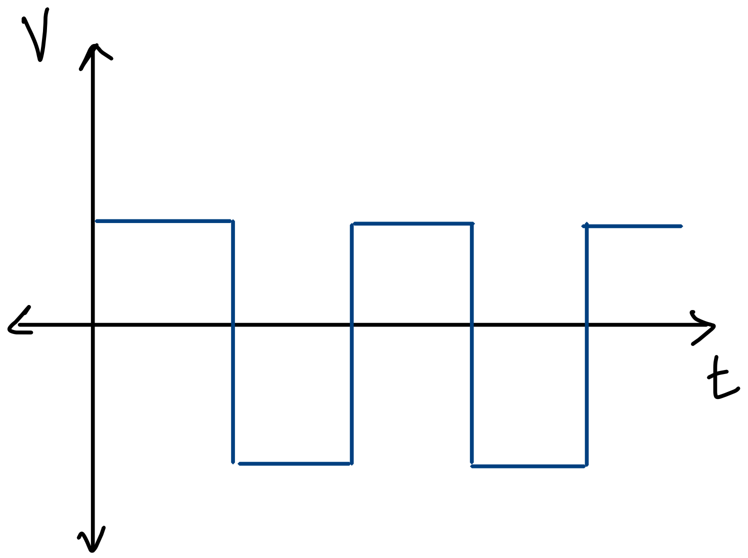


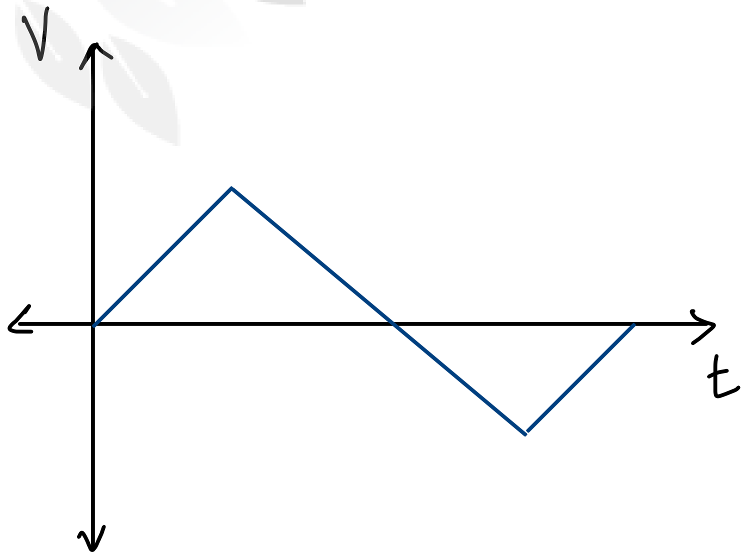




Alternating Currents:- The current is switching its direction of flow.



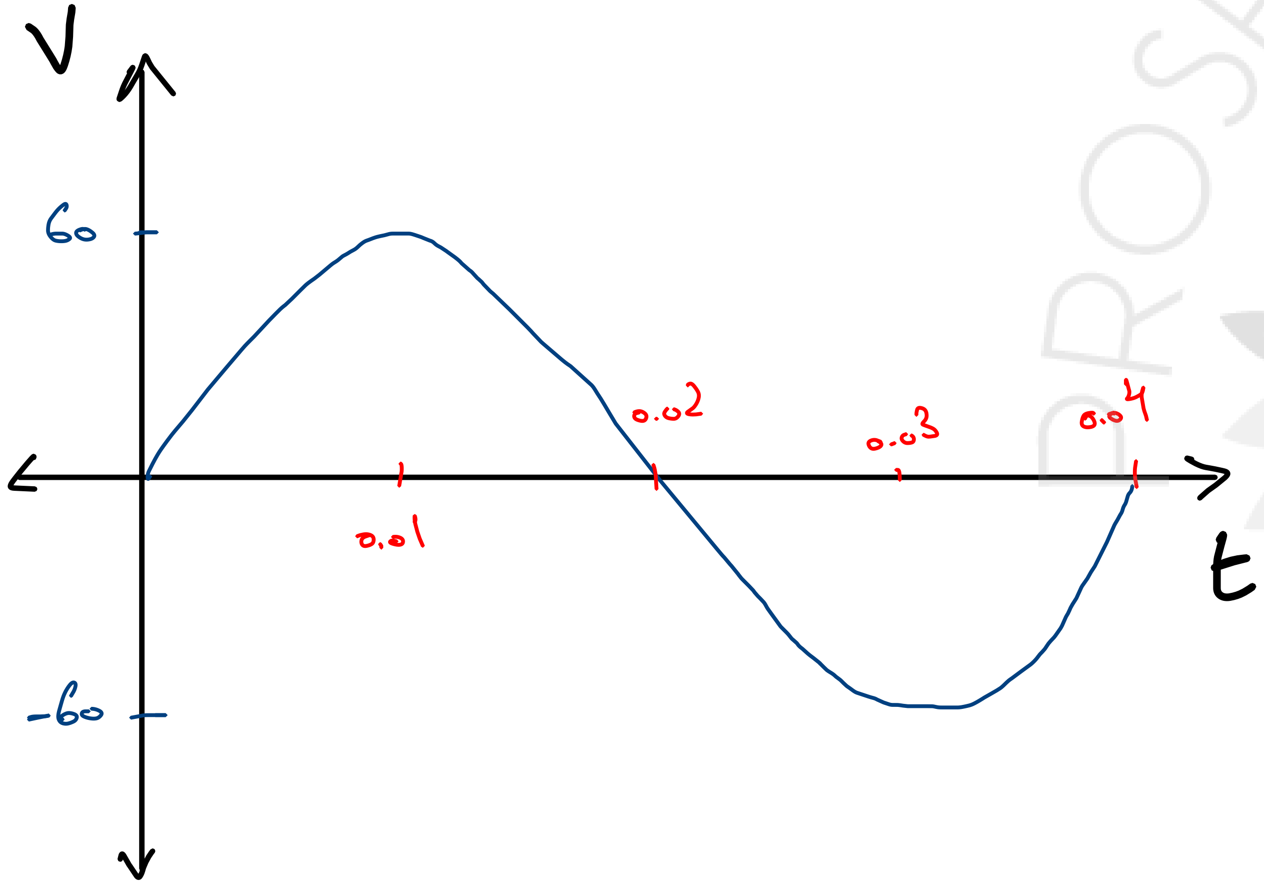




Sinusodial Alternating Currents:-

$$V = V_0 \sin(\omega t)$$

Q.



$$V = 60 \sin(\omega t)$$

$$\omega = \frac{2\pi}{T} \Rightarrow \omega = \frac{2\pi}{0.04} = 50\pi$$

$$V = 60 \sin(50\pi t) \quad \text{or} \quad V = 60 \sin(157t)$$

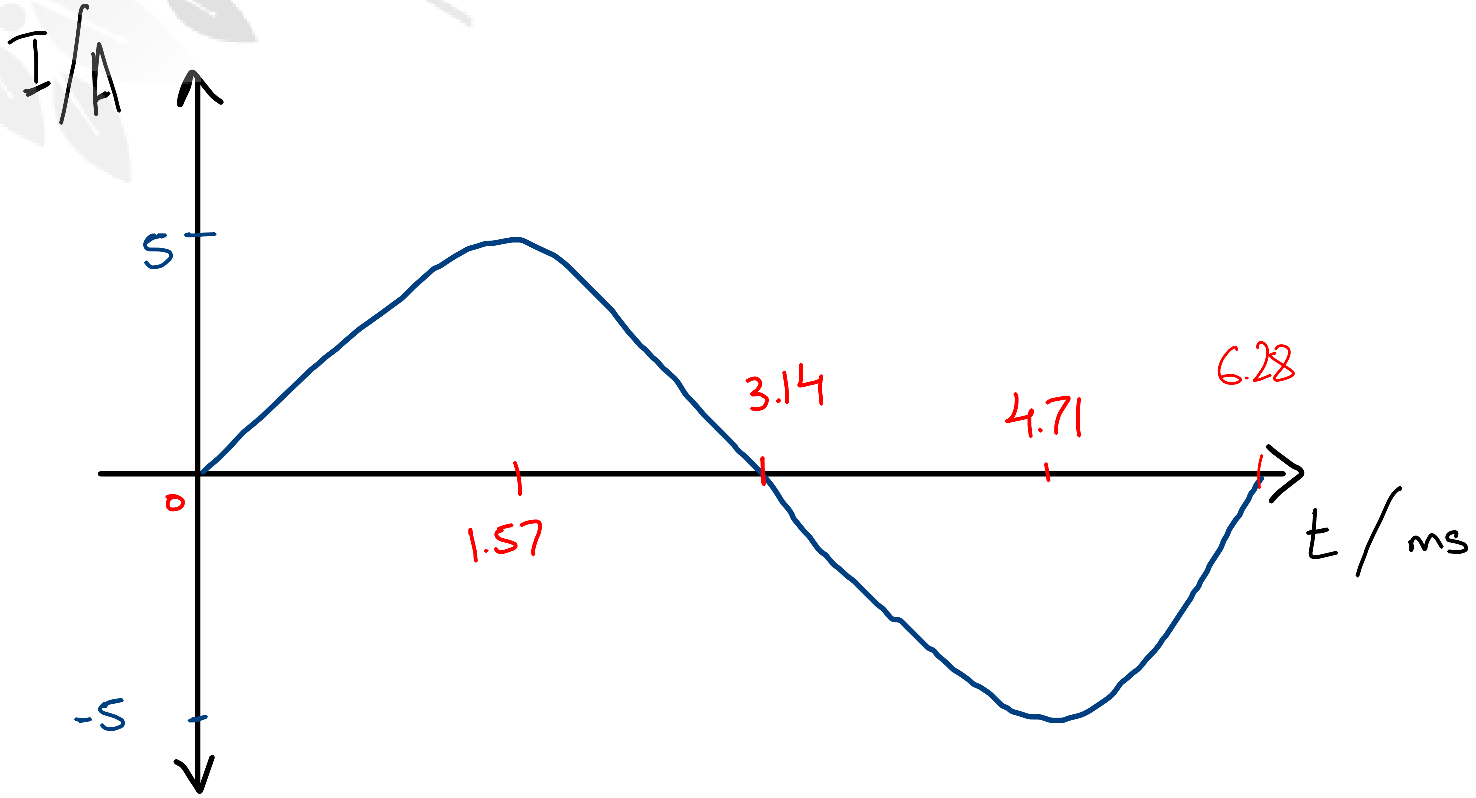
Q. $I = 5 \sin(1000t)$

$I_0 = 5$

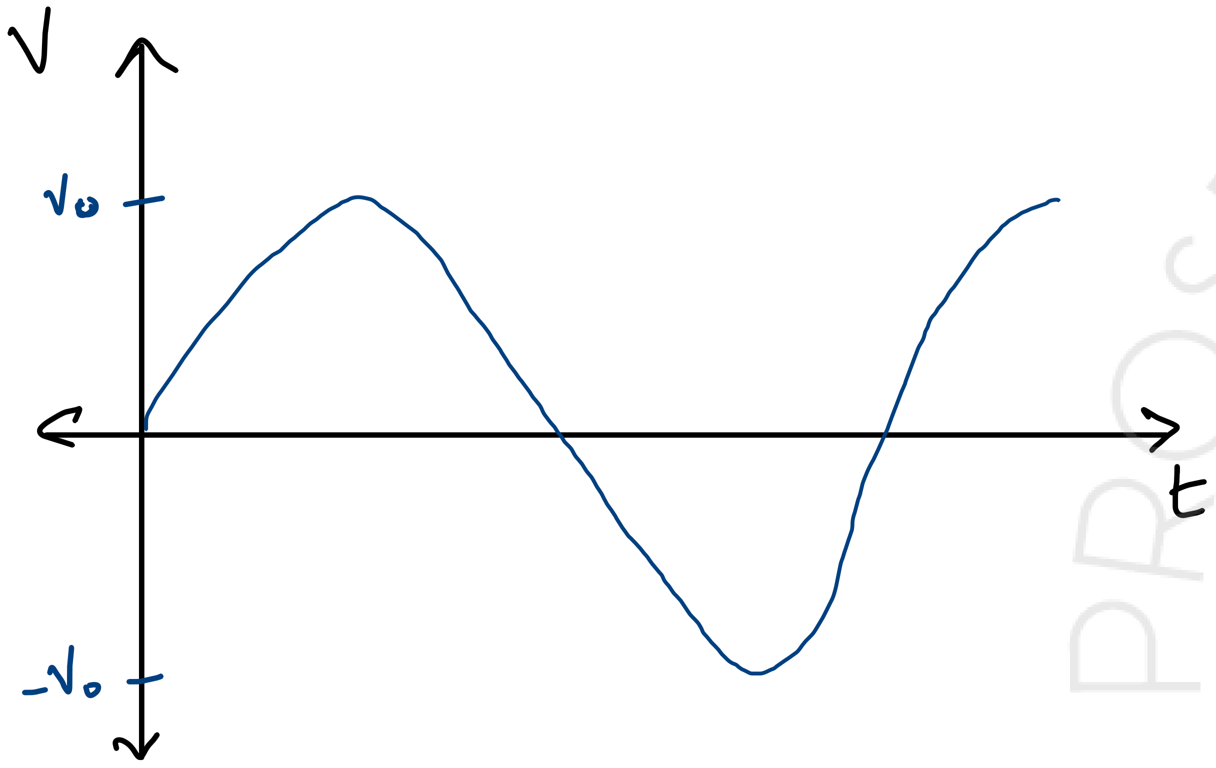
$$\omega = 1000$$

$$\frac{2\pi}{T} = 1000$$

$$T = \frac{2\pi}{1000} = 6.28 \times 10^{-3}$$



Root mean square:-



Mean Voltage = 0
Mean Current = 0

$$V_{r.m.s} = \frac{V_0}{\sqrt{2}}$$

$$I_{r.m.s} = \frac{I_0}{\sqrt{2}}$$

Charge:-

$$Q = I_{r.m.s} \times t$$

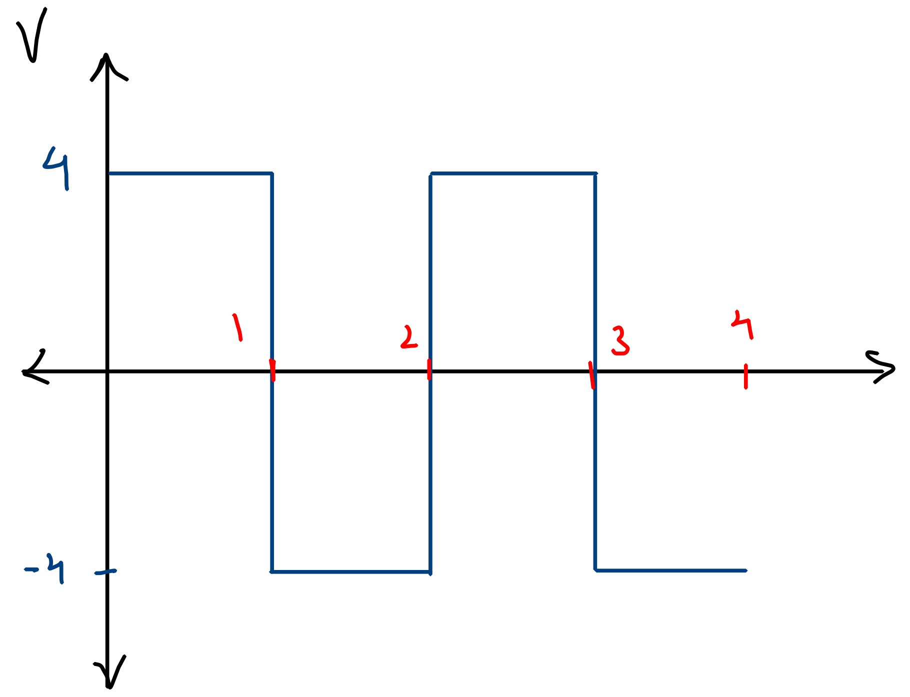
Ohm's law:-

$$V_{r.m.s} = R \times I_{r.m.s}$$

Power:-

$$P = I_{r.m.s} \times V_{r.m.s}$$

Square wave R.M.S. Voltage:-



$T = 2s$

$+4$ for $\frac{1}{2}T$

-4 for $\frac{1}{2}T$

$$= \sqrt{\left(\text{Positive voltage}^2 \times \text{fraction of time}\right) + \left(\text{negative voltage}^2 \times \text{fraction of time}\right)}$$

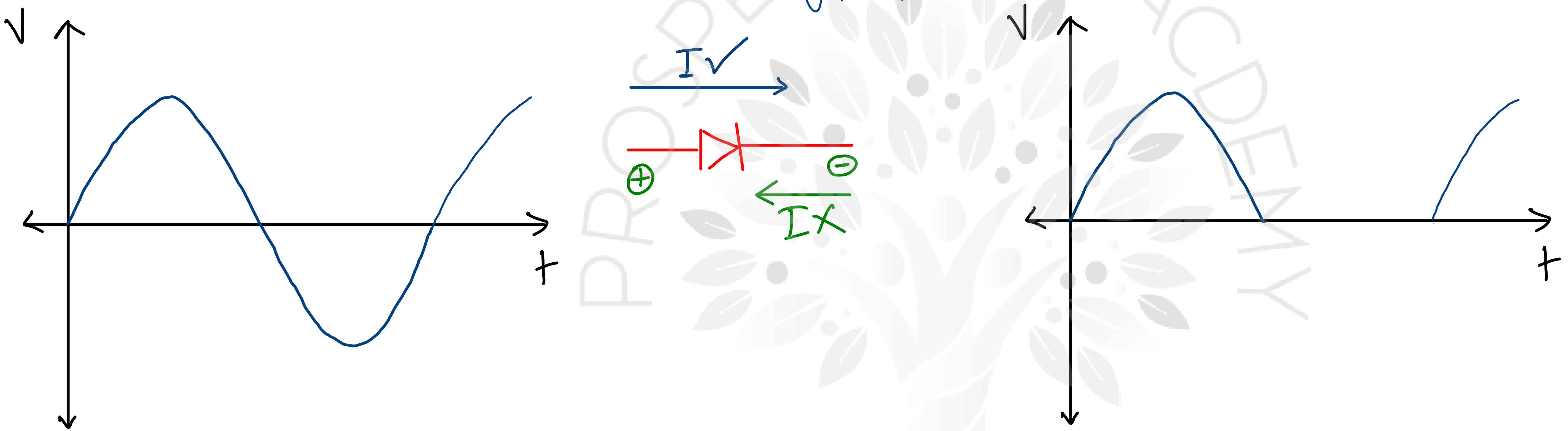
$$V_{r.m.s} = \sqrt{\left[4^2 \times \frac{1}{2}\right] + \left[-4^2 \times \frac{1}{2}\right]}$$

$$= \sqrt{8 + 8}$$

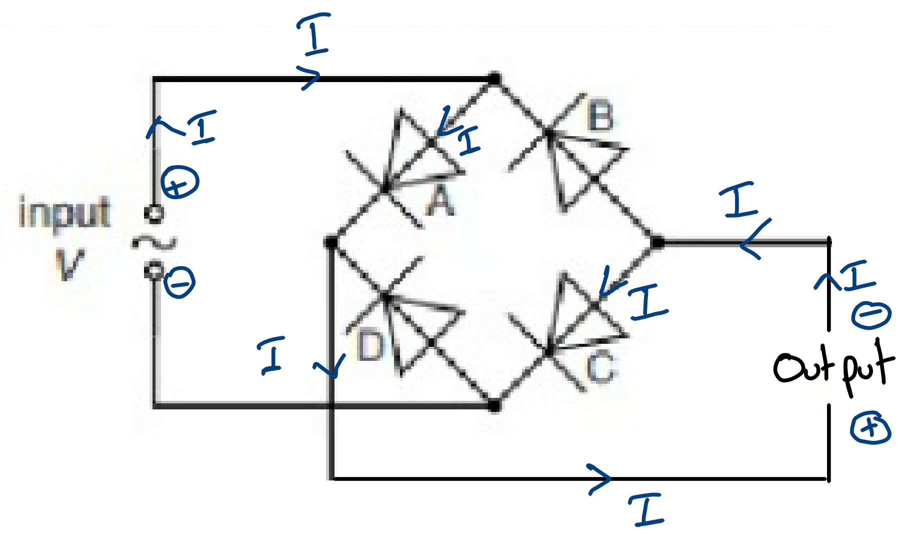
$V_{r.m.s}$ of square wave $= 4$

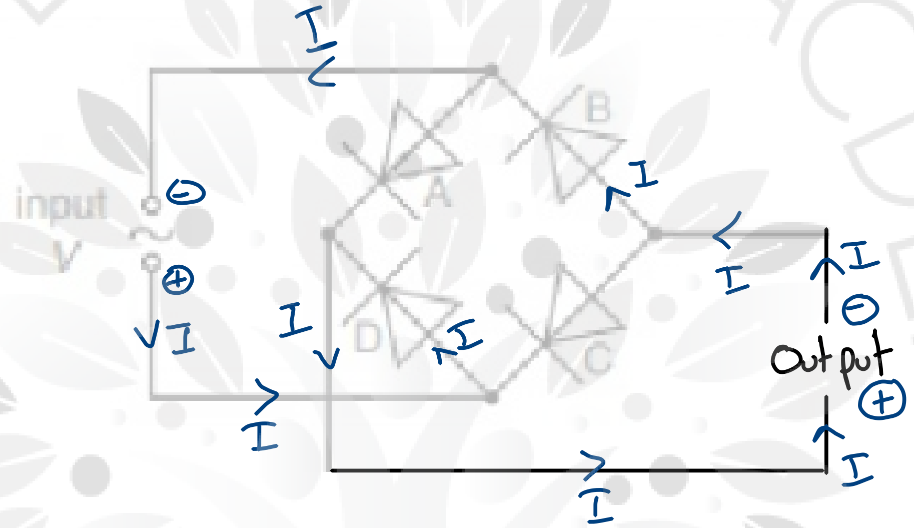
Conversion of AC to DC:- (Rectification)

Half wave rectification:- (Gives half amount of power)

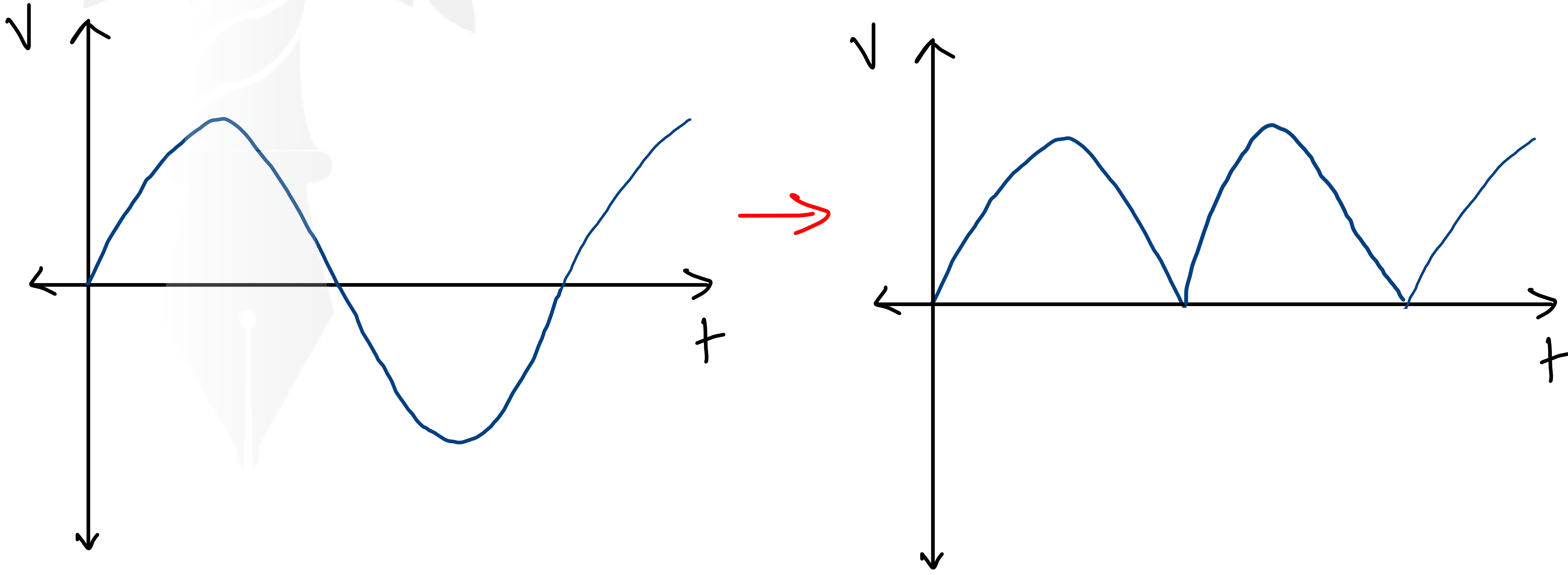


Full bridge Rectifier:-





1) Remember the diagram
2) Be able to mark +ve & -ve on load.
3) Make path of current



s16 qp41 q11

11 The variation with time t of the sinusoidal current I in a resistor of resistance 450 Ω is shown in Fig. 11.1.

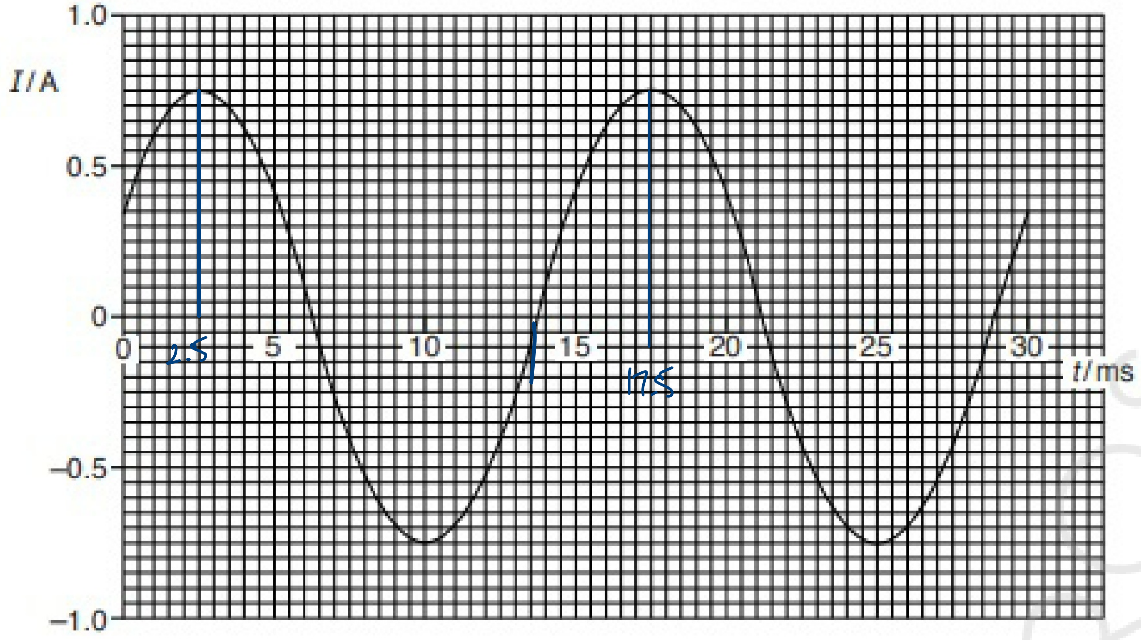


Fig. 11.1

Use data from Fig. 11.1 to determine, for the time t = 0 to t = 30 ms,

(a) the frequency of the current,

$T = 17.5 - 2.5 = 15\,\text{ms}$ $f = \frac{1}{15 \times 10^{-3}}$

frequency = ...67........ Hz [2]

(b) the mean current,

mean current = ...0........ A [1]

(c) the root-mean-square (r.m.s.) current,

$I_{r.m.s} = \frac{I_0}{\sqrt{2}} = \frac{0.75}{\sqrt{2}} = 0.53$

r.m.s. current = ...0.53........ A [2]

(d) the energy dissipated by the resistor.

$E = I_{r.m.s}^2 \times R \times t$

$= (0.53)^2 \times 450 \times (30 \times 10^{-3})$

$= 3.8$

energy = ...3.8........ J [2]

[Total: 7]

s16 qp42 q11

11 A bridge rectifier contains four ideal diodes A, B, C and D, as shown in Fig. 11.1.

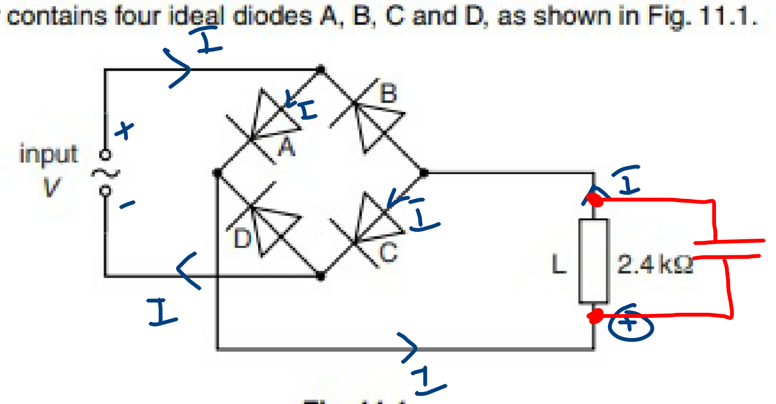
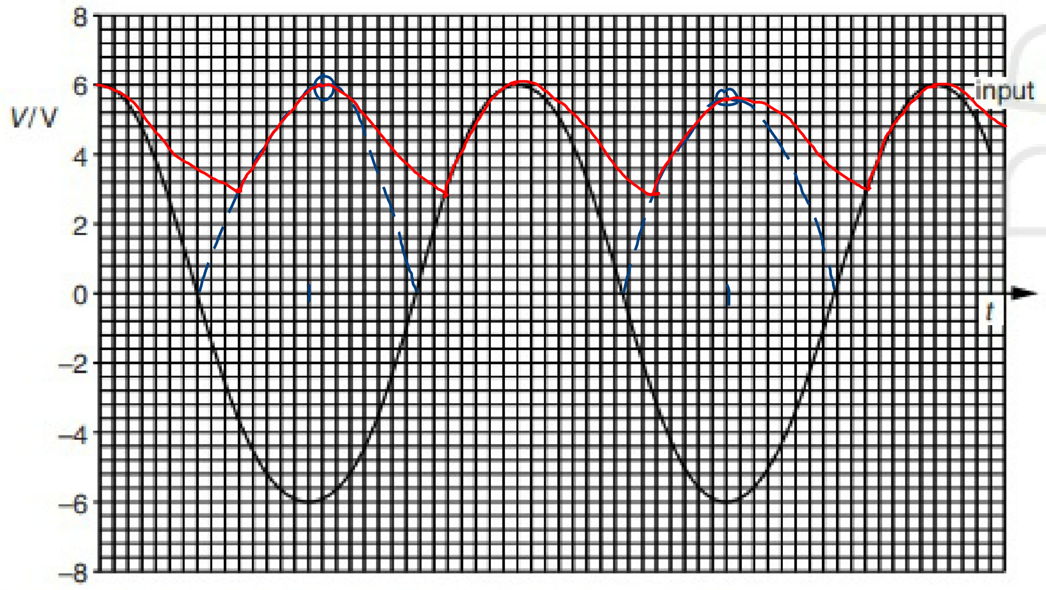


Fig. 11.1

The output of the rectifier is connected to a load L of resistance 2.4 kΩ.

(a) On Fig. 11.1, mark with the letter P the positive terminal of the load. [1]

(b) The variation with time *t* of the potential difference *V* across the input to the rectifier is shown in Fig. 11.2.



Calculate the root-mean-square (r.m.s.) current in the load L.

$V_{r.m.s} = I_{r.m.s} \times R$

$\frac{6}{\sqrt{2}} = I_{r.m.s} \times (2.4 \times 10^3)$

$I_{r.m.s} = 1.77$

r.m.s. current = ...1.8...... A [2]

(c) The potential difference across the load L is to be smoothed using a capacitor.

(i) On Fig. 11.1, draw the symbol for a capacitor, connected to produce smoothing. [1]

parallel with load

(ii) The minimum potential difference across the load L with the smoothing capacitor connected is 3.0 V.

On Fig. 11.2, sketch the variation with time *t* of the potential difference across the load L. [3]

[Total: 7]

m22 qp42 q7

7 **(a)** Alternating current (a.c.) is converted into direct current (d.c.) using a full-wave rectification circuit. Part of the diagram of this circuit is shown in Fig. 7.1.

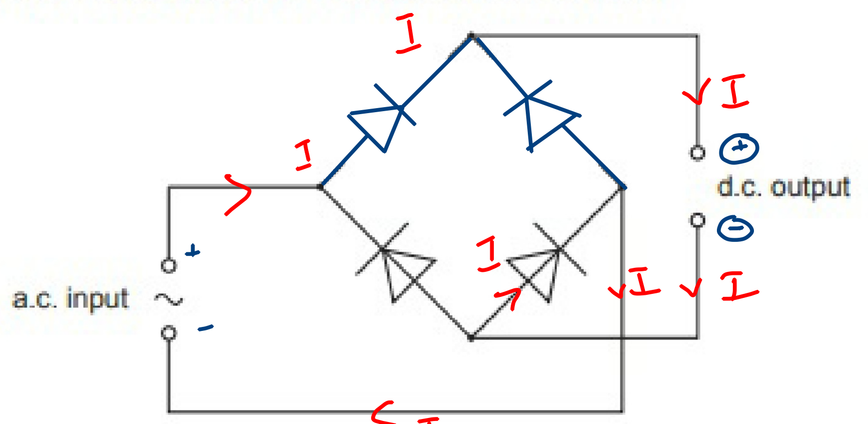


Fig. 7.1

(i) Complete the circuit in Fig. 7.1 by adding the necessary components in the gaps. [1]

(ii) On Fig. 7.1 mark with a + the positive output terminal of the rectifier. [1]

(b) The output voltage V of an a.c. power supply varies sinusoidally with time t as shown in Fig. 7.2.

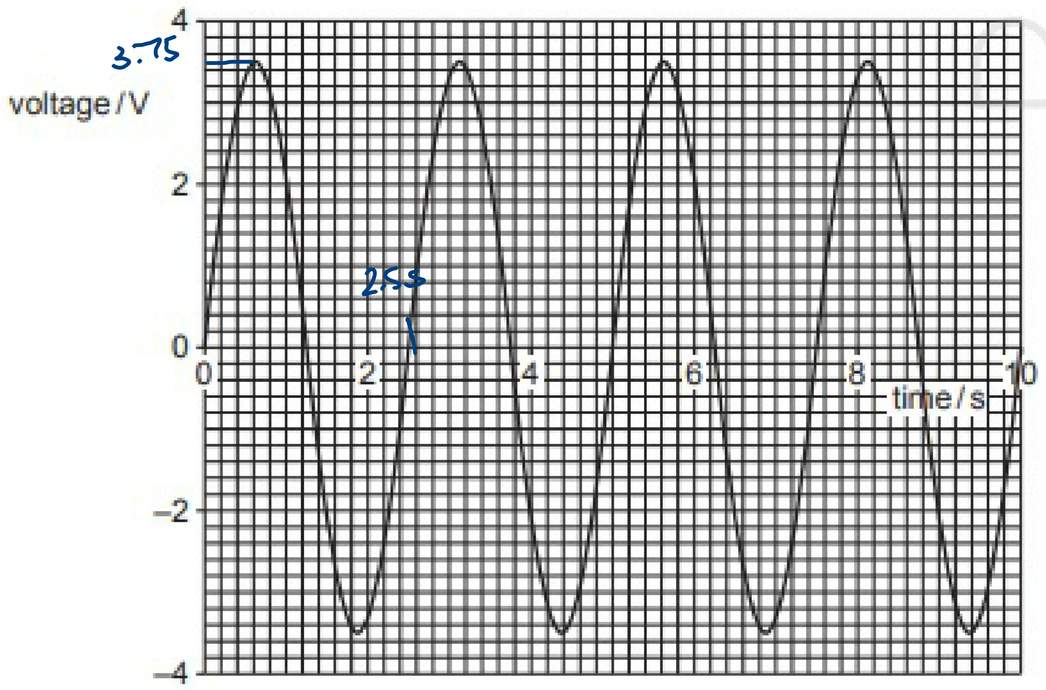


Fig. 7.2

(i) Determine the equation for V in terms of t, where V is in volts and t is in seconds.

$V = V_0 \sin(\omega t) \Rightarrow V = 3.75 \sin\left(\frac{2\pi}{2.5} t\right)$

V = $3.75 \sin(0.8t)$ [2]

(ii) The supply is connected to a 12 Ω resistor. Calculate the mean power dissipated in the resistor.

$P = \frac{V_{r.m.s}^2}{R} = \frac{\left(\frac{3.75}{\sqrt{2}}\right)^2}{12}$

mean power = 0.59 W [2]

[Total: 6]