# Physicsaholics

## DPP – 1 (Alternating Current)

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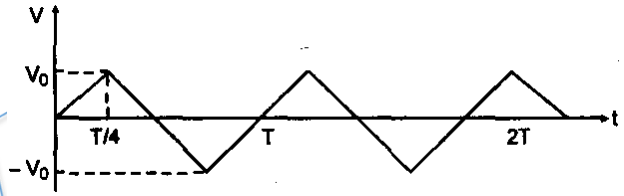
Q 1. The electric current in a circuit is given by i = 3t Here, t is in second and i in ampere. Then rms current for the period t = 0 to t = 1 s is:

(a) 3 A (b) 9 A (c) $\sqrt{3}$ A (d) $\sqrt[3]{3}$

Q 2. Average value of voltage from t = 0 to t = $\frac{2\pi}{\omega}$ for function: $V = V_0 \sin \omega t$ for $0 \le t \le \frac{\pi}{\omega}$ and $V = -V_0 \sin \omega t$ for $\frac{\pi}{\omega} \le t \le \frac{2\pi}{\omega}$ is :

(a) $\frac{V_0}{\sqrt{2}}$ (b) $\left(\frac{2}{\pi}\right) V_0$ (c) $\frac{V_0}{2}$ (d) zero

Q 3. The voltage time (V —t) graph for a triangular wave having peak value $V_0$ is as shown in figure. The rms value of V is:




(a) $\frac{V_0}{3}$ (b) $\frac{V_0}{2}$

(c) $\frac{V_0}{\sqrt{2}}$ (d) $\frac{V_0}{\sqrt{3}}$

Q 4. The current through a wire changes with time according to the equation I = $\sqrt{t}$ . The correct value of the rms current within the time interval t = 2 to t = 4s will be -

(a) $\sqrt{3}$A (b) 3 A

(c) 3 A (d) None of these

Q 5. In a circuit an A.C. current and a D. C. current are supplied together. The expression of the instantaneous current is given as i = 3 + 6 sin wt Then the rms value of the current is –

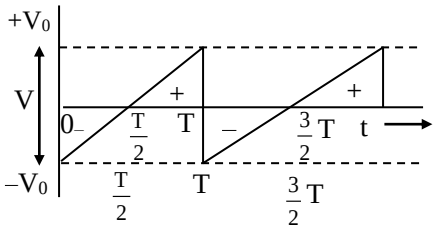
(a) 3 (b) 6 (c) $3\sqrt{2}$ (d) $3\sqrt{3}$

Q 6. The time required for a 50Hz alternating current to increase from zero to 70.7% of its peak value is -

(a) 2.5 ms (b) 10 ms

(c) 20 ms (d) 14.14 ms

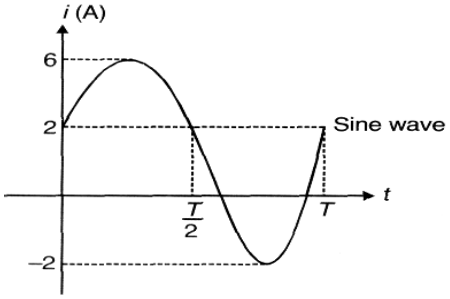
Q 7. Find rms value for the saw-tooth voltage of peak value $V_0$ as shown in figure.




(a) $V_0$ (b) $\frac{V_0}{2}$

(c) $\frac{V_0}{3}$ (d) none of these

Q 8. The current 'i' through a wire varies with time t as shown in the figure. The effective (rms) value of the current is




(a) 6A (b) $2\sqrt{3}$

(c) $2 + 2\sqrt{2}$ A (d) 3 A

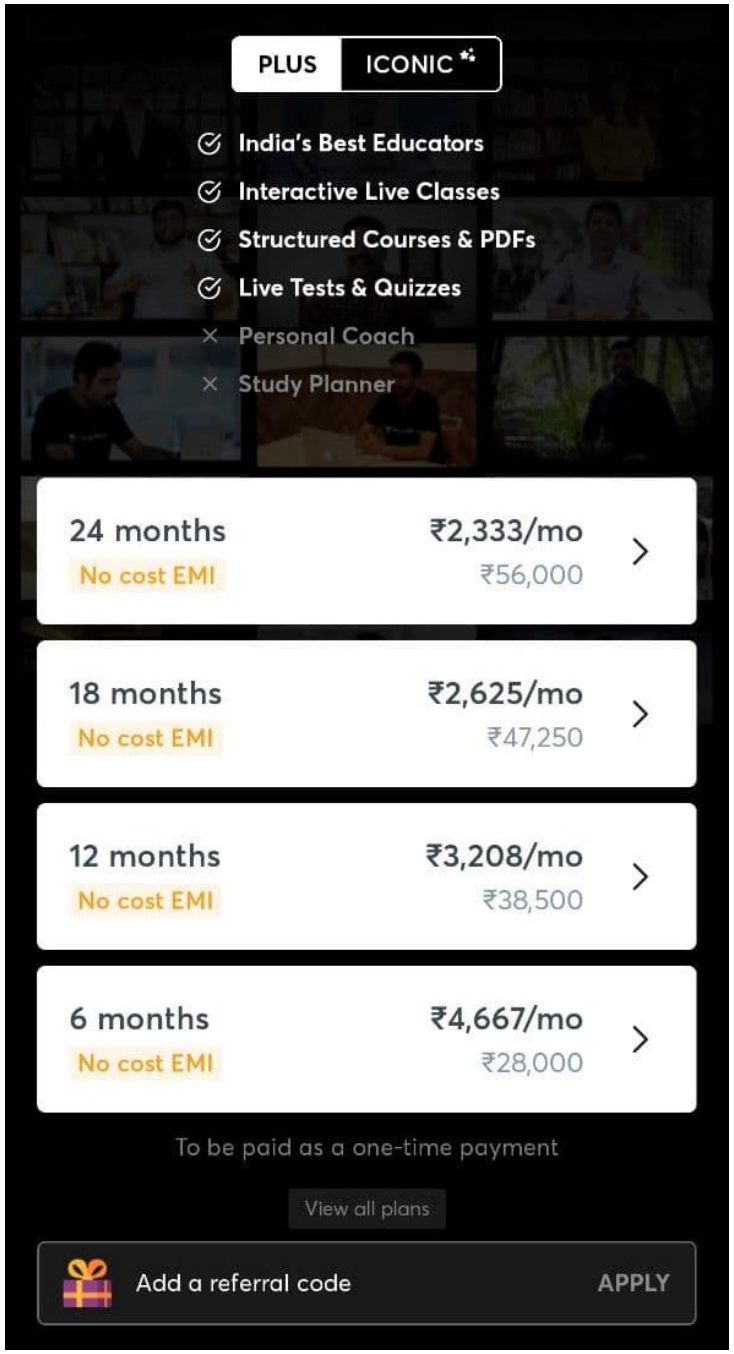
Q 9. Instantaneous current in an ac circuit is given I = $i_0$ Sin ωt. Average value of current from t= 0 to t= $\frac{3\pi}{\omega}$ is

(a) Zero (b) $i_0$ (c) $\frac{i_0}{2}$ (d) $\frac{2i_0}{3\pi}$



# Answer Key

| | | | | |
|---|---|---|---|---|
| **Q.1 c** | **Q.2 b** | **Q.3 d** | **Q.4 a** | **Q.5 d** |
| **Q.6 a** | **Q.7 d** | **Q.8 b** | **Q.9 d** | |

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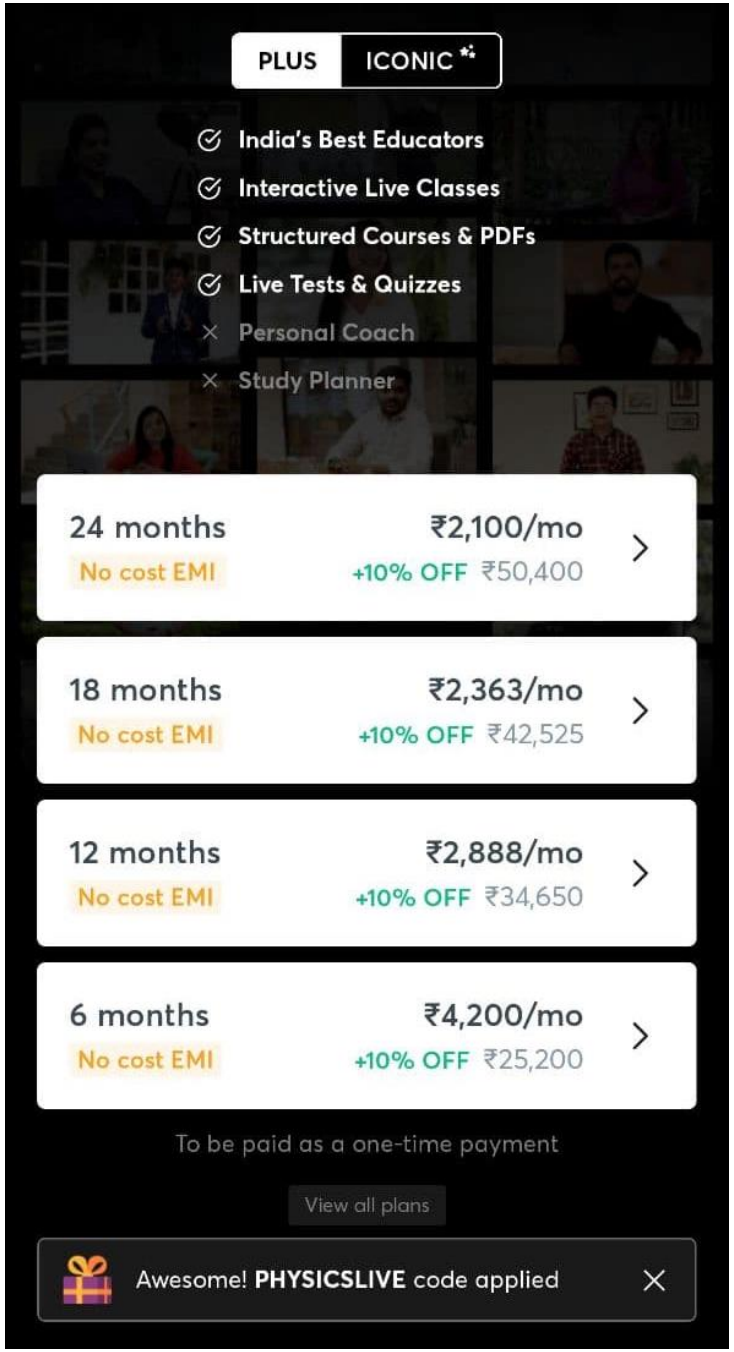


# Written Solution

## DPP-1 AC- Generation of AC, Instantaneous, Peak, Average and RMS Value of AC

## By Physicsaholics Team

$y = f(x)$

$$y_{rms} = \sqrt{\frac{\int [f(x)]^2 dx}{\int dx}}$$

Q.1) The electric current in a circuit is given by

$$i = 3t$$

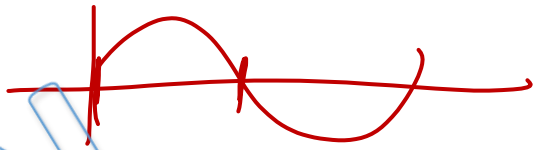
Here, t is in second and i in ampere. Then rms current for the period t = 0 to t = 1 s is:

$$i_{rms}^2 = \frac{\int_0^1 9t^2\, dt}{\int_0^1 dt} = \frac{\left[9\,\frac{t^3}{3}\right]_0^1}{1} = 3$$

$$i_{rms} = \sqrt{3}$$

(a) 3 A (b) 9 A (c) $\sqrt{3}$ A (d) $\sqrt[3]{3}$

$y = f(x)$ , $y_{av} = \dfrac{\int f(x)\,dx}{\int dx}$



Q.2) average value of voltage from t = 0 to t = $\frac{2\pi}{\omega}$ for function: $V = V_0 \sin \omega t$ for $0 \le t \le \frac{\pi}{\omega}$ and $V = -V_0 \sin \omega t$ for $\frac{\pi}{\omega} \le t \le \frac{2\pi}{\omega}$ is :

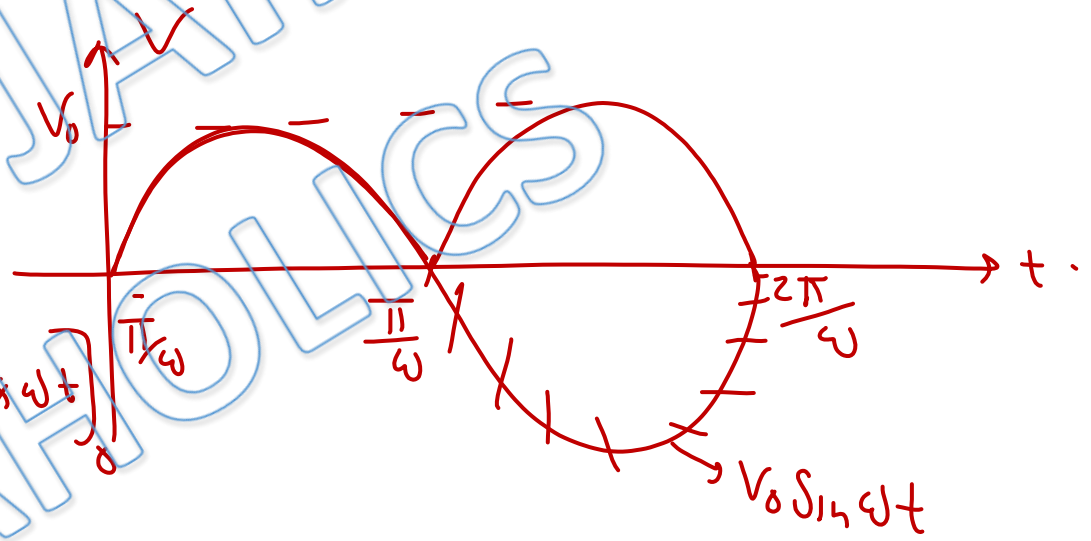
$V_{av}$ from $t = 0$ to $t = 2\pi/\omega$

$=$ " " $t = 0$ to $t = \pi/\omega$

$$= \frac{\int_0^{\pi/\omega} V_0 \sin \omega t\, dt}{\int_0^{\frac{\pi}{\omega}} dt} = \frac{\omega V_0 \left(-\frac{1}{\omega}\right)\left[\cos \omega t\right]_0^{\pi/\omega}}{\pi}$$

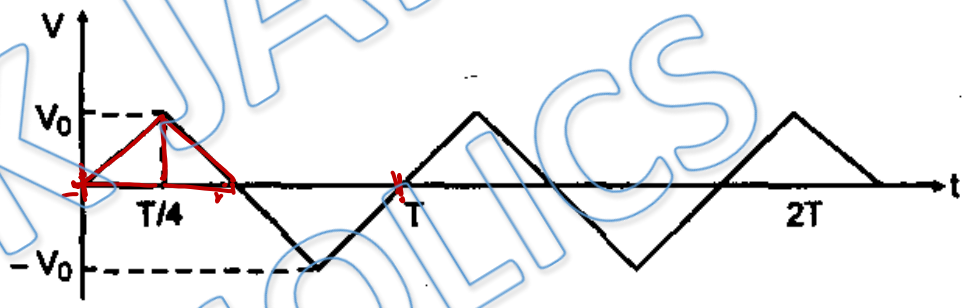
$$= -\frac{V_0}{\pi}\left[\cos \pi - \cos 0\right]$$

$$= \frac{2V_0}{\pi}$$




(a) $\frac{V_0}{\sqrt{2}}$ (b) $\left(\frac{2}{\pi}\right) V_0$ (c) $\frac{V_0}{2}$ (d) zero

Q.3) The voltage time (V —t) graph for a triangular wave having peak value $V_0$ is as shown in figure. The rms value of V is:



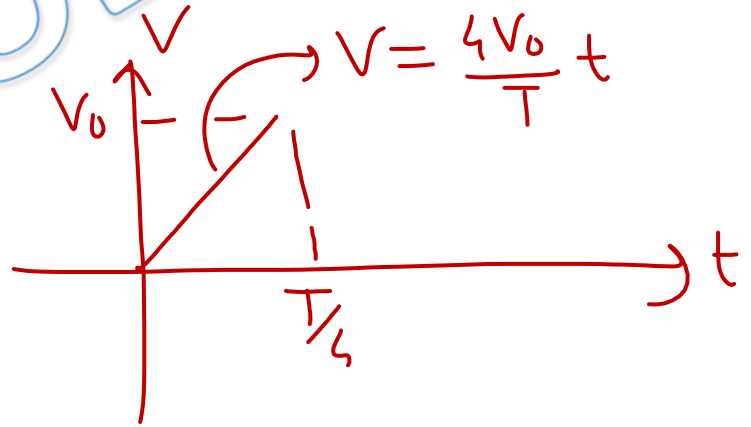

rms value over long time interval

$= $ " " from $t=0$ to $t=T/4$

$$= \sqrt{\frac{\int_0^{T/4} \frac{16V_0^2}{T^2}t^2\,dt}{\int_0^{T/4} dt}}$$

$$= \sqrt{\frac{16}{T^2}\times\frac{4V_0^2}{T}\left[\frac{t^3}{3}\right]_0^{T/4}}$$

$$= \sqrt{\frac{64}{T^3}\times\frac{T^3V_0^2}{64\times 3}} = \frac{V_0}{\sqrt{3}}$$




(a) $\frac{V_0}{3}$ (b) $\frac{V_0}{2}$

(c) $\frac{V_0}{\sqrt{2}}$ (d) $\frac{V_0}{\sqrt{3}}$

Q.4) The current through a wire changes with time according to the equation $I = \sqrt{t}$ . The correct value of the rms current within the time interval t = 2 to t = 4s will be -

$I = \sqrt{t}$

$I^2 = t$

$\langle I^2 \rangle = 3$

(a) $\sqrt{3}$A

(b) 3 A

(c) 3 A

(d) None of these

Q.5) In a circuit an A.C. current and a D. C. current are supplied together. The expression of the instantaneous current is given as

$i = 3 + 6 \sin \omega t$ Then the rms value of the current is –

$$i_{rms}^2 = \frac{\int (9 + 36\sin^2\omega t + 36\sin\omega t)\,dt}{\int dt}$$

$$= \frac{\int [9 + 18(2\sin^2\omega t)]\,dt}{\int dt} + 36\,\frac{\int \sin\omega t\,dt}{\int dt}$$

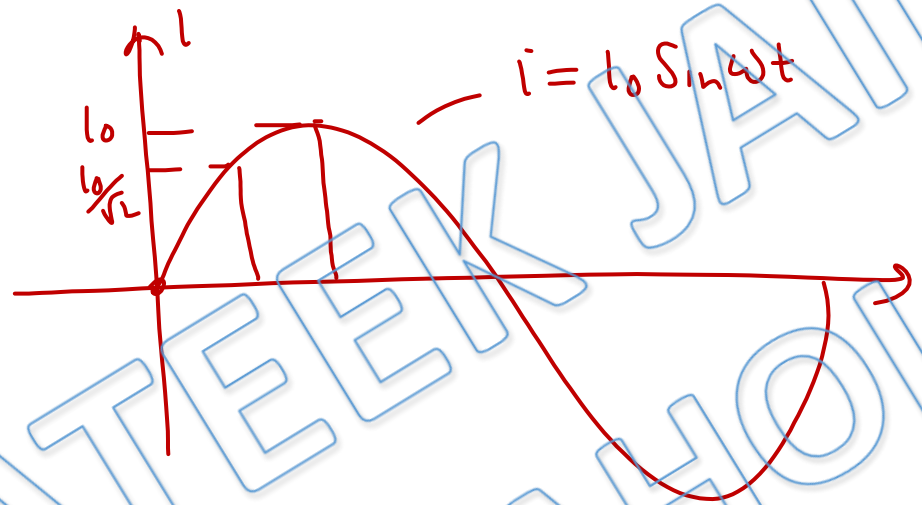
(a) 3 (b) 6 (c) $3\sqrt{2}$ (d) $3\sqrt{3}$

$$= \frac{\int_0^{2\pi/\omega} [9 + 18(1 - \cos 2\omega t)]\,dt}{\int_0^{2\pi/\omega} dt} = \frac{\int 27\,dt}{\int dt} - \frac{\int_0^{2\pi/\omega} 18\cos 2\omega t\,dt}{\int dt}$$

$= 27 + 0$

$T = \frac{1}{f} = \frac{1}{50}$

Q.6) The time required for a 50Hz alternating current to increase from zero to 70.7% of its peak value is -




$\frac{1}{\sqrt{2}}$ times

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

(a) 2.5 ms (b) 10 ms

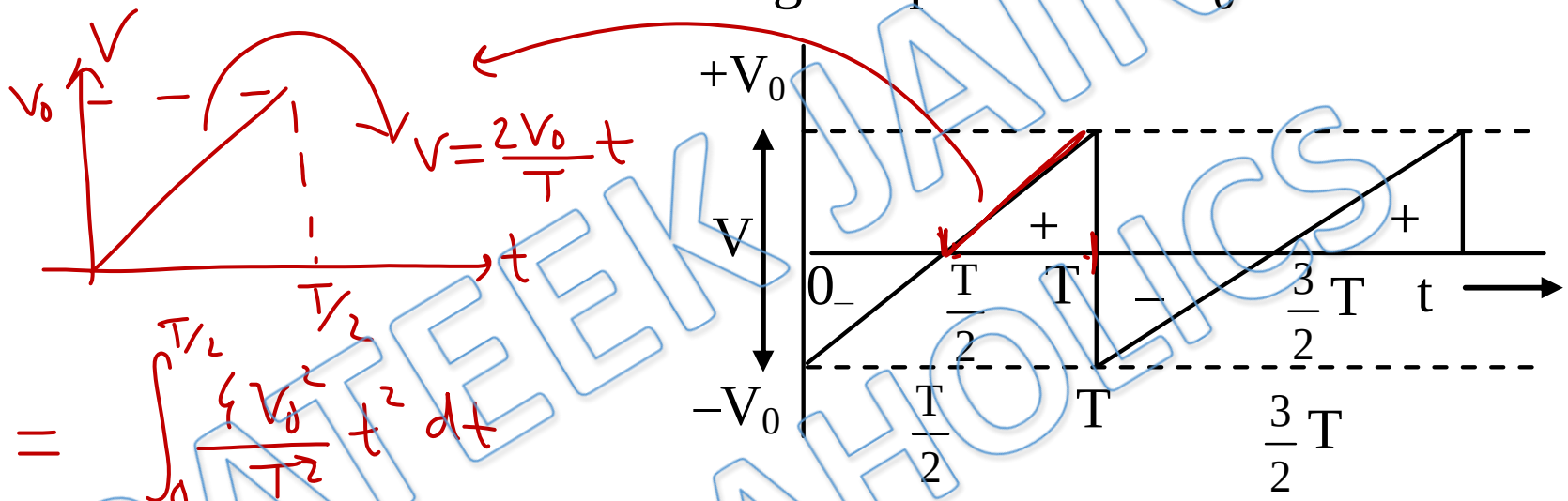
(c) 20 ms (d) 14.14 ms

$\omega t = \pi/4$

$t = \frac{\pi}{4\omega} = \frac{T}{8} = \frac{1}{50 \times 8}$ Sec

$= \frac{1000}{8 \times 400}$ msec

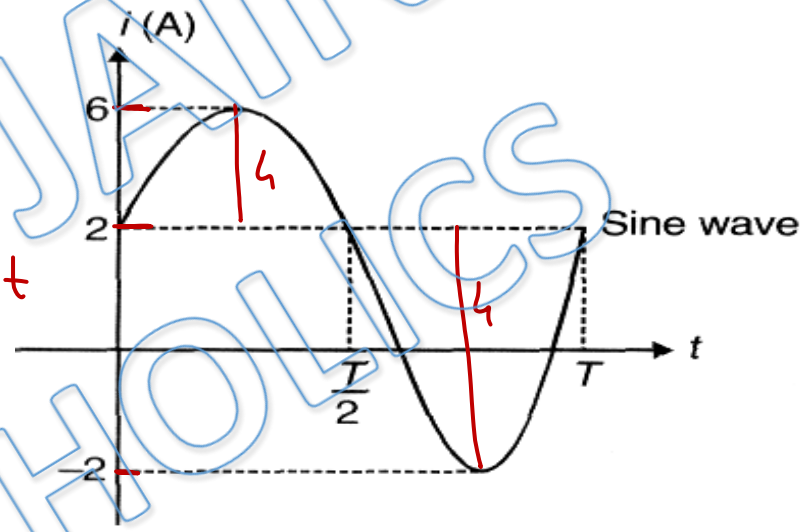
Q.7) Find rms value for the saw-tooth voltage of peak value $V_0$ as shown in figure.




(a) $V_0$ (b) $\frac{V_0}{2}$

(c) $\frac{V_0}{3}$ (d) none of these

Q.8) The current 'i' through a wire varies with time t as shown in the figure. The effective (rms) value of the current is




$i = 2 + 4\sin\omega t$

$$i_{rms}^2 = \frac{\int_0^{2\pi/\omega} (4 + 16\sin^2\omega t + 16\sin\omega t)\,dt}{\int_0^{2\pi/\omega} dt}$$

$$= \frac{\int_0^{2\pi/\omega} [4 + 8(1 - \cos 2\omega t)]\,dt}{2\pi/\omega}$$

$$= \frac{\int_0^{2\pi/\omega} 12\,dt}{2\pi/\omega} - \frac{8\int_0^{2\pi/\omega} \cos 2\omega t\,dt}{2\pi/\omega} = 12$$

(a) 6A (b) $2\sqrt{3}$

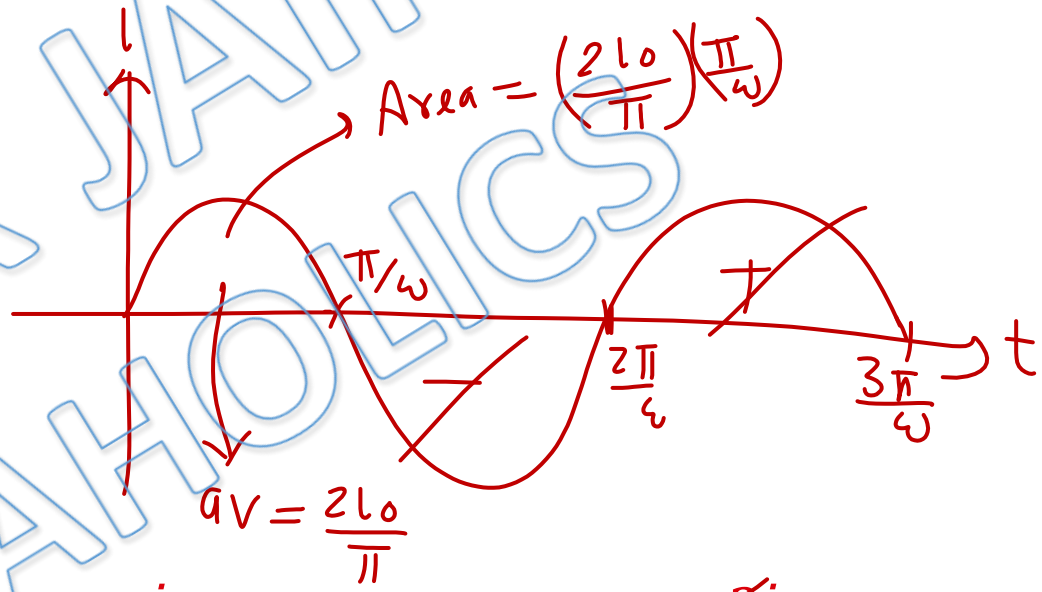
(c) $2 + 2\sqrt{2}$ A (d) 3 A

Q.9) Instantaneous current in an ac circuit is given I = $i_0$ Sin ωt. Average value of current from t= 0 to t= $\frac{3\pi}{\omega}$ is

Total Area = $\left(\frac{2i_0}{\pi}\right)\left(\frac{\pi}{\omega}\right)$

" time = $\frac{3\pi}{\omega}$

$i_{av} = \frac{2i_0}{3\pi}$




(a) Zero (b) $i_0$ (c) $\frac{i_0}{2}$ (d) $\frac{2i_0}{3\pi}$

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