Physicsaholics

DPP – 1

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Q 1. Alternating current can not be measured by dc ammeter because
(a) ac cannot pass through dc ammeter
(b) Average value of complete cycle is zero
(c) ac is virtual
(d) ac changes its direction

Q 2. If instantaneous current is given by i=4cos(ωt+φ) amperes, then the r.m.s. value of current is
(a) 4 amp (b) $2\sqrt{2}$ amp
(c) $4\sqrt{2}$ amp (d) zero amp

Q 3. r.m.s. value of current $i = 3 + 4\sin\left(\omega t + \frac{\pi}{3}\right)$ is:
(a) 5 Amp (b) $\sqrt{17}$ Amp
(c) $\frac{5}{\sqrt{2}}$ Amp (d) $\frac{7}{\sqrt{2}}$ Amp

Q 4. The average value of current $i = I_m \sin(\omega t)$, from $t = \frac{\pi}{2\omega}$ to $t = \frac{3\pi}{2\omega}$ is how many times of I_m ?
(a) zero (b) 1
(c) $\frac{1}{\pi}$ (d) $\frac{2}{\pi}$

Q 5. The r.m.s. value of an ac of 50 Hz is 10 amp. The time taken by the alternating current in reaching from zero to peak current and the value of peak current will be
(a) 2×10^{-2} sec and 14.14 A
(b) 1×10^{-2} sec and 7.07 A
(c) 5×10^{-3} sec and 7.07 A
(d) 5×10^{-3} sec and 14.14 A

Q 6. A current as function of time 't' is given I = $I_0(\frac{3t}{T} - 1)$. Find average current over t = 0 to t = T
(a) $0.8I_0$ (b) $0.5I_0$
(c) $0.75I_0$ (d) zero

Q 7. Alternating current in circuit is given by I = I_o sin(2πnt). Then the time taken by the current to rise from zero to r.m.s. value is equal to

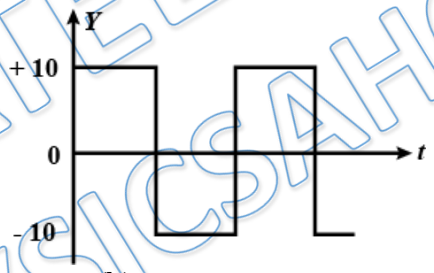
(a) $\frac{1}{2n}$ (b) $\frac{1}{n}$
(c) $\frac{1}{4n}$ (d) $\frac{1}{8n}$

Q 8. Current in an ac circuit is given by $I = 3\sin(\omega t) + 4\cos(\omega t)$, then rms value of current will be
(a) 5 A (b) $5\sqrt{2}$ A
(c) $\frac{5}{\sqrt{2}}$ A (d) 10 A

Q 9. A coil of 150 turns, each of area 50 cm^2, is rotating in a magnetic field of 0.15 T with a constant frequency of 20 rotations per second about an axis in the plane of the coil and normal to the field. Calculate the peak emf and rms emf induced in the coil.
(a) 10 V, 14.14 V (b) 7.84 V, 10 V
(c) 14.14 V, 18.18 V (d) 14.14 V, 10 V

Q 10. In general in an alternating current circuit
(a) The average value of current is zero
(b) The average value of square of the current is zero
(c) The phase difference between voltage and current is zero
(d) none of these

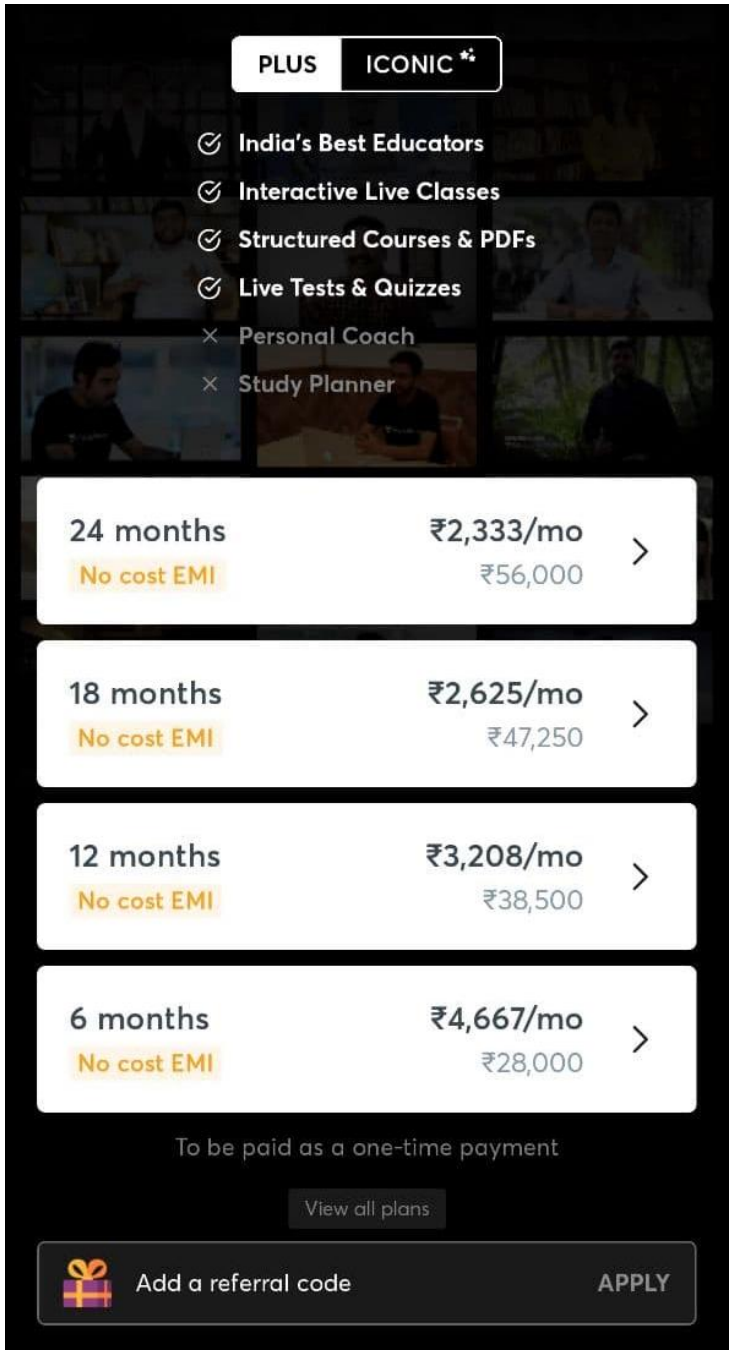
Q 11. The r.m.s. voltage of the wave form shown is



(a) 10 V (b) 7 V
(c) 6.37 V (d) none of these

Answer Key

Q.1 b	**Q.2 b**	**Q.3 b**	**Q.4 a**	**Q.5 d**
Q.6 b	**Q.7 d**	**Q.8 c**	**Q.9 d**	**Q.10 a**
Q.11 a				



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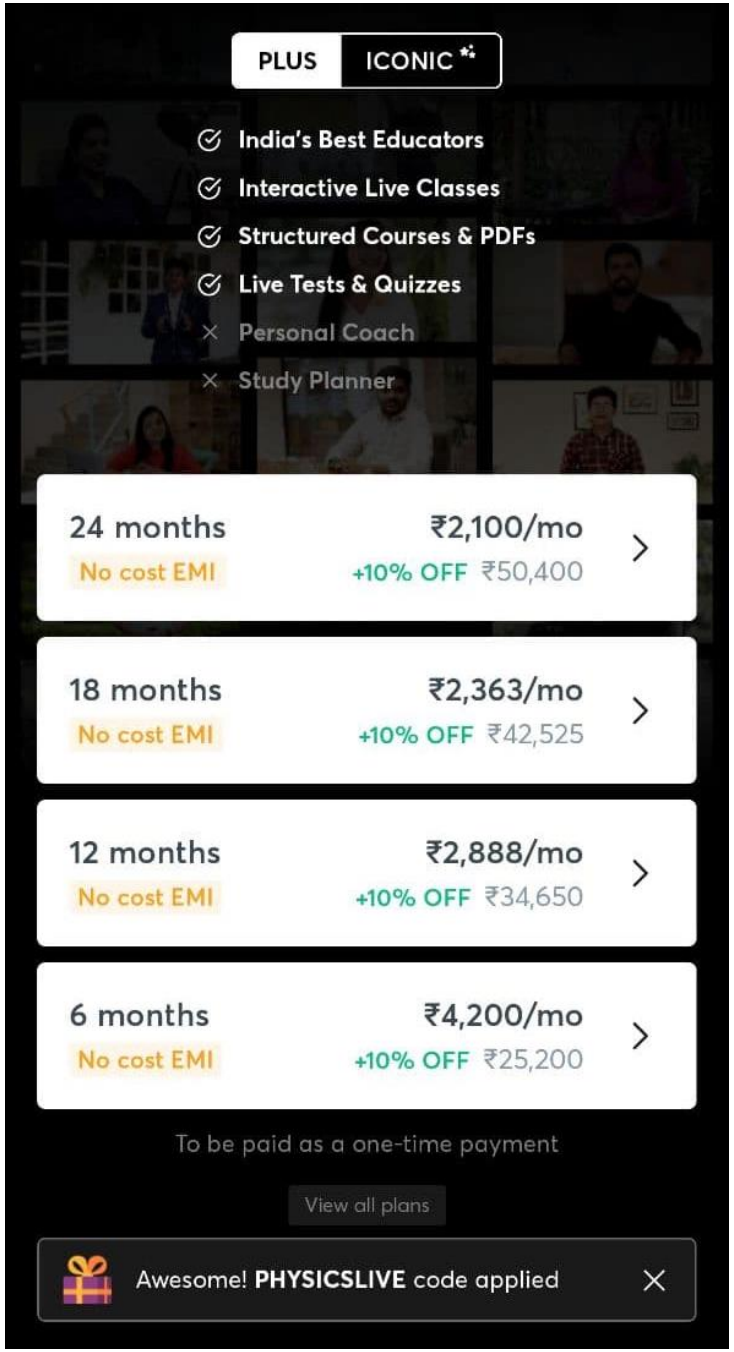


Written Solution

DPP-1 AC: Generation of AC, Instantaneous, Peak, Average & RMS Value of AC

By Physicsaholics Team

Solution: 1

In dc ammeter, a coil is free to rotate in the magnetic field of a fixed magnet. If an alternating current is passed through such a coil, the torque will reverse it's direction each time the current changes direction and the average value of the torque will be zero.

Ans. b

Solution: 2

$$I_{rms} = \frac{I_{max}}{\sqrt{2}}$$

$$I_{rms} = \frac{4}{\sqrt{2}}$$

$$I_{rms} = 2\sqrt{2} \text{ amp}$$ Ans.

Ans. b

Solution: 3

$$i = 3 + 4\sin\left(\omega t + \frac{\pi}{3}\right)$$

$$i^2 = 9 + 16\sin^2\left(\omega t + \frac{\pi}{3}\right) + 2\times 3\times 4\sin\left(\omega t + \frac{\pi}{3}\right)$$

$$i^2 = 9 + 16\sin^2\left(\omega t + \frac{\pi}{3}\right) + 24\sin\left(\omega t + \frac{\pi}{3}\right)$$

$$\langle i^2\rangle = 9 + 16\left\langle \sin^2\left(\omega t + \frac{\pi}{3}\right)\right\rangle + 24\left\langle \sin\left(\omega t + \frac{\pi}{3}\right)\right\rangle$$

$$= 9 + 16\times\frac{1}{2} + 24\times 0$$

$$= 9 + 8 + 0$$

$$\langle i^2\rangle = 17$$

$$i_{rms} = \sqrt{\langle i^2\rangle} = \sqrt{17}$$

$$\boxed{i_{rms} = \sqrt{17}\ \text{amp}}$$ Ans.

Ans. b

Solution: 4

$$I_{avg} = \frac{\int_{t_1}^{t_2} I\,dt}{\int_{t_1}^{t_2} dt} = \frac{\int_{\pi/2\omega}^{3\pi/2\omega} (I_m \sin(\omega t))\,dt}{\int_{\pi/2\omega}^{3\pi/2\omega} dt}$$

$$= \frac{\left[-\frac{I_m \cos\omega t}{\omega}\right]_{\pi/2\omega}^{3\pi/2\omega}}{[t]_{\pi/2\omega}^{3\pi/2\omega}} = -\frac{I_m}{\omega}\left[\cos\left(\frac{3\pi}{2\omega}\cdot\omega\right) - \cos\left(\frac{\pi}{2\omega}\cdot\omega\right)\right] \Big/ \left[\frac{3\pi}{2\omega} - \frac{\pi}{2\omega}\right]$$

$$= -\frac{I_m}{\omega}\left[0 - 0\right] \Big/ \frac{\pi}{\omega} = -\frac{I_m}{\pi}(0) = 0$$

$\boxed{I_{avg} = 0}$ Ans. or $\boxed{I_{avg} = 0 \times I_m}$

Ans. a

Solution: 5

$I_{rms} = 10$ amp

$I_{max} = \sqrt{2}\, I_{rms} = 10\sqrt{2}$ amp. $= 10 \times 1.414$

$\boxed{I_{max} = 14.14 \text{ amp}}$ Ans.

for 0 to max

$t = \frac{T}{4}$ & $T = \frac{2\pi}{\omega} = \frac{1}{f} = \frac{1}{50} = \frac{0.1}{5}$ sec

$T = 0.02$ sec

$t = \frac{0.02}{4} = \frac{2 \times 10^{-2}}{4} = 5 \times 10^{-3}$ sec

$\boxed{t = 5 \times 10^{-3} \text{ sec}}$ Ans.

Ans. d

Solution: 6

$$i = I_0\left(\frac{3t}{T} - 1\right)$$

$$I_{avg} = \frac{\int_{t_1}^{t_2} i\,dt}{\int_{t_1}^{t_2} dt} = \frac{\int_0^T I_0\left(\frac{3t}{T} - 1\right)dt}{\int_0^T dt} = \frac{I_0\left[\frac{3t^2}{2T} - t\right]_0^T}{T-0}$$

$$I_{avg} = \frac{I_0\left[\frac{3T^2}{2T} - T - 0\right]}{T} = \frac{I_0\left[\frac{3}{2}T - T\right]}{T} = \frac{1}{2}I_0$$

$$\boxed{I_{avg} = 0.5\, I_0}$$ Ans.

Ans. b

Solution: 7

$$I = I_0 \sin(2\pi n t)$$

for $I = I_{rms} = \frac{I_0}{\sqrt{2}}$

$$\frac{I_0}{\sqrt{2}} = I_0 \sin(2\pi n t)$$

$$\sin(2\pi n t) = \frac{1}{\sqrt{2}}$$

$$2\pi n t = \frac{\pi}{4}$$

$$\boxed{t = \frac{1}{8n}} \quad \text{Ans.}$$

Ans. d

Solution: 8

$$I = 3\sin(\omega t) + 4\cos(\omega t)$$

$$I_{max} = \sqrt{3^2 + 4^2} = \sqrt{25}$$

$$I_{max} = 5 \text{ Amp}$$

$$I_{rms} = \frac{I_{max}}{\sqrt{2}}$$

$$\boxed{I_{rms} = \frac{5}{\sqrt{2}}} \text{ Amp.}$$

Ans. c

Solution: 9

$$E_{max} = NBA\omega = 150 \times 0.15 \times (50 \times 10^{-4}) \times (2\pi \times 20)$$

$$\boxed{E_{max} = 14.14 \text{ V}} \quad \text{Ans.}$$

$$E_{rms} = \frac{E_{max}}{\sqrt{2}} = \frac{14.14}{\sqrt{2}}$$

$$\boxed{E_{rms} = 10 \text{ V}} \quad \text{Ans.}$$

Ans. d

Solution: 10

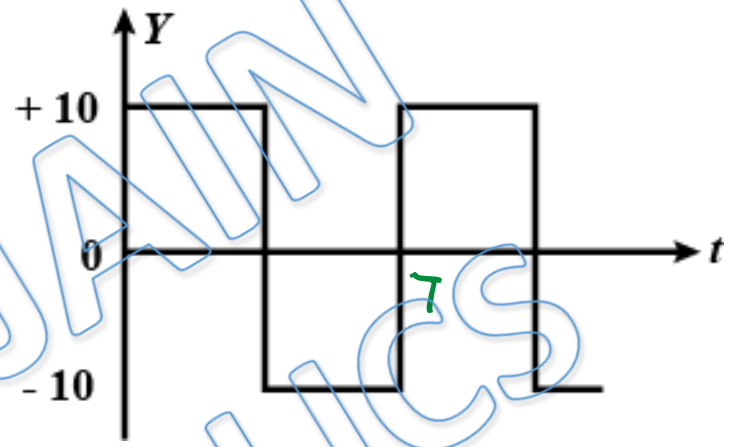
The average value of current can be zero because all positive and negative currents can cancel each other.

The average value of square of the current cannot be zero because after squaring the currents all becomes positive and cannot cancel each other.

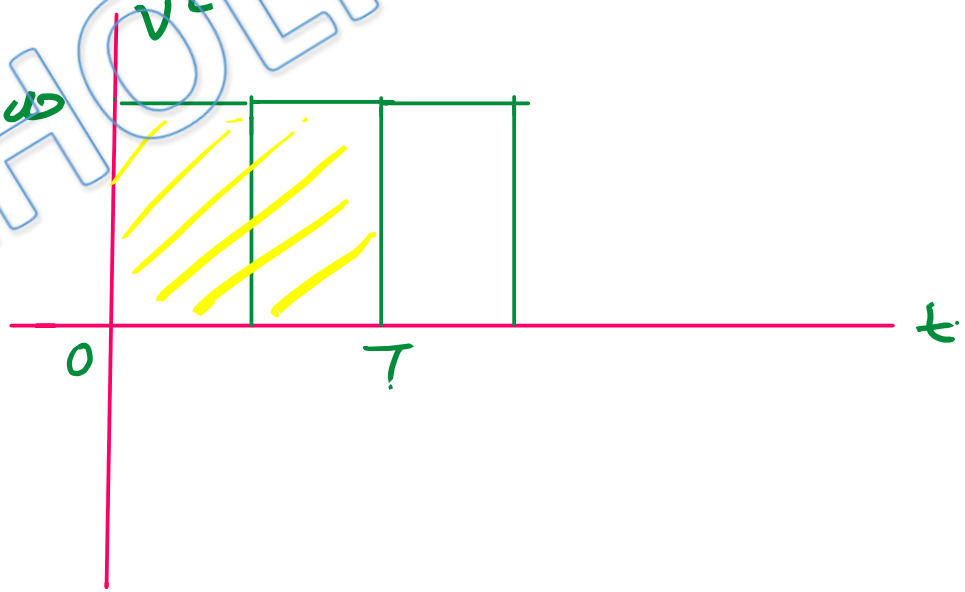
Ans. a

Solution: 11

$$V_{rms} = \sqrt{\frac{\int_0^T V^2\,dt}{\int_0^T dt}}$$



$$= \sqrt{\frac{(100 \times T)}{T}}$$



$$V_{rms} = 10 \text{ Volt}$$ Ans.

Ans. a

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