WEEKLY TEST MEDICAL PLUS - 01 R
SOLUTION Date 09 -02-2020

[PHYSICS]

1. D
2. C
3. B
4. C
5. D
6. B
7. A
8. D
9. The electromagnetic wave having the shortest wavelength is γ-rays.
10. The part of the spectrum of the electromagnetic radiation used to cook food is ultraviolet rays.
11. Velocity of light $= \sqrt{\mu\,\varepsilon}$, where, μ is permeability and ε is permittivity of the medium.
12. $$\frac{E_0}{B_0} = c$$
    Also, $k = \frac{2\pi}{\lambda}$ and $\omega = 2\pi\nu$
    These relation given $E_0\ k = B_0\omega$.
13. The wavelength of the γ-rays is shorter. However the main distinguishing feature is the nature of emission.
14. Speed of electromagnetic waves in vacuum
    $$= \frac{1}{\sqrt{\mu_0\ \varepsilon_0}} = \text{constant}$$
15. The electron placed in the path of electromagnetic wave will experience force due to electric field vector and not due to magnetic field vector.
16. In purely inductive circuit voltage leads the current by 90°.
17. We have $X_C = \frac{1}{C \times 2\pi f}$ and $X_L = L \times 2\pi f$
18. $$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C} \Rightarrow X_C \propto \frac{1}{f}$$
19. $$X_L = 2\pi\nu L = 2 \times \pi \times 50 \times \frac{1}{\pi} = 100\,\Omega$$

20.

$Z = \sqrt{R^2 + X_L^2}$, $X_L = \omega L$ and $\omega = 2\pi f$

$\therefore Z = \sqrt{R^2 + 4\pi^2 f^2 L^2}$

21.

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$= \sqrt{100^2 + \left(0.5 \times 100\pi - \frac{1}{10 \times 10^{-6} \times 100\pi}\right)^2}$$

$= 189.72\ \Omega$.

22.

At $A : X_C > X_L$

At $B : X_C = X_L$

At $C : X_C < X_L$

23.

$$X_L = 2\pi f L \Rightarrow X_L \propto f \Rightarrow \frac{1}{X_L} \propto \frac{1}{f}$$

i.e., graph between $\frac{1}{X_L}$ and f will be a hyperbola.

24.

From phasor diagram it is clear that current is lagging with respect to E_{rms}. This may be happen in LCR or LR circuit.

25.

$$\nu = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{10^{-6} \times 10^{-4}}} = \frac{10^5}{2\pi} Hz$$

26.

Reactance $X = X_L - X_C = 2\pi f L - \frac{1}{2\pi f C}$

27.

Phase angle $\tan\varphi = \frac{\omega L}{R} = \frac{2\pi \times 200}{300} \times \frac{1}{\pi} = \frac{4}{3}$

$\therefore\ \varphi = \tan^{-1}\frac{4}{3}$

28.

As explained in solution (1) for frequency $0 - f_r$, Z decreases hence $(i = V/Z)$, increases and for frequency $f_r - \infty$, Z increases hence i decrees.

29.

Frequency $= \frac{1}{2\pi\sqrt{LC}}$

So the combination which represents dimension of frequency is $\frac{1}{\sqrt{LC}} = (LC)^{-1/2}$

30.

Impedance of LCR circuit will be minimum at resonant frequency so $\nu_0 = \frac{1}{2\pi\sqrt{LC}}$

$$= \frac{1}{2\pi\sqrt{1\times10^{-3}\times0.1\times10^{-6}}} = \frac{10^5}{2\pi} Hz$$

31.

$R = 6 + 4 = 10\,\Omega$

$X_L = \omega L = 2000\times5\times10^{-3} = 10\Omega$

$X_C = \frac{1}{\omega C} = \frac{1}{2000\times50\times10^{-6}} = 10\Omega$

$\therefore Z = \sqrt{R^2 + (X_L - X_C)^2} = 10\Omega$

Amplitude of current $= i_0 = \frac{V_0}{Z} = \frac{20}{10} = 2A$

32.

$R = \frac{P}{i_{rms}^2} = \frac{240}{16} = 15\Omega$

$Z = \frac{V}{i} = \frac{100}{4} = 25\Omega$

Now $X_L = \sqrt{Z^2 - R^2} = \sqrt{(25)^2 - (15)^2} = 20\Omega$

$\therefore \quad 2\pi\nu L = 20 \Rightarrow L = \frac{20}{2\pi\times50} = \frac{1}{5\pi} Hz$

33.

At resonant frequency current in series LCR circuit is maximum.

34.

As the current i leads the voltage by $\frac{\pi}{4}$, it is an RC circuit, hence $\tan\varphi = \frac{X_C}{R} \Rightarrow \tan\frac{\pi}{4} = \frac{1}{\omega CR}$

$\Rightarrow \omega CR = 1$ as $\omega = 100$ rad/sec

$\Rightarrow CR = \frac{1}{100}\sec^{-1}$.

From all the given options only option (a) is correct.

35.

Power $= I^2 R = \left(\frac{I_p}{\sqrt{2}}\right)^2 R = \frac{I_p^2 R}{2}$

36.

Phase angle $\varphi = 90°$, so power $P = Vi\cos\varphi = 0$

37.

$$V_{rms} = \frac{200}{\sqrt{2}},\ i_{rms} = \frac{1}{\sqrt{2}}$$

$$\therefore P = V_{rms}\, i_{rms} \cos\varphi = \frac{200}{\sqrt{2}} \frac{1}{\sqrt{2}} \cos\frac{\pi}{3} = 50 \text{ watt}$$

38.

$$\because P = Vi\cos\varphi,\ \therefore P \propto \cos\varphi$$

39.

The instantaneous values of e.m.f. and current in inductive circuit are given by $E = E_0 \sin\omega t$ and $i = i_0 \sin\left(\omega t - \frac{\pi}{2}\right)$ respectively.

So, $P_{inst} = Ei = E_0 \sin\omega t \times i_0 \sin\left(\omega t - \frac{\pi}{2}\right)$

$$= E_0 i_0 \sin\omega t\left(\sin\omega t \cos\frac{\pi}{2} - \cos\omega t \sin\frac{\pi}{2}\right)$$

$$= E_0 i_0 \sin\omega t \cos\omega t$$

$$= \frac{1}{2} E_0 i_0 \sin 2\omega t (\sin 2\omega t = 2\sin\omega t \cos\omega t)$$

Hence, angular frequency of instantaneous power is 2ω.

40.

$$i_{WL} = i_{rms} \sin\varphi \Rightarrow \sqrt{3} = 2\sin\varphi \Rightarrow \sin\varphi = \frac{\sqrt{3}}{2}$$

$$\Rightarrow \phi = 60^\circ \text{ so p.f. } = \cos\varphi = \cos 60^o = \frac{1}{2}$$

41.

$$P = E_{rms} i_{rms} \cos\varphi = \frac{E_0}{\sqrt{2}} \times \frac{i_0}{\sqrt{2}} \times \frac{R}{Z}$$

$$\Rightarrow \frac{E_0}{\sqrt{2}} \times \frac{E_0}{Z\sqrt{2}} \times \frac{R}{Z} \Rightarrow P = \frac{E_0^2 R}{2Z^2}$$

Given $X_L = R$ so, $Z = \sqrt{2}R \Rightarrow P = \frac{E_0^2}{4R}$

42.

$$\tan\phi = \frac{X_L}{R} = \frac{X_C}{R} \Rightarrow \tan 60^o = \frac{X_L}{R} = \frac{X_C}{R}$$

$$\Rightarrow X_L = X_C = \sqrt{3}\, R$$

i.e., $Z = \sqrt{R^2 + (X_L - X_C)^2} = R$

So average power $P = \frac{V^2}{R} = \frac{200 \times 200}{100} = 400\text{ W}$

43.

$$P = E_v I_v \cos\phi; P = E_v \frac{E_v}{R}\frac{R}{Z}$$

$$P = \frac{E_v^2 R}{Z^2} = \frac{110 \times 110 \times 11}{22 \times 22} W = 275\,\text{W}.$$

44.

With DC : $P = \frac{V^2}{R} \Rightarrow R = \frac{(10)^2}{20} = 5\,\Omega$;

With AC : $P = \frac{V_{rms}^2 R}{Z^2} \Rightarrow Z^2 = \frac{(10)^2 \times 5}{10} = 50\,\Omega^2$

Also $Z^2 = R^2 + 4\pi^2 v^2 L^2$

$\Rightarrow 50 = (5)^2 + 4(3.14)^2 v^2 (10 \times 10^{-3})^2 \Rightarrow v = 80$ Hz.

45.

$$P = \frac{1}{2} V_0 i_0 \cos\varphi \Rightarrow 1000 = \frac{1}{2} \times 200 \times i_0 \cos 60^o$$

$$\Rightarrow i_0 = 20\,\text{A} \Rightarrow i_{rms} = \frac{i_0}{\sqrt{2}} = \frac{20}{\sqrt{2}} = 10\sqrt{2}A.$$

[CHEMISTRY]

53. **(a)** $n = 4$ ∴ Fe^{2+}

If BM = $\sqrt{24}$ = $\sqrt{4(4+2)}$

number of unpaired e = 4

Then Fe must have +2 charge

57. **(d)** Ni^{2+} and Ti^{3+} ions are coloured in aqueous solution because they contain unpaired electrons.

58. **(b)** $_{30}Zn$ $[Ar]^{18}$ $3d^{10}$, so $n = 0$; Fe^{2+} $[Ar]^{18}$ $3d^6$, so $n = 4$; Ni^{2+} $[Ar]^{18}$ $3d^8$, so $n = 2$; Cu^{2+} [Ar]18 $3d^9$, so $n = 1$.

72. **(d)** Cuprous ion (Cu^+) $3d^{10}$ Completely filled d subshell

$3d^{10}$

↑↓	↑↓	↑↓	↑↓	↑↓

No. unpaired $d - e^{-1}$

Cupric ion Cu^{+2}

$3d^9$

↑↓	↑↓	↑↓	↑↓	↑

1. unpaired $d - e^{-1}$

73. **(c)** The ability of d-block element to form is due to the small and highly charged ions and vacant low energy orbital to accept lone pair electrons from ligands