PHYSICS

11. (4)
12. (1)
13. (3)

$$(i_d)_{max} = (i_c)_{max} = i_0 = \frac{\varepsilon_0}{Z}$$

$$= \frac{200\sqrt{2}}{\sqrt{100^2 + 100^2}} = 2.2 \text{ A}$$

14. (3)

$$I = \frac{1}{2}\varepsilon_0 E_0^2 c \quad I = E_{rms}^2 \varepsilon_0 c$$

$$I = (100)^2 \times 8.85 \times 10^{-12} \times 3 \times 10^8$$

$$I = 26.5 \text{ W m}^{-2}$$

15. (1)

Energy density of an electromagnetic wave in electric field,

$$U_E = \frac{1}{2}\varepsilon_0 E^2 \quad \dots \text{(i)}$$

Energy density of an electromagnetic wave in magnetic field,

$$U_B = \frac{B^2}{2\mu_0} \quad \dots \text{(ii)}$$

where, E = electric field,

B = magnetic field,

ε_0 = permittivity of medium and

μ_0 = magnetic permeability of medium.

From the theory of electro-magnetic waves, the relation between μ_0 and ε_0 is

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} \quad \dots \text{(iii)}$$

where, c = velocity of light

$= 3 \times 10^8$ m s^{-1} and

$$\frac{E}{B} = c \quad \dots \text{(iv)}$$

Dividing Eq. (i) by Eq. (ii), we get

$$\frac{U_E}{U_B} = \frac{\frac{1}{2}\varepsilon_0 E^2}{\frac{1}{2}B^2 \times \frac{1}{\mu_0}} = \frac{\mu_0 \varepsilon_0 E^2}{B^2} \quad \dots \text{(v)}$$

Using Eqs. (iii), (iv) and (v), we get

$$\frac{U_E}{U_B} = \frac{c^2}{c^2} = 1$$

Therefore, $U_E = U_B$

16. (1)

As, we know energy liberated, $E = \frac{hc}{\lambda}$

i.e., $E \propto \frac{1}{\lambda}$. So, lesser the wavelength, than greater will be energy liberated by electromagnetic radiations per quantum.

As, order of wavelength is given by X-ray, VIBGYOR, Radio waves (3) (1) (2) (4). Therefore, order of electromagnetic radiations per quantum. $\Rightarrow D < B < A < C$

17. (4)

(1) Infrared rays are used to treat muscular strain.

(2) Radiowaves are used for broadcasting purposes.

(3) X-rays are used to detect fracture of bones.

(4) Ultraviolet rays are absorbed by ozone.

18. (3)

In vacuum, $\varepsilon_0 = 1$; In medium, $\varepsilon = 4$

$\therefore$ Refractive index, $\mu = \sqrt{\frac{\varepsilon}{\varepsilon_0}} = \sqrt{\frac{4}{1}} = 2$

Wavelength, $\lambda' = \frac{\lambda}{\mu} = \frac{\lambda}{2}$

and wave velocity, $v = \frac{c}{\mu} = \frac{c}{2} \quad \left[\because \mu = \frac{c}{v}\right]$

Hence, it is clear that wavelength and velocity will become half but frequency remains unchanged when the wave is passing through any medium.

19. (1)

The spectrum of electromagnetic waves stretches over an infinite range of wavelengths, from 10^{-12} m to 10^6 m, least wavelength being of gamma rays from 10^{-10} m to 10^{-14} m (γ has highest frequency).

20. (4)

According to Faraday's law of electromagnetic induction,

Induced emf, $e = \frac{L di}{dt} \Rightarrow 50 = L\left(\frac{5-2}{0.1 \text{ s}}\right)$

$$\Rightarrow L = \frac{50 \times 0.1}{3} = \frac{5}{3} = 1.67 \text{ H}$$