# Electromagnetic Waves

## ANSWERS

**1.** The increase in frequency of a.c., will decrease the reactance of the capacitor [$X_c = 1/(2\pi \upsilon C)$] and hence will increase the conduction current. Since the displacement current is equal to the conduction current, therefore, the displacement. current will increase with the increase in frequency of a.c.

**2.** From the property of continuity, (a) conducting current equals to displacement currents. During charging up process, there is a conduction current in connecting wires and equivalent displacement current in the region between the two plates of capacitor.

(b) After the capacitor gets fully charged, the conduction current in the connecting wires becomes zero. Now displacement current in a region between the two plates is also zero due to property of continuity.

**3.** No, the displacement current also produces magnetic field between the two plates of capacitor during charging or discharging of capacitor.

**4.** When capacitor is fully charged, let $q$ be the charge on the plate of capacitor, which is constant. Electric flux through the plates of capacitor,

$$\phi_E = \frac{q}{\varepsilon_0} = a\,constant$$

Displacement current,

$$I_D = \varepsilon_0 \frac{d\phi_E}{dt} = E_0 \frac{dq}{dt} = 0$$

Let $C$ be the capacitance, $V$ be the potential difference between two plates of capacitor. When capacitor is fully charged then $q = CV$

$$I = \frac{dq}{dt} = \frac{d(CV)}{dt} = C\frac{dV}{dt} = 0$$

**5.** Light is an electromagnetic wave do not require any material medium for their propagation. So, light can travel through vacuum. Sound is a mechanical wave, it requires a material medium for its propagation. So, sound can not travel in vacuum.

**6.** As, $\lambda = \dfrac{c}{\upsilon} = \dfrac{3\times10^8}{6\times10^{12}} = 5\times10^{-5}\,m$.

**7.** Pressure exerted by reflected wave on surface is

$$P = \frac{2I}{c} = \frac{2\times1}{3\times10^8} = 6.67\times10^{-9}\,N/m^2.$$

**8.** If the earth did not have atmosphere, the average surface temperature of earth will be lower, because there will be no green house effect in the absence of atmosphere.

**9.** Eye is most sensitive for $\lambda = 5600\,\text{Å}$

Time period, $T = \dfrac{1}{\upsilon} = \dfrac{\lambda}{c} = \dfrac{5600\times10^{-10}}{3\times10^8} = 1.87\times10^{-15}\,s.$