**CL2_Q1: What is the fundamental difference between the integral and the differential form of Maxwell's equations?**

**Answer**

Integral form of Maxwell's equations apply to a large region of space and many a times it is very difficult to calculate terms like ʃE.dS, ʃE.dl, ʃB.dS and ʃB.dl. Only if E and B are constants or make constant angles with lines and surfaces, then these integrals can be calculated. It is desirable to convert Maxwell's equations into the so called differential forms which apply to every point in space in contrast to the integral forms that apply to large regions of space.

**CL2_Q2: Which are the Maxwell's equations that contain 'sources'?**

**Answer**

- $\vec{\nabla}.\vec{E} = \frac{\rho}{\varepsilon_o}$
- $\vec{\nabla} x \vec{B} = \mu_o \vec{J} + \mu_o \varepsilon_o \frac{\partial \vec{E}}{\partial t}$

**CL2_Q3: How do Maxwell's equations describe electromagnetic waves?**

**Answer**

Using Maxwell's equations we can construct wave equations for both electric and magnetic fields as

$$\nabla^2 \vec{E} = \left(\frac{1}{c^2}\frac{\partial^2 \vec{E}}{\partial t^2}\right) \text{ and } \nabla^2 \vec{B} = \left(\frac{1}{c^2}\frac{\partial^2 \vec{B}}{\partial t^2}\right)$$

Maxwell concluded that they should be electric and magnetic vector in free space travelling at the speed of light $c = \sqrt{\frac{1}{\mu_o \varepsilon_o}}$

The electric and magnetic waves must therefore be representing light and hence Maxwell proposed that light could be treated as electromagnetic waves, where the electric and magnetic vectors are mutually perpendicular and perpendicular to the direction of propagation of the radiation.

**CL2_Q4: Discuss the phase correlation and direction of the E and B fields of an EM Wave.**

**Answer**

The electric field and the magnetic field are described by

$$E = E_0 \sin(\omega t - kx) \ \ and\ B = B_0 \sin(\omega t - kx).$$

There is no phase difference between them. However, they are perpendicular to each other.