# Chapter 12

## DUAL NATURE OF RADIATION Exercise

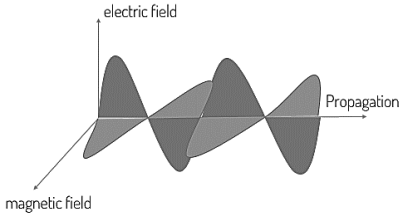
**Q.1** According to Maxwell's electromagnetic wave theory, light consists of electric and magnetic fields which are -

**(A)**Parallel to each other

**(B)**Perpendicular to each other

**(C)**Inclined at an angle of 45° to each other.

**(D)**None of these




**Q.2** The correct statement from the following is -

**(A)**Light exhibits particle nature in propagation and wave nature in mutual interaction with matter.

**(B)**Light exhibits both wave nature and particle nature in mutual interaction with matter.

**(C)**Light exhibits both wave nature and particle nature in propagation.

**(D)**Light exhibits wave nature in propagation and particle nature in mutual interaction with matter.

**Q.3** Consider the following statements and choose the correct option.

(**A**) Newton's corpuscular theory can explain reflection and refraction of light.

(**B**)Huygen 's wave theory can explain interference and diffraction of light.

**(A)**AandB are true. **(B)**A is true and B is false.

**(C)**A is false and B is true. **(D)**AandB are false.

**Q.4** Which of the following is not the characteristics of Planck's quantum theory of radiation?

**(A)**The energy is not absorbed or emitted in whole numbers or multiples of quantum.

**(B)**Radiation is associated with energy.

**(C)**Radiation energy is not emitted or absorbed continuously, but in the form of small packets called quanta

**(D)**The magnitude of energy associated with a quantum is proportional to the frequency.

**Q.5** Estimate how many visible light photons a $\mathbf{120\ W}$ light bulb emits per second. Assume the bulb has an efficiency of about$\mathbf{5}$%.($\boldsymbol{\lambda = 500\ nm}$ , $\mathbf{h = 6.63 \times 10^{-34}\ Joule - sec}$)

**(A)**$1.508 \times 10^{19}$ **(B)**$15.08 \times 10^{19}$ **(C)**$0.15 \times 10^{19}$ **(D)**$150.8 \times 10^{19}$

**Q.6** Monochromatic light of wavelength $\mathbf{3000\ \text{Å}}$ is incident on a surface area $\mathbf{4\ cm^2}$. If the intensity of light is $\mathbf{150\ mW/m^2}$, then the rate at which photons strike the target is

**(A)** $9 \times 10^{13}\ \text{sec}^{-1}$ **(B)** $18 \times 10^{12}\ \text{sec}^{-1}$ **(C)** $27 \times 10^{7}\ \text{sec}^{-1}$ **(D)** $36 \times 10^{13}\ \text{sec}^{-1}$

**Q.7** The equation $\mathbf{E = pc}$ is valid for

**(A)** Electron as well as a photon.
**(B)** For an electron but not for a photon.
**(C)** For a photon but not for an electron.
**(D)** Neither for an electron nor for a photon.

**Q.8** Find the ratio of de-Broglie wavelength of an $\boldsymbol{\alpha}$ −particle to that of a proton. The proton is subjected to double the strength of the magnetic field that of $\boldsymbol{\alpha}$ −particles so that the radii of their path are equal to each other. Assume the field induction $\vec{\mathbf{B}}$ perpendicular to the velocity vector of the $\boldsymbol{\alpha}$ −particle.

**(A)** 1:1 **(B)** 1:2 **(C)** 1:3 **(D)** 1:4

**Q.9** We wish to see inside the atom. Assuming the atom to have a diameter of **100 pm**, this means that one must be able to resolve a width of say **10 pm**. If an electron-microscope is used, the minimum electron energy required is about. (Assume the wavelength of light used in an electron microscope is nearly equal to the resolving power of the electron microscope.)

**(A)** 15 keV **(B)** 1.5 keV **(C)** 150 keV **(D)** 1.5 MeV

**Q.10** A proton and an alpha particle are accelerating by the same potential difference. Find the ratio of their de-Broglie wavelength?

$\left(\mathbf{charge}(q_\alpha) = +2e,\ q_{proton} = +e \ \mathbf{and}\ m_\alpha = 4m_{proton}\right)$

**(A)** $\sqrt{2}$ **(B)** $\sqrt{8}$ **(C)** $\sqrt{6}$ **(D)** $\sqrt{16}$

## ANSWER KEY

| Q. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Sol. | (B) | (D) | (A) | (A) | (A) | (A) | (C) | (A) | (A) | (B) |