Chapter 8

Electromagnetic Waves

(Assertion and Reason questions)

Directions: These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

Q.1. Assertion: Electromagnetic wave are transverse in nature.
Reason: The electric and magnetic fields in electromagnetic waves are perpendicular to each other and the direction of propagation.

Q.2. Assertion: Electromagnetic waves interact with matter and set up oscillations.
Reason: Interaction is independent of the wavelength of the electromagnetic wave.

Q.3. Assertion: Electromagnetic waves carry energy and momentum.
Reason: Electromagnetic waves can be polarised.

Q.4. Assertion: Electromagnetic waves exert radiation pressure.
Reason: Electromagnetic waves carry energy.

Q.5. Assertion: The electromagnetic wave is transverse in nature.
Reason: Electromagnetic wave propagates parallel to the direction of electric and magnetic fields.

Q.6. Assertion: The velocity of electromagnetic waves depends on electric and magnetic properties of the medium.
Reason: Velocity of electromagnetic waves in free space is constant.

Q.7. Assertion: The basic difference between various types of electromagnetic waves lies in their wavelength or frequencies.
Reason: Electromagnetic waves travel through vacuum with the same speed.

Q.8. Assertion: Microwaves are better carrier of signals than optical waves.
Reason: Microwaves move faster than optical waves.

Q.9. Assertion: Infrared radiation plays an important role in maintaining the average temperature of earth.
Reason: Infrared radiations are sometimes referred to as heat waves

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ANSWER KEY

Q.1 : (a) Transverse waves are those waves in which the particles of the medium oscillate perpendicular to the direction of wave propagation.

Q.2 : (c) Electromagnetic waves interact with matter via their electric and magnetic field which in oscillation of charges present in all matter. The detailed interaction and so the mechanism of absorption, scattering, etc. depend of the wavelength of the electromagnetic wave, and the nature of the atoms and molecules in the medium.

Q.3 : (b) Consider a plane perpendicular to the direction of propagation of the electromagnetic wave. If electric charges are present in this plane, they will be set and sustained in motion by the electric and magnetic fields of the electromagnetic wave. The charge thus acquired energy and momentum from the wave. This illustrate the fact that an electromagnetic wave like other waves carries energy and momentum.

Q.4 : (a) Electromagnetic waves have linear momentum as well as energy. This concludes that they can exert radiation pressure by falling beam of electromagnetic radiation on an object.

Q.5 : (c) This electromagnetic wave contains sinusoidally time varying electric and magnetic field which act perpendicular to each other as well as at right angle to the direction of propagation of waves, so electromagnetic waves are transverse in nature. Electromagnetic wave propagate in the perpendicular direction to both fields.

Q.6 : (b)

Q.7 : (a) The basic difference between various types of electromagnetic waves lies in their wavelengths or frequencies since all of them travel through vacuum with the same speed. Consequently, the waves differ considerably in their mode of interaction with matter.

Q.8 : (d) The optical waves used in optical fibre communication are better carrier of signals than microwaves. The speed of microwave and optical wave is the same in vacuum.

Q.9 : (b) Infrared radiation help to maintain the earth warmth through the greenhouse effect. Incoming visible light which passes relatively easily through the atmosphere is absorbed by the earth's surface and re-radiated as infrared radiation. The radiation is trapped by greenhouse gases such as carbon dioxide and water vapour and they heat up and heat their surroundings.