Electromagnetic Waves

1. The range of wavelength of the visible light is

(a) $10\,\overset{0}{\text{A}}$ to $100\,\overset{0}{\text{A}}$ (b) $4,000\,\overset{0}{\text{A}}$ to $8,000\,\overset{0}{\text{A}}$

(c) $8,000\,\overset{0}{\text{A}}$ to $10,000\,\overset{0}{\text{A}}$ (d) $10,000\,\overset{0}{\text{A}}$ to $15,000\,\overset{0}{\text{A}}$

2. The frequencies of X-rays, $\gamma-$rays and ultraviolet rays are respectively a, b and c. Then

(a) $a < b,\ b > c$ (b) $a > b,\ b > c$

(c) $a > b,\ b < c$ (d) $a < b,\ b < c$

3. Energy stored in electromagnetic oscillations is in the form of-

(a) Electrical Energy (b) Magnetic Energy (c) Both (a) and (b) (d) None of these

4. The oscillating electric and magnetic vectors of an electromagnetic wave are oriented along

(a) The same direction but differ in phase by 90^0

(b) The same direction and are in phase

(c) Mutually perpendicular directions and are in phase

(d) Mutually perpendicular directions and differ in phase by 90^0

5. An electromagnetic wave, going through vacuum described by $E = E_0 \sin(kx - \omega t)$. Which of following is independent of wavelength?

(a) k (b) ω (c) k/ω (d) $k\omega$

6. In a plane electromagnetic wave, the electric oscillates sinusoidal at a frequency of 2×10^{10} amplitude $48\ \text{Vm}^{-1}$. The wavelength of the wave is

(a) $24\times10^{-10}\,m$ (b) $1.5\times10^{-2}\,m$ (c) $4.16\times10^{8}\,m$ (d) $3\times10^{8}\,m$

7. Which of the following electromagnetic waves have the longest wavelength?

(a) Heat waves (b) Light waves (c) Radio waves (d) Microwaves

8. In an electromagnetic wave, the average energy density associated with magnetic field is-

(a) $Li_0^2/2$ (b) $B^2/2\mu_0$ (c) $\mu_0 B^2/2$ (d) $\mu_0/2B^2$

9. The electromagnetic waves do not transport

(a) Energy (b) Charge (c) Momentum (d) Information

10. The velocity of light c measured by an observer moving with velocity equal to that of light in the direction of propagation of light is

(a) Zero (b) c (c) 2c (d) Uncertain

11. Total energy density of electromagnetic waves in vacuum is given by the relation:

(a) $\frac{1}{2}\cdot\frac{E^2}{\varepsilon_0}+\frac{B^2}{2\mu_0}$ (b) $\frac{1}{2}\varepsilon_0 E^2+\frac{1}{2}\mu_0 B^2$

(c) $\frac{E^2+B^2}{c}$ (d) $\frac{1}{2}\varepsilon_0 E^2+\frac{B^2}{2\mu_0}$

12. Energy of electromagnetic waves is due to their

(a) Wavelength (b) Frequency

(c) Electric and Magnetic Field (d) None of the above

13. Dimensions of $\varepsilon_0\frac{d\phi_E}{dt}$ are

(a) Charge (b) Potential (c) Capacitance (d) Current

14. The conduction current is same as displacement current when source is

(a) AC only (b) DC only

(c) Both AC and DC (d) Neither for DC nor AC

15. What is the cause of "Green house effect"?

(a) Infrared rays (b) Ultraviolet rays

(c) X-rays (d) Radio waves

16. The theory of electromagnetic waves predicted by Maxwell in 1888 was confirmed experimentally first by

(a) Maxwell (b) Hertz (c) Marconi (d) J.C.Bose

17. The conduction current ideal case through a circuit is zero when a charge on capacitor is

(a) Zero (b) Maximum

(c) Any transient value (d) Depends on capacitor used

18. If ε_0 and μ_0 are respectively the electric permittivity and magnetic permeability of free space, ε and μ are the corresponding quantities in a medium the index of refraction of the medium is

(a) $\sqrt{\frac{\varepsilon_0\mu_0}{\varepsilon\mu}}$ (b) $\sqrt{\frac{\varepsilon\mu}{\varepsilon_0\mu_0}}$

(c) $\sqrt{\frac{\varepsilon_0\mu}{\varepsilon\mu_0}}$ (d) $\sqrt{\frac{\varepsilon}{\varepsilon_0}}$

19. The most penetrating radiation out of the following is

(a) $\gamma-$rays (b) $\alpha-$particles (c) $\beta-$rays (d) $X-$rays

20. Electromagnetic radiation of frequency n, of velocity c and wavelength λ in air, enters a glass slab of refractive index μ. The frequency, wavelength and velocity of radiation in glass slab will be, respectively

(a) $\frac{n}{\mu},\frac{\lambda}{\mu},c$ (b) $n,\lambda,\frac{c}{\mu}$

(c) $n,\frac{\lambda}{\mu},\frac{c}{\mu}$ (d) $\frac{n}{\mu},\frac{\lambda}{\mu},\frac{c}{\mu}$

21. The electromagnetic radiations are caused by

(A) Stationary Charges (B) Uniformly Moving Charges

(c) Accelerated Charges (d) All of these

22. Pick out the statement which is not true?

(a) Shorter wavelength UV radiation are beneficial to living tissue while longer wavelength are harmful.

(b) UV radiations have wavelength extending from 200 nm to 400 nm.

(c) UV radiations are used for sterilization of water.

(d) Sun is natural source of UV radiations.

23. Highest frequency waves are

(a) Microwaves (b) Infrared Rays

(c) Ultraviolet Rays (d) None of these

24. The wavelength of X-rays is of the order of

(a) 1 fermi (b) $1\overset{0}{A}$ (c) 1 mm (d) 1 micron

25. Assertion: Displacement current decreases with the increase in frequency of AC supplied to a capacitor.

Reason: Reactance due to capacitance is inversely proportional to the frequency of AC.

A) If both assertion and reason are true and reason is the correct explanation of assertion.

(B) If both assertion and reason are true but reason is not the correct explanation of assertion.

(C) If assertion is true but reason is false.

(D) If assertion is false but reason is true.

(a) A (b) B (c) C (d) D

26. Assertion: In an electromagnetic wave, magnitude of magnetic field vector $\vec{B}$ is much smaller than the magnitude of vector $\vec{E}$.

Reason: This is because in an electromagnetic wave $E/B = c = 3\times10^8\ m/s$.

A) If both assertion and reason are true and reason is the correct explanation of assertion.

(B) If both assertion and reason are true but reason is not the correct explanation of assertion.

(C) If assertion is true but reason is false.

(D) If assertion is false but reason is true.

(a) A (b) B (c) C (d) D

27. Assertion: The velocity of all electromagnetic waves in vacuum is different.
Reason: The different electromagnetic waves are of different frequencies.
A) If both assertion and reason are true and reason is the correct explanation of assertion.
(B) If both assertion and reason are true but reason is not the correct explanation of assertion.
(C) If assertion is true but reason is false.
(D) If assertion is false but reason is true.
(a) A (b) B (c) C (d) D

28. Assertion: The electromagnetic waves are transverse in nature.
Reason: They can be polarized.
A) If both assertion and reason are true and reason is the correct explanation of assertion.
(B) If both assertion and reason are true but reason is not the correct explanation of assertion.
(C) If assertion is true but reason is false.
(D) If assertion is false but reason is true.
(a) A (b) B (c) C (d) D

29. Assertion: Accelerated charge radiates electromagnetic waves.
Reason: As the wave propagate through the space, the oscillating electric and magnetic field regenerate each other.
A) If both assertion and reason are true and reason is the correct explanation of assertion.
(B) If both assertion and reason are true but reason is not the correct explanation of assertion.
(C) If assertion is true but reason is false.
(D) If assertion is false but reason is true.
(a) A (b) B (c) C (d) D

30. Assertion: In an electromagnetic wave, magnitude of magnetic field vector is much smaller than the magnitude of electric field vector.

Reason: Energy of electromagnetic waves is shared equally by the electric and magnetic fields.

A) If both assertion and reason are true and reason is the correct explanation of assertion.

(B) If both assertion and reason are true but reason is not the correct explanation of assertion.

(C) If assertion is true but reason is false.

(D) If assertion is false but reason is true.

(a) A (b) B (c) C (d) D

31. Instantaneous displacement current of 1.0 A in the space between the parallel plates of $1\ \mu F$ capacitor can be established by changing potential difference of

(a) $10^{-6}\ V/s$ (b) $10^{6}\ V/s$ (c) $10^{-8}\ V/s$ (d) $10^{8}\ V/s$

32. The magnetic field between he plates of radius 12 cm separated by distance of 4 mm of a parallel plate capacitor of capacitance 100 pF along the axis of plates having conduction current of 0.15 A is

(a) Zero (b) 1.5 T (c) 15 T (d) 0.15 T

33. In an apparatus, the electric field was found to oscillate with amplitude of 18 V/m. The magnitude of the oscillating magnetic field will be

(a) $4\times10^{-6}\ T$ (b) $6\times10^{-8}\ T$

(c) $9\times10^{-9}\ T$ (d) $11\times10^{-11}\ T$

34. A point source of electromagnetic radiation has an average power output of 800 W. The maximum value of electric field at a distance 4.0 m from the source is:

(a) 64.7 V/m

(b) 57.8 V/m

(c) 56.72 V/m

(d) 54.77 V/m

35. Maxwell's equation $\int \vec{B}.\vec{ds} = 0$ is a statement of

a) Faraday's law of induction

b) Modified Ampere's law

c) Gauss's law of electricity

d) Gauss's law of magnetism

Key

1) b	52 a	3) c	4) c	5) c	
6) b	7) b	8) c	9) 2	10) b	11) d
12) c	13) d	14) c	15) a	16) b	17) b
18) b	19) a	20) c	21) c	22) a	23) c
24) b	25) d	26) a	27) d	28) a	29) a
30) b	31) b	32) a	33) b	34) d	35) d

Solutions

6. $\lambda = \frac{c}{f} = \frac{3.0\times10^{8}}{2.0\times10^{10}} = 1.5\times10^{-2}\,m$

31. $\frac{Q}{E} = \frac{CV}{t}$ Or $i_d = C\left(\frac{V}{t}\right)$

Or $\frac{V}{t} = \frac{i_d}{C} = \frac{1.0}{10^{-6}} = 10^{6}\ \text{V/s}$

32. As $B \propto r$, since the point is on the axis, where r = 0, so B = 0.

33. Here, $E_0 = 18\ V/m$, $B_0 = ?$

$\therefore \quad B_0 = \frac{E_0}{c} = \frac{18}{3\times10^{8}} = 6\times10^{-8}\ T$

34. Intensity of electromagnetic wave is

$$I = \frac{P_{av}}{2\pi r^2} = \frac{E_0^2}{\mu_0 c}$$

Or $E_0 = \sqrt{\frac{\mu_0 C P_{av}}{2\pi r^2}} = \sqrt{\frac{\left(4\pi\times10^{-7}\right)\times\left(3\times10^{8}\right)\times800}{2\pi\times(4)^2}}$

= 54.77 V/m.