Electromagnetic waves Assignment

1. A parallel plate capacitor of plate separation 2 *mm* is connected in an electric circuit having source voltage 400 *V*. if the plate area is 60 cm^2, then the value of displacement current for 10^{-6} sec will be

(a) 1.062 *amp* (b) 1.062×10^{-2} *amp* (c) 1.062×10^{-3} *amp* (d) 1.062×10^{-4} *amp*

2. A long straight wire of resistance *R*, radius *a* and length *l* carries a constant current *I*. The Poynting vector for the wire will be

(a) $\frac{IR}{2\pi al}$ (b) $\frac{IR^2}{al}$ (c) $\frac{I^2R}{al}$ (d) $\frac{I^2R}{2\pi al}$

3. In an electromagnetic wave, the amplitude of electric field is 1 *V/m*. the frequency of wave is 5×10^{14} *Hz*. The wave is propagating along *z*-axis. The average energy density of electric field, in *Joule*/m^3, will be

(a) 1.1×10^{-11} (b) 2.2×10^{-12} (c) 3.3×10^{-13} (d) 4.4×10^{-14}

4. To establish an instantaneous displacement current of 2*A* in the space between two parallel plates of 1μF capacitor, the potential difference across the capacitor plates will have to be changed at the rate of

(a) 4×10^4 V/s (b) 4×10^6 V/s (c) 2×10^4 V/s (d) 2×10^6 V/s

5. A laser beam can be focussed on an area equal to the square of its wavelength *A He-Ne* laser radiates energy at the rate of 1*mW* and its wavelength is 632.8 *nm*. The intensity of focussed beam will be

(a) 1.5×10^{13} W/m^2 (b) 2.5×10^9 W/m^2 (c) 3.5×10^{17} W/m^2 (d) None of these

6. An electric field of 300 *V/m* is confined to a circular area 10 *cm* in diameter. If the field is increasing at the rate of 20 *V/m-s*, the magnitude of magnetic field at a point 15*cm* from the centre of the circle will be

(a) 1.85×10^{-15} T (b) 1.85×10^{-16} T (c) 1.85×10^{-17} T (d) 1.85×10^{-18} T

7. A lamp emits monochromatic green light uniformly in an directions. The lamp is 3% efficient in converting electrical power to electromagnetic waves and consumes 100*W* of power. The amplitude of the electric field associated with the electromagnetic radiation at a distance of 10*m* from the lamp will be

(a) 1.34 *V/m* (b) 2.68 *V/m* (c) 5.36 *V/m* (d) 9.37 *V/m*

8. 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*

9. A lamp radiates power P_0 uniformly in all directions, the magnitude of electric field strength E_0 at a distance *r* from it is

(a) $E_0=\frac{P_0}{2\pi\varepsilon_0 cr^2}$ (b) $E_0=\sqrt{\frac{P_0}{2\pi\varepsilon_0 cr^2}}$ (c) $E_0=\sqrt{\frac{P_0}{4\pi\varepsilon_0 cr^2}}$ (d) $E_0=\sqrt{\frac{P_0}{8\pi\varepsilon_0 cr}}$

10. The wave impedance of free space is

(a) Zero (b) 376.6 Ω (c) 33.66 Ω (d) 3.76 Ω

11. The transmitting antenna of a radio-station is mounted vertically. At a point 10 *km* due north of the transmitter the peak electric field is $10^{-3}\,Vm^{-1}$. The magnitude of the radiated magnetic field is

(a) 3.33×10^{-10} *T* (b) 3.33×10^{-12} *T* (c) 10^{-3} *T* (d) 3×10^5 *T*

12. A wave is propagating in a medium of electric dielectric constant 2 and relative magnetic permeability 50. The wave impedance of such a medium is

(a) 5 Ω (b) 376.6 Ω (c) 1883 Ω (d) 3776 Ω

13. If a source is transmitting electromagnetic wave of frequency 8.2×10^6 *Hz*, then wavelength of the electromagnetic waves transmitted from the source will be

(a) 36.6 *m* (b) 40.5 *m* (c) 42.3 *m* (d) 50.9 *m*

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

(a) 4×10^{-6} *T* (b) 6×10^{-8} *T* (c) 9×10^{-9} *T* (d) 11×10^{-11} *T*

15. According to Maxwell's hypothesis, a changing electric field gives rise to

(a) An e.m.f. (b) Electric current (c) Magnetic field (d) Pressure radiant

16. In an electromagnetic wave, the electric and magnetising fields are $100\ V\,m^{-1}$ and $0.265\ A\,m^{-1}$. The maximum energy flow is

(a) $26.5\ W/m^2$ (b) $36.5\ W/m^2$ (c) $46.7\ W/m^2$ (d) $765\ W/m^2$

17. The 21 *cm* radio wave emitted by hydrogen in interstellar space is due to the interaction called the hyperfine interaction is atomic hydrogen. the energy of the emitted wave is nearly

(a) 10^{-17} *Joule* (b) 1 *Joule* (c) 7×10^{-8} *Joule* (d) 10^{-24} *Joule*

18. TV waves have a wavelength range of 1-10 *meter*. Their frequency range in *MHz* is

(a) 30-300 (b) 3-30 (c) 300-3000 (d) 3-3000

19. The velocity of all radio waves in free space is $3\times10^8\ m/s$. The frequency of a radio wave of wavelength 150 *m*, is

(a) 45 *MHz* (b) 2 *MHz* (c) 2 *KHz* (d) 20 *KHz*

20. Maxwell's equations describe the fundamental laws of
(a) Electricity only (b) Magnetism only (c) Mechanics only (d) Both (a) and (b)

21. An electric charge moving with a uniform velocity has
(a) Only an electric field around it (b) Only a magnetic field around it
(c) Both electric and magnetic field around it (d) Neither an electric field nor a magnetic field around it

22. Which of the following rays has minimum frequency
(a) U.V. rays (b) *X*-rays (c) Microwaves (d) Infrared rays

23. Which one of the following electromagnetic radiations have the smallest wavelength
(a) Ultraviolet waves (b) *X*-rays (c) γ-rays (d) Microwaves

24. The oscillating electric and magnetic vectors of an electromagnetic wave are oriented along
(a) The same direction but differ in phase by 90° (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°

25. Energy of E.M. waves is due to their
(a) Wavelength (b) Frequency
(c) Electric and magnetic field (d) None of these

26. In which one of the following regions of the electromagnetic spectrum will the vibrational motion of molecules give rise to absorption
(a) Ultraviolet (b) Microwaves (c) Infrared (d) Radio waves

27. An electromagnetic wave travels along *z*-axis. Which of the following pairs of space and time varying fields would generate such a wave
(a) E_x, B_y (b) E_y, B_x (c) E_z, B_x (d) E_y, B_z

28. Which of the following rays has the maximum frequency
(a) Gamma rays (b) Blue light (c) Infrared rays (d) Ultraviolet rays

29. Radio waves of constant amplitude can be generated with
(a) FET (b) Filter (c) Rectifier (d) Oscillator

30. A signal emitted by an antenna from a certain point can be received at another point of the surface in the form of
(a) Sky wave (b) Ground wave (c) Sea wave (d) Both (a) and (b)

31. Speed *c* of E.M. waves through vacuum is given by
(a) $c = \sqrt{\mu_0 \varepsilon_0}$ (b) $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ (c) $c = \sqrt{\frac{\mu_0}{\varepsilon_0}}$ (d) $c = \sqrt{\frac{\varepsilon_0}{\mu_0}}$

32. Approximate height of ozone layer above the ground is
(a) 60 to 70 *km* (b) 59 *km* to 80 *km* (c) 70 *km* to 100 *km* (d) 100 *km* to 200 *km*

33. The electromagnetic waves do not transport
(a) Energy (b) Charge (c) Momentum (d) Information

34. An electromagnetic radiation of wavelength λ and frequency ν propagating in air with velocity *c*, is incident on a glass plate and is transmitted through. Which of the following statements is true for the wave inside the glass plate
(a) The velocity of wave remains *c* but wavelength changes
(b) The frequency ν and wavelength λ remain unchanged but the velocity changes
(c) The wavelength λ remain unchanged but frequency changes
(d) The frequency ν remains unchanged but the wavelength changes

35. An electric charge oscillating with a frequency of 1 *kilo* cycles/*second* can radiate electromagnetic waves of wavelength
(a) 100 *km* (b) 200 *km* (c) 300 *km* (d) 400 *km*

36. If a free electron is placed in the path of a plane electromagnetic wave, it will start moving along
(a) Centre of earth (b) Equator of earth (c) Magnetic field (d) Electric field

37. A plane electromagnetic wave is incident on a material surface. If the wave delivers momentum *p* and energy *E*, then
(a) $p = 0, E = 0$ (b) $p \neq 0, E \neq 0$ (c) $p \neq 0, E = 0$ (d) $p = 0, E \neq 0$

38. An electric field $\vec{E}$ and magnetic field $\vec{B}$ exist in a region. If these fields are not perpendicular to each other, then the electromagnetic wave
(a) Will not pass through the region (b) Will pass through region
(c) May pass through the region (d) Nothing is definite

39. Which of the following has zero average value in a plane electromagnetic wave
(a) Kinetic energy (b) Magnetic field (c) Electric field (d) Both (b) and (c)

40. In a plane E.M. wave, the electric field oscillates sinusoidal at a frequency of 2.0×10^{10} *Hz* and amplitude $48\ V\,m^{-1}$. The wavelength of the wave is
(a) $24 \times 10^{-10}\ m$ (b) $1.5 \times 10^{-2}\ m$ (c) $4.16 \times 10^{8}\ m$ (d) $3 \times 10^{8}\ m$

41. In electromagnetic wave, the average energy density is associated to
(a) Electric field only (b) Magnetic field only
(c) Equally with electric and magnetic fields (d) Average energy density is zero

42. A laser beam is sent to the moon and reflected back to earth by a mirror placed on the moon by an astronaut. If the moon is 384000 *km* from earth, how long does it take the light to make the round trip

(a) 5 *minutes* (b) 2.5 *minutes* (c) 2.5 *s* (d) 500 *s*

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

(a) k (b) ω (c) k/ω (d) $k\omega$

44. The energy contained in a small volume through which an electromagnetic wave is passing, oscillates with

(a) Zero frequency (b) One-fourth frequency of wave

(c) One-third frequency of wave (d) Double frequency of wave

45. (P-151) An electromagnetic wave going through vacuum is described by $E = E_0 \sin(kx - \omega t)$; $B = B_0 \sin(kx - \omega t)$. Which of the following equation is true

(a) $E_0 k = B_0 \omega$ (b) $E_0 \omega = B_0 k$ (c) $E_0 B_0 = \omega k$ (d) None of these

46. An *LC* resonant circuit contains a 400 *pF* capacitor and a 100 μH inductor. It is set into oscillation coupled to an antenna. The wavelength of the radiated electromagnetic waves is

(a) 377 *mm* (b) 377 *metre* (c) 377 *cm* (d) 3.77 *cm*

47. A brilliant arc lamp delivers a luminous flux of 100 *W* to a 1 cm^2 absorber. The force due to radiation pressure is

(a) 3.3×10^{-4} *N* (b) 16.5×10^{-7} *N* (c) 3.3×10^{-6} *N* (d) 3.3×10^{-7} *N*

48. Waves used for telecommunication are

(a) Visible light (b) Infrared (c) Ultraviolet (d) Microwaves

49. To double the covering range of a TV transmitter tower, its height should be made

(a) Two times (b) Four times (c) $\sqrt{2}$ times (d) 8 times

50. A radio receiver antenna that is 2 *m* long is oriented along the direction of the electromagnetic wave and receives a signal of intensity $5 \times 10^{-16} W/m^2$. The maximum instantaneous potential difference across the two ends of the antenna is

(a) 1.23 μV (b) 1.23 *mV* (c) 1.23 *V* (d) 12.3 *mV*