EXERCISE-I

BASIC EQUATIONS OF ELECTRICITYAND MAGNETISM

1. If E and B are the electric and magnetic field vectors of electromagnetic waves then the direction of propagation of electromagnetic wave is along the direction of:

(A) $\vec{E}$ (B) $\vec{B}$

(C) $\vec{E}\times\vec{B}$ (D) None of these

2. The charge on a parallel plate capacitor is varying as $q = q_0 \sin 2\pi nt$ The plates are very large and close together. Neglecting the edge effects, the displacement current through the capacitor is:

(A) $\frac{q}{\varepsilon_0 A}$

(B) $\frac{q_0}{\varepsilon_0}\sin 2\pi nt$

(C) $2\pi n q_0 \cos\pi nt$

(D) $\frac{2\pi n q_0}{\varepsilon_0}\cos 2\pi nt$

3. The value of magnetic field between plates of capacitor, at distance of 1m from centre where electric field varies by 10^{10} V/m/s will be:

(A) 5.56T (B) 5.56μT

(C) 5.56mT (D) 55.6nT

4. The electromagnetic waves do not transport:

(A) Energy (B) charge

(C) momentum (D) information

5. A capacitor is connected in an electric circuit. When key is pressed, the current in the circuit is:

(A) Zero

(B) Maximum

(C) any transient value

(D) depends on capacitor used

6. The magnetic field between the plates of a capacitor when r > R is given by:

(A) $\frac{\mu_0 I_D r}{2\pi R^2}$ (B) $\frac{\mu_0 I_D}{2\pi R}$

(C) $\frac{\mu_0 I_D}{2\pi r}$ (D) Zero

7. The magnetic field between the plates of a capacitor is given by $B = \frac{\mu_0 I r}{2\pi R^2}$:

(A) $r \geq R$ (B) $r \leq R$

(C) $r < R$ (D) $r = R$

8. A parallel plate capacitor consists of two circular plates each of radius 12 cm and separated by 5.0 mm. The capacitor is being charged by an external source. The charging is being charged and is equal to 0.15 A. The rate of change of potential difference between the plates will be:

(A) 8.173×10^7 V/s

(B) 7.817×10^8 V/s

(C) 1.873×10^9 V/s

(D) 3.781×10^{10} V/s

9. In the above problem, the displacement current is:

(A) 15A (B) 1.5A

(C) 0.15A (D) 0.015A

10. A parallel plate capacitor made to circular plates each of radius R = 6cm has capacitance C = 100pF. The capacitance is connected to a 230V A.C. supply with an angular frequency of 300 rad/s. The r.m.s. value of conduction current will be:

(A) 5.7μa (B) 6.3μA

(C) 9.6μA (D) 6.9μA

11. In the above problem, the displacement current will be:
(A) 6.9μA (B) 9.6μA
(C) 6.3μA (D) 5.7μA

12. In Q. 37, the value of B at a point 3 cm from the axis between the plates will be:
(A) 1.63×10^{-8}T (B) 1.63×10^{-9}T
(C) 1.63×10^{-10}T (D) 1.63×10^{-11}T

13. 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 15cm 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

14. A 100 pF capacitor is connected to a 230V, 50 Hz A.C. source. The r.m.s. value of conduction current will be:
(A) 7.2×10^{-6}A (B) 3.6×10^{-5}A
(C) 1.8×10^{-4}A (D) 0.9×10^{-3}A

CONCEPT OF DISPLACEMENT CURRENT

15. Displacement current is continuous:
(A) when electric field is changing in the circuit
(B) when magnetic field is changing in the circuit
(C) in both types of fields
(D) through wires and resistance only

16. Instantaneous displacement current 1A in the space between the parallel plates of 1μF capacitor can be established by changing the potential difference at the rate of:
(A) 0.1 V/s (B) 1 V/s
(C) 10^6 V/s (D) 10^{-6} V/s

17. The conduction current is the same as displacement current when the source is:
(A) A.C. only
(B) D.C. only
(C) Both A.C. and D.C.
(D) neither for A.C. nor for D.C.

18. The wave function (in S.I. units) for an electromagnetic wave is given as:
$\Psi(x, t) = 10^3 \sin\pi (3 \times 10^6 x - 9 - 10^{14} t)$
The speed of the wave as:
(A) 9×10^{14} m/s (B) 3×10^8 m/s
(C) 3×10^{16} m/s (D) 3×10^7 m/s

19. In the above problem, wavelength of the wave is:
(A) 666 nm (B) 666 Å
(C) 666μm (D) 6.66 nm

20. The displacement current flows in the dielectric of a capacitor
(A) becomes zero
(B) has assumed a constant value
(C) is increasing with time
(D) is decreasing with time

MAXWELL'S EQUATIONS AND ORENTZ FORCE

21. The Maxwell's four equations are written as:

(i) $\oint \vec{E}.\overrightarrow{ds} = \frac{q_0}{\varepsilon_0}$

(ii) $\oint \vec{B}.\overrightarrow{ds} = 0$

(iii) $\oint \vec{E}.\overrightarrow{dl} = \frac{d}{dt}\oint \vec{B}.\overrightarrow{ds}$

(iv) $\oint \vec{B}.\overrightarrow{ds} = \mu_0\varepsilon_0 \frac{d}{dt}\oint \vec{E}.\overrightarrow{ds}$

The equations which have sources of $\vec{E}$ and $\vec{B}$
(A) (i), (ii), (iii) (B) (i), (ii)
(C) (i) and (iii) (D) (i) and (iv)

22. Out of the above four equations which do not contain source field are:
(A) (i) and (ii) (B) (ii) only
(C) all of four (D) (iii) only

23. Out of four Maxwell's equations above, which one shows non-existence of monopoles?
(A) (i) and (iv) (B) (ii) only
(C) (iii) only (D) only

24. Which of the above Maxwell's equations shows that electric field lines do not form closed loops?
(A) (i) only (B) (ii) only
(C) (iii) only (D) (iv) only

25. In an electromagnetic wave the average energy density is associated with:
(A) electric field only
(B) magnetic field only
(C) equally with electric and magnetic fields
(D) average energy density is zero

26. In an electromagnetic wave the average energy density associated with magnetic field will be:
(A) $\frac{1}{2}LI^2$ (B) $\frac{B^2}{2\mu_0}$
(C) $\frac{1}{2}\mu_0 B^2$ (D) $\frac{1}{2}\frac{q}{B^2}$

27. In the above problem, the energy density associated with the electric field will be:
(A) $\frac{1}{2}CV^2$ (B) $\frac{1}{2}\frac{q^2}{C}$
(C) $\frac{1}{2}\frac{\varepsilon^2}{E}$ (D) $\frac{1}{2}\varepsilon_0 E^2$

EARTH'S ATMOSPHERE AND ELECTROMAGNETIC WAVES

28. If there were no atmosphere, the average temperature on earth surface would be:
(A) Lower (B) Higher
(C) same (D) 0^oC

29. In which part of earth's atmosphere is the ozone layer present?
(A) Troposphere (B) Stratosphere
(C) Ionosphere (D) Mesosphere

30. Kenneley's Heaviside layer lies between:
(A) 50Km to 80 Km
(B) 80Km to 400 Km
(C) beyond 110 Km
(D) beyond 250 Km

31. The ozone layer in earth's atmosphere is crucial for human survival because it:
(A) has ions
(B) reflects radio signals
(C) reflects ultraviolet ray
(D) reflects infra red rays

32. The frequency from 3×10^9 Hz to 3×10^{10} Hz:
(A) High frequency band
(B) Super high frequency band
(C) Ultra high frequency band
(D) High frequency band

33. Select wrong statement from the following Electromagnetic waves:
(A) are transverse
(B) travel with same speed in all media
(C) travel with the speed of light
(D) are produced by acceleration charge

34. Greenhouse effect keeps the earth surface:
(A) cold at night (B) dusty and cold
(C) warm at night (D) moist

ELECTROMAGNETIC SPECTRUM

35. The frequency from 3 to MHz is known as:
(A) Audio band
(B) Medium frequency band
(C) Very high frequency band
(D) High frequency band

36. The AM range of radio waves have frequency:
(A) less than 30 MHz
(B) More than 30 MHz
(C) less than 20000 Hz
(D) More than 20000 Hz

37. The waves related to telecommunication are:
(A) infra red (B) visible light
(C) microwaves (D) ultraviolet rays

38. Electromagnetic waves do not transport:
(A) energy (B) charge
(C) momentum (D) information

39. The nature of electromagnetic wave is:
(A) longitudinal
(B) longitudinal stationary
(C) transverse
(D) transverse stationary

40. The wave emitted by any atom or molecule must have some finite total length which is known as the coherence length. For sodium light, this length is 2.4cm. The number of oscillations in this length will be:
(A) 4.068×10^5 (B) 4.068×10^6
(C) 4.068×10^7 (D) 4.068×10^8

41. In the above problem, the coherence time will be:
(A) 8×10^{-8}s (B) 8×10^{-9}s
(C) 8×10^{-10}s (D) 8×10^{-11}s

42. A plane electromagnetic wave of frequency 40 MHz travels in free space in the X-direction. At some point and at some instant, the electric field $\vec{E}$ has its maximum value of 750 N/C in Y-direction. The wavelength of the wave is:
(A) 3.5 m (B) 5.5 m
(C) 7.5 m (D) 9.5 m

43. In the above problem, the period of the wave will be:
(A) 2.5 μs (B) 0.25 μs
(C) 0.025 μs (D) None of these

44. In Q. 40, the magnitude and direction of magnetic field will be:
(A) 2.5 μT in X-direction
(B) 2.5 μT in Y-direction
(C) 2.5 μT Z-direction
(D) none of these

45. In Q. 40, the angular frequency of e.m.f. wave will be:(in rad/s)
(A) $8\pi \times 10^7$ (B) $4\pi \times 10^6$
(C) $4\pi \times 10^5$ (D) $8\pi \times 10^4$

46. In Q. 40, the propagation constant of the wave will be:
(A) 8.38m^{-1} (B) 0.838m^{-1}
(C) 4.19m^{-1} (D) 0.419m^{-1}

47. The sun delivers 10^3 W/m^2 of electromagnetic flux to the earth's surface. The total power that is incident on a roof of dimensions 8m × 20m, will be:
(A) 6.4×10^3W (B) 3.4×10^4W
(C) 1.6×10^5W (D) None of these

48. In the above problem, the radiation force on the
(A) 3.33×10^{-5}N (B) 5.33×10^{-4} N
(C) 7.33×10^{-3} N (D) None of these

49. In Q. 45, the solar energy incident on the roof in 1 hour will be:
(A) 5.76×10^8J (B) 5.76×10^7J
(C) 5.76×10^6J (D) 5.76×10^5J

50. The sun radiates electromagnetic energy at the rate of 3.9×10^{26}W. Its radius is 6.96×10^8m. The intensity of sun light at the solar surface will be:
(A) 1.4×10^4 (B) 2.8×10^5
(C) 4.2×10^6 (D) 5.6×10^7

51. In the above problem, if the distance from the sun to the earth is 1.5×10^{11} m, then the intensity of sunlight on earth's surface will be-(in W/m^2)

(A) 1.38×10^3 (B) 2.76×10^4
(C) 5.52×10^5 (D) None of these

52. A laser beam can be focused on an area equal to the square of its wavelength. A He-Ne laser radiates energy at the rate of 1nW and its wavelength is 632.8 nm. The intensity of focused 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

53. A flood light is covered with a filter that transmits red light. The electric field of the emerging beam is represented by a sinusoidal plane wave:

$E_x = 36\sin(1.20 \times 10^7 z - 3.6 \times 10^{15} t)$ V/m

The average intensity of the beam will be:

(A) 0.86 W/m^2 (B) 1.72 W/m^2
(C) 3.44 W/m^2 (D) 6.88 W/m^2

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

55. In the above problem, the wavelength of the wave will be:

(A) 1.5m (B) 66.6m
(C) 1.5cm (D) 66.6cm

56. A plane electromagnetic wave of wave intensity 6W/m^2 strikes a small mirror of area 40 cm^2, held perpendicular to the approaching wave. The momentum transferred by the wave to the mirror each second will be:

(A) 6.4×10^{-7} kg–m/s
(B) 4.8×10^{-8} kg–m/s
(C) 3.2×10^{-9} kg–m/s
(D) 1.6×10^{-10} kg–m/s

57. In the above problem, the radiation force on the mirror will be:

(A) 6.4×10^{-7} N
(B) 4.8×10^{-8} N
(C) 3.2×10^{-9} N
(D) 1.6×10^{-10} N

58. In Q. 5, the energy density at a distance 3.5m from the source will be_
(in joule/m^3)

(A) 1.73×10^{-5} (B) 1.73×10^{-6}
(C) 1.73×10^{-7} (D) 1.73×10^{-8}

59. What should be the height of transmitting antenna if the T.V. telecast is to cover a radius of 128 km?

(A) 1560m (B) 1280m
(C) 1050m (D) 79m

60. The area to be covered for T.V. telecast is doubled, then the height of transmitting antenna (T.V. tower) will have to be:

(A) doubled
(B) halved
(C) quadrupled
(D) kept unchanged