GPLUS EDUCATION

Date :
Time : **PHYSICS**
Marks :

ELECTROMAGNETIC WAVES

Single Correct Answer Type

1. The curve drawn between velocity and frequency of a photon in vacuum will be
   a) Straight line parallel to frequency axis b) Straight line parallel to velocity axis
   c) Straight line passing through origin and making angle of 45° with frequency axis d) Hyperbola
2. The rms value of the electric field of the light coming from the sun is 720 NC^{-1}. The average total energy density of the Electromagnetic Wave is
   a) $4.58 \times 10^{-6}\ Jm^{-3}$ b) $6.37 \times 10^{-9}\ Jm^{-3}$ c) $81.35 \times 10^{-12}\ Jm^{-3}$ d) $3.3 \times 10^{-3} Jm^{-3}$
3. 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) $k\omega$
4. Velocity of Electromagnetic Waves in a medium depends upon
   a) Thermal properties of medium
   b) Mechanical and electrical properties of medium
   c) electrical and magnetic properties of the medium
   d) Mechanical and magnetic properties of the medium
5. A parallel plate capacitor is charged to60μC. Due to a radioactive source, the plate loss charge at the rate of $1.8 \times 10^{-8}\ Cs^{-1}$. The magnitude of displacement current is
   a) $1.8 \times 10^{-8}\ Cs^{-1}$ b) $3.6 \times 10^{-8} Cs^{-1}$ c) $4.1 \times 10^{-11} Cs^{-1}$ d) $5.7 \times 10^{-12}\ Cs^{-1}$
6. Clouds are contained in a layer from the earth's surface, which is called
   a) Troposphere b) Stratosphere c) Mesosphere d) Ionosphere
7. The electric field of an electromagnetic wave travelling through vacuum is given by the equation $E = E_0 \sin(kx - \omega t)$. The quantity that is independent of wavelength is
   a) $\frac{k}{\omega}$ b) $k\omega$ c) ω d) k
8. In a plane electromagnetic wave propagating in space has an electric field of amplitude $9 \times 10^3\ Vm^{-1}$, then the amplitude of the magnetic field is
   a) 2.7×10^{12} T b) 9.0×10^{-3} T c) 3.0×10^{-4} T d) 3.0×10^{-5} T
9. Molybdenum is used as a target element for the production of X-rays because it is
   a) Light and can easily defect electrons b) Light and can absorb electrons
   c) A heavy element with a high melting point d) An element having high thermal conductivity
10. A radiation of 200 W is incident on a surface which is 60% reflecting and 40% absorbing. The total force on the surface is
    a) 1.07×10^{-6}N b) 1.3×10^{-6}N c) 1.07×10^{-7}N d) 1.03×10^{-7}N
11. According to Maxwell's hypothesis, changing electric field gives rise to
    a) Magnetic field b) Pressure gradient c) Charge d) Voltage
12. Ozone layer blocks the radiations of wavelength
    a) Less than 3×10^{-7}m b) Equal to 3×10^{-7}m
    c) More than 3×10^{-7}m d) All of the above
13. A point source of Electromagnetic radiation has an average power output of 1500 W. The maximum value of electric field at a distance of 3 m from this source in Vm^{-1} is
    a) 500 b) 100 c) $\frac{500}{3}$ d) $\frac{250}{3}$

14. An expression for the magnetic field strength B at the point between the capacitor plates indicates in figure express B in terms of the rate of change of the electric field strength $ie, dE/dt$ between the plates
    a) $\frac{\mu_0 i}{2\pi r}$ b) $\frac{\varepsilon_0 \mu_0 r}{2} dE/dt$ c) Zero d) $\frac{\mu_0 i}{2r}$
15. The Electromagnetic theory of light failed to explain
    a) Photoelectric effect b) Polarization c) Diffraction d) Interference
16. A layer of ionosphere does not reflect waves with frequencies greater than 10 MHz; then maximum electron density in this layer is
    a) 1.23×10^{11} m^{-3} b) 1.23×10^{10} m^{-3} c) 12.3×10^{10} m^{-3} d) 1.23×10^{12} m^{-3}
17. A plane Electromagnetic Wave of frequency 30 MHz travels in free space along the x-direction. The electric field component of the wave at a particular point of space and time E=6 Vm^{-1} along y-direction. Its magnetic field component B at this point would be
    a) 2×10^{-8} T along z-direction b) 6×10^{-8} T along x-direction
    c) 2×10^{-8} T along y-direction d) 6×10^{-8} T along z-direction
18. The average value of electric energy density in an Electromagnetic Waves is (E_0 is peak value)
    a) $\frac{1}{2}\varepsilon_0 E_0^2$ b) $\frac{E_0^2}{2\varepsilon_0}$ c) $\varepsilon_0 E_0^2$ d) $\frac{1}{4}\varepsilon_0 E_0^2$
19. X-rays are produced by jumping of
    a) Electrons from lower to higher energy orbit of atom b) Electrons from higher to lower energy orbit of atom
    c) Protons from lower to higher energy orbit of nucleus d) Proton from higher to lower energy orbit of nucleus
20. The density of air at the top of mesosphere in comparison to that of near the earth's surface is
    a) 10^{-3}times b) 10^{-5} times c) 10^{3} times d) 10^{5} times
21. If 150 J of energy is incident on area 2 m^2. If $Q_r = 15$ J, coefficient of absorption is 0.6, then amount of energy transmitted is
    a) 50 J b) 45 J c) 40 J d) 30 J
22. The wavelength of infrared rays is of the order of
    a) 5×10^{-7}m b) 10^{-3}m c) Diverge more d) None of these
23. The speed of electromagnetic Wave in vacuum depends upon the source radiation. It
    a) Increases as we move from $\gamma - rays$ to radio waves
    b) Decreases as we move from $\gamma - rays$ to radio waves
    c) Is same for all of them
    d) None of the above
24. Consider the following two statements regarding a linearly polarized plane electromagnetic wave
    (i)Electric field and the magnetic field have equal average values
    (ii)Electric energy and the magnetic energy have equal average values
    a) (i)is true b) (ii)is true c) Both are true d) Both are false
25. The amplitude of the magnetic field part of a harmonic Electromagnetic Wave in vacuum is B_0=510 nT. What is the amplitude of the electric field part of the wave?
    a) 140 NC^{-1} b) 153 NC^{-1} c) 163 NC^{-1} d) 133 NC^{-1}
26. The temperature variation in the region of stratosphere lies from
    a) 290 K to 220 K b) 220 K to 280 K c) 220 K to 380 K d) 180 K to 700 K
27. A TV tower has a height of 100 m. How much population is covered by the TV broadcast if the average population density around the tower is 100 km^{-2} (radius of the earth= 6.37×10^6 m)
    a) 4 lakh b) 4 billion c) 40,000 d) 40 lakh
28. Radio wave diffract around building although light waves do not. The reason is that radio waves
    a) Travel with speed target than c b) Have much larger wavelength than light
    c) Carry news d) Are not electromagnetic waves

29. The maximum distance upto which TV transmission from a TV tower of height h can be received is proportional to
a) $h^{1/2}$ b) h c) $h^{3/2}$ d) h^2

30. The magnetic field between the plate of a capacitor where $r > R$ is given by (where r is the distance from the axis of plates and R is the radius of each plate of capacitor)
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

31. A radar sends the waves towards a distant object and receives the signal reflected by object. These waves are
a) Sound waves b) Light waves c) Radio waves d) Micro waves

32. Which of the following rays is emitted by a human body?
a) X-rays b) UV rays c) Visible rays d) IR rays

33. Which of the following relation is correct?
a) $\sqrt{\varepsilon_0}E_0 = \sqrt{\mu_0}B_0$ b) $\sqrt{\mu_0\varepsilon_0}E_0 = B_0$ c) $E_0 = \sqrt{\mu_0\varepsilon_0}B_0$ d) $\sqrt{\mu_0}E_0 = \sqrt{\varepsilon_0}B_0$

34. The frequency 1057 MHz of radiation arising from two close energy levels in hydrogen belongs to
a) Radio waves b) Infrared waves c) Micro waves d) $\gamma-$ rays

35. A circular ring of radius r is placed in a homogenous magnetic field perpendicular to the plane of the ring. The field B chnages with time according to the equation $B = kt$, where k is a constant and t is the time. The electric field in the ring is
a) $\frac{kr}{4}$ b) $\frac{kr}{3}$ c) $\frac{kr}{2}$ d) $\frac{k}{2r}$

36. A capacitor having a capacity of 2 pF. Electric field across the capacitor is changing with a value of 10^{12} Vs^{-1}. The displacement current is
a) 2 A b) 4 A c) 6 A d) 10 A

37. The magnetic field between the plate 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

38. If ε_0 and μ_0 represent the permittivity and permeability of vacuum and ε and μ represent the permittivity and permeability of medium, then refractive index of the medium is given by
a) $\sqrt{\frac{\mu_0\varepsilon_0}{\mu\varepsilon}}$ b) $\sqrt{\frac{\mu\varepsilon}{\mu_0\varepsilon_0}}$ c) $\sqrt{\frac{\mu}{\mu_0\varepsilon_0}}$ d) $\sqrt{\frac{\mu_0\varepsilon_0}{\mu}}$

39. X-ray are not used for radar purpose, because they are not
a) Reflected by target b) Partly absorbed by target
c) Electromagnetic waves d) Completely absorbed by target

40. If alpha, beta and gamma rays carry same momentum, which has the longest wavelength?
a) Alpha rays b) Beta rays
c) Gamma rays d) None, all have same wavelength

41. If the earth did not have atmosphere, its surface temperature on a day time would be
a) Higher b) Lower c) Same as now d) Not sure

42. Which is having minimum wavelength?
a) X-rays b) Ultraviolet rays c) γ-rays d) Cosmic rays

43. Which of the following shows green house effect?
a) Ultraviolet rays b) Infrared rays c) X-rays d) None of these

44. A charged particle with charge q enters a region of constant, uniform and mutually orthogonal fields $\mathbf{E}$ and $\mathbf{B}$ with a velocity $\mathbf{v}$ perpendicular to both $\mathbf{E}$ and $\mathbf{B}$, and comes out without any change in magnitude or direction of $\mathbf{v}$. Then
a) $\mathbf{v} = \mathbf{E} \times \mathbf{B}/B^2$ b) $\mathbf{v} = \mathbf{B} \times \mathbf{E}/B^2$ c) $\mathbf{v} = \mathbf{E} \times \mathbf{B}/E^2$ d) $\mathbf{v} = \mathbf{B} \times \mathbf{E}/E^2$

45. A perfectly reflecting mirror has an area of 1 cm^2 Light energy is allowed to fall on it for 1h at the rate of 10 Wcm^{-2}. The force that acts on the mirror is

a) 3.35×10^{-8}N b) 6.7×10^{-8}N c) 1.34×10^{-7}N d) 2.4×10^{-4}N

46. An electromagnetic radiation has an energy of 13.2 keV. Then the radiation belongs to the region of
a) Visible light b) Ultraviolet c) Infrared d) X-ray

47. Out of the following electromagnetic radiation, which has the shortest wavelength?
a) Radiowaves b) Infrared c) Ultraviolet d) X-rays

48. The fact that radiosignals reach the earth from outside the atmosphere, was discovered accidently by
a) K. G. Jansky b) Millikan c) Aryabhatta d) Prof. Kanu

49. For EM wave prorogating along x-axis, $E_{max} = 30\ \text{Vm}^{-1}$. what is maximum value of magnetic field?
a) 10^{-7} T b) 10^{-8} T c) 10^{-9} T d) 10^{-6} T

50. The ozone layer of the atmosphere lies in the region called
a) Troposphere b) Stratosphere c) Mesosphere d) Ionosphere

51. Maxwell in his famous equation of electromagnetism introduced the concept
a) AC current b) DC current c) Displacement current d) Impedance

52. The relation between electric field vector **E**, the displacement vector **D** and the polarization vector **P** for a dielectric placed in electric field **E** is given by
a) $\mathbf{P} = \varepsilon_0\mathbf{E} + \mathbf{D}$ b) $\mathbf{P} = \mathbf{D} + \mathbf{E}$ c) $\mathbf{D} = \varepsilon_0\mathbf{E} + \mathbf{P}$ d) $\mathbf{E} = \mathbf{D} + \mathbf{P}$

53. Electromagnetic Waves can be deflected by
a) Electric field only b) Magnetic field only
c) Both (a) and (b) d) None of these

54. A charged particles oscillates about its mean equilibrium position with a frequency of 10^9 Hz. Frequency of the Electromagnetic Waves produced by the oscillator is
a) 10 Hz b) 10^5 Hz c) 10^9 Hz d) 10^{10} Hz

55. A plane electromagnetic wave of intensity 10 Wm^{-2} strikes a small mirror of area 20 cm^2, held perpendicular to the approaching wave. The radiation force on the mirror will be
a) 6.6×10^{-11} N b) 1.33×10^{-11} N c) 1.33×10^{-10} N d) 6.6×10^{-10} N

56. What is order of energy of X-rays (E_X), radio waves (E_R) and microwave (E_M)?
a) $E_X < E_R < E_M$ b) $E_X < E_M > E_R$ c) $E_M > E_X > E_R$ d) $E_M < E_R < E_X$

57. The magnetic field of an Electromagnetic Wave is given by
$B_Y = 3 \times 10^{-7} \sin(10^3 x + 6.29 \times 10^{12} t)$.
The wavelength of the Electromagnetic Wave is
a) 6.28 cm b) 3.14 cm c) 0.63 cm d) 0.32 cm

58. Electric fields induced by changing magnetic fields are
a) Conservation b) Non-conservation
c) May be conservative or non-conservation depending on the conditions d) Nothing can be said

59. The correct sequence of the increasing wavelength of the given radiation sources is
a) Radioactive sources, X-ray tube, crystal oscillator, sodium vapour lamp b) Radioactive source, X-ray tube, sodium vapour lamp, crystal oscillator
c) X-ray tube, radioactive source, crystal oscillator, sodium vapour lamp d) X-ray tube, crystal oscillator, radioactive source, sodium vapour lamp

60. In a phase electromagnetic wave, the electric filed oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude 48 Vm^{-1}. The wavelength of the wave is
a) 24×10^{-10} m b) 1.5×10^{-2} m c) 4.16×10^8 m d) 3×10^8 m

61. Maxwell in his famous equation of electromagnetism introduced the concept of
a) AC current b) DC current
c) Displacement current d) Impedance

62. A lasser beam is sent to the moon and reflected back to earth by ay 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 min b) 2.5 min c) 2.5 s d) 500 s

63. The amplitude of electric field in a parallel beam of light of intensity 4 Wm^{-2} is
a) 40.5 NC^{-1} b) 45.5 NC^{-1} c) 50.5 NC^{-1} d) 55.5 NC^{-1}

64. The refractive index and the permeability of a medium are respectively 1.5 and 5 $\times$ $10^{-7}Hm^{-1}$. The relative permittivity of the medium is nearly
a) 25 b) 15 c) 81 d) 6

65. The energy of X-ray photon is 2200 eV. Its frequency would be
a) 5.3×10^{16} Hz b) 5.3×10^{17} Hz c) 5×10^{17} Hz d) 5×10^{16} Hz

66. According to Maxwell's hypothesis, a changing electric field gives rise to
a) An emf b) Electric current c) Magnetic field d) Pressure radiant

67. The shortest wavelength of X-rays emitted from an X-rays tube depends upon
a) Nature of the gas in the tube b) Voltage applied to tube
c) Current in the tube d) Nature of target of the tube

68. Hydrogen atom does not emit X-rays because
a) It has signal electron b) It has no neutron
c) It has single neutron d) Its energy levels are too close to each other

69. Assume that a lamp radiates power P uniformly in all directions. What is the magnitude of electric field strength at a distance r from the lamp?
a) $\frac{P}{\pi c \varepsilon_0 r^2}$ b) $\frac{P}{2\pi c \varepsilon r^2}$ c) $\sqrt{\frac{P}{2\pi \varepsilon_0 r^2 c}}$ d) $\sqrt{\frac{P}{\pi \varepsilon_0 c r^2}}$

70. The waves which have revolutionized telecommunication in more recent time, are
a) Micro wave b) Radio waves c) Light waves d) TV waves

71. If v_s, v_x and v_m are the speeds of gamma rays, X-rays and microwaves respectively in vacuum, then
a) $v_s > v_x > v_m$ b) $v_s < v_x < v_m$ c) $v_s < v_x < v_m$ d) $v_s = v_x = v_m$

72. Electromagnetic Waves of frequencies higher than $9\sqrt{2}$ MHz are found to be reflected by the ionosphere on a particular day at a place. The maximum electron density in the ionosphere is
a) $\sqrt{5} \times 10^{12}$ m^{-3} b) $\sqrt{2} \times 10^{12}$ m^{-3} c) 2×10^{12} m^{-3} d) 5×10^{12} m^{-3}

73. Given the wavefunction (in SI units) for a wave to be $\psi_{(x,t)} = 10^3 \sin\pi(3 \times 10^6\, x - 9 \times 10^{14}\, t)$ The speed of the wave is
a) 9×10^{14} ms^{-1} b) 3×10^8 ms^{-1} c) 3×10^6 ms^{-1} d) 3×10^7 ms^{-1}

74. The wave of wavelength 5900 Å 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 2.4 cm. The number of oscillations in this length will be
a) 4.068×10^8 b) 4.068×10^7 c) 4.068×10^6 d) 4.068×10^5

75. If c is the speed of Electromagnetic Waves in vacuum, its speed in a medium of dielectric constant K and relative permeability μ, is
a) $v = \frac{1}{\sqrt{\mu_r, K}}$ b) $v = c\sqrt{\mu_{r_c} K}$ c) $v = \frac{c}{\sqrt{\mu_r, K}}$ d) $v = \frac{K}{\sqrt{\mu_r, c}}$

76. Dimensions of $\frac{1}{\mu_0 \varepsilon_0}$, where symbols have their usual meanings, are
a) $[L^{-1}T]$ b) $[L^{-2}T^2]$ c) $[L^2T^{-2}]$ d) $[LT^{-1}]$

77. The magnetic field between the 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

78. 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

79. A radio wave of frequency 90 MHz enters a ferrite rod. If $\varepsilon_r = 10^3$ and $\mu_r = 10$, then the velocity and

wavelength of the wave in ferrite are

a) 3×10^8 ms^{-1}; 3.33×10^{-2} m b) 3×10^6 ms^{-1}; 3.33×10^{-2} m

c) 3×10^8 ms^{-1}; 3.33×10^{-1} m d) 3×10^7 ms^{-1}; 3.33×10^{-3} m

80. According to Maxwell's equation the velocity of light in any medium is expressed as

a) $\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ b) $\frac{1}{\sqrt{\mu\varepsilon}}$ c) $\sqrt{\mu/\varepsilon}$ d) $\sqrt{\frac{\mu_0}{\varepsilon}}$

81. The sun delivers 10^3 Wm^{-2} of Electromagnetic flux on the earth's surface. The total power that is incident on a roof of dimensions 6m × 30m,is

a) 1.8×10^5 W b) 7.2×10^5 W c) 0.9×10^5 W d) 4.5×10^5 W

82. If μ_0 is permeability of free space and ε_0 is permittivity of free space, the speed of light in vacuum is given by

a) $\sqrt{\mu_0 \varepsilon_0}$ b) $\sqrt{\frac{\mu_0}{\varepsilon_0}}$ c) $\sqrt{\frac{1}{\mu_0 \varepsilon_0}}$ d) $\sqrt{\frac{\varepsilon_0}{\mu_0}}$

83. The sun delivers 10^4 Wm^{-2} of electromagnetic flux to the earth's surface. The total power that in incident on a roof of dimensions 10m square will be

a) 10^4W b) 10^5 W c) 10^6 W d) 10^7 W

84. In a medium of dielectric constant K, the electric field is **E**. If ε_0 is permittivity of the free space, the electric displacement vector is

a) $\frac{K\mathbf{E}}{\varepsilon_0}$ b) $\frac{\mathbf{E}}{K\varepsilon_0}$ c) $\frac{\varepsilon_0 \mathbf{E}}{K}$ d) $K\varepsilon_0 \mathbf{E}$

85. In a plane electromagnetic wave electric field varies with time having an amplitude 1 Vm^{-1}. The frequency of wave is 0.5×10^{15} Hz. The wave is propagation along X-axis. What is the average energy density of magnetic field?

a) 1.1×10^{-12}J m^{-3} b) 2.2×10^{-12}J m^{-3} c) 3.3×10^{-12}J m^{-3} d) 4.4×10^{-12}J m^{-3}

86. A plane Electromagnetic Waves travels in free space along x-axis. At a particular point in space, the electric field along y-axis is 9.3 Vm^{-1}. The magnetic induction is

a) $3.1 \times 10^{-8}\ T$ b) $3 \times 10^{-5}\ T$ c) $3 \times 10^{-6}\ T$ d) $9.3 \times 10^{-6}\ T$

87. Height h of transmitter antenna when R is radius of earth to have range d is

a) $d^2/2R$ b) $\sqrt{2dR}$ c) $2d^2/R$ d) $2R^2/d$

88. If a source is transmitting Electromagnetic Waves of frequency 8.196×10^6 Hz, then the wavelength of the Electromagnetic Waves transmitted from the source will be

a) 5090 cm b) 4050 cm c) 4230 cm d) 3660 cm

89. The voltage applied across an X-ray tube is nearly equal to

a) 10 V b) 100 V c) 1000 V d) 10, 000 V

90. The charge of a parallel plate capacitor is varying as $q = q_0 \sin 2\pi f t$. The plates are very large and close together (area= A, separation= d). Neglecting edge effects, the displacement current through the capacitor is

a) $\frac{d}{A\varepsilon_0}$ b) $\frac{d}{\varepsilon_0} \sin 2\pi f t$ c) $2\pi f q_0 \cos 2\pi f t$ d) $\frac{2\pi f q_0}{\varepsilon_0} \cos 2\pi f t$

91. An Electromagnetic Wave has

a) Electric vector only

b) Magnetic vector only

c) Electric and Magnetic vector Perpendicular to each other

d) Neither the Electric vector nor the Magnetic vector

92. The dielectric constant of air is 1.006. The speed of Electromagnetic Wave travelling in air is $a \times 10^8$ ms^{-1}, where a is about

a) 3 b) 3.88 c) 2.5 d) 3.2

93. The waves which are reflected back to the earth by ionosphere is

a) Ground wave b) Sky wave c) Space wave d) All of these

94. A radiation of energy E falls normally on a perfectly reflecting surface. The momentum transferred to the surface is

a) $\frac{E}{c}$ b) $\frac{2E}{c}$ c) Ec d) $\frac{E}{c^2}$

95. A plane Electromagnetic Waves travelling along the X-direction has a wavelength of 3 mm. The variation in the electric field occurs in the Y-direction with an amplitude 66 Vm^{-1}. The equations for the electric and magnetic fields as a function of x and t are respectively

a) $E_y = 33\cos\pi \times 10^{11}\left(t - \frac{x}{c}\right)$, $B_z = 1.1 \times 10^{-7}\cos\pi \times 10^{11}\left(t - \frac{x}{c}\right)$

b) $E_y = 11\cos 2\pi \times 10^{11}\left(t - \frac{x}{c}\right)$, $B_y = 11 \times 10^{-7}\cos 2\pi \times 10^{11}\left(t - \frac{x}{c}\right)$

c) $E_x = 33\cos\pi \times 10^{11}\left(t - \frac{x}{c}\right)$, $B_x = 11 \times 10^{-7}\cos\pi \times 10^{11}\left(t - \frac{x}{c}\right)$

d) $E_y = 66\cos 2\pi \times 10^{11}\left(t - \frac{x}{c}\right)$, $B_z = 2.2 \times 10^{-7}\cos 2\pi \times 10^{11}\left(t - \frac{x}{c}\right)$

96. The unit of expression $\mu_0\varepsilon_0$ are

a) ms^{-1} b) m^2s^{-2} c) s^2m^{-2} d) sm^{-1}

97. In an Electromagnetic Wave, direction of propagation is in the direction of

a) $\mathbf{E}$ b) $\mathbf{B}$ c) $\mathbf{E} \times \mathbf{B}$ d) None of these

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

a) 64.7 Vm^{-1} b) 57.8 Vm^{-1} c) 56.72 Vm^{-1} d) 54.77 Vm^{-1}

99. An electric field of 1500 Vm^{-1} and a magnetic field of 0.40 Wbm^{-2} act on a moving electron. The minimum uniform speed along a straight line the electron could have is

a) 1.6×10^{15} ms^{-1} b) $6 \times 10^{16} ms^{-1}$ c) $3.75 \times 10^3 ms^{-1}$ d) $3.75 \times 10^2 ms^{-1}$

100. The electric field of plane electromagnetic wave in vacuum is represented by $\vec{\mathbf{E}}_x = 0$; $\vec{\mathbf{E}}_y = 0.5\cos[2\pi \times 10^8(t - x/c)]$: $\vec{\mathbf{E}}_z = 0$

What is the direction of propagation of electromagnetic waves?

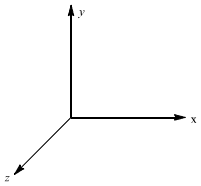
a) Along $x - z$ direction b) Along y-direction

c) Along x-direction d) A long $y - z$ direction

101. The electric field of a plane electromagnetic wave varies with time of amplitude 2 Vm^{-1} propagating along z-axis. The average energy density of the magnetic field is (in Jm^{-3})

a) 13.29×10^{-12} b) 8.86×10^{-12} c) 17.72×10^{-12} d) 4.43×10^{-12}

102. Light wave is travelling along y-direction. If the corresponding $\mathbf{E}$ vector at any time is along the x-axis, the direction of $\mathbf{B}$ vector at that time is along



a) y-axis b) x- axis c) $+z$- axis d) $-z$- axis

103. If an electromagnetic wave is propagation in a medium with permittivity ε and permittivity μ, then $\sqrt{\frac{\mu}{\varepsilon}}$ is

the

a) Intrinsic impedance of the medium
b) Square of the refractive index of the medium
c) Refractive index of the medium
d) Energy density of the medium

104. The energy of X-ray photon is 3.3×10^{-16} J. Its frequency is

a) 2×10^{19} Hz
b) 5×10^{18} Hz
c) 5×10^{17} Hz
d) 5×10^{16} Hz

105. The oscillating electric and magnetic field vectors of electromagnetic wave are oriented along

a) The same direction and in phase
b) The same direction but have a phase difference of 90°
c) Mutually perpendicular directions and are in phase
d) Mutually perpendicular directions but has a phase difference of 90°

106. A radiowave has a maximum magnetic field induction of 10^{-4} T on arrival at a receiving antenna. The maximum electric field intensity of such a wave is

a) Zero
b) 3×10^{4} Vm^{-1}
c) 5.8×10^{-4} T
d) 3.0×10^{-5} T

107. The electric field (in NC^{-1}) in an electromagnetic wave is given by $E = 50 \sin \omega (t - x/c)$. The energy stored in a cylinder of cross-section 10 cm^2 and length 100 cm, along the x-axis will be

a) 5.5×60^{-12} J
b) 1.1×10^{-11} J
c) 2.2×10^{-11} J
d) 1.65×10^{-11} J

108. Radiations of intensity 0.5 Wm^{-2} are striking a metal plate. The pressure on the plate is

a) 0.166×10^{-8} Nm^{-2}
b) 0.332×10^{-8} Nm^{-2}
c) 0.111×10^{-8} Nm^{-2}
d) 0.083×10^{-8} Nm^{-2}

109. The electric field for a plane electromagnetic wave travelling in the positive z-direction is represented by which one of the following?

a) $\hat{\mathbf{k}}_1 E_0 e^{i}(kz - \omega t + \phi)$
b) $\hat{\mathbf{i}}_1 E_0 e^{i}(kx - \omega t + \phi)$
c) $\hat{\mathbf{i}}_1 E_0 e^{i}(kz + \omega t + \phi)$
d) $\hat{\mathbf{k}}_1 E_0 e^{i}(kz + \omega t + \phi)$

110. Television signals reach us only through the ground waves. The range R related with the transmitter height h is in proportion to

a) h
b) $h^{1/2}$
c) $h^{-1/2}$
d) h^{-1}

111. A cube of edge a has its edges parallel to x, y and z-axis of rectangular coordinate system. A uniform electric field $\vec{E}$ is parallel to y-axis and a uniform magnetic field is $\vec{E}$ parallel to x-axis. The rate at which flows through each face of the cube is

a) $\frac{a^2.EB}{2\mu_0}$ parallel to $x - y$ plane and zero in others
b) $\frac{a^2EB}{\mu_0}$ parallel to $x - y$ plane and zero in others
c) $\frac{a^2EB}{2\mu_0}$ from all faces
d) $\frac{a^2EB}{2\mu_0}$ parallel; to $y - z$ faces and zero in others

112. The phase velocity (v_p) of travelling wave is

a) $v_p = \frac{\omega}{k}$
b) $v_p = \frac{d\omega}{dk}$
c) $v_p = c$
d) $v_p = \frac{c}{v_g}$

113. A large parallel plate capacitor, whose plates have an area of 1 m^2 and are separated from each other by 1 mm, is being charged at a rate of 25 Vs^{-1}. If the dielectric between the plates has the dielectric constant 10, then the displacement current at this instant is

a) 25 μA
b) 11 μA
c) 2.2 μA
d) 1.1 μA

114. Solar radiation is

a) Transverse Electromagnetic wave
b) Longitudinal Electromagnetic wave
c) Stationary wave
d) None of the above

115. Instantaneous displacement current of 1.0 A in the space between the parallel plate of 1 μF capacitor can be estabilished by changing potential difference of

a) $10^{-6}Vs^{-1}$
b) $10^{6}Vs^{-1}$
c) 1 Vs^{-1}
d) 0.1 Vs^{-1}

116. Ground waves have wavelength

a) Less than 200 m
b) Equal to 200 m
c) More than 200 m
d) All of these

117. An Electromagnetic Wave of frequency v = 3.0 MHz passes from vacuum into a dielectric medium with permittivity $\varepsilon = 4.0$. Them

a) Wavelength is doubled and the frequency remains unchanged
b) Wavelength is doubled and frequency becomes half
c) Wavelength is halved and frequency remains unchanged
d) Wavelength and frequency both become unchanged

118. An earth orbiting satellite has solar energy collecting panel with total area 5 m^2. If solar radiations are perpendicular and completely absorbed, the average force associated with the radiation pressure is (Solar constant= 1.4 kWm^{-2})
a) 2.33×10^{-3} N b) 2.33×10^{-4} N c) 2.33×10^{-5} N d) 2.33×10^{-6} N

119. The wavelength of X-rays lies between
a) Maximum to finite limits b) Minimum to certain limits
c) Minimum to infinite limits d) Infinite to finite limits

120. Which of the following is absorbed by the ozone layer?
a) Only gamma rays b) Visible light c) Radio Waves d) Ultraviolet rays

121. The small ozone layer on top of the atmosphere is crucial for human survival because it
a) Has ions b) Reflects radio signals c) Absorbs UV rays d) Reflects IR rays

122. If ε_0 and μ_0 are the electric permittivity and magnetic permeability of free space and ε and μ are the corresponding quantities in the medium, the index of refraction of the medium in terms of above parameter is
a) $\frac{\varepsilon\mu}{\varepsilon_0\mu_0}$ b) $\left(\frac{\varepsilon\mu}{\varepsilon_0\mu_0}\right)^{1/2}$ c) $\left(\frac{\varepsilon_0\mu_0}{\varepsilon\mu}\right)$ d) $\left(\frac{\varepsilon_0\mu_0}{\varepsilon\mu}\right)^{1/2}$

123. The atmosphere above the height of 80 km is called
a) Stratosphere b) Troposphere c) Mesosphere d) Ionosphere

124. The atmosphere between the heights of 50 km and 80 km is called
a) Mesosphere b) Ozonosphere c) Ionosphere d) Troposphere

125. 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

126. Infrared radiation is detected by
a) Spectrometer b) Pyrometer c) Nanometer d) Photometer

127. A particles of mass 1×10^{-26}kg and charge 1.6×10^{-19}C travelling with a velocity 1.28×10^6 ms^{-1} along the positive X-axis enters a region in which a uniform electric field $\mathbf{E}$ and a uniform magnetic field of induction $\mathbf{B}$ are present. If $\boldsymbol{E} = -10.24 \times 10^3\ \hat{\mathbf{k}}$ NC^{-1} and $B = 8 \times 10^{-2}\hat{\mathbf{j}}$ Wbm^{-2}, the direction of motion of the particles is
a) Along the positive X-axis b) Along the negative X-axis
c) At 45^0 to the positive X-axis d) At 135^0 to the positive X-axis

128. All components of the Electromagnetic Spectrum in vacuum have the same
a) Energy b) Velocity c) Wavelength d) Frequency

129. A. The wavelength of microwaves is greater than that of UV-rays.
B. The wavelength of IR rays is lesser than that of UV-rays.
C. The wavelength of microwaves is lesser than that of IR-rays.
D. Gamma rays have shortest wavelength in the Electromagnetic Spectrum.
Of the above statements
a) A and B are true b) B and C are true
c) C and D are true d) A and D are true

130. In an electromagnetic wave, the electric and magnetizing fields are 100 Vm^{-1} and 0.265 Am^{-1}. The maximum energy flow is
a) 26.5 Wm^{-2} b) 36.5 Wm^{-2} c) 46.7 Wm^{-2} d) 765 Wm^{-2}

131. If $\vec{\mathbf{E}}$ is an electric field and $\vec{\mathbf{B}}$ is the magnetic induction then the energy flow per unit area per unit time in an electromagnetic field is given by
a) $\vec{\mathbf{E}} \times \vec{\mathbf{B}}$ b) $\vec{\mathbf{E}} \cdot \vec{\mathbf{B}}$ c) $E^2 + B^2$ d) E/B

132. The ozone layer absorbs
   a) Infrared radiations
   b) Ultraviolet radiations
   c) X-rays
   d) γ-rays

133. 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)

134. The Maxwell's four equations are written as
   (i) $\oint \vec{\mathbf{E}} \cdot \overrightarrow{\mathbf{ds}} = q/\varepsilon_0$
   (ii) $\oint \vec{\mathbf{B}} \cdot \overrightarrow{\mathbf{ds}} = 0$
   (iii) $\oint \mathbf{E} \cdot \overrightarrow{\mathbf{dl}} = -\frac{d}{dt}\oint_s \vec{\mathbf{B}} \cdot \overrightarrow{\mathbf{ds}}$
   (iv) $\oint \vec{\mathbf{B}} \cdot \overrightarrow{\mathbf{dl}} = \mu_0 I + \mu_0 \varepsilon_0 \frac{d}{dt}\oint_s \vec{\mathbf{E}}.\overrightarrow{\mathbf{ds}}$
   The equation which have sources of $\vec{\mathbf{E}}$ and $\vec{\mathbf{B}}$ are
   a) (i), (ii), (iii)
   b) (i), (ii)
   c) (i)and (iii) only
   d) (i)and (iv) only

135. 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

136. An electric field $\vec{\mathbf{E}}$ and magnetic filed $\vec{\mathbf{B}}$ 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

137. Which of the following electromagnetic waves have the longest wavelength?
   a) Heat waves
   b) Light waves
   c) Radio waves
   d) Ultraviolet waves