ABHINAV ACADEMY

UDUPI

CET25P8 CET25P7 ALTERNATING CURRENT

Class 12 - Physics

Time Allowed: 1 hour and 30 minutes **Maximum Marks: 75**

1. An em wave is propagating in a medium with a velocity $\vec{V} = V\hat{i}$. The instantaneous oscillating electric field of this em wave is along +y axis. Then the direction of the oscillating magnetic field of the em wave will be along: **[1]**

   a) -y direction
   b) -x direction
   c) +z direction
   d) -z direction

2. The ratio of the amplitude of magnetic field to the amplitude of electric field for an electromagnetic wave propagating in a vacuum is equal to **[1]**

   a) the speed of light in vacuum
   b) the ratio of magnetic permeability to the electric susceptibility of vacuum
   c) reciprocal of speed of light in vacuum
   d) unity

3. A parallel plate capacitor is charged by a current of 2×10^{-7} A displaced between the plates of the capacitor. When the discharge of the capacitor takes place through a resistance, the rate of change of electric flux (in Wb/s) will be: **[1]**

   a) 6.26×10^{9}
   b) 3.26×10^{6}
   c) 4.26×10^{8}
   d) 2.26×10^{4}

4. Radio station WCCO in Minneapolis broadcasts at a frequency of 830 kHz. Wavelength and angular wave number are **[1]**

   a) 361 m, 0.0174 /m
   b) 381 m, 0.89 rad/m
   c) 391 m, 0.48 rad/m
   d) 371 m, 0.0245 rad/m

5. Electromagnetic waves travel in a medium that has relative permeability 1.3 and relative permittivity 2.14. Then the speed of the electromagnetic wave in the medium will be: **[1]**

   a) 1.8×10^{2} m/s
   b) 1.8×10^{6} m/s
   c) 1.8×10^{8} m/s
   d) 1.8×10^{4} m/s

6. The temperature of an object that emits electromagnetic radiation must be **[1]**

   a) high enough for it to glow
   b) higher than 0 K
   c) higher than that of its surroundings
   d) higher than 0°C

7. Medical x-rays are taken with electromagnetic waves having a wavelength of around 0.10 nm. What are the frequency and period of such waves? **[1]**

   a) $20.4 \times 10^{15}\text{kHz}, 5.7 \times 10^{-17}\text{s}$
   b) $3 \times 10^{15}\text{kHz}, 3.3 \times 10^{-17}\text{s}$

c) $4.2 \times 10^{15}\text{kHz}, 2.8 \times 10^{-17}\text{s}$

d) $37.8 \times 10^{15}\text{kHz}, 5.6 \times 10^{-17}\text{s}$

8. The velocity of light is equal to **[1]**

a) $\frac{\sqrt{\varepsilon_0}}{\mu_0}$

b) $\sqrt{\varepsilon_0 \mu_0}$

c) $\frac{\varepsilon_0}{\mu_0}$

d) $\frac{1}{\sqrt{\varepsilon_0 \mu_0}}$

9. Out of the following options which one can be used to produce a propagating electromagnetic wave? **[1]**

a) An accelerating charge

b) A charge moving at a constant velocity

c) A chargeless particle

d) A stationary charge

10. The amplitude of the magnetic field part of a harmonic electromagnetic wave in vacuum is B_o = 510 nT. **[1]**

Amplitude of the electric field part of the wave is

a) 163 N/C

b) 158 N/C

c) 153 N/C

d) 173 N/C

11. An electromagnetic wave is produced by a charge **[1]**

a) moving with a constant speed parallel to a magnetic field

b) moving with an acceleration

c) moving with a constant velocity

d) at rest

12. According to Maxwell's hypothesis, a changing electric field gives rise to **[1]**

a) electric current

b) pressure gradient

c) an e.m.f.

d) magnetic field

13. An electromagnetic wave of frequency 3 MHz passes from vacuum into a dielectric medium with permittivity ε = 4. Then, **[1]**

a) wavelength and frequency both remain unchanged

b) wavelength is doubled and the frequency remain unchanged

c) wavelength is doubled and the frequency becomes half

d) wavelength is halved and the frequency remains unchanged

14. The frequency of γ-rays, X-rays and ultraviolet rays are a, b and c respectively. Then, **[1]**

a) a < b < c

b) a > b > c

c) a = b = c

d) a > c > b

15. A charged particle oscillates about its mean equilibrium position with a frequency of 10^9 Hz. Frequency of the electromagnetic waves produced by the oscillator is **[1]**

a) 600 MHz

b) 400 MHz

c) $10^9 Hz$

d) 200 MHz

16. These are three wavelengths 10^7m, 10^{-10}m, 10^{-7}m. Find their respective names. **[1]**

a) Visible rays, γ-rays, X-rays

b) X-Rays, Visible rays, Radiowaves

c) Radiowaves, X-rays, Visible rays

d) X-rays, γ-rays, Visible rays

17. The velocity of light in vacuum can be changed by changing: **[1]**

a) amplitude

b) wavelength

c) None of these

d) frequency

18. Transverse nature of electromagnetic waves is evident by **[1]**

a) Polarization

b) Reflection

c) Diffraction

d) Interference

19. The electromagnetic radiations used for water purification and eye surgery is **[1]**

a) None of these

b) Microwave

c) Infrared

d) X-rays

20. The intensity of a plane electromagnetic wave is proportional to **[1]**

a) Electric field squared

b) Electric field cubed

c) 1/ Electric field squared

d) Electric field

21. A linearly polarized electromagnetic wave given as $E = E_0\hat{i}\cos(kz - \omega t)$ is incident normally on a perfectly reflecting infinite wall at z = a. Assuming that the material of the wall is optically inactive, the reflected wave will be given as **[1]**

a) $E_r = E_0\hat{i}\sin(kz - \omega t)$

b) $E_r = E_0\hat{i}\cos(kz + \omega t)$

c) $E_r = -E_0\hat{i}\cos(kz + \omega t)$

d) $E_r = -E_0\hat{i}\cos(kz - \omega t)$

22. Light with an energy flux of 25×10^4 Wm^{-2} falls on a perfectly reflecting surface at normal incidence. If the surface area is 15 cm^2, the average force exerted on the surface is **[1]**

a) 3.0×10^{-6} N

b) 2.50×10^{-6} N

c) 1.25×10^{-6} N

d) 1.20×10^{-6} N

23. Which one of the following electromagnetic radiation has the least wavelength? **[1]**

a) Microwaves

b) Gamma rays

c) X-rays

d) Visible light

24. The energy of a photon of wavelength 663 nm is **[1]**

a) 2.0×10^{-20} J

b) 5.18×10^{-19} J

c) 3.0×10^{-19} J

d) 6.64×10^{-20} J

25. A proton and an alpha particle have the same kinetic energy. The ratio of de Broglie wavelengths associated with the proton to that with the alpha particle is: **[1]**

a) 1

b) $\frac{1}{2}$

c) 2

d) $2\sqrt{2}$

26. The frequency of electromagnetic wave, which is best suited to observe a particle of radius 3×10^{-4} cm, is of the order of **[1]**

a) 10^{15}

b) 10^{12}

c) 10^{13}

d) 10^{14}

27. If, λ_v, λ_x and λ_m represent the wavelengths of visible light, x-rays and microwaves respectively in the free space then, **[1]**

a) $\lambda_m > \lambda_v > \lambda_x$ b) $\lambda_v > \lambda_x > \lambda_m$

c) $\lambda_m > \lambda_x > \lambda_v$ d) $\lambda_v > \lambda_m > \lambda_x$

28. Plane electromagnetic wave travels in vacuum along z-direction. If the frequency of the wave is 30 MHz, its wavelength is **[1]**

a) 10 m b) 13 m

c) 11 m d) 12 m

29. What physical quantity is the same for X-rays of wavelength 10^{-10} m, red light of wavelength 6800 $\overset{0}{A}$ and radio waves of wavelength 500m? **[1]**

a) speed b) phase

c) frequency d) energy

30. Electromagnetic waves of wavelength of the order of a few meters were first produced and detected in the laboratory by: **[1]**

a) H.R. Hertz b) J.C. Bose

c) J.C. Maxwell d) G. Marconi

31. The correct option, if speeds of gamma rays, X-rays and microwaves are v_g, u_x and v_m respectively will be: **[1]**

a) $v_g > v_x > v_m$ b) $v_g > v_x > v_m$

c) $v_g < v_x < v_m$ d) $v_g = v_x = v_m$

32. The r.m.s. 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: **[1]**

a) $6.37 \times 10^{-9} Jm^{-3}$ b) $1.35 \times 10^{-12} Jm^{-3}$

c) $3.3 \times 10^{-3} Jm^{-3}$ d) $4.58 \times 10^{-6} Jm^{-3}$

33. Solar radiation is **[1]**

a) latitudinal electromagnetic wave b) none of these

c) transverse electromagnetic wave d) longitudinal electromagnetic wave

34. In a travelling plane electromagnetic wave, which of the following have zero average value? **[1]**

a) Magnetic energy and magnetic field b) Electric energy and electric field

c) Magnetic field and electric field d) Magnetic energy and electric energy

35. 7.5 MHz to 12 MHz band corresponds to wavelength band of **[1]**

a) 7.5 m - 12 m b) 25 m - 40 m

c) 50 m - 75 m d) 12 m - 7.5 m

36. A carbon dioxide laser emits a sinusoidal electromagnetic wave that travels in vacuum in the negative x-direction. The wavelength is 10.6μm and the field is parallel to the z-axis, with E_{max} = 1.5 MV/m. Vector equation for E as function of time and position is **[1]**

a) E(x, t) = -E_{max} cos $\left(5.93 \times 10^5\ x + 1.78 \times 10^{14}\ t\right)$

b) E(y, t) = E_{max} cos $\left(5.93 \times 10^5\ y - 1.78 \times 10^{14}\ t\right)$

c) E(x, t) = E_{max} cos $\left(5.93 \times 10^5\ x + 1.78 \times 10^{14}\ t\right)$

d) E(y, t) = E_{max} cos $\left(5.93 \times 10^5\ y + 1.78 \times 10^{14}\ t\right)$

37. There are three wavelengths: 10^{-8} m, 10^{-2} m, 10^{8} m. Their respective names are: **[1]**

a) ultraviolet rays, microwaves, radiowaves

b) visible rays, γ-rays, ultraviolet rays

c) X-rays, visible rays, radiowaves

d) radiowaves, X-rays, microwaves.

38. If a source is transmitting electromagnetic waves of frequency 8.2×10^6 Hz, the wavelength of an electromagnetic wave transmitted from the source is: **[1]**

a) 18.8 m

b) 58 m

c) 35.6 m

d) 42.8 m

39. Characteristic X-rays are produced due to **[1]**

a) transfer of momentum in collisiori of electrons with target atoms

b) transition of electrons from higher to lower electronic orbits of an atom

c) heating of the target

d) transfer of energy in collision of electrons with atoms in the target

40. Electromagnetic waves travelling in a medium has speed 2×10^8 m/s. If the relative permeability is 1, then the relative permittivity of medium must be **[1]**

a) 2.25

b) 1.5

c) 2

d) 2.5

41. An EM wave radiates outwards from a dipole antenna, with E_0 as the amplitude of its electric field vector. The electric field E_0 which transports significant energy from the source falls off as **[1]**

a) $\frac{1}{r}$

b) $\frac{1}{r^3}$

c) remains constant

d) $\frac{1}{r^2}$

42. The frequencies of X-rays, γ-rays and ultra violet rays are respectively a, b and c. Then **[1]**

a) a > b, b > c

b) a < b, b < c

c) a > b, b < c

d) a < b, b > c

43. The electromagnetic radiations used to kill germs in water purifiers are called: **[1]**

a) Ultraviolet rays

b) Infrared waves

c) X-rays

d) Gamma rays

44. X-rays are produced when an element of high atomic weight is bombarded by high energy **[1]**

a) electrons

b) neutrons

c) protons

d) photons

45. The mean electric energy density between the plates of charged capacitor is_____ ? (q = charge on the capacitor and A = area of the capacitor plate) **[1]**

a) $\frac{q^2}{2\epsilon_0 A}$

b) $\frac{q}{2\epsilon_0 A^2}$

c) $\frac{q^2}{2\epsilon_0 A^2}$

d) $\frac{q}{2\epsilon_0 A}$

46. In electromagnetic waves, the phase difference between magnetic and electric field vectors is **[1]**

a) $\frac{\pi}{4}$

b) zero

c) $\frac{\pi}{2}$

d) π

47. For a wave propagating in a medium, identify the property that is independent of the others. **[1]**

a) wavelength

b) all these depend on each other

c) velocity

d) frequency

48. The ozone layer blocks the radiation of wavelength **[1]**

a) more than 3×10^{-7} m

b) equal to 3×10^{-7} m

c) all of these

d) less than 3×10^{-7} m

49. The amplitude of the sinusoidally oscillating electric field of the plane wave is 60 V/m. Then the amplitude of the magnetic field is: **[1]**

a) $2 \times 10^{-7} T$

b) $6 \times 10^{-7} T$

c) $6 \times 10^{7} T$

d) $2 \times 10^{7} T$

50. Which radiations are used in the treatment of muscles ache? **[1]**

a) ultraviolet

b) microwave

c) infrared

d) X-rays

51. Optical and radio telescopes are built on the ground, but X-ray Astronomy is possible only from satellites orbiting the earth because **[1]**

a) Atmosphere reflects X-rays away from earth

b) Atmosphere reflects X-rays horizontally so they don't reach the earth

c) Atmosphere absorbs X-rays, while visible and radio waves can penetrate it.

d) Satellites orbiting the earth make use of interstellar effects

52. A welder wears special glasses to protect his eyes mostly from the harmful effect of **[1]**

a) ultraviolet rays

b) very intense visible light

c) infrared radiation

d) microwaves

53. Light from the star Sirius takes 8.61 years to reach the earth. What is the distance from earth to Sirius in kilometers? **[1]**

a) 7.85×10^{13} km

b) 8.05×10^{13} km

c) 7.95×10^{13} km

d) 8.15×10^{13} km

54. Name the electromagnetic waves also known as **heat waves**. **[1]**

a) Microwaves

b) X-rays

c) Radio waves

d) Infrared waves

55. Electromagnetic wave having frequency 5×10^{11} Hz is **[1]**

a) X-rays

b) Ultraviolet wave

c) Radio wave

d) Microwave

56. The electric field associated with an e.m. wave in vacuum is given by $\vec{E} = \hat{i}40\cos\left(\kappa z - 6 \times 10^8 t\right)$, where E, z and t are in volt/m, metre and seconds respectively. The value of wave vector κ is **[1]**

a) 2 m^{-1}

b) 3 m^{-1}

c) 6 m^{-1}

d) 0.5 m^{-1}

57. In vacuum, the physical property which remains same for microwave of wavelength 1 mm and UV radiation $1600\overset{o}{A}$ is **[1]**

a) Speed

b) Frequency

c) Magnet

d) Wavelength

58. Which wavelength of the sun is used finally as electric energy? **[1]**

a) Radio waves

b) Visible light

c) Infrared waves

d) Microwaves

59. About 5% of the power of a 100 W light bulb is converted to visible radiation. What is the average intensity of visible radiation at a distance of 1m from the bulb and at a distance of 10 m are **[1]**

a) 0.45 W/m^2, 0.004 W/m^2

b) 0.5 W/m^2, 0.004 W/m^2

c) 0.4 W/m^2, 0.004 W/m^2

d) 0.55 W/m^2, 0.004 W/m^2

60. Which of the following physical quantities remain the same for X-ray, red light and radio waves when travelling through a medium? **[1]**

a) Momentum

b) Wavelength

c) Speed

d) Frequency

61. A 100Ω resistance and a capacitor of 100Ω reactance are connected in series across a 220 V source. When the capacitor is 50% charged, the peak value of the displacement current is: **[1]**

a) 4.4 A

b) $11\sqrt{2}$ A

c) 2.2 A

d) 11 A

62. Choose the correct option related to wavelengths (λ) of different parts of electromagnetic spectrum. **[1]**

a) $\lambda_{\text{radio wave}} > \lambda_{\text{micro waves}} > \lambda_{\text{visible}} > \lambda_{\text{x.rays}}$

b) $\lambda_{\text{x-rays}} < \lambda_{\text{micro waves}} < \lambda_{\text{radio waves}} < \lambda_{\text{visible}}$

c) $\lambda_{\text{visible}} > \lambda_{\text{x}-\text{rays}} > \lambda_{\text{radio waves}} > \lambda_{\text{micro waves}}$

d) $\lambda_{\text{visible}} < \lambda_{\text{micro waves}} < \lambda_{\text{radio waves}} < \lambda_{\text{x-rays}}$

63. Displacement current exists only when **[1]**

a) magnetic field is not changing

b) electric field is not changing

c) magnetic field is changing

d) electric field is changing

64. For a medium with permittivity $\mathcal{E}$ and permeability μ, the velocity of light is given by: **[1]**

a) $\sqrt{\frac{\varepsilon}{\mu}}$

b) $\frac{1}{\sqrt{\mu\varepsilon}}$

c) $\sqrt{\mu\varepsilon}$

d) $\sqrt{\frac{\mu}{\varepsilon}}$

65. Electromagnetic waves used as a diagnostic tool in medicine are **[1]**

a) ultrasonic waves
b) ultraviolet rays
c) X-rays
d) infrared radiation

66. The frequency of red light with a wavelength of 4.2×10^{-7} m is **[1]**

a) 7.14×10^{14}Hz
b) 7.34×10^{14}Hz
c) 7.64×10^{14}Hz
d) 7.94×10^{14}Hz

67. The energy of the e.m. waves is of the order of 15 keV. To which part of the spectrum does it belong? **[1]**

a) Ultraviolet rays
b) X-rays
c) γ-rays
d) Infrared rays

68. The conduction current is the same as the displacement current when the source is: **[1]**

a) neither for d.c. nor for a.c.
b) a.c. only
c) both a.c. and d.c.
d) d.c. only

69. A radiation of energy E falls normally on a perfectly reflecting surface. The momentum transferred to the surface (c = velocity of light) is **[1]**

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

70. An electromagnetic wave radiates outwards from a dipole antenna, with E_0 as the amplitude of its electric field vector. The electric field E_0 which transports significant energy from the source falls off as **[1]**

a) $\frac{1}{r^3}$
b) remains constant
c) $\frac{1}{r^2}$
d) $\frac{1}{r}$

71. If v_s, v_x and v_m are the speeds of gamma rays, X-rays and microwaves respectively in vacuum, then **[1]**

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. The condition under which a microwave oven heats up a food item containing water molecules most efficiently is **[1]**

a) the frequency of the microwaves must match the resonant frequency of the water molecules
b) the frequency of the microwaves has no relation with the natural frequency of water molecules
c) infrared waves produce heating in a microwave oven
d) microwaves are heat waves, so always produce heating

73. The electromagnetic waves used in radar systems are: **[1]**

a) X-rays
b) Infrared waves
c) Microwaves
d) Ultraviolet rays

74. In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude 48 V m^{-1}. Wavelength of the wave and amplitude of the oscillating magnetic field are **[1]**

a) 1.8×10^{-2}m, 1.8×10^{-7}T

b) 2.5×10^{-2}m, 2.6×10^{-7} T

c) 1.5×10^{-2}m, 1.6×10^{-7}T

d) 2.2×10^{-2}m, 1.6×10^{-7} T

75. Using the formula λ_m T = 0.29 cmK, the characteristic temperature range obtained for $\lambda_m = 5 \times 10^{-7}$ m is **[1]**

a) 5800 K

b) 7000 K

c) 6500 K

d) 7500 K