Exercise-1

ONLY ONE OPTION CORRECT TYPE

1. The displacement current was first postulated by
(1) Ampere (2) Maxwell (3) Hertz (4) Marconi

2. The fundamental source of e. m. waves
(1) is varying magnetic field (2) constant magnetic and electric fields
(3) oscillations of electric charge (4) is planets

3. An accelerated electric charge emits
(1) β – rays (2) γ – rays (3) e.m. waves (4) none of the above

4. Electromagnetic waves in nature are
(1) longitudinal (2) longitudinal stationary
(3) transverse (4) transverse – stationary

5. The speed of e. m. waves is given by the relation
(1) $\mu_0 \varepsilon_0$ (2) $\sqrt{\mu_0 \varepsilon_0}$ (3) $1/\mu_0 \varepsilon_0$ (4) $1/\sqrt{(\mu_0 \varepsilon_0)}$

6. Choose the only wrong statement from the following about electromagnetic waves
(1) are transverse (2) travels free space at the speed of light
(3) are produced by accelerating charges (4) travel with the same speed in all media

7. Electromagnetic waves
(1) are longitudinal waves
(2) travel in free space at the speed of light
(3) are produced by charges moving with uniform velocity
(4) travel with the same speed in all media

8. An accelerated charge
(1) emits an electromagnetic wave (2) produces stationary electric and magnetic fields
(3) produces a gravitational field (4) none of the above

9. In an electromagnetic wave, electric field **E** and magnetic field **B** are
(1) mutually perpendicular to each other (2) all parallel
(3) at 30^0 to each other (4) depends upon polarization

10. If **E** and **B** be the electric and magnetic fields of electromagnetic waves, then the direction of propagation of e. m. wave is along the direction of
(1) E (2) B (3) E × B (4) None of the above

11. Which of the following pairs of space and time varying **E** and **B** fields would generate a plane electromagnetic wave travelling in the Z– direction
(1) E_x, B_y (2) E_y, B_x (3) E_x, B_z (4) E_z, B_x

12. Electromagnetic wave obey the principle of
(1) superposition (2) interference (3) 1 and 2 both (4) none of the above

13. Hertz produced electromagnetic wave by using
(1) L C R circuit (2) C R circuit (3) L C circuit (4) None of the above

14. Choose the correct statement about electromagnetic waves
(1) they are supersonic waves (2) they are the electrically charged particles
(3) they travel with the speed of light (4) they can only be produced in laboratory.

15. Visible range of light has wavelength in cm is
(1) 3×10^{-6} to 10^{-10} (2) 7×10^{-5} to 4×10^{-5} (3) 4×10^{-5} to 3×10^{-6} (4) 6×10^{4} to 1.5×10^{3}

16. The following electromagnetic waves has the shortest wavelength
(1) γ – rays (2) x – rays (3) ultraviolet rays (4) microwaves

17. Which of the following has the longest wavelength
(1) infrared light (2) ultraviolet light (3) microwaves (4) X–rays

18. Only microwaves are used for
(1) television (2) radio transmission (3) radar system (4) all the above

19. The earth's atmosphere is richer in
(1) infra - red radiation (2) ultraviolet radiations
(3) visible radiations (4) blue colour radiations

20. Greenhouse effect is due to
(1) visible radiations (2) red colour radiation
(3) green colour radiation (4) infra - red radiation

21. Greenhouse effect keeps the earth surface
(1) cold in night (2) dusty and cold (3) warm in night (4) moist in night

22. Ozone layer protectes the living organism from
(1) ultraviolet radiations (2) unfra –red radiations
(3) X–rays (4) all the radiations

23. Practically ozone layer absorbs the radiation of wavelength
(1) less than 3×10^{-7} m (2) greater than 3×10^{-7} m
(3) equal to 3×10^{-7} m (4) all the above

24. Frequency of a wave is 6×10^{15} Hz. The wave is **[ORISSA JEE 2004]**
(1) radioactive (2) microwave (3) X-rays (4) ultraviolet

25. If the wavelength of light is 4000 Å, then the number of waves in 1 mm length will be **[J & KCET 2004]**
(1) 25 (2) 0.25 (3) 0.25×10^{4} (4) 25×10^{4}

26. What is the range of frequency for ultrasonic wave ? **[Manipal 2005]**
(1) 1kHz (2) 5kHz (3) 50 kHz (4) 10 kHz

27. If c is the speed of electromagnetic waves in vacuum, its speed v in a medium of dielectric constant k and relative permeability μ_r, is **[CET 2005]**
(1) $v = \frac{1}{\sqrt{\mu_r k}}$ (2) $v = c\sqrt{\mu_r k}$ (3) $v = \frac{c}{\sqrt{\mu_r k}}$ (4) $v = \frac{k}{\sqrt{\mu_r c}}$

28. Which one of the following is not an electromagnetic waves ? **[CET 2005]**
(1) X-rays (2) gamma rays (3) cathode rays (4) infrared rays

29. The dimensions of $\frac{1}{2}\varepsilon_0 E^2$ (ε_0 : permittivity of free space; E : electric field) is **[IIT 2000]**
(1) M L T^{-1} (2) M L^2 T^{-2} (3) M L^{-1} T^{-2} (4) M L^2 T^{-1}

30. The speed of electromagnetic waves in vacuum **[AIPMT 2004]**
(1) depends upon the source of radiation
(2) increases as we move from γ-rays to radiowves
(3) decreases as we move from γ-rays to radiowaves
(4) is same for all of them

31. If λ_v , λ_x, and λ_m represent the wavelengths of visible light, x-rays and microwave respectively then **[AIPMT 2005]**
(1) $\lambda_m > \lambda_x > \lambda_v$ (2) $\lambda_v > \lambda_m > \lambda_x$ (3) $\lambda_u > \lambda_x > \lambda_m$ (4) $\lambda_m > \lambda_v > \lambda_x$

32. The frequency of light wave in a material is $2 \times 10_{14}$ Hz and wavelength is 5000 Å. The refractive index of material will be : **[AIPMT 2007]**
(1) 1.40 (2) 1.50 (3) 3.00 (4) 1.33

33. The electric and magnetic fields of an electromagnetic wave are : **[AIPMT 2007]**
(1) in phase and parallel to each other
(2) in opposite phase and perpendicular to each other
(3) in opposite phase and parallel to each other
(4) in phase and perpendicular to each other.

34. The velocity of electromagnetic radiation in a medium of permittivity ε_0 and permeability μ_0 is given by : **[AIPMT 2008]**
(1) $\sqrt{\frac{\varepsilon_0}{\mu_0}}$ (2) $\sqrt{\mu_0 \varepsilon_0}$ (3) $\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ (4) $\sqrt{\frac{\mu_0}{\varepsilon_0}}$

35. Which of the following is the infra-red wavelength ? **[AIIMS 1997]**
(1) 10_{-4} cm (2) 10_{-5} cm (3) 10_{-6} cm (4) 10_{-7} cm

36. According to maxwell's hypothesis, a changing electric field gives rise to **[AIIMS 1998]**
(1) an e.m.f (2) electric current (3) magnetic field (4) pressure gradiant

37. Maxwell in his famous equation of electromagnetism introduced the concept of **[AIIMS 2003]**
(1) a.c. current (2) d.c. current
(3) displacement current (4) impedance

38. Sodium lamps are used in foggy conditions because **[AIIMS 2003]**
(1) yellow light is scattered less by the fog particles
(2) yellow light is scattered more by the fog particles
(3) yellow light is unaffected during its passage throught the fog
(4) wavelength of yellow light is the mean of the visible part of the spectrum.

39. The pressure exerted by an electromagnetic wave of intensity I (watt / m_2) on a non-reflecting surface is [c is the velocity of light] **[AIIMS 2005]**
(1) I c (2) I c_2 (3) I / c (4) I / c_2

40. An electromagnetic wave of frequency v = 3.0 MHz passes vacuum into a dielectric medium with permittivity $\varepsilon = 4.0$, then **[AIEEE 2004]**
(1) wavelength is doubled and the frequency remains unchanged
(2) wavelength is doubled and frequency becomes half
(3) wavelength is halved and frequency remains unchanged
(4) wavelength and frequency both remain unchanged

41. The S.I unit of displacement current is
(1) H (2) A (3) Fm_{-1} (4) C

42. The speed of electromagnetic waves is independent of
(1) wavelength (2) frequency
(3) intensity (4) medium, in which it travels

43. Dimension of $\varepsilon_0\mu_0$ is :
(1) LT_{-1} (2) $L_{-1}T$ (3) L_2T_{-2} (4) $L_{-2}T_2$

44. If ε_0 and μ_0 are the electric permittivity and magnetic permeability in free space, ε and μ are the corresponding quantities in a medium, then index of refraction of the medium is
(1) $\sqrt{\frac{\varepsilon_0\mu}{\varepsilon\mu_0}}$ (2) $\sqrt{\frac{\varepsilon}{\varepsilon_0}}$ (3) $\sqrt{\frac{\varepsilon_0\mu_0}{\varepsilon\mu}}$ (4) $\sqrt{\frac{\varepsilon\mu}{\varepsilon_0\mu_0}}$

45. Red light differs from blue light while traveling in vacuum is
(1) speed (2) frequency (3) intensity (4) amplitude

46. If an electromagnetic wave propagating through vacuum is described by following then $E = E_0 \sin(kx - \omega t)$; $B = B_0 \sin(kx - \omega t)$
(1) $E_0 k = B_0 \omega$ (2) $E_0 B_0 = \omega k$ (3) $E_0 \omega = B_0 k$ (4) $E_0 B_0 = \omega / k$

47. Which of the following is independent of wavelength? (k = propagation contact, ω = angular frequency)
(1) k (2) ω (3) ωk (4) k / ω

48. A magnetic field can be produced by
(1) A charge at rest only (2) A moving charge only
(2) Time varying electric field (4) both by (2) and (3)

49. An electric charge in uniform motion produces **[CPMT 1990, 1983]**
(1) an electric field only (2) a magnetic field only.
(3) both electric and magnetic field (4) no such field at all.

50. Which of the following radiation form the part of electromagnetic spectrum **[C.P.M.T. 92]**
(1) alpha rays (2) beta rays (3) cathode rays (4) gamma rays

51. The oscillating electric and magnetic field vectors of electromagnetic wave are oriented along **[CBSE PMT 1994]**
(1) The same direction and in phase
(2) The same direction but have a phase difference of 90º
(3) mutually perpendicular direction and are in phase
(4) mutually perpendicular directions but has a phase difference of 90º

52. Which one of the following electromagnetic radiations have the smallest wavelength? **[CBSE PMT 1994]**
(1) ultraviolet waves (2) X-rays (3) γ-rays (4) micorwaves

53. Which of the following rays has minimum frequency ? **[CBSE PMT 1995]**
(1) U.V-rays (2) X-rays (3) micorwaves (4) infra-red-rays

54. An accelerated electron would produce **[CBSE PMT 1996]**
(1) γ-rays (2) β-rays (3) α-rays (4) e.m. rays

55. Ozone layer blocks the radiation of wavelength : **[CBSE 1999]**
(1) less than 3×10^{-7} m. (2) equal to 3×10^{-7} m.
(3) more than 3×10^{-7} m. (4) None of these.

56. The frequencies of X-rays, γ-rays and ultraviolt rays are respectively a, b and c. Then **[CBSE PMT 2000]**
(1) a < b, b > c (2) a > b, b > c (3) a > b, b < c (4) a < b, b < c.

57. When light travels from air to water, which parameter does not change ? **[CPMT 1999, DPMT 2000]**
(1) wavelength (2) frequency (3) velocity (4) all of these

58. The velocity of light in vacuum can be changed by changing **[AFMC 2000]**
(1) frequency (2) amplitude (3) wavelength (4) none of these.

59. Which of the following statement is wrong **[NCERT 1976]**
(1) Ultra-violet rays have a wavelength longer than infra-red rays.
(2) Infra-red rays travel with the same velocity as visible light.
(3) Infra-red can be focussed by a lens and can be reflected by a mirror just as visible light
(4) Infra-red rays have more heating power than visible light rays

60. In an electromagnetic wave, the electric and magnetic fields are 100 Vm^{-1} and 0.265 Am^{-1}. The maximum energy flow is **[Pb. PMT 1998, 1997]**
(1) 26.5W/m^2 (2) 36.5W/m^2 (3) 46.7 Wm^2 (4) 765 W/m^2

61. In an apparatus, the electric field was found to oscillate with an amlitude of 18 V/m. The magnitude of the oscillating magnetic field will be **[Pb. PMT 1999]**
(1) 4×10^{-6} T (2) 6×10^{-8} T (3) 9×10^{-9} T (4) 11×10^{-11} T

62. If a source is transmitting electromagnetic wave of frequency $8.2 \times 10_6$ Hz, then wavelength of the electromagnetic waves transmitted from the source will be **[DPMT 1999]**
(1) 36.6 m (2) 40.5 m (3) 42.3 m (4) 50.9 m

63. There are three wavelength 10_7 m, 10_{-10} m, 10_{-7} m. Find their respective names **[PMT 2001]**
(1) Radiowaves, X-rays, visible rays (2) X-rays, Visible rays, Radio waves
(3) X-rays, γ-rays, Visible rays (4) Visible rays, γ-rays, X-rays

64. Which of the following has the minimum frequency ? **[CET 2001]**
(1) radio wave (2) micro wave (3) audible wave (4) ultrasonic wave

65. Electromagnetic radiation of highest frequency is **[PMT 2002]**
(1) Infrared radiations (2) Visible radiations (3) Radiowaves (4) γ-rays

66. Which is having minimum wavelength : **[PMT 2002]**
(1) X-rays (2) Ultraviolet rays (3) γ-rays (4) cosmic rays

67. The range of wavelength of visible light is **[PET 2002]**
(1) 10 Å to 100 Å (2) 4000 Å to 8000 Å (3) 8000 Å to 10,000 Å (4) 10,000 Å to 15, 000 Å

68. The fact that radiosignals reach the earth from outside the atmosphere, was discoverd accidently by **[TNPEE 2002]**
(1) K.G. Jansky (2) Millikan (3) Aryabhatta (4) Prof. Kanu

69. Which of the following statement is true ? **[ORISSA JEE 2002]**
(1) Velocity of light is constant in all media
(2) Velocity of light in vacuum is maximum
(3) Velocity of light is same in all reference frames
(4) Laws of nature have identical form in all reference frames

70. The ozone layer absorbs **[PET 2002]**
(1) Infrared radiations (2) ultraviolet radiations (3) X-rays (4) γ-rays

71. A microwave and an ultrasonic sound wave have the same wavelength. Their frequencies are in the ratio (approximately) **[PET 2002]**
(1) $10_6 : 1$ (2) $10_4 : 1$ (3) $10_2 : 1$ (4) 10 : 1

72. The electromagnetic waves travel with a velocity **[J & K CET 2002]**
(1) equal to the velocity of light (2) equal to velocity of sound
(3) less than velocity of light (4) none of these

73. A capacitor is having a capacity of 2pF. Electric field across the capacitor is changing with a value of 10_{12}V/s. The displacement current is **[DPMT 2002]**
(1) 2 A (2) 3 A (3) 6 A (4) 9 A

74. In a certain region of space electric field $\vec{E}$ and magnetic field $\vec{B}$ are perpendicular to each other and an electron enters in region perpendicular to the direction of and $\vec{E}$ both moves undeflected, then velocity of electron is : **[AIPMT 2001]**
(1) $\frac{|\vec{E}|}{|\vec{B}|}$ (2) $\vec{E} \times \vec{B}$ (3) $\frac{|\vec{B}|}{|\vec{E}|}$ (4) $\vec{E} \cdot \vec{B}$

75. What is the cause of "Green house effect" ? **[AIPMT 2002]**
(1) Infrared rays (2) Ultraviolet rays (3) X-rays (4) Radiowaves

76. The velocity of electromagnetic wave is paralled to **[AIPMT 2002]**
(1) $\vec{B} \times \vec{E}$ (2) $\vec{E} \times \vec{B}$ (3) $\vec{E}$ (4) $\vec{B}$

77. Which of the following rays are not electromagnetic wave ? **[AIPMT 2003]**
(1) X-rays (2) γ-rays (3) β-rays (4) heat rays

78. Which of the following waves have the maximum wavelength ? **[AFMC 2002]**
(1) X-rays (2) I.R. rays (3) UV rays (4) radiowaves

79. Infrared radiation is detected by **[AIEEE 2002]**
(1) spectrometer (2) pyrometer (3) nanometer (4) photometer

80. Dimensions of $\frac{1}{\mu_0 \in_0}$, where symbols have their usual meanings, are **[AIEEE 2003]**
(1) $[L^{-1} T]$ (2) $[L^{-2} T^2]$ (3) $[L^2 T^{-2}]$ (4) $[L T^{-1}]$

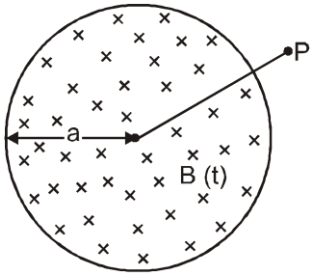
81. Which of the following radiation has the least wavelength ? **[AIEEE 2003]**
(1) γ-rays (2) β-rays (3) α-rays (4) X-rays

82. Which of the following required no medium for propagation ? **[RPMT-2001]**
(1) Cathode rays (2) Electromagnetic rays
(3) Sound waves (4) None of these

Exercise-2

ONLY ONE OPTION CORRECT TYPE

1. A uniform but time varying magnetic field B (t) exists in a circular region of radius a it is directed into the plane of the paper as shown. The magnitude of the induced electric field at point P at a distance r from the centre of the circular region.



(1) is zero (2) decreases as 1/r
(3) increases as r (4) decreases as $1/r^2$

2. Out of the following statement which is Not true ? **[CET 2002]**
(1) Infrared radiations arise due to minor electron transitions in lighter atoms
(2) Infrared radiations are used for long distance photography
(3) Sun is the only natural source of infrared radiations
(4) Infrared radiations are detected by using a spectrometer

3. Which of the following has minimum wavelength ? **[AIPMT 2002]**
(1) X-rays (2) Ultraviolet rays (3) γ–rays (4) Cosmic rays

4. If a light wave passes through a transparent medium (like as glass). Then : **[RPMT-2002]**
(1) velocity of all light waves will be same
(2) velocity of longer wavelength will be less
(3) velocity of longest wavelength will be maximum
(4) velocity of shorter wavelength will be maximum

5. The velocity of all radio waves in free space is 3×10^8 m/s. The frequency of a radio wave of wavelength 150 m is : **[RPMT-2005]**
(1) 50 kHz (2) 2 kHz (3) 2 MHz (4) 1 MHz

6. Light waves travel in vacuum along the y-axis. Which of the following may represent the wavefront ? **[RPMT-2006]**
(1) y = constant (2) x = constant (3) z = constant (4) x + y + z = constant

7. Which of these statement is false : **[RPMT 2010]**
(1) Photographic plate is sensitive for infrared rays
(2) Photographic plate is sensitive for ultraviolet rays.

(3) Infrared rays are invisible but make shadow like visible light
(4) As compared to visible light photon, infrared photon has more energy.

8. The $\vec{E}$ and $\vec{B}$ vectors associated with an electromagnetic wave are : **[RPMT-2011]**
(1) parallel to each other and are in the same phase
(2) parallel to each other and are opposite in phase
(3) perpendicular to each other and are opposite in phase
(4) perpendicular to each other and are in phase

9. The electric vector of an electromagnetic wave in vacuum is represented by $\vec{E} = 6.3\hat{j}V/m$. The frequency of the wave is 20 MHz and it is propagating along the positive z-direction. At this point magnetic vector is **[RPMT-2014]**

(1) $-2.1 \times 10^{-8}\ \hat{i}$ T (2) $+2.1 \times 10^{-8}\ \hat{i}$ T (3) $+ 4.0 \times 10^{-8}\ \hat{i}$ T (4) $-18.9 \times 10^{-8}\ \hat{i}$ T

10. An electromagnetic radiation of frequency ν, wavelength λ, travelling with velocity c in air, enters a glass slab of refractive index μ. The frequency, wavelength and velocity of light in the glass slab will be respectively :

(1) $\frac{\nu}{\mu}, \frac{\lambda}{\mu}$ and $\frac{c}{\mu}$ (2) ν, $\frac{\lambda}{\mu}$ and $\frac{c}{\mu}$ (3) ν, μλ and $\frac{c}{\mu}$ (4) $\frac{\nu}{\mu}, \frac{\lambda}{\mu}$ and c

Exercise-3

PART - I : NEET / AIPMT QUESTION (PREVIOUS YEARS)

1. The electric field of an electromagnetic wave in a medium is represented by
$E_x = 0$;
$E_y = 2.5\frac{N}{C}\cos\left[\left(2\pi\times10^6\frac{rad}{s}\right)t-\left(\pi\times10^{-2}\frac{rad}{m}\right)x\right]$
$E_z = 0$. The wave is : **[AIPMT 2009]**
(1) moving along y direction with frequency $2\pi \times 10_6$ Hz and wavelength 200 m.
(2) moving along x direction with frequency 10_6 Hz and wavelength 100m
(3) moving along x direction with frequency 10_6 Hz and wavelength 200m
(4) moving along –x direction with frequency 10_6 Hz and wavelength 200m

2. Which of the following statement is false for the properties of electromagnetic waves? **[AIPMT 2010]**
(1) Both electric and magnetic field vectors attain the maxima minima at the same place and same time.
(2) The energy in electromagnetic wave is divided equally between electric and magnetic vectors.
(3) Both electric and magnetic field vectors are parallel to each other perpendicular to the direction of propagation of wave.
(4) These waves do not require any material medium for propagation.

3. The electric field of an electromagnetic wave in free space is given by $\vec{E} = 10\cos(10^7 t + kx)\hat{j}$ V/m, where t and x are in seconds and metres respectively. It can be inferred that **[AIPMT 2010 (mains)]**
(i) the wavelength λ is 188.4 m. (ii) the wave number k is 0.33 rad/m
(iii) the wave amplitude is 10 V/m (iv) the wave is propagating along +x direction
Which one of the following pairs of statements is correct ?
(1) (iii) and (iv) (2) (i) and (ii) (3) (ii) and (iii) (4) (i) and (iii)

4. The electric field associated with an e.m. wave in vacuum is given by $\vec{E} = \hat{i}\,40\cos$ (kz – $6 \times 10_8$ t), where E, z and t are in volt/m, meter and seconds respectively. The value of wave vector k is : **[EMW_ AIPMT_Pre_2012]**
(1) 2 m_{-1} (2) 0.5 m_{-1} (3) 6 m_{-1} (4) 3 m_{-1}

5. The ratio of amplitude of magnetic field to the amplitude of electric field for an electromagnetic wave propagating in vacuum is equal to : **[AIPMT 2012 (Mains)]**
(1) the speed of light in vacuum

(2) reciprocal of speed of light in vacuum
(3) the ratio of magnetic permeability to the electric susceptibility of vacuum
(4) unity

6. The condition under which a microwave oven heats up a food items containing water molecules most efficiently is : **[NEET-2013]**
(1) The frequency of the microwaves has no relation with natural frequency of water molecules.
(2) Microwaves are heat waves, so always produce heating.
(3) Infra-red waves produce heating in a microwave oven.
(4) The frequency of the microwaves must match the resonant frequency of the water molecules.

7. Out of the following options which one can be used to produce a propagating electromagnetic wave ? **[AIPMT-2016]**
(1) An accelerating charge (2) A charge moving at constant velocity
(3) A stationary charge (4) A chargeless particle

8. In an electromagnetic wave in free space the root mean square value of the electric field is E_{rms} = 6V/m. The peak value of the magnetic field is : **[NEET 2017]**
(1) 1.41×10^{-8} T (2) 2.83×10^{-8} T (3) 0.70×10^{-8} T (4) 4.23×10^{-8} T

9. 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 oscillating magnetic field of the em wave will be along **[NEET 2018]**
(1) – z direction (2) – x direction (3) – y direction (4) + z direction

10. Which colour of the light has the longest wavelength? **[NEET 2019-I]**
(1) violet (2) red (3) blue (4) green

11. A parallel plate capacitor of capacitance 20 μF is being charged by a voltage source whose potential is changing at the rate of 3 V/s. The conduction current through the connecting wires, and the displacement current through the plates of the capacitor, would be, respectively: **[NEET 2019-I]**
(1) zero, zero (2) zero, 60 μA (3) 60 μA, 60 μA (4) 60 μA, zero

12. For a transparent medium, relative permeability and permittivity, μ_r and $\in_r$ are 1.0 and 1.44 respectively. The velocity of light in this medium would be : **[NEET 2019-II]**
(1) 2.5×10^8 (2) 3×10^8 (3) 2.08×10^8 m/s (4) 4.32×10^8 m/s

PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. An electromagnetic wave in vacuum has the electric and magnetic field $\vec{E}$ and $\vec{B}$, which are always perpendicular to each other. The direction of polarization is given by $\vec{X}$ and that of wave propagation by $\vec{k}$. Then
(1) $\vec{X} \| \vec{B}$ and $\vec{k} \| \vec{B} \times \vec{E}$ (2) $\vec{X} \| \vec{E}$ and $\vec{k} \| \vec{E} \times \vec{B}$ **[AIEEE 2012, 4. – 1]**
(3) $\vec{X} \| \vec{B}$ and $\vec{k} \| \vec{E} \times \vec{B}$ (4) $\vec{X} \| \vec{E}$ and $\vec{k} \| \vec{B} \times \vec{E}$

2. The magnetic field in a travelling electromagnetic wave has a peak value of 20 nT. The peak value of electric field strength is : **[JEE-MAIN 2013]**
(1) 3 V/m (2) 6 V/m (3) 9 V/m (4) 12 V/m

3. During the propagation of electromagnetic waves in a medium :
(1) Electric energy density is double of the magnetic energy density. **[JEE-Mains 2014]**
(2) Electric energy density is half of the magnetic energy density.
(3) Electric energy density is equal to the magnetic energy density.
(4) Both electric and magnetic energy densities are zero.

4. Match List-I (Electromagnetic wave type) with List-II (Its association/application) and select the correct option from the choices given below the lists : **[JEE-Mains 2014]**

List-I		List-II	
(a)	Infrared waves	(i)	To treat muscular strain
(b)	Radio waves	(ii)	For broadcasting
(c)	X-rays	(iii)	To detect fractureof bones
(d)	Ultraviolet	(iv)	Absorbed by the ozone layer of the atmosphere

	(a)	(b)	(c)	(d)
(1)	(iv)	(iii)	(ii)	(i)
(2)	(i)	(ii)	(iv)	(iii)
(3)	(iii)	(ii)	(i)	(iv)
(4)	(i)	(ii)	(iii)	(iv)

5. A red LED emits light at 0.1 watt uniformly around it. The amplitude of the electric field of the light at a distance of 1 m from the diode is : **[JEE(Main)-2015; 4/120, –1]**

(1) 1.73 V/m (2) 2.45 V/m (3) 5.48 V/m (4) 7.75 V/m

6. Arrange the following electromagnetic radiations per quantum in the order of increasing energy :

A : Blue light B : Yellow light **[JEE Main 2016 ; 4/120, –1]**

C : X-ray D : Radiowave

(1) A, B, D, C (2) C, A, B, D (3) B, A, D, C (4) D, B, A, C

7. An EM wave from air enters a medium. The electric fields are $\vec{E}_1 = E_{01}\hat{x}\cos\left[2\pi\nu\left(\frac{z}{c}-t\right)\right]$ in air and $\vec{E}_2 = E_{02}\hat{x}\cos\left[k(2z-ct)\right]$ in medium, where the wave number k and frequency υ refer to their values in air.

The medium is non-magnetic. If ε_{r_1} and ε_{r_2} refer to relative permittivities of air and medium respectively, which of the following options is correct ? **[JEE-Main-2018]**

(1) $\frac{\varepsilon_{r_1}}{\varepsilon_{r_2}} = \frac{1}{4}$ (2) $\frac{\varepsilon_{r_1}}{\varepsilon_{r_2}} = \frac{1}{2}$ (3) $\frac{\varepsilon_{r_1}}{\varepsilon_{r_2}} = 4$ (4) $\frac{\varepsilon_{r_1}}{\varepsilon_{r_2}} = 2$

8. The energy associated with electric field is (U_E) and with magnetic field is (U_B) for an electromagnetic wave in free space. Then : **[JEE-Main-2019]**

(1) $U_E < U_B$ (2) $U_E = \frac{U_B}{2}$ (3) $U_E > U_B$ (4) $U_E = U_B$

9. If the magnetic field of a plane electromagnetic wave is given by (The speed of light $=3 \times 10^8$ m/s)

$B=100 \times 10^{-6} \sin\left[2\pi \times 2 \times 10^{15}\left(t-\frac{x}{c}\right)\right]$ then the maximum electric field associated with it is **[JEE-Main-2019]**

(1) 4.5×10^4 N/C (2) 4×10^4 N/C (3) 6×10^4 N/C (4) 3×10^4 N/C

10. An amplitude modulated signal is given by $V(t) = 10\,[1+ 0.3\cos(2.2 \times 10^4 t)\sin(5.5 \times 10^5 t)]$. Here t is in seconds. The sideband frequencies (in kHz) are, [Given $\pi = 22/7$] **[JEE-Main-2019]**

(1) 892.5 and 857.5 (2) 89.25 and 85.75 (3) 1785 and 1715 (4) 178.5 and 171.5

11. An electromagnetic wave of intensity 50 Wm^{-2} enters in a medium of refractive index 'n' without any loss. The ratio of the magnitudes of electric fields, and the ratio of the magnitudes of magnetic field of the wave before and after entering into the medium are respectively, given by : **[JEE-Main-2019]**

(1) $\left(\sqrt{n},\sqrt{n}\right)$ (2) $\left(\frac{1}{\sqrt{n}},\sqrt{n}\right)$ (3) $\left(\sqrt{n},\frac{1}{\sqrt{n}}\right)$ (4) $\left(\frac{1}{\sqrt{n}},\frac{1}{\sqrt{n}}\right)$

Answers

EXERCISE # 1

1.	(2)	**2.**	(3)	**3.**	(3)	**4.**	(3)	**5.**	(4)	**6.**	(4)	**7.**	(2)
8.	(1)	**9.**	(1)	**10.**	(3)	**11.**	(1)	**12.**	(3)	**13.**	(3)	**14.**	(3)
15.	(2)	**16.**	(1)	**17.**	(3)	**18.**	(3)	**19.**	(1)	**20.**	(4)	**21.**	(3)
22.	(1)	**23.**	(1)	**24.**	(4)	**25.**	(3)	**26.**	(3)	**27.**	(3)	**28.**	(3)
29.	(3)	**30.**	(4)	**31.**	(4)	**32.**	(3)	**33.**	(4)	**34.**	(3)	**35.**	(1)
36.	(3)	**37.**	(3)	**38.**	(1)	**39.**	(3)	**40.**	(3)	**41.**	(2)	**42.**	(3)
43.	(4)	**44.**	(4)	**45.**	(2)	**46.**	(1)	**47.**	(4)	**48.**	(4)	**49.**	(3)
50.	(4)	**51.**	(3)	**52.**	(3)	**53.**	(3)	**54.**	(4)	**55.**	(1)	**56.**	(1)
57.	(2)	**58.**	(4)	**59.**	(1)	**60.**	(1)	**61.**	(2)	**62.**	(1)	**63.**	(1)
64.	(3)	**65.**	(4)	**66.**	(4)	**67.**	(2)	**68.**	(1)	**69.**	(2)	**70.**	(2)
71.	(1)	**72.**	(1)	**73.**	(1)	**74.**	(1)	**75.**	(1)	**76.**	(2)	**77.**	(3)
78.	(4)	**79.**	(2)	**80.**	(3)	**81.**	(1)	**82.**	(2)				

EXERCISE # 2

1.	(2)	**2.**	(4)	**3.**	(4)	**4.**	(3)	**5.**	(3)	**6.**	(1)	**7.**	(4)
8.	(4)	**9.**	(1)	**10.**	(2)								

EXERCISE # 3

PART – I

1.	(3)	**2.**	(3)	**3.**	(4)	**4.**	(1)	**5.**	(2)	**6.**	(4)	**7.**	(1)
8.	(2)	**9.**	(4)	**10.**	(2)	**11.**	(3)	**12.**	(1)				

PART – II

1.	(2)	**2.**	(2)	**3.**	(3)	**4.**	(4)	**5.**	(2)	**6.**	(4)	**7.**	(1)
8.	(4)	**9.**	(4)	**10.**	(2)	**11.**	(3)						