PHYSICS

BOOKS - MTG GUIDE

ELECTROMAGNETIC WAVES

Illustration

1. Figure shown a capacitor made of two circular plates each of radius 12 cm and separated by 5 mm. The capacitor is being charged by an

external source. The charging current is constant and equal to 0.15 A.

(a) Calculate the capacitance and the rate of change of potential difference across the plates.

(b) Obtain the displacement current across the plates.

(c) If Kirchhoff's junction rule valid at each plate of the capacitor ?

$\left(\varepsilon_0 = 8.85 \times 10^{-12} C^2 N^{-1} m^{-2}\right)$

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2. An electromagnetic wave going through vacuum is described by

$E = E_0 \sin(kx - \omega t), B = B_0 \sin(kx - \omega t).$

Then

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3. A radio can tune into any station in the $7.5MHz$ to $12MHz$ band. What is the corresponding wavelength of band?

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4. The terminology of different parts of the electromagnetic spectrum is given in the text. Use the formula $E = h \nu$ (for energy of a quantum of radiation: photon) and obtain the photon energy in units of eV for different parts of the electromagnetic spectrum. In what way are the different scales of photon energies that you obtain related to the sources of electromagnetic radiation?

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Neet Cafe Topicwise Practice Questions

1. Maxwell's equations describe the fundamental laws of

A. electricity only

B. mechanics only

C. magnetism only

D. both (a) and (c)

Answer: D

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2. A parallel- plate capacitor with plate area A and separation between the plates d, is charged by a constant current i. Consider a plane surface of area A/2 parallel to the plates and drawn summetrically between the plates. Find the displacement current through this area.

A. I

B. $\frac{I}{2}$

C. $\frac{I}{4}$

D. $\frac{I}{8}$

Answer: B

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3. An electromagnetic wave going through vacuum is described by $\vec{E} = E_0 \sin(kx - wt)$ and $\vec{B} = B_0 \sin(kx - wt)$. 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. $E_0 = B_0$

Answer: A

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4. The amplitude of the electric field of a plane electromagnetic wave in air is $6.0 \times 10^{-4} Vm^{-1}$. The amplitude of the imagnetic field will be

A. $1.8 \times 10^5 T1$

B. $5.0 \times 10^3 T$

C. $2.0 \times 10^{-4} T$

D. $2.0 \times 10^{-12} T$

Answer: D

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5. A plane electromagnetic wave propagating in the x-direction has wavelength of $6.0mm$. The electric field is in the y-direction and its maximum magnitude of $33Vm^{-1}$. The equation for the electric field as function of x and l is

A. $11 \sin\left[\pi\left(t - \frac{x}{c}\right)\right]$

B. $33 \sin\left[\pi \times 10^{11}\left(t - \frac{x}{c}\right)\right]$

C. $33 \sin\left[\pi\left(t - \frac{x}{c}\right)\right]$

D. $11 \sin\left[\pi \times 10^{11}\left(t - \frac{x}{c}\right)\right]$

Answer: B

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6. A place electromagnetic wave

$F_s = 100 \cos\left(6 \times 10^8 t + 4x\right) V/m$

Propagates in a medium of dielectric constant.

The refractive index is

A. 1.5

B. 2.0

C. 2.4

D. 4.0

Answer: B

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7. The pressure exerted by an electromagnetic wave of intensity I $\left(\text{watt}/\text{m}^2\right)$ on a nonreflecting surface is [c is the velocity of light]

A. Ic

B. Ic^2

C. I/c

D. I/c^2

Answer: C

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8. If the electric amplitude of the electromagnetic wave is $5Vm^{-1}$, its magnetic amplitude will be

A. $5 \times 10^{-8} T$

B. $1.67 \times 10^{-8} T$

C. $1.67 \times 10^{-10} T$

D. $5 \times 10^{-10} T$

Answer: B

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9. If C the velocity of light, which of the following is correct?

A. $\mu_0\varepsilon_0 = c$

B. $\mu_0\varepsilon_0 \frac{E}{B}$

C. $\mu_0\varepsilon_0 = \frac{1}{c}$

D. $\mu_0\varepsilon_0 = \frac{1}{c^2}$

Answer: D

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10. The velocity of an electromagnetic wave in a medium is $2 \times 10^8 mS^{-1}$. If the relative

permeability is 1 the relative permittivity of the medium is $\left(C_0 = 3 \times 10^8 mS^{-1}\right)$

A. 1.0

B. 1.8

C. 2.5

D. 1.2

Answer: B

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11. An electromagnetic wave of frequency $v = 3.0MHz$ passes from vacuum into a dielectric medium with permittivity $\varepsilon = 4.0$. Then

A. wavelength is double and frequency unchanged

B. wavelength is doubled and frequency becomes half

C. wavelength is halved and frequency remain unchanged

D. wavelength and frequency both remain unchanged.

Answer: C

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12. The rms value of the electric field of the light from the sun is $720N/C$ The total energy density of the electromagnetic wave is

A. $3.3 \times 10^{-3} Jm^{-3}$

B. $4.58 \times 10^{-6} Jm^{-3}$

C. $6.37 \times 10^{-9} Jm^{-3}$

D. $81.35 \times 10^{-12} Jm^{-3}$

Answer: B

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13. In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of 2.0×10^{10}Hz and amplitude $48 Vm^{-1}$. The total energy density of the electromagnetic field of the wave is :

A. $1.0 \times 10^{-2} m$

B. $1.5 \times 10^{-2} m$

C. $2.5 \times 10^{-2} m$

D. $3.0 \times 10^{2} m$

Answer: B

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14. The relation between electric field E and magnetic field H in an electromagnetic wave is

A. $E = \frac{B}{c}$

B. $E = cB$

C. $E = \frac{B}{c^2}$

D. $E = c^2 B$

Answer: B

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15. The velocity of electromagnetic wave is parallel to

A. $\overrightarrow{B} \times \overrightarrow{E}$

B. $\overrightarrow{E} \times \overrightarrow{B}$

C. $\overrightarrow{E}$

D. $\overrightarrow{B}$

Answer: B

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16. A point source of electromagnetic radiation has an average power output of $1500W$. The

maximum value of electric field at a distance $3m$ from this source in Vm^{-1} is

A. 500

B. 100

C. $\frac{500}{3}$

D. $\frac{250}{3}$

Answer: B

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17. Radiations of intensity $0.5W/m^2$ are striking a metal plate. The pressure on the plate is

A. $0.166 \times 10^{-8} Nm^{-2}$

B. $0.332 \times 10^{-8} Nm^{-2}$

C. $0.111 \times 10^{-8} Nm^{-2}$

D. $0.083 \times 10^{-8} Nm^{-2}$

Answer: A

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18. The magnetic field in the plane electromagnetic wave is given by

$B_z = 2 \times 10^{-7} \sin\left(0.5 \times 10^3 x + 1.5 \times 10^{11} t\right)$

tesla.

The expression for electric field will be:

A.

$E_y = 2 \times 10^{-7} \sin\left(0.5 \times 10^3 z + 1.5 \times 10^{11} t\right)$

B.

$E_x = 2 \times 10^{-7} \sin\left(0.5 \times 10^3 z + 1.5 \times 10^{11} t\right)$

C. $E_y = 60 \sin\left(0.5 \times 10^3 z + 1.5 \times 10^{11} t\right)$

D. $E_x = 60 \sin\left(0.5 \times 10^3 z + 1.5 \times 10^{11} t\right)$

Answer: D

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19. If E and B denote electric and magnetic fields respectively, which of the following is dimensionless?

A. $\sqrt{\mu_0 \varepsilon_0} \frac{E}{B}$

B. $\mu_0 \varepsilon_0 \frac{E}{B}$

C. $\mu_0 \varepsilon_0 \left(\frac{B}{E} \right)^2$

D. $\frac{E}{\varepsilon_0} \frac{\mu_0}{B}$

Answer: A

20. The frequnecy of visible light is of the order of

A. 10^{-2}

B. 10^{-2}

C. 10^{-6}

D. 10^{8}

Answer: C

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21. The electric field of an electromagnetic wave travelling through vaccum 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

Answer: A

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

A. $13,29 \times 10^{-12}$

B. 8.86×10^{-12}

C. 17.72×10^{-12}

D. 4.43×10^{-12}

Answer: B

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23. If the total electromagnetic energy falling on a surface is U then the total momentum delivered (for complate absorption) is

A. $\frac{U}{c}$

B. cU

C. $\frac{U}{c^2}$

D. c^2U

Answer: A

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24. Which one of the following is the property of a monochromatic, plane electromagnetic wave in free space?

A. Electric and magnetic fields have a phase difference of $\pi/2$

B. The energy contribution of both electric and magnetic fields are equal.

C. The direction of propagation is in the direction of $\overrightarrow{B} \times \overrightarrow{E}$

D. The pressure exerted by the wave is the product of its speed and energy density.

Answer: B

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25. A plane electromagnetic wave of frequency $25Mhz$ travels in free space along the x-direction. At a particular point in space and time, $E = (6.3j)V/m$. What is B at this point?

A. $8.33 \times 10^{-8}\hat{k}T$

B. $18.9 \times 10^{-8}\hat{k}T$

C. $2.1 \times 10^{-8}\hat{k}T$

D. $2.1 \times 10^{-8}\hat{i}T$

Answer: C

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26. The magnetic field of an electromagnetic wave is given by $3 \times 10^{-7} \sin\left(10^3 x + 6.28 \times 10^{12} t\right)$. The wave length of the electromagnetic wave is

A. 6.28 cm

B. 3.14 cm

C. 0.63 cm

D. 0.32 cm

Answer: C

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27. Eelctromagnetic wave consists of periodically oscillating electric and magnetic vectors

A. in mutually perpendicular planes but vibrating with a phase difference of it π

B. in mutually perpendicular planes but vibrating with a phase difference of $\frac{\pi}{2}$

C. in randomly oriented planes but vibrating in phase

D. in mutually perpendicular planes but vibrating in phase.

Answer: D

28. An electromagnetic wave propagating along north has its electric field vector upwards. Its magnetic field vector point towards

A. north

B. each

C. west

D. downwards

Answer: B

29. The speed of electromagnetic wave in vacuum

A. depends upon the source of radiation

B. increases as we move from $\gamma -$ rays to radio waves

C. decreases as we move from $\gamma -$ rays to radio waves

D. is same for all of them.

Answer: D

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30. The average electric field of electromagnetic waves in certain region of free space is

$9 \times 10^{-4} NC^{-1}$. Then the average magnetic field in the same region is of the order of

A. $27 \times 10^{-4} T$

B. $3 \times 10^{-12} T$

C. $\left(\frac{1}{3}\right) \times 10^{-12} T$

D. $3 \times 10^{12} T$

Answer: B

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31. Which of the following has/have zero average value in a plane electromagnetic wave?

A. Both magnetic and electric fields

B. Electric field only

C. Magnetic field only

D. Magnetic energy only

Answer: A

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32. Electromagnetic waves travel in a medium which has relative permeability 1.3 and relative permittivity 2.14. Then the speed of the electromagnetic wave in the medium will be

A. $13.6 \times 10^6 ms^{-1}$

B. $1.8 \times 10^6 ms^{-1}$

C. $3.6 \times 10^8 ms^{-1}$

D. $1.8 \times 10^8 ms^{-1}$

Answer: D

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33. Express velocity of electromagnetic wave in a material medium in terms of μ and ε.

A. $\frac{1}{\mu\varepsilon}$

B. $\frac{1}{2\mu\varepsilon}$

C. $\frac{1}{\sqrt{\mu\varepsilon}}$

D. $\frac{1}{\sqrt{2\mu\varepsilon}}$

Answer: C

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34. An electroagnetic wave is propagating along x-axis. At x = 1 m and t = 10 s, its electric vector $\left|\overrightarrow{E}\right| = 6V/m$ then the magnitude of its magnetic vector is

A. $2 \times 10^{-8}T$

B. $3 \times 10^{-7}T$

C. $6 \times 10^{-8}T$

D. $5 \times 10^{-7}T$

Answer: A

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35. A plane electromagnetic wave travels in free space along X-direction. If the value of $\overrightarrow{B}$ (in tesla) at a particular point in space and time is $1.2 \times 10^{-8}\hat{k}$. The value of $\overrightarrow{E}$ (in Vm^{-1}) at that point is

A. $1.2\hat{j}$

B. $3.6\hat{k}$

C. $1.2\hat{k}$

D. $3.6\hat{j}$

Answer: D

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36. The waves used by artificial satellites for communication is

A. microwaves

B. infrared waves

C. radio waves

D. X-rays.

Answer: A

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37. If V_g,V_x and V_m are the speeds of gamma rays, x-rays and microwaves respectively in vacuum then

A. $v_y > v_x > v_m$

B. $v_y < v_x < v_m$

C. $v_y > v_x < v_x$

D. $v_x = v_y = v_m$

Answer: D

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38. The produced rays in sonography are

A. Microwaves

B. Infrared rays

C. Radio waves

D. Ultrasonic waves

Answer: D

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39. A. Wavelength of microwaves is greater than that of ultraviolet rays.

B. The wavelength of infrared rays is lesser than that of ultraviolet rays.

C. The wavelength of microwaves is lesser than that of infrared rays

D. Gamma ray has shortest wavelength in the electomagnetic specturum

Choose the correct option.

A. A and B are true

B. B and C are true

C. C and D are true

D. A and D are true

Answer: D

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40. Wave which cannot travel in vacumm is

A. X-rays

B. radio waves

C. infrasonic waves

D. ultraviolet rays

Answer: C

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41. It travelling at same speeds, whichof the following mater waves have the shortest wavelength?

A. X-rays

B. $\gamma -$ rays

C. infrared rays

D. microwaves

Answer: B

42. Electromagnetic radiation of highest frequency is

A. infrared radiations

B. $\gamma -$ rays

C. radio waves

D. X-rays

Answer: B

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43. Which one of the following pairs of rays is electromagnetic in nature?

A. X-rays

B. Gamma rays

C. Cathode rays

D. Infrared rays

Answer: C

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44. An electromagnetic radiation has an energy of 13.2 keV. Then the radiation belongs to region of

A. visible light

B. ultraviolet

C. infrared

D. X-rays

Answer: D

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45. Given below is a list of electromagnetic spectrum and its mode of production. Which one does not match?

A. Gamma rays - Radioactive decay of the nucleus

B. Ultraviolet - Magnetron valve

C. Infra-red - Vibration of atoms and molecules

D. X-rays - Coolidge tube

Answer: B

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46. All types of electromagnetic radiations possess same

A. Radio waves

B. Visible light

C. X-rays

D. All of these travel at the same speed.

Answer: D

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47. The energy of infrared waves is greater than that of

A. visible light

B. ultraviolet waves

C. X-rays

D. microwaves

Answer: D

48. X-rays, gamma rays and microwaves travelling in vacuum have

A. same wavelengths but different velocities

B. same frequency but different velocities

C. same velocity but different wavelengths

D. same velocity and same frequency.

Answer: C

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49. The crystal structure can be studied by using

A. UV rays

B. X-rays

C. IR radiation

D. Microwaves

Answer: B

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50. The part of the spectrum of the electromagnetic radiation used to cook food is

A. ultraviolet rays

B. cosmic rays

C. X-rays

D. microwaves

Answer: D

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Check Your Neet Vitals

1. The electric field portion of an electromagnetic wave is given by (all variables in SI units) $E = 10^{-4}\sin\left(6 \times 10^{5}t - 0.01x\right)$ The.

Frequency (f) and the speed (v) of electromagnetic wave are

A. $f = 30/\pi \ \text{kHz and} \ v = 1.5 \times 10^7 ms^{-1}$

B. $f = 90/\pi \ \text{kHz and} \ v = 6.0 \times 10^7 ms^{-1}$

C. $f = 300/\pi \ \text{kHz and} \ v = 6.0 \times 10^7 ms^{-1}$

D. $f = 600/\pi \ \text{kHz and} \ v = 7.5 \times 10^7 ms^{-1}$

Answer: C

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2. In a plane electromagnetic wave, the electric field of amplitude $1Vm^{-1}$ varies with time in free space. The average energy density of magnetic field is $\left(\text{in J m}^{-3}\right)$

A. 8.86×10^{-12}

B. 4.43×10^{-12}

C. 17.72×10^{-12}

D. 2.21×10^{-12}

Answer: D

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3. The magnetic field of an electromagnetic wave is given by $3 \times 10^{-7} \sin\left(10^3 x + 6.28 \times 10^{12} t\right)$. The wave length of the electromagnetic wave is

A. 0.314 mm

B. 0.628 mm

C. 6.28 mm

D. 1.26 mm

Answer: C

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4. A place electromagnetic wave is propagating along the z-direction $\left(\hat{i}+\hat{j}\right)$, then which of the following is the direction of the magnetic field component.

A. $\left(-\hat{i}+\hat{j}\right)$

B. $\left(\hat{i}-\hat{j}\right)$

C. $\left(-\hat{i}-\hat{j}\right)$

D. $\left(\hat{i}+\hat{k}\right)$

Answer: A

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5. An electromagnetic wave travels in xy plane making an angle θ with x-axis. Then the equation of the wave is

A. $E = E_0 \sin(\omega t - kx\cos\theta + ky\sin\theta)$

B. $E = E_0 \sin(\omega t - kx\sin\theta - ky\cos\theta)$

C. $E = E_0 \sin(\omega t + kx\cos\theta + ky\sin\theta)$

D. $E = E_0 \sin(\omega t + kx\sin\theta + ky\cos\theta)$

Answer: A

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6. The electric field of an electromagnetic wave travelling through vaccum 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

Answer: A

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7. The electric field of a plane electromagnetic wave varies with time of amplitude $3Vm^{-1}$ propagating along z-axis. The average energy density of the magnetic field in $\left(\text{in J m}^{-3}\right)$

A. $13.29 \times x10^{-12}$

B. 20×10^{-12}

C. 17.72×10^{-12}

D. 15×10^{-12}

Answer: B

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8. The refractive index and the permiability of a medium are respectively 1.5 and $5 \times 10^{-7} Hm^{-1}$. The relative permitivity of the medium is nearly

A. 25

B. 15

C. 81

D. 3

Answer: D

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9. If the magnetic field B of a polarised electromagnetic wave oscillates parallel to y-axis and is given by : $B_y = B_m \sin(kz - \omega t)$. What is the direction of propagation of the electromagnetic wave and parallel to which axis does the associated electric field oscillates ?

A. $+ve$ y - $\mathrm{axis}, \mathrm{x}$ - axis

B. $-ve$ z - $\mathrm{axis}, \mathrm{y}$ - axis

C. $+ve$ z - $\mathrm{axis}, \mathrm{x}$ - axis

D. $+ve$ x - $\mathrm{axis}, \mathrm{z}$ - axis

Answer: C

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10. The dielectric constant for air is 1.006. The speed of em 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

Answer: A

11. Rank the following radiations according to their associated energies, greatest first.

(1) yellow light from a sodium lamp

(2) gamma ray emitted by a radioactive nucleus

(3) radio wave emitted by the antenna

(4) microwave beam emitted by radar

A. (2), (1), (4), (3)

B. (1), (2), (3), (4)

C. (3), (4), (1), (2)

D. (1), (2), (4), (3)

Answer: A

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12. Arrrange the following electromagnetic waves in the order of their increasing wavelength:

(a) γ-rays (b) microwaves.

(c) x-rays (d) Radiowaves.

A. Gamma rays lt Micro waves lt AM radio waves ltFM radio waves

B. Micro waves lt AM radio waves ltFM radio wave lt Gamma rays

C. Gamma rays ltAM radio waves ltFM radio wave ltMicro waves

D. Gamma rays ltMicro waves ltFM radio waves ltAM radio waves

Answer: D

13. Which of the following is the correct arrangement of the electromagnetic spectrum in the increasing order of frequency?

A. Microwaves, infrared, radio waves, visible light, X-rays

B. Radio waves, microwaves, infrared, visible light, X-rays

C. X-rays, visible light, infrared, microwaves, radio waves

D. Microwaves, radio waves, infrared, visible light, X-rays

Answer: B

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14. In an electromagnetic wave, the electric and magnetizing field are $100V/m$ and $0.265A/m$. The maximum energy flow is:

A. $79W/m^2$

B. $13.2W/m^2$

C. $53.0W/m^2$

D. $26.5W/m^2$

Answer: D

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

A. 36.5 m

B. 18.8 m

C. 42.8 m

D. 58

Answer: A

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16. What is the order of energy, in eV for a photon of visible light?

A. 10^{-2}

B. 10^{-4}

C. 10^{-6}

D. 10^{-8}

Answer: C

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17. A parallel plate capacitor is charged by a current of $2 \times 10^{-7} A$ displaced between the plates of capacitor. When discharge of the capacitor takes place through a resistance, the rate of change of electric flux (in Wb/s) will be

A. 2.26×10^{4}

B. 4.26×10^{8}

C. 3.26×10^{6}

D. 6.26×10^{9}

Answer: A

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18. Electromagnetic radiation of frequency n, wavelength λ, travelling with velocity v in air, enters a glass slab of refractive index μ. The frequency, wavelength and velocity of light in the glass slab will be respectively

A. $\frac{v}{\mu}, \frac{\lambda}{\mu}$ and $\frac{c}{\mu}$

B. $v, \frac{v}{\mu}$ and $\frac{c}{\mu}$

C. $v, 2\lambda$ and $\frac{c}{\mu}$

D. $\frac{2v}{\mu}, \frac{\lambda}{\mu}$ and c

Answer: B

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19. The frequency of $e.m$ wave which is best suit to observe a particle of radius 3×10^{-4} is of order of:

A. 10^{15}

B. 10^{14}

C. 10^{13}

D. 10^{12}

Answer: B

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20. The condition under which a microwave oven heats up a food item containing water molecules most efficiently is:

A. Microwaves are heat waves, so always produce heating

B. Infra-red waves produce heating in a microwave oven.

C. The frequency of the microwaves must match the resonant frequency of the water molecules.

D. The frequency of the microwaves has no relation with natural frequency of water molecules

Answer: C

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21. Ozone layer blocks the radiaitons of wave length

A. more than $3 \times 10^{-7} m$

B. equal to $3 \times 10^{-7} m$

C. less than $3 \times 10^{-7} m$

D. all of these

Answer: D

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22. A small metallic ball is charged positively and negatively in a sinusoidally manner at a frequency of $10^6 cps$. The maximum charge on the ball is $10^{-6} C$. What is the displacement current due to the alternating current?

A. 6.28A

B. 3.8A

C. $3.75 \times 10^{-4} A$

D. $122.56 A$

Answer: A

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23. A plane electromagnetic wave travels in vacuum along z-direction. What can you say about the direction of electric and magnetic field vectors?

A. $\hat{i}$ and $\hat{j}$

B. $\hat{i}$ and $-\hat{j}$

C. j and $\hat{i}$

D. $\hat{k}$ and $\hat{i}$

Answer: A

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24. For e.m. wave propagating along x-axis, $E_{\max} = 30V/m$. What is the maximum value of magnetic field?

A. $10^{-7}T$

B. $10^{-8}T$

C. $10^{-9}T$

D. $10^{-6}T$

Answer: A

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25. Electromangnetic waves travel in a medium at a speed of $2.2 \times 10^8 ms^{-1}$. The relative permeabillity of the medium is 1.0. Find the relative permitivity of the medium.

A. 2.2

B. 4.00

C. 2.30

D. 2.35

Answer: B

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Aipmt Neet Mcqs

1. Which of the following statement is false for the properties of electromagnetic waves?

A. Both electric and magnetic field vectors attain the maxima and minima at the same

place and same time.

B. The energy in electromagnetic wave is divided equally between electric and magnetic vectors.

C. Both electric and magnetic field vectors are parallel to each other and perpendicular to the direction of propagation of wave.

D. These waves do not require any material medium for propagation.

Answer: C

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2. The electric field on an electromagnetic wave in free space is given by

$E = 10\cos\left(10^7 t + kx\right)\hat{j}V/m,$

Where t and x are in seconds and metres respectively. It can be inferred that

(1) the wavelength λ is $188.4m$.

(2) the wave number k is $0.33rad/m$

(3) the wave amplitude is $10V/m$

(4) the wave is propagating along +x direction.

which one of the following pairs of statement is correct?

A. (2) and (4)

B. (1) and (2)

C. (2) and (3)

D. (1) and (3)

Answer: D

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3. The electric and the magnetic field, associated with an e.m. wave propagating along the $+z$axis, can be represented by

A. $\left[\vec{E} = E_0\hat{i}, \vec{B} = B_0\hat{j}\right]$

B. $\left[\vec{E} = E_0\hat{k}, \vec{B} = B_0\hat{k}\right]$

C. $\left[\vec{E} = E_0\hat{j}, \vec{B} = B_0\hat{k}\right]$

D. $\left[\vec{E} = E_0\hat{j}, \vec{B} = B_0\hat{k}\right]$

Answer: A

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4. The decreasing order of wavelength of infrared, microwave, ultraviolet and gamma rays is

A. microwave, infrared, ultraviolet, gamma rays

B. gamma rays, ultraviolet, infrared, microwaves

C. microwaves, gamma rays, infrared, ultraviolet

D. infrared, microwave, ultraviolet, gamma rays

Answer: A

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5. The electric field associated with an electromagnetic wave in vacuum is given by $\overrightarrow{E} = 40\cos\left(kz - 6 \times 10^{8}t\right)\hat{i}$,

where E, z and t are in volt per meter, meter and second respectively. The value of wave vector k is

A. $2m^{-1}$

B. $0.4m^{-1}$

C. $6m^{-1}$

D. $3m^{-1}$

Answer: A

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6. The ratio of amplitude of magnetic field to the amplitude of electric field for an electromagnetic wave propagating in vacumm is equal to

A. the speed of light in vacuum

B. reciprocal of speed of light in vacuum

C. the ratio of magnetic permeability to the electric susceptibility of vacuum

D. unity

Answer: B

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7. The condition under which a microwave oven heats up a food item containing water molecules most efficiently is:

A. Microwaves are heat waves, so always produce heating.

B. Infra-red waves produce heating in a microwave oven.

C. The frequency of the microwaves must match the resonant frequency of the water molecules.

D. The frequency of the microwaves has no relation with natural frequency of water molecules.

Answer: C

8. Light with an enargy flux of $25 \times 10^4 Wm^{-2}$ falls on a perfectly reflecting surface at normal incidence. If the surface area is $15cm^2$, the average force exerted on the surface is

A. $1.25 \times 106(-6)N$

B. $2.50 \times 10^{-6}N$

C. $1.20 \times 10^{-6}N$

D. $3.0 \times 10^{-6}N$

Answer: B

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9. A radiation of energy E falls normally on a perfctly refelecting surface . The momentum transferred to the surface is

A. $\frac{2E}{C^2}$

B. $\frac{E}{C^2}$

C. $\frac{E}{C}$

D. $\frac{2E}{C}$

Answer: D

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10. The energy of the electromagetic wave is of the order of 15 keV. To which part of the spectrum dose it belong?

A. Ultraviolet rays

B. γ-rays

C. X-rays

D. Infrared rays

Answer: C

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11. Out of the following options which one can be used produce a propagating electromagnetic wave?

A. A chargeless particle

B. An accelerating charge

C. A charge moving al constant velocity

D. A stationary charge

Answer: B

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12. 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

A. 2.2 A

B. 4.4

C. 4.4 A

D. $11\sqrt{A}$

Answer: A

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13. 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

A. $2.83 \times 10^{-8}T$

B. $0.70 \times 10^{-8}T$

C. $4.23 \times 10^{-8}T$

D. $1.41 \times 10^{-8}T$

Answer: A

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14. An EM wave is propagating in a medium whith a velocity $\overrightarrow{v} = v\hat{i}$. The instantaneous oscillating electric field of this of em wave is along $+y$ axis. Then the direction of oscillating magnetic field of the EM wave will be along

A. $-z$ direction

B. $+z$ direction

C. $-y$ direction

D. $-x$ direction

Answer: B

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15. A parallel plate capacitor 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:

A. zero, zero

B. zero, $60 \mu A$

C. $60\mu A$, $60\mu A$

D. $60\mu A$, zero

Answer: C