PHYSICS

BOOKS - DISHA PUBLICATION PHYSICS (HINGLISH)

ELECTROMAGNETIC WAVES

Jee Main 5 Years At A Glance

1. A plane electromagnetic wave3 of wavelength λ has an indentsity I. It is propagating along the position Y - direction. The allowed expressions for the electric and magnetic fields are given by

A. $\vec{E} = \sqrt{\frac{I}{\varepsilon_0 C}} \cos\left[\frac{2\pi}{\lambda}(y - ct)\right]\hat{i}, \vec{B} = \frac{1}{c}E\hat{k}$

B. $\vec{E} = \sqrt{\frac{I}{\varepsilon_0 C}} \cos\left[\frac{2\pi}{\lambda}(y - ct)\right]\hat{k}, \vec{B} = -\frac{1}{c}E\hat{i}$

C. $\vec{E} = \sqrt{\frac{2I}{\varepsilon_0 C}} \cos\left[\frac{2\pi}{\lambda}(y - ct)\right]\hat{k}, \vec{B} = +\frac{1}{c}E\hat{i}$

D. $\vec{E} = \sqrt{\frac{2I}{\varepsilon_0 C}} \cos\left[\frac{2\pi}{\lambda}(y - ct)\right]\hat{k}, \vec{B} = -\frac{1}{c}E\hat{j}$

Answer: C

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2. A plane plarized monochromatic EM wave is traveling in vacuum along Z direction such that at t=t_1 it is found th at the elctric field is zero at a spatial point z_1 The

next zero that occurs in its neighbourhood is at z_2 The frequency of the electromagnetic wave is :

A. $\frac{3 \times 10^8}{|z_2 - z_1|}$

B. $\frac{6 \times 10^8}{|z_2 - z_1|}$

C. $\frac{1.5 \times 10^8}{|z_2 - z_1|}$

D. $\frac{1}{t_1 + \frac{|z_2 - z_1|}{3 \times 108}}$

Answer: A

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3. An EM wave from air enters a medium. The electric fields are

$\vec{E}_1 = E_{01}\hat{x}\cos\left[2\pi v\left(\frac{z}{c} - t\right)\right]$ in air and $\vec{E} = E_{02}\hat{x}\cos[k(2z - ct)]$ in medium, where the wave number k and frequency v refer to their values in air. The medium is non-magnetic. If $\in_{r_1}$ and $\in_{r_2}$ refer to relative permittivities of air and medium respectively, which of the following options is correct ?

A. $\frac{\in_{r_1}}{\in_{r_2}} = 4$

B. $\frac{\in_{r_1}}{\in_{r_2}} = 2$

C. $\frac{\in_{r_1}}{\in_{r_2}} = \frac{1}{4}$

D. $\frac{\in_{r_1}}{\in_{r_2}} = \frac{1}{2}$

Answer: C

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4. The electric field component of a monochromatic radiation is given by

$\vec{E} = 2E_0 \hat{i} \cos kz \cos \omega t$

Its magnetic field $\vec{B}$ is then given by :

A. $\frac{2E_o}{c} \hat{j} \sin kz \cos \omega t$

B. $-\frac{2E_o}{c} \hat{j} \sin kz \sin \omega t$

C. $\frac{2E_o}{c} \hat{j} \sin kz \sin \omega t$

D. $\frac{2E_o}{c} \hat{j} \cos kz \cos \omega t$

Answer: C

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5. Magnetic field in a plane electromagnetic wave is given by

$$\overline{B} = B_0 \sin(kx + \omega t)\hat{j}T$$

Expression for corresponding electric field will be

A. $\vec{E} = B_0 c \sin(kx + \omega t)\hat{k}V/m$

B. $\vec{E} - \frac{B_0}{c}\sin(kx + \omega t)\hat{k}V/m$

C. $\vec{E} = -B_0 c \sin(kx + \omega t)\hat{k}V/m$

D. $\vec{E} = B_0 c \sin(kx - \omega t)\hat{k}V/m$

Answer: A

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6. Microwave oven acts on the principle of :

A. giving rotational energy of water molecules

B. giving translational energy to water molecules

C. giving vibrational energy to water molecules

D. transferring electrons from lower to higher energy levels in water molecule

Answer: C

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

A: Blue light

B: Yellow light

C: X-ray

D: Radiowave

A. C, A, B, D

B. B, A D, C

C. D, B, A, C

D. A, B, D, C

Answer: C

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8. For plane electromagnetic waves propagating in the z-direction , which one of the following combinations gives the correct possible direction for $\vec{E}$ and $\vec{B}$ field respectively ?

A. $\left(2\hat{i}+3\hat{j} \text{ and } \left(\hat{i}+2\hat{j}\right)\right.$

B. $\left(-2\hat{i}-3\hat{j}\right)$ and $\left(3\hat{i}-2\hat{j}\right)$

C. $\left(3\hat{i}+4\hat{j}\right)$ and $\left(4\hat{i}-3\hat{j}\right)$

D. $\left(\hat{i}+2\hat{j}\right)$ and $\left(2\hat{i}-\hat{j}\right)$

Answer: B

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9. An electromagnetic wave of frequency 1×10^{14} Hertz is propagating along z-axis. The amplitude of electric field is $4V/m$. If $\varepsilon_0 = 8.8 \times 10^{-12} C^2/N - m^2$, then average energy density of electric field will be:

A. $35.2 \times 10^{-10} J/m^3$

B. $35.2 \times 10^{-11} J/m^3$

C. $35.2 \times 10^{-12} J/m^3$

D. $35.2 \times 10^{-13} J/m^3$

Answer: C

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10. During the propagation of electromagnetic waves in a medium:

A. Electric energy density is double of the magnetic energy density.

B. Electric energy density is half of the magnetic energy density.

C. Electric energy density is equal to the magnetic energy density.

D. Both electric magnetic energy densities are zero.

Answer: C

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11. Match List - I (Electromagnetic wave type) with List - II (Its association/aaplication) and select the correct option from the choices given below the lists :

A. $\begin{matrix} 1 & 2 & 3 & 4 \\ (\text{iv}) & (\text{iii}) & (\text{ii}) & (\text{i}) \end{matrix}$

B. $\begin{matrix} 1 & 2 & 3 & 4 \\ (\text{i}) & (\text{ii}) & (\text{iv}) & (\text{iii}) \end{matrix}$

C. $\begin{matrix} 1 & 2 & 3 & 4 \\ (\text{iii}) & (\text{ii}) & (\text{i}) & (\text{iv}) \end{matrix}$

D. $\begin{matrix} 1 & 2 & 3 & 4 \\ (\text{i}) & (\text{ii}) & (\text{iii}) & (\text{iv}) \end{matrix}$

Answer: D

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1. If $\vec{E}$ and $\vec{B}$ be the electric and magnetic field of E.M. wave then the direction of propogation of E.M. wave is along the direction.

A. $\vec{E}$

B. $\vec{B}$

C. $\vec{E} \times \vec{B}$

D. None of these

Answer: C

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2. The figure shows graphs of the electric field magnitude E versus time t for four uniform electric fields, all contained within identical circular regions. Which of them is according to the magnitudes of the magnetic field?

A. A

B. B

C. C

D. D

Answer: C

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3. An electromagnetic wave of intensity I falls on a surface kept in vacuum and exerts radiation pressure P on it. Which of the following statements are true?

I. Radiation pressure is I/c if the wave is totally absorbed.

II. Radiation pressure is I/c if the wave is totally reflected.

III. Radiation pressure is 2 I/c if the wave is totally reflected.

A. I and II

B. I and III

C. III only

D. I, II and III

Answer: B

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4. 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. 36.6 m

B. 40.5 m

C. 42.3 m

D. 50.9 m

Answer: A

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

A. Both electric and magnetic field vectors attains 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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6. A radiation of energy E falss normally on a perfectly reflecting surface. The momentum transferred to the surface is

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

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

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

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

Answer: A

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

A. A charge moving at constant velocity

B. A stationary charge

C. A chargeless particle

D. An accelerating charge

Answer: D

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8. Displacement current goes through the gap between the plates of a capacitor when the charge of the capacitor

A. increases

B. decreases

C. is zero

D. remains unchanged

Answer: C

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9. The speed of electromagnetic wave is same for

A. odd frequencies

B. even frequencies

C. all frequencies

D. all intensities

Answer: D

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10. The electromagnetic waves

A. travel with the speed of sound

B. travel with the same speed in all media

C. travel in free space with the speed of light

D. do not travel through a medium

Answer: C

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11. The amplitudes of electric and magnetic field increases by a factor of 2 each then velocity of light:

A. decreases

B. remains constant

C. increases thrice

D. increases twice

Answer: B

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12. A plane electromagnetic wave is incident on a material surface. The wave delivers momentum p and energy E.

A. $p = 0, E = 0$

B. $p \neq 0, E \neq 0$

C. $p \neq 0, E = 0$

D. $p = 0, E \neq 0$

Answer: B

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13. The electromagentic waves do not transport

A. energy

B. charge

C. momentum

D. information

Answer: B

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14. In an electromagnetic wave the average energy density is associated with-

A. with electric field only

B. with magnetic field only

C. equally with electric and magnetic fields

D. None of these

Answer: C

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15. A plane electromagnetic wave is incident on a plane surface of area A, normally and is perfectly reflected. If energy E strikes the surface in time t then average pressure exerted on the surface is (c = speed of light)

A. zero

B. E/Atc

C. 2E/Atc

D. E/c

Answer: A

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16. The speed of electromagnetic wave in vacuum

A. increases as we move from $\gamma -$ rays waves

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

C. is same for all of them

D. None of these

Answer: C

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17. Electrimagnetic waves are transverse is nature is evident by

A. polarization

B. interference

C. reflection

D. diffraction

Answer: C

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18. Which of the following shows green house effect?

A. Ultraviolet rays

B. Infrared rays

C. X -rays

D. None of these

Answer: B

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19. The magnetic field In a travelling electromagnetic wave has a peak value of $20nT$ The peak value of electric field strength is :

A. 3V/m

B. 6V/m

C. 9V/m

D. 12V/m

Answer: B

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20. Maxwell's modified form of Ampere's circuital law is

A. $\oint \vec{B} \cdot \vec{ds} = 0$

B. $\oint \vec{B} \cdot \vec{dl} = \mu_0 I$

C. $\oint \vec{B} \cdot \vec{dl} = \mu_0 I + \frac{1}{\varepsilon_o} \frac{dq}{dt}$

D. $\oint \vec{B} \cdot \vec{dl} = \mu_0 I + \mu_0 \varepsilon_o \frac{d \oint_E}{dt}$

Answer: D

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21. The speed of electromagnetic wave in vacuum

A. $v = \frac{1}{\sqrt{\mu_r K}}$

B. $v = c\sqrt{\mu_r K}$

C. $v = \dfrac{c}{\sqrt{\mu_r K}}$

D. $v = \dfrac{K}{\sqrt{\mu_r C}}$

Answer: C

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22. Which of the following type of radiations are radiated by an oscillating electric charge?

A. Electric

B. Magnetic

C. Thermoelectric

D. Electromagnetic

Answer: D

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23. According to Maxwell's hypothesis, a changing electrio field gives rise to

A. an e.m.f

B. electric displacement current

C. magnetic field

D. pressure gradient

Answer: C

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24. In an electromagnetic wave

A. power is transmitted along the magnetic field

B. power is transmitted along the electric field

C. power is equally transferred along the electric and magnetic fields

D. power is transmitted in a direction perpendicular to both the fields

Answer: D

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25. A beam has intensity $2.5 \times 10^{14} Wm^{-2}$. The ratio of electric and magnetic fields in the beam is

A. $2.98 \times 10^{8} NC^{-1} T^{-1}$

B. $8.32 \times 10^{5} NCT^{-1}$

C. $6.22 \times 10^{7} NC^{-1} T^{-1}$

D. $2.88 \times 10^{6} NCT^{-1}$

Answer: A

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26. Conduction current flows

A. only through resistance

B. through wires and resistance

C. only through capacitor

D. through wires, resistance and capacitor

Answer: B

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27. The displacement current is

A. $\varepsilon_o d\phi_E / dt$

B. $\frac{\varepsilon_o}{R} d\phi_E / dt$

C. $\varepsilon_o E / R$

D. $\varepsilon_o qC / R$

Answer: A

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28. If a source is transmitting electromagnetic wave of frequency $5.2 \times 10^6 Hz$, then wavelength of the electromagnetic waves transmitted from the source will be

A. 57.6 m

B. 39.8 m

C. 94.8 m

D. 48.6 m

Answer: A

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29. In an apparatus the electric field was found to oscillate with an amplitude of $18\ V/m$. The magnitude of the oscillating magnrtic field will be

A. $4 \times 10^{-6} T$

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

C. $9 \times 10^{-9} T$

D. $11 \times 10^{-11} T$

Answer: B

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30. In an electromagnetic wave, the electric and magnetising fields are $100 V m^{-1}$ and $0.265 A m^{-1}$. The maximum energy flow is

A. $26.5 W / m^2$

B. $36.5 W / m^2$

C. $46.7W/m^2$

D. $765W/m^2$

Answer: A

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31. A plane electromagnetic wave travels in free space along x-axis. At a particular point in space, the electric field along y-axis is $9.3Vm^{-1}$. The magnetic induction (B) along z-axis is

A. $3.1 \times 10^{-8}T$

B. $3 \times 10^{-5}T$

C. $3 \times 10^{-6} T$

D. $9.3 \times 10^{-6} T$

Answer: A

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32. A new system of unit is evolved in which the values of μ_0 and $\in_0$ are 2 and 8 respectively. Then the speed of light in this system will be

A. 0.25

B. 0.5

C. 0.75

D. 1

Answer: A

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33. 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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34. Figure shows a parallel plate capacitor and the current in the connecting wires that is discharging the capacitor.

A. The displacement current is leftward

B. The displacement current is rightward

C. The electric field $\vec{E}$ is rightward

D. The magnetic field at point P is out the page.

Answer: A

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

A. $4.58 \times 10^{-6} J/m^3$

B. $6.37 \times 10^{-9} J/m^3$

C. $81.35 \times 10^{-12} J/m^3$

D. $3.3 \times 10^{-3} J/m^3$

Answer: A

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36. In order to establish an instantaneous displacemet current of 1 mA in the space between the plates of 2μF parallel plate capacitor, the potential difference need to apply is

A. $100Vs^{-1}$

B. $200Vs^{-1}$

C. $300Vs^{-1}$

D. $500Vs^{-1}$

Answer: D

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37. 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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38. The electric field associted with an electromagnetic wave in vacuum is given by $\vec{E} = \hat{i}40\cos\left(kz = 6 \times 10^8 t\right)$, when E, z and t are in volt/m metre and second respectively

find the wave vector.

A. $2m^{-1}$

B. $0.5m^{-1}$

C. $6m^{-1}$

D. $3m^{-1}$

Answer: A

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Exercise 1 Concept Builder Topicwise Topic 2 Electromagnetic Spectrum

1. Electromagnetic radiation of highest frequency is

A. infrared radiations

B. visible rediation

C. radio waves

D. $\gamma -$ rays

Answer: D

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2. Which of the following EM radiations shows green house effect?

A. Ultraviolet rays

B. Infrared rays

C. X - rays

D. None of these

Answer: B

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3. Light of an electromagnetic radiation has an energy 2.06 eV each. To which region of electromagnetic

spectrum does it belong?

A. X - ray region

B. Ultra violet region

C. Infrared region

D. Visible region

Answer: D

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4. Which rays are not the portion of electro-magnetic spectrum?

A. X - rays

B. Microwaves

C. $\alpha -$ rays

D. Radio waves

Answer: C

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5. The range of wavelength of the visible light is

A. $10Å \text{ to } 100Å$

B. $4000Å \text{ to } 8000Å$

C. $8000Å \text{ to } 10,000Å$

D. $10,000Å \text{ to } 15,000Å$

Answer: B

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6. Which of the following are not electromagnetic waves?

A. Cosmic rays

B. Gamma rays

C. $\beta -$ rays

D. X - rays

Answer: A:C

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7. The electromagnetic radiation used in food processing sterilizing agent is

A. microwaves

B. UV rays

C. gamma rays

D. radio waves

Answer: B

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8. Microwaves are detected by

A. balometer

B. point contact diodes

C. thermopiles

D. the eye

Answer: B

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9. Radio waves with frequencies higher than television signals are

A. ultrasonic waves

B. sound waves

C. light waves

D. microwaves

Answer: D

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10. Which of the following electromagnetic waves have the longest wavelength ?

A. Heat waves

B. Visible light

C. Radio frequency waves

D. Microwaves

Answer: B

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11. Radio waves do not penetrate in the bond of

A. ionosphere

B. mesosphere

C. troposphere

D. stratosphere

Answer: A

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12. 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. microwaves

Answer: D

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13. A man can take pictures of those objects which are not fully visible to the eye using camera films acceptable to

A. ultraviolet rays

B. infrared rays

C. microwaves

D. radiowaves

Answer: B

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14. The basic source of electromagnetic radiation is an accelerated :

A. charge

B. magnet

C. light

D. $\alpha -$ particle

Answer: A

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15. The ozone layer convert the ultraviolet radiation to [which is used to heat the atmosphere and the earth's surface.]

A. Infrared ray

B. Visible ray

C. $\gamma -$ ray

D. None of these

Answer: A

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16. Radio waves and visible light in vacuum have

A. same velocity but different wavelength

B. continuous emission spectrum

C. band absorption spectrum

D. line emission spectrum

Answer: A

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17. Which of the following waves have the maximum wavelength?

A. X - rays

B. I.R. rays

C. UV rays

D. Radio waves

Answer: D

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18. The ozone layer absorbs radiation of wavelengths

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

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

C. less than $3 \times 10^{-5} m$

D. more than $3 \times 10^{-5} m$

Answer: A

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19. The structure of solids is invested by using

A. cosmic rays

B. X - rays

C. $\gamma -$ rays

D. infra - red radiations

Answer: B

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20. We consider the radiation emitted by the human body. Which of the following statements is true

A. the radiation emitted lies in the ultraviolet region and hence is not visible

B. the radiation emitted is in the infra- red region.

C. the radiation is emitted only during the day.

D. the radiation is emitted during the summers and absorbed duuring the winters.

Answer: B

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21. Photons of an electromagnetic radiation has an energy 11 keV each. To which region of electromagnetic spectrum does it belong ?

A. X - rays region

B. Ultraviolet region

C. Infrared region

D. Visible region

Answer: A

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22. If V_g,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. $v_s = v_x = v_m$

Answer: D

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Exercise 2 Concept Applicator

1. The electric field part of an electromagnetic wave in a medium is represented by

$$E_x = 0,$$

$$E_y = 2.5\frac{N}{C}\cos\left[\left(2\pi \times 10^6 \frac{rad}{m}\right)t - \left(\pi \times 10^{-2}\frac{rad}{s}\right)x\right]$$

$$E_z = 0.$$

The wave is

A. moving along x direction x direction with frequency $10^6 Hz$ and wave length 100 m.

B. moving along x direction with frequency $10^6 Hz$ and wave length 200 m.

C. moving along -x direction with frequency $10^6 Hz$ and wave length 200m.

D. moving along y direction with frequency $2\pi \times 10^6 Hz$ and wave length 200 m.

Answer: B

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

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

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

Answer: A

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3. An electromagnetic wave going through vacuum is described by

$E = E_0 \sin(kx - \omega t)$. Which of the following is/are independent of the wavelength?

A. k

B. ω

C. k/ω

D. $k\omega$

Answer: C

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4. An em wave going through vacuum is described by

$E = E_0 \sin(kx - \omega t)$

$B = B_0 \sin(kx - \omega t)$

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

Answer: A

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

A. wavelength is halved and frequency remains unchanged

B. wavelength is doubled and frequency becomes half

C. wavelength is doubled and the frequency remains unchanged

D. wavelength and frequency both remain unchanged

Answer: A

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6. The charge on a parallel plate capacitor varies as $q = q_0 \cos 2\pi t$. The plates are very large and close together (area = A, separation = d). The displacement current through the capacitor is

A. $q_0 2\pi v \sin \pi v >$

B. $-q_0 2\pi v \sin 2\pi vt$

C. $q_0 2\pi \sin \pi vt$

D. $q_0 \pi v \sin 2\pi vt$

Answer: B

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7. When an electromagnetic wave enters the ionised layer of ionosphere, the motion of electron cloud produces a space current and the electric field has its own capacitative displacement current then.

A. the space current is in phase of displacement current

B. the space current lags behind the displacement current by a phase 180°.

C. the space current lags behind the displacement current by a phase $906(\circ)$

D. the space current leads the displacement current by aphase 90°

Answer: B

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8. A plane electromagnetic wave in a non-magnetic dielectric medium is given by $\vec{E} = \vec{E}_0(4 \times 10^{-7}x - 50t)$ with distance being in meter and time in seconds. The dielectric constant of the medium is :

A. 2.4

B. 5.8

C. 8.2

D. 4.8

Answer: B

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9. The magnetic component of a polarised wave of light is $\left[B_x = \left(4.0 \times 10^{-6} T\right) \sin\left(1.57 \times 10^{7} m^{-1}\right) y + \omega t\right]$. The intensity of light is

A. $1.9 kW / m^2$

B. $3.8 kW / m^2$

C. $5.7 kW / m^2$

D. $7.6 kW / m^2$

Answer: A

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10. The sunlight reaching the earth has maximum electric field of 810V $\left(m^{-1}\right)$. What is the maximum magnetic field in this light?

A. $2.7\mu T$

B. 8.3T

C. $9.28\mu T$

D. $11.3T$

Answer: A

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11. In which one of the following regions of the electromagnetic spectrum will the vibrational motion of molecules give rise to absorption

A. Ultraviolet rays

B. Microwaves

C. Infrared

D. Radio waves

Answer: B

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12. Match List I (Wavelength range of electromagnetic spectrum) with List II (Method of production of these waves) and slect the correct option from the options given below the lists.

A. $(1)-(iv),(2)-(iii),(3)-(ii),(4)-(i)$

B. $(1)-(iii),(2)-(iv),(3)-(i),(4)-(ii)$

C. $(1)-(ii),(2)-(ii),(3)-(iv),(4)-(i)$

D. $(1)-(i),(2)-(ii),(3)-(iii),(4)-(iv)$

Answer: D

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13. 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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14. A lamp emits monochromatic green light uniformly in all directions. The lamp is $3\,\%$ efficient in converting electrical power to electromagnetic waves and consumes $100W$ of power. The amplitude of the electric field associated with the electromagnetic radiation at a distance of 5 m from the lamp will be:

A. 1.34 V/m

B. 2.68 V/m

C. 4.02 V/m

D. 5.36 V/m

Answer: B

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15. In a plane electromagnetic wave propagating in space has an electric field of amplitude $9 \times 10^3 V/m$, then the amplitude of the magnetic field is

A. $2.7 \times 10^{12} T$

B. $9.0 \times 10^{-3} T$

C. $3.0 \times 10^{-4} T$

D. $3.0 \times 10^{-5} T$

Answer: D

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16. If ε_0 and μ_0 are respectively, the electric permittivity and the magnetic permeability of free space, ε and μ the corresponding quantities in a medium, the refractive index of the medium is

A. $\sqrt{\frac{\varepsilon}{\varepsilon_0}}$

B. $\sqrt{\frac{\varepsilon_0\mu}{\varepsilon\mu_0}}$

C. $\sqrt{\frac{\varepsilon_0\mu_0}{\varepsilon\mu}}$

D. $\sqrt{\frac{\varepsilon\mu}{\varepsilon_0\mu_0}}$

Answer: D

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17. A wave is propagating in a medium of electric dielectric constant 2 and relative magnetic permeability 50. The wave impeldance of such a medium is

A. 5Ω

B. 376.6Ω

C. 1883Ω

D. 3776Ω

Answer: C

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

A. microwave, infrared, ultraviolet, gamma rays

B. gamma rays ultraviolet, infrared, micro-waves

C. microwaves, gamma rays, infrared, ultraviolet

D. infrared, microwave, ultraviolet, gamma rays

Answer: A

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19. 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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20. 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

A. $\vec{X} \| \vec{B}$ and $\vec{k} \| \vec{B} \times \vec{E}$

B. $\vec{X} \| \vec{E}$ and $\vec{k} \| \vec{E} \times \vec{B}$

C. $\vec{X} \| \vec{B}$ and $\vec{k} \| \vec{E} \times \vec{B}$

D. $\vec{X} \| \vec{E}$ and $\vec{k} \| \vec{B} \times \vec{E}$

Answer: B

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21. 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. $1.25 \times 10^{-6} N$

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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22. A point source of electromagnetic radiation has an average power output of $800W$. The maximum value of elecvtric field at a distance $4.0m$ from the source is

A. 64.7 V.m

B. 57.8V/m

C. 56.72V/m

D. 54.77V/m

Answer: D

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23. An electromagnetic wave with frequency ω and wavelength λ travels in the + y direction. Its magnetic field is along + xaxis. The vector equation for the associated electric field (of amplitude E_0) is

A. $\vec{E} = -E_0 \cos\left(\omega t + \frac{2\pi}{\lambda} y\right) z$

B. $\vec{E} = E_0 \cos\left(\omega t - \frac{2\pi}{\lambda} y\right) \hat{i}$

C. $\vec{E} = E_0 \cos\left(\omega t - \frac{2\pi}{\lambda} y\right) \hat{z}$

D. $\vec{E} = -E_0 \cos\left(\omega t + \frac{2\pi}{\lambda} y\right) \hat{z}$

Answer: C

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24. 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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25. Find the energy contained in a cyllinder of cross - section $10cm^2$ and length 50 along x - axis, if $E = 50\sin\omega(t - x/C)$ be the electric field in an electromagnetic wave

A. $5.5 \times 10^{-12}J$

B. $1.5 \times 10^{-11}J$

C. $6.2 \times 10^{-10}J$

D. $1.1 \times 10^{-15}J$

Answer: A

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26. Radio wave diffract around building although light waves do not. The reason is that radio waves

A. travel with speed larger than c.

B. have much larger wavlength than light

C. are not electromagnetic waves

D. None of these

Answer: B

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27. Which of the following wave can not be produced by charges accelerating in AC circuits having an inductor

and capacitor?

A. Radio wave

B. Microwave

C. Infrared

D. None of these

Answer: C

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28. Intensity of electromagnetic wave will be

A. $I = c\mu_0 B_0^2 / 2$

B. $I = c\varepsilon_0 B_0^2 / 2$

C. $I = B_0^2 / c\mu_0$

D. $I = E_0^2 / 2c\varepsilon_0$

Answer: B

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29. The conduction current is the same as displacement current when the source is

A. ac only

B. dc only

C. either ac or dc

D. neither dc nor ac

Answer: C

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30. Given below is a list of E.M. spectrum and its use. Which one does not match?

A. U.V. rays - finger prints detection

B. I.R. rays - Secret writing on ancient walls

C. X - rays - Atomic structure

D. Microwaves - forged document detection

Answer: D