PHYSICS

AAKASH INSTITUTE ENGLISH

ELECTROMAGNETIC WAVES

Illustration

1. Show that displacement current is equal to conduction current charging of a capactior.

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2. A parallel plate capacitor consists of two circular plates of radius $R = 0.1$ m. they are separated by a distance $d = 0.5mm$, if electric field between the capacitor plates changes as $\frac{dE}{dt} = 5 \times 10^{13} \frac{V}{m \times s}$. Find displacement current between the plates.

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3. Show that in an electromagnetic wave average energy density of the electric field $\overline{E}$ equals the average energy density of the magnetic field $\overline{B}$

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4. Show that instantaneous energy density in electromagnetic wave is equally divided among electric and magnetic field.

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5. Calculate the electric and magnetic fields produced by the radiation coming from a 100 W bulb at a distance of $3m$. Assume that the efficiency of the bulb is $25\,\%$ and it is a point source.

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6. Manitude of the electric and magnetic field in an electromagnetic wave radiated by a $200W$ bulb at a distance 2m from it is assuming efficiency of bulb is $5\,\%$ and it behaves like a point source.

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7. A plane electromagnetic wave of frequency 40 MHz travels in free spae in the x-direction. At some point and at some instant, the electric field $\vec{E}$ has its maximum value of 750 N/C in y-direction.

(i) What is the wavelenght of the wave ?

(ii) What is the period of the wave?

(iii) What is the amplitude of magnetic field?

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8. In an electromagnetic wave, the amplitude of electri field is 1 V/m, What is

(i) the amplitude of magnetic field?

(ii) average energy density of electric field ?

(iii) average energy density of magnetic field ?

(iv) average energy density of wave ?

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

A. E_x, B_y

B. E_2, B_x

C. E_y, B_x

D. E_y, B_2

Answer:

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10. A plane electromagnetic wave of intensity of $10W/m^2$ strikes a small mmirror of area $20cm^2$, held perpendicular to the approcaching wave. The radiation froce on the mirror will be:

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11. Show that displacement current is equal to conduction during charging of a capacitor.

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12. A parallel plate capacitor consists of two circular plates of radius $R = 0.1$ m. they are separated by a distance $d = 0.5mm$, if electric field between the capacitor plates changes as $\frac{dE}{dt} = 5 \times 10^{13} \frac{V}{m \times s}$. Find displacement current between the plates.

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13. Show that the avearge energy density of the electric field $\vec{E}$ equals the average energy density of the magnetic field $\vec{B}$, in electromagnetic waves.

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14. Show that instantaneous energy density in electromagnetic wave is equally divided among electric and magnetic field.

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Example

1. The oscillating magnetic field in a plane electromagnetic wave is given as $B_Y = 8 \times 10^{-6} \sin\left(5000\pi x \times -3 \times 10^{11}\pi t\right) T.$

(a) Frequency

(b) Wavelength

(c) Speed of the wave

(d) Electric field

(e) Write down expression for oscillating electric field.

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2. The oscillating magnetic field in a plane electromagnetic wave is given as $B_Y = 8 \times 10^{-6} \sin\left(5000\pi x \times -3 \times 10^{11}\pi t\right) T.$

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3. Calculate the electric and magnetic fields produced by the radiation coming from a 100 W bulb at a distance of $3m$. Assume that the efficiency of the bulb is $25\,\%$ and it is a point source.

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4. Calculate the electric and magnetic fields amplitude in an electromagnetic wave radiate by a 200 W bulb at a distance 2 m from it assuming efficiency of bulb is 5% and it behave like a point source.

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Try Yourself

1. If potential difference between the plates of capacitor changes with rate of $\frac{dV}{dt} = 10^6 \frac{\text{volt}}{\text{sec}}$, and capacitance of capacitors is $1\mu F$, then find displacement current between the plates.

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2. A parallel plate capacitor consists of two circular plates of radius 0.05 m. If electric field between the plate is change as $\frac{dE}{dt} = 10^{10}\frac{V}{m-s}$, then find displacement current between the plates.

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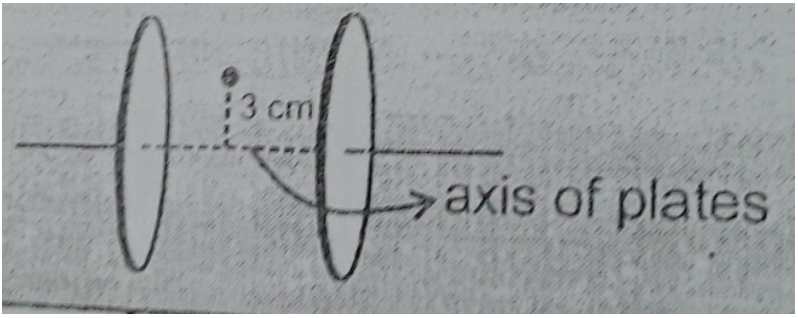
3. Two circular plates of radius 0.1m are used to from a parallel plate capacitor. If displacement current between the plates is 2π.ampere, then find m agnetic filed produced by displacement current 4 cm from the axis of

the plates.



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4. An electromagnetic wave is propagating in vacuum along x-axis,which is produce by oscillating charge of frequeny $3 \times 10^{10} Hz$ amplitude of magnetic filed (B_0) is $1 \times 10^{-7} T$ along z-axis. Find ?

(a) Wavelengths of the wave

(b) Propagation constat of the wave

(c) Equation for oscilating electric field and magnetic field.

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5. The electric field part of the electromagnetic wave in vacuum is given by $E = 6\cos\left[1.2\frac{\text{rad}}{m}y + 3.6 \times 10^8 \frac{\text{rad}}{s}t\right] l\frac{N}{C}$, then find

(a) Frequency of propagation (f)

(b) Wavelength (λ)

(c) Direction of propagation

(d) Amplitude of magnetic field in electromagnetic wave

(e) An expression for magnetic field part of the wave.

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6. The Magnetic field in plane electromagnetic wave is given by $B_y = 4 \times 10^{-6} \sin\left(0.2 \times 10^4 x + 0.6 \times 10^{12} t\right)$ T, then find

(a)n Frequency

(b) Wavelength

(c) Speed of the wave

(d) Expression for electric field part of electromagnetic wave

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7. Calculate the root mean square value of electric field produced by the radiation from 100W bulb at a distance 1m. Assume bulb as point source and its efficiency is 2%.

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8. A point source of electromagnetic radiation has average power output of 800 watt, then find

(a) Maximum value of electric field at a distance 3.5 m from the source

(b) Maximum value of magnetic field

(c) Average energy density at 3.5 m from the source.

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9. Ozone layer blocks the radiations of wave length:

(1.) less than $3 \times 10 - 7$ m

(2.)equal to $3 \times 10 - 7$ m

(3.)more than $3 \times 10 - 7$ m

(4.)All of the above

A. $320nm - 100nm$

B. $600nm - 100nm$

C. $0.6nm - 100nm$

D. $0.6nm - 0.4nm$

Answer:

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10. The electromagnetic radiations are caused by :

(1.) A stationary charge

(2.) uniformly moving charges

(3.) accelerated charges

(4.) All of the above

A. Stationary charges

B. Uniformly moving charges

C. Accelerated charges

D. All of these

Answer:

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11. If λ_v, λ_x and λ_m represent the wavelength of visible light , x-rays and microwaves respectively , then -

A. $\lambda_m > \lambda_x > \lambda_v$

B. $\lambda_k > \lambda_m > \lambda_x$

C. $\lambda_m > \lambda_v > \lambda_x$

D. $\lambda_y > \lambda_x > \lambda_m$

Answer:

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12. If potential difference between the plates of capacitor changes with rate of $\frac{dV}{dt} = 10^6 \frac{\text{volt}}{\text{sec}}$, and capacitance of capacitors is $1\mu F$, then find displacement current between the plates.

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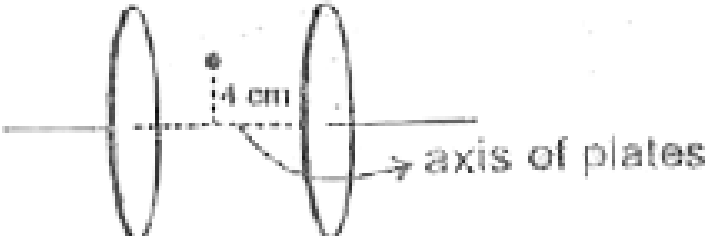

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(a)n Frequency

(b) Wavelength

(c) Speed of the wave

(d) Expression for electric field part of electromagnetic wave

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18. Calculate the root mean square value of electric field produced by the radiation from 100W bulb at a distance 1m. Assume bulb as point source and its efficiency is 2%.

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19. A point source of electromagnetic radiation has average power output of 800 watt, then find

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A. 320 nm -100 nm

B. 600 nm - 100 nm

C. 0.6 nm - 100 nm

D. 0.6 nm - 0.4 nm

Answer: A

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21. The electromagnetic radiations are caused by :

(1.) A stationary charge

(2.) uniformly moving charges

(3.) accelerated charges

(4.) All of the above

A. Stationary charges

B. Uniformly moving charges

C. Accelerated charges

D. All of these

Answer: C

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22. If λ_v, λ_x and λ_m represent the wavelength of visible light , x-rays and microwaves respectively , then -

A. $\lambda_m > \lambda_x > \lambda_v$

B. $\lambda_k > \lambda_m > \lambda_x$

C. $\lambda_m > \lambda_v > \lambda_x$

D. $\lambda_y > \lambda_x > \lambda_m$

Answer:

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Assignment Section A Objective Type Questions One Optione Is Correct

1. Which of the following ares assorciated with Maxwell ?

a. Displacement current

(b) Unification of the laws of elecriciry and magnestism

(c) Development of Ampere's circuital law

(d) Velocity distribuation of molecues in gas

(e) Modification of Ampere's law

A. a,de

B. a,b,d,e

C. b,c

D. All of these

Answer: D

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2. When a capacitor is being charged, then (I_c - conduction current,I_d - displacement current)

A. $l_e = 0, l_d \neq 0$

B. $l_e \neq 0, l_d = 0$

C. $l_c = l_d$ but is same direction.

D. $l_c = l_d$ but in opposite direction

Answer: C

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3. Which of the following is incorrect regarding ozone?

A. It absorbas UV radiations

B. It converts UV radiation into heat radiations

C. It is situated at height range 40-50 km from surface of earth (in stratosphere)

D. It can be reparied by chloro-fluoro-carbon (CFC) gas

Answer: D

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4. Dimensions of $\varepsilon_0 \frac{d\phi_E}{dt}$ are same as that of

A. [AT]

B. [A]

C. $\left[ML^2T^{-2}\right]$

D. $\left[ML^{-1}T^{-2}\right]$

Answer: B

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5. Displacement current flows in

A. Resistannce only

B. Capacitor only

C. Inductor only

D. All of these

Answer: B

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6. Displacement current is maximum during charging of capacitor. When charge on the capacitor is

A. Maximum

B. Minimum

C. Any value of charge

D. Depends on nature of capacitor

Answer: B

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7. Electromagnetic wave is produced by

A. Charge at rest

B. Acclerating charge

C. Oscillating charge

D. Both (2) & (3)

Answer: D

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8. Which of the following electromagnetic radiations is used for viewing through haze and fog

A. Radiowave

B. Infrared wave

C. Microwave

D. Mattor wave

Answer: B

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9. Electro magnetic waves travel in a medium with speed of $2 \times 10^8 m/\sec$. The relative permeability of the medium is 1 find relative permittivity.

A. 2.25

B. 4.5

C. 0.5

D. 4

Answer: A

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10. If electric field is changing at rate of 6×10^6 V/ms between the plates of a capacitor. Having plate areas $2.0cm^2$, then the displacement current is

A. 1.06×10^{-9}A

B. $2.7 \times 10^{-9}A$

C. $5.4 \times 10^{-7} A$

D. $2 \times 10^{-6} A$

Answer: A

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

A. Microwave

B. X-ray

C. Infrared

D. Visible

Answer: B

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12. Electromagnetic waves are produced by

A. Steady electric field

B. Steady megnetic field

C. Time varying magnetic field

D. Both (2) & (3)

Answer: C

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13. An electromagneti wave propagationg through vacuum is given $B = B_0 \sin(kx - \omega)$. Which of the following is/are independent of frequency?

A. k

B. $\frac{\omega}{k}$

C. $k\omega$

D. ω

Answer: B

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14. If in a region there is a time varying electrinc field then which of the following Maxwell equation will be most suitable ?

A. $\oint \vec{B} . \vec{d} = I\varepsilon_0 \frac{d\phi_E}{dt}$

B. $\oint \vec{B} . \vec{d} = \mu_0 I$

C. $\oint \vec{B} . \vec{d} = \mu_0 \left[I + \varepsilon_0 \frac{d\phi_E}{dt} \right]$

D. $\oint \vec{B} . \vec{d} = \mu_0 \left[I + \varepsilon_0 \frac{d\phi_B}{dt} \right]$

Answer: C

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

A. Constant

B. Maximum

C. Changing

D. Both (1) &(3)

Answer: C

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16. Which of the following rays is not an electromagnetic wave?

A. X-rays

B. β-rays

C. Cosmic rays

D. Both (2) & (3)

Answer: D

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17. An electronmagnetic wae propagating along x-axis then oscillating electric and magnetic field vectors are

along

A. $E_y \& B_z$

B. $E_x \& B_y$

C. $E_x \& B_x$

D. $E_z \& B_x$

Answer: A

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18. Hertz's expriment confirm that

A. An electron ar rest produced EM waves

B. An oscillating electron produced EM waves

C. An electron in conductor moving with drift velocity produces EM waves

D. All of these

Answer: B

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19. The dimensional formula of radiation pressure is

A. $[MLT^{-2}]$

B. $[ML^{-1}T^{-2}]$

C. $[M^{-2}T^{-2}]$

D. $[ML^{2}T^{-2}]$

Answer: B

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20. An electromagnetic wave is propagating in vacuum along z-axis, the electric field component is given by $E_x = E_0 \sin(kz - \omega t)$. Then magnetic components is

A. $B_x = \frac{E_0}{C}\sin(kz - \omega t)$

B. $B_y = \frac{B_0}{C}\sin(kz - \omega t)$

C. $B_y = \frac{E_0}{C}\sin(kz - \omega t)$

D. $B_y = B_0 C \sin(kz - \omega t)$

Answer: C

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21. The part of electromagnetic spectrum referred as heat wave is

A. Microwaves

B. Radio waves

C. X-rays

D. infrared

Answer: D

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22. Welders wear special glass goggles or facemask with glass window to protect their eyes from

A. Gamma rays

B. X-ray

C. Infrared

D. UV-radiations

Answer: D

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23. The momentum carried by E-M waves in vaccum is P, then energy associated with the wave is equal to (C) is

speed of light)

A. $p \times c$

B. $\frac{Pc}{-2}$

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

D. $\frac{P}{c}$

Answer: A

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24. The essential distinction between X - rays and γ - rays is that

A. Fequency

B. Wavelength

C. Energy of one photon

D. Energy

Answer: D

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25. In a plane electromagnetic wave the electric field osciliates sinusoidally with frequency $3X10^5$ Hz. Then wavelenght of the wave in vaccuum is

A. 10^2m

B. $10m$

C. $10^4 m$

D. $10^3 m$

Answer: D

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26. The dimensional formula $\mu_0 \varepsilon_0$ is

A. $\left[M^0 L^{-1} T^{-1}\right]$

B. $\left[M^0 L^{-2} T^{-2}\right]$

C. $\left[M^0 L^{-2} T^2\right]$

D. $\left[M^0 L^{-1} T\right]$

Answer:

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27. An electromagnetic wave consists of oscillating electric and magnetic fields. What is the phase relationship between these fields?

A. π

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

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

D. Zero

Answer: D

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28. Which of the following radiation has the least wavelength?

A. γ-ray

B. X-ray

C. Infrared

D. Radio waves

Answer: A

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29. The speed of electromagnetic wave in a medium (whose dielectric constant is 2.25 and relative permeability is 4) is equal to

A. 0.5×10^8m/s

B. 0.25×10^8m/s

C. 0.75×10^8 m/s

D. 1×10^8 m/s

Answer: D

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30. Which component of electromagnetic wave primarily interacts with medium ?

A. Magnetic vector

B. Electric vector

C. Both (1)& (2)

D. None of these

Answer: B

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31. A ratio of contributions made by the electric field and magnetic field components to the intensity of an EM

wave is

A. $C:1$

B. $1:1$

C. $C^2:1$

D. $\sqrt{C}:1$

Answer: B

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32. Which is the following is correct (symbol have their usual meaning)

A. P=PC

B. Intensity $= \frac{\text{Power}}{\text{area}}$

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

D. All of these

Answer: D

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33. Which of the following is a greenhouse gas ?

A. CO_2

B. H_2O

C. CFC

D. All of these

Answer: D

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34. Which of the following is correct about microwave oven?

A. Energy produced by the microwave oven is efficiently transferrred to the kinetic energy of water molecules at resonance

B. The frequency of rotation of water molecules is 3GHz.

C. We should not use metla containers in a miecrowave oven because of getting shock from accumulated electric charges.

D. All of these

Answer: D

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35. Which gas produced by the welding arcs are harmful the eyes ?

A. γ-ray

B. X-ray

C. UV ray

D. IR rays

Answer: C

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36. The magnetic field in a plane electromagnetic wave is given by

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

This electromagnetic wave is

A. Visible light

B. Infared

C. Microwave

D. Radiowaves

Answer: D

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37. Thermoplies are used for the detection of

A. IR-waves

B. UV-rays

C. X-rays

D. γrays

Answer: A

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38. The bombardent of high energy electrons on a metal target of high atomic number produces

A. X Rays

B. Gamma Rays

C. UV Rays

D. IR Rays

Answer: A

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39. The bombardent of high energy electrons on a metal target of high atomic number produces

A. X-rays

B. γ-ray

C. UV ray

D. IR-rays

Answer: A

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40. Which of the following is/are not used as diagnostic tool in medicine?

A. X-ray

B. γ-ray

C. Ultrasonic wave

D. None of these

Answer: B

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41. Diffefent types of electromagnetic waves are defined on the basis of

A. The source from which they are produced

B. Frequency

C. Wavelenght

D. Colour

Answer: A

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42. LASIK stand for

A. Laser Amplifired in situ keratomileusis

B. Light Amplified in situe keratomileusis

C. Light Amplified in stimulated keratomileusis

D. Laser-assisted in situ keratomileusis

Answer: D

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43. Ozone layer exists at oan altitude of

A. 10-20 kms

B. 20-30 kms

C. 30-40 kms

D. 40-50 kms

Answer: D

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44. Which of the following can be used in cancer treatment ?

A. X-rays

B. UV-rays

C. γ -rays

D. Both (1) &(3)

Answer: D

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45. Earth satellite use the detectors of which electromagnetic waves ?

A. IR-waves

B. X-ray

C. UR-rays

D. Radio waves

Answer: A

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46. One cannot get tanned or sunburn through glass window because

A. Glass absorbs UV ratiation

B. Glass reflects UV radiation

C. Glass is transport to UV radiation

D. None of these

Answer: A

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47. The following can be arranged in decreasing order of wave number

A. AM radio

B. TV and FM radio

C. Microwave

D. Short radio wave

A. $A > B > D > C$

B. $C > D > B > A$

C. $A > B > C > D$

D. $D > C > B > A$

Answer: B

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48. The greatest technological importane of electromagnetic wave stem from the fact that they

A. Can carry energy from one place to another

B. Can reflect

C. Can refract

D. Can polarize

Answer: A

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49. Which of the following is /are correct ?

A. Electric and magnetic fields, oscillating in space and time can sustain each

B. Electromagnetic waves can carry energy as well as momentum

C. Electromagnetic waves can event mechanical pressure

D. All of these

Answer: D

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50. Whose experiment worked the beginning of the field of communication using electromagnetic waves ?

A. Hertz

B. Marconi

C. Jagdihs Chandra Bose

D. Michelson and Morley

Answer: B

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Assignment Section B Objective Type Questions One Option Is Correct

1. Electromagnetic waves are produced by

A. A charge at rest

B. A moving charge

C. An accelerated charge

D. None of these

Answer: C

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2. Which of the following has the largest wavelength?

A. Radio wave

B. X-ray

C. Ultraviolet ray

D. Infra-red ray

Answer: A

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3. Which of the following represents an infra-red wavelength ?

A. 10^{-4} cm

B. $10^{-5}cm$

C. 10^{-6} cm

D. $10^{-7}cm$

Answer: A

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4. Ozone layer blocks the radiations of wave length:

(1.) less than 3 × 10 − 7 m

(2.)equal to 3 × 10 − 7 m

(3.)more than 3 × 10 − 7 m

(4.)All of the above

A. Less than 4×10^{-7}m

B. Between $4 \times 10^{-7}m \rightarrow 8 \times 10^{-7}$

C. More than $8 \times 10^{-7}m$

D. None of these

Answer: A

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5. Finger prints on a piece of paper may be detected by sprinkling fluorescent powder on the paper and then looking it into

A. Red light

B. Sun light

C. Infrared light

D. Ultraviolet light

Answer: D

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6. Electromagnetic wave is deflected by

A. Electric field

B. Magnetic field

C. Both (1)& (2)

D. Neither electric field nor magnetic field

Answer: D

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7. The speed of electromagnetic waves depends upon

A. Wavelength

B. Frequency

C. Intensity

D. Medium, in which it travels

Answer: D

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8. Refractive index of a medium depends on

A. $\sqrt{\mu_r \varepsilon_r}$

B. $\sqrt{\mu_0 \varepsilon_0}$

C. $\frac{1}{\sqrt{\mu_r \varepsilon_r}}$

D. $\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

Answer: A

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9. If E and B represent electric and magnetic field vectors of the electromagnetic wave the direction of propagation of electromagnetic wave is along

A. $\vec{E}$

B. $\vec{B}$

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

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

Answer: C

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10. An electromagnetic wave going through vacuum is described by

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

Then

A. $E_o k = B_0 \omega$

B. $E_0 B_0 = \omega k$

C. $E_0 \omega = B_0 k$

D. $E_0 B_0 = \frac{\omega}{k}$

Answer: A

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11. Out of the following, choose the ray which does not travel with the velicty of light

A. X-ray

B. Microwave

C. γ -rays

D. β-rays

Answer: D

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12. In a plane electromagnetic wave, which of does not travel with the velocity of light

(a) Magnetic field (b) Magnetic energy

(c) Electric field (d) Electric energy

A. (a),(c)

B. (b),(c)

C. (a),(d)

D. All of these

Answer: A

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13. The ratio of amplitude B_0 and E_0 of the magnetic electric fields associated with an electromagnetic wave is

A. $\frac{1}{c}$

B. c

C. c^2

D. $\frac{1}{c^2}$

Answer: A

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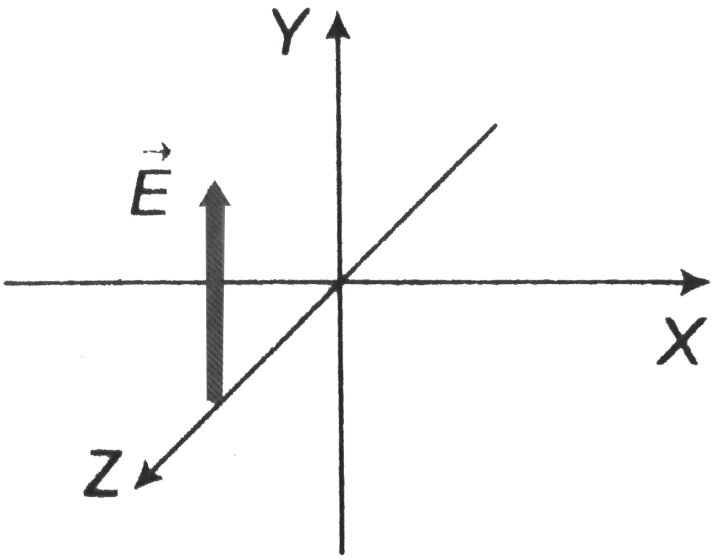
14. The figure here gives the electric field of an EM wave at a certain point and a certain. The wave is transporting energy in the negative z direction. What is the direction of the magnetic field of the wave at the point and instant?



A. Towards + X direction

B. Towards - X direction

C. Towards + direction

D. Towards - Z direction

A. Towards + X direction

B. Towards - X direction

C. Towards + direction

D. Towards - Z direction

Answer: B

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15. The amplitude of electric field at a distance r from a point source of power P is (taking 100% efficiency).

A. $\sqrt{\frac{P}{2\pi r^2 c\varepsilon_0}}$

B. $\sqrt{\frac{P}{4\pi r^2 c\varepsilon_0}}$

C. $\sqrt{\frac{P}{8\pi r^2 c\varepsilon_0}}$

D. $\frac{P}{2\pi r^2 c\varepsilon_0}$

Answer: A

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Assignment Section C Linked Comprehension Type Questions

1. A plane polarized electromagnetic wave of frequency 6×10^8Hz is propagating through a region of space.

Electric field is along positive z-direction and magnetic field is along positive y-direction at some instant. The peak value of electric field is 3 milli-volt/m.

The direction of propagation of wave is

A. Positive x-direction

B. Negative x-direction

C. Positive y-direction

D. Negative y-direction

Answer: B

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2. A plane polarized electromagnetic wave of frequency 6×10^8Hz is propagating through a region of space. Electric field is along positive z-direction and magnetic field is along positive y-direction at some instant. The peak value of electric field is 3 milli-volt/m.

The direction of propagation of wave is

A. $B = \left(10^{-8} \sin 2\pi\left[2x - \left(6 \times 10^{-8}\right)t\right]\right.$

B. $B = \left(10^{-11} \sin 2\pi\left[2x - \left(6 \times 10^{-8}\right)t\right]\right.$

C. $B = \left(10^{-11} \sin 2\pi\left[2x - \left(6 \times 10^{-8}\right)t\right]\right.$

D. $B = \left(10^{-11} \sin 2\pi\left[2x - \left(6 \times 10^{-8}\right)t\right]\right.$

Answer: C

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3. A plane polarized electromagnetic wave of frequency 6×10^8Hz is propagating through a region of space. Electric field is along positive z-direction and magnetic field is along positive y-direction at some instant. The peak value of electric field is 3 milli-volt/m.

The direction of propagation of wave is

A. $4 \times 10^{-14} J/m^3$

B. $2 \times 10^{-14} J/m^3$

C. $2 \times 10^{-17} J/m^3$

D. $4 \times 10^{-17} J/m^3$

Answer: D

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Assignment Section D Assertion Reason Type Questions

1. STATEMENT-1 : An oscillating charge must give out electromagnetic waves.

STATEMENT-2 : Accroding to Maxwell's theory. Accelerated charges raadiates electromagnetic wave

A. Statement-1 is True, Statement-2 is True-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True, Statement-2 is True-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: A

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2. STATEMENT-1 : Visible light is an electromagnetic wave.

STATEMENT-2 : Visible light is an electromagnetic wave.

A. Statement-1 is True, Statement-2 is True-2 is True , Statement-2 is a correct explanation for Statement-2

B. Statement-1 is True, Statement-2 is True-2, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: D

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3. STATEMENT-1 : Velocity of light depends on electric and magnetic properties of medium,

STATEMENT-2 : Electromagnetic wve does not need any material medium for its propagation.

A. Statement-1 is True, Statement-2 is True-2 is True , Statement-2 is a correct explanation for Statement-3

B. Statement-1 is True, Statement-2 is True-2 is NOT a correct explanation for Statement-3

C. Statement-1 is True Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: B

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4. STATEMENT-1 : Electromagnetic waves may set tiny charged particies into motion.

STATEMENT-2 : Electromagnetic waves have momentum and energy

A. Statement-1 is True, Statement-2 is True-2 is True , Statement-2 is a correct explanation for Statement-4

B. Statement-1 is True, Statement-2 is True-2 is NOT a correct explanation for Statement-4

C. Statement-1 is True Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: A

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5. STATEMENT-1 : Infra-red waves are caleld heat-waves.

STATEMENT-2 : Infra-red waves cause the vibration of not only electrons, but entiie or moelcules of a substance.

A. Statement-1 is True, Statement-2 is True-2 is True , Statement-2 is a correct explanation for Statement-5

B. Statement-1 is True, Statement-2 is True-2 is NOT a correct explanation for Statement-5

C. Statement-1 is True Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: A

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6. STATEMENT-1 : Radiowaves are produced by the accelerated motion of charges in conductors.

STATEMENT-2 : Radiowaves are used for radio and telecommunication purpose.

A. Statement-1 is True, Statement-2 is True-2 is True , Statement-2 is a correct explanation for

Statement-6

B. Statement-1 is True, Statement-2 is True-2 is NOT a correct explanation for Statement-6

C. Statement-1 is True Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: B

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7. STATEMENT-1 : Ratio of magnitudes of electric field magnetic field in an electromangnetic wave is constant.

STATEMENT-2 : Electric field and magnetic field are always is same phase in an electromagnetic wave.

A. Statement-1 is True, Statement-2 is True-2 is True , Statement-2 is a correct explanation for Statement-7

B. Statement-1 is True, Statement-2 is True-2 is NOT a correct explanation for Statement-7

C. Statement-1 is True Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: A

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8. STATEMENT-1 : Magnitude of poying vector represents power per unit area.

STATEMENT-2 : Directionn of poynting vector gives the direction of propagation of electro-magnetic wave.

A. Statement-1 is True, Statement-2 is True-2 is True , Statement-2 is a correct explanation for Statement-8

B. Statement-1 is True, Statement-2 is True-2 is NOT a correct explanation for Statement-8

C. Statement-1 is True Statement-2 is False

D. Statement-1 is False, Statement-2 is True

Answer: B

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Exercise

1. Maxwell in his famous equations of electro-magnetism introduced the concept of

A. a. c. current

B. d. c. current

C. Displacement current

D. Reactance

Answer: C

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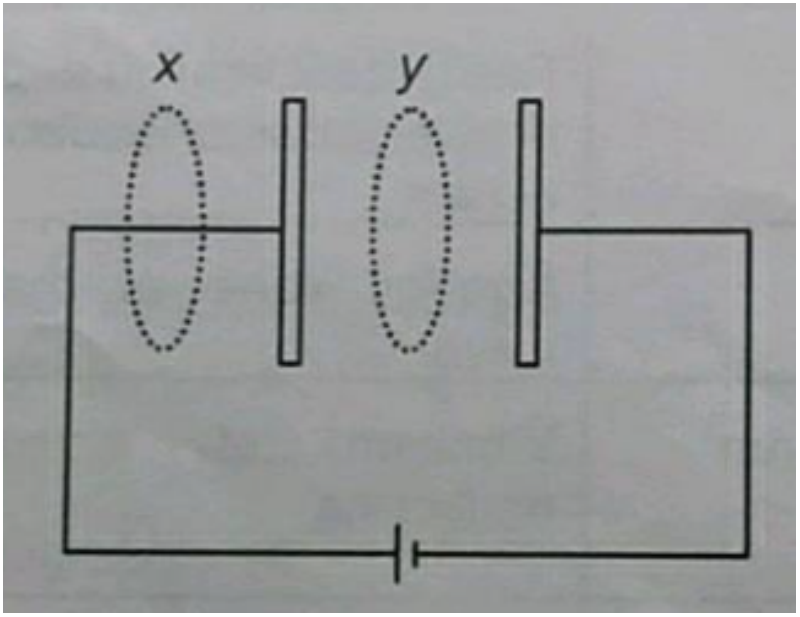
2. A parallel plate capacitor is charged by a battery as shown in the figure. If two circular amperian loops x and y are drawn then $\oint \overline{B}.\overline{dI}$ will be zero along



A. x only

B. y only

C. Both x and y

D. Neither x nor y

Answer: D

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3. 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

symmetrically between the plates. Find the displacement current through this area.

A. I

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

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

D. $\frac{3I}{2}$

Answer: C

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4. A parallel plate capacitor is charged to $60\mu C$. Due to a radioactive source, the plate losses charge at the rate of

$1.8 \times 10^{-8} Cs^{-1}$. The magnitued of displacement current is

A. $3.6 \times 10^{-8} Cs^{-1}$

B. $1.8 \times 10^{-8} Cs^{-1}$

C. $4.1 \times 10^{-11} Cs^{-1}$

D. $5.7 \times 10^{-12} Cs^{-1}$

Answer: B

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5. The electric and magnetic field of an electromagnetic wave are:-

A. Phase and parallel to each other

B. Opposite phase and perpendicular to each other

C. Opposite phase and parallel to each other

D. Phase and perpendicular to each other

Answer: D

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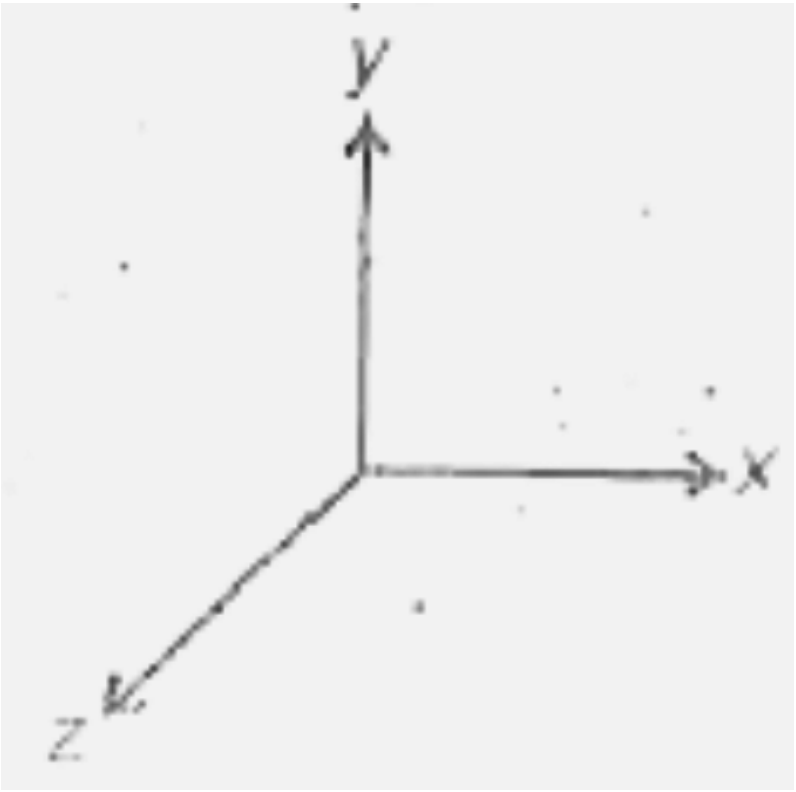
6. Light wave travelling along y-direction. If the corresponding $\overline{E}$ vector at any time along x-axis, the

direction of $\overline{B}$ vector at that time is along



A. y-axis

B. x-axis

C. z-axis

D. -z-axis

Answer: D

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7. 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. 9×10^{-9} T

D. 11×10^{-11} T

Answer: B

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8. The frequency of a wave is $6 \times 10^{15} s^{-1}$ its wave number would be

A. Radiowave

B. Microwave

C. X-ray

D. Infrared

Answer: C

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9. What is ozone hole?

A. Hole in the ozone layer

B. Thinning of ozone layer in troposphere

C. Formation of ozone layer

D. Reduction in ozone thickness in stratosphere

Answer: D

Watch Video Solution

10. Biological importance of Ozone layer is : -

A. Stops ultraviolet rays

B. Reduces green house effect

C. Reflects radio waves

D. Controls O_2 / H_2 ratio in atmosphere

Answer: A

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Assignment Section A Objective Type Questions

1. According to Ampere's circuital law

A. $\oint \overline{B} . \overline{dI} = \mu_0 \left(i_C + \varepsilon_0 \frac{d\phi_E}{dt} \right)$

B. $\oint \overline{B} . \overline{dI} = \mu_0 \varepsilon_0 \frac{d\phi_E}{dt}$

C. $\oint \overline{B}.\overline{dI} = \mu_0 \varepsilon_0 i$

D. $\oint \overline{B}.\overline{dI} = \mu_0 \left(i_C \frac{d\phi_E}{dt} + i_O \right)$

Answer: A

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2. The displacement current flows in the dielectric of a capacitor when the potential difference across its plates-

A. Maximum

B. Zero

C. Minimum

D. Varying

Answer: D

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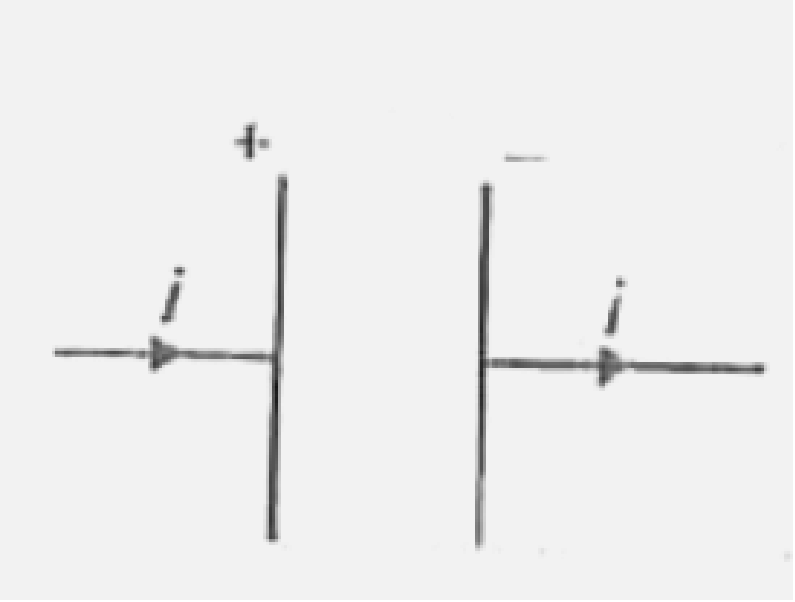
3. A parallel plate capacitor with circular plates of radius R is being charged as shown. At the instant shown, the displacement current in the region between the plates

enclosed between $\frac{R}{2}$ and R is given by



A. $\frac{3}{4}i$

B. $\frac{1}{4}i$

C. $3i$

D. $\frac{4}{3}i$

Answer: A

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4. Figure shows a circular region of radius R in which uniform magnetic field B exists. The magnetic field is increasing at a rate $\frac{dB}{dt}$. The induced electric field at a distance r from the centre for $r < R$ is

A. $\frac{dB}{dt}\frac{r}{2}$

B. Zero

C. $\frac{dB}{dt}$

D. $\frac{dB}{dt}\frac{R^2}{2r}$

Answer: A

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5. The speed of electromagnetic waves depend upon

A. Wavelength

B. Frequency

C. Intensity

D. Medium, in which it travels

Answer: D

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6. If E and B represent electric and magnetic field vectors of the electromagnetic wave the direction of propagation of electromagnetic wave is along

A. $\vec{E}$

B. $\vec{B}$

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

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

Answer: C

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7. An electromagnetic wave going through vacuum is described by

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

Then

A. $E_0 k = B_0 \omega$

B. $E_0 B_0 = \omega k$

C. $E_0 \omega = B_0 k$

D. $E_0 B_0 = \frac{\omega}{k}$

Answer: A

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8. Electromagnetic wave is deflected by

A. Electric field

B. Magnetic field

C. Both (1) and (2)

D. Neither electric field nor magnetic field

Answer: D

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9. Which of the following travels with the speed of light ?

A. X-ray

B. Microwave

C. γ-rays

D. β-rays

Answer: D

Watch Video Solution

10. Red light differs from blue light in its

A. Speed

B. Frequency

C. Intensity

D. Amplitude

Answer: B

Watch Video Solution

11. Which of the following has the largest wavelength?

A. Radiowave

B. x-rays

C. Ultraviolet ray

D. Infra-red ray

Answer: A

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

A. $(\varepsilon_0\mu_0)^{-1/2}$

B. $(\varepsilon_0 e_r \mu_0 \mu_r)^{-1/2}$

C. 3×10^8 m/s

D. $\left(\frac{\varepsilon_0\varepsilon_r}{\mu_0\mu_r}\right)^{+1/2}$

Answer: B

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13. Which of the following statement is incorrect about electromagnetic waves?

A. The electric field and magnetic field have equal average values.

B. The electric energy and the magnetic energy have equal average values

C. The electric field and magnetic field both oscillate in same phase

D. The electric field and magnetic field oscillate in opposite phase

Answer: D

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14. Which of the following have zero average value in a plane electromagnetic wave?

A. (a), (c)

B. (b), (c)

C. (a), (d)

D. All of these

Answer: A

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15. An electromagnetic wave is propagating in vacuum along z-axis, the electric field component is given by $E_x = E_0 \sin(kz - \omega t)$. Then magnetic components is

A. $B_x = \frac{E_0}{C}\sin(kz - \omega t)$

B. $B_\gamma = \frac{B_0}{C}\sin(kz - \omega t)$

C. $B_\gamma = \frac{E_0}{C}\sin(kz - \omega t)$

D. $B_\gamma = B_0 \sin(kz - \omega t)$

Answer: C

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16. The speed of em wave in the unit of $10^8 m/s$, in a medium of dielectric constant 2.25 and relative permeablity 4 is:

A. 0.5×10^8 m/s

B. 0.25×10^8 m//s

C. 0.75×10^8 m/s

D. 1×10^8 m/s

Answer: D

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17. The magnetic field in plane electromagnetic wave is given by $= 2 \times 10^{-7} \sin\left(0.5 \times 10^{3} \times 10^{11} t\right)$ This electro magnetic wave is

A. Visible light

B. Infrared

C. Microwave

D. Radiowave

Answer: D

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18. The dimensional formula of $\frac{1}{2}\varepsilon_0 E^2$ is $(E = \text{electric field})$

A. $[MLT^{-1}]$

B. $[ML^2T^{-2}]$

C. $[ML^{-1}T^{-2}]$

D. $[ML^2T^{-1}]$

Answer: C

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19. Which of the following represents an infrared wavelength

A. $10^{-4}cm$

B. $10^{-5}cm$

C. $10^{-8}cm$

D. $10^{-7}cm$

Answer: A

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20. Which of the following is not transported by electromagnetic waves?

A. Energy

B. Momentum

C. Charge

D. Information

Answer: C

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21. Hertz experiment is used for

A. Production of electromagnetic wave

B. Detection of electromagnetic wave

C. Both (1) and (2)

D. None of these

Answer: C

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22. The electromagnetic radiations are caused by :

(1.) A stationary charge

(2.) uniformly moving charges

(3.) accelerated charges

(4.) All of the above

A. A charge at rest

B. A moving charge

C. An accelerated charge

D. None of these

Answer: C

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23. Ozone layer blocks the radiations of wave length:

(1.) less than 3 × 10 − 7 m

(2.)equal to 3 × 10 − 7 m

(3.)more than 3 × 10 − 7 m

(4.)All of the above

A. Less than 4×10^{-7} m

B. Between 4×10^{-7} m to 8×10^{-7} m

C. More than 8×10^{-7} m

D. None of these

Answer: A

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24. Which of the following is used in the treatment of cancer

A. X - rays

B. UV - rays

C. γ-rays

D. Both (1) and (3)

Answer: D

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25. The following can be arranged in decreasing order of wave number

A. Am radio

B. TV and FM radio

C Microwave

D Short radio wave

A. $A > B > D > C$

B. $C > D > B > A$

C. $A > B > C > D$

D. $D > C > B > A$

Answer: B

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Assignment Section B Objective Type Questions

1. If the electric field and magnetic field of an electromagnetic wave are related as $B = \frac{E}{c}$ where the symbols have their usual meanings and the energy in a given volume of space due to the electric field part is U, then the energy due to the magnetic field part will be

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

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

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

D. U

Answer: D

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2. The direction of poynting vector represents

A. The direction of electric field

B. The direction of magnetic field

C. The direction of propagation of EM wave

D. The direction opposite to the propagation of EM wave

Answer: C

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3. 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. $\frac{E}{\mathrm{Atc}}$

C. $\frac{2E}{\mathrm{Atc}}$

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

Answer: C

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4. About $5\,\%$ of the power of a $100W$ light bulb is converted to visible radiation. What is the average intensity of visible radiation

(a) at a distance of $1m$ from the bulb?

(b) at a distance of $10m$?

Assume that the radiation is esmitted isotropically and neglect reflection.

A. $\dfrac{5}{2\pi(10)^2}$ watt/m^2

B. $\dfrac{5}{4\pi(10)^2}$ watt/m^2

C. $\dfrac{5}{\pi(10)^2}$ watt/m^2

D. $\dfrac{5}{8\pi(10)^2}$ watt/m^2

Answer: B

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5. Which of the following physical quantities contained in a small volume oscillates at double the frequency of passing electromagnetic wave?

A. Electric field

B. Magnetic field

C. Magnetic energy

D. All of these

Answer: C

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6. The charging current for a capacitor is 1 A, then the displacement current is

A. $1A$

B. $0A$

C. $2A$

D. $\frac{1}{2}A$

Answer: A

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7. The magnetic field in plane electromagnetic wave is given by

$B = 3.01 \times 10^{-7} \sin\left(6.28 \times 10^{2} x + 2.2 \times 10^{10} t\right)$ I. [where x in cm and t in second] The wavelength of the given wave is

A. 1 cm

B. 628 cm

C. 1.129 cm

D. 3.14 cm

Answer: A

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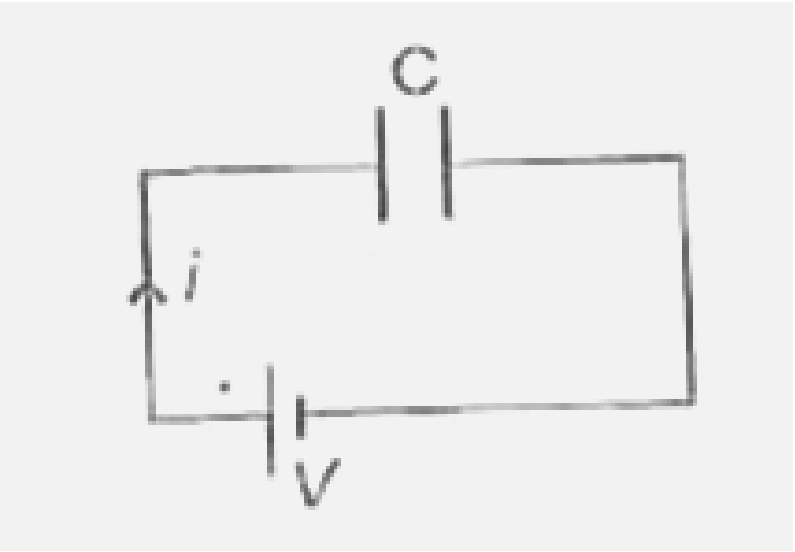
8. At a particle state the current in the circuit given below is i. The displacement current between the plates

of the capacitor shown below is



A. Zero

B. i

C. $\frac{i}{2}$

D. $\frac{i}{4}$

Answer: B

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9. To establish an instantaneous displacement current of I ampere in the space between the plates of a parallel plate capacitor of $\frac{1}{2}$ farad, the value of $\frac{dV}{dt}$ is

A. $2I$

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

C. $\frac{1}{2}I$

D. I

Answer: A

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10. A plane electromagnetic wave of frequency 28 MHz travels in free space along the positive x-direction . At a particular point in space and time, electric field is 9.3 V/m along positive y-direction. The magnetic field (in T) at that point is

A. 3.1×10^{-8} along positive z-direction

B. 3.1×10^{-8} along negative z-direction

C. 3.2×10^{7} along positive z-direction

D. 3.2×10^{7} along negative z-direction

Answer: A

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Assignment Section C Previous Years Questions

1. In a electomagnetic wave in free space the root mean squre value of the electric field is $E_{rms} = 6V/m$. The peak value of the magnetic field is

A. $1.41x10^{-8}T$

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

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

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

Answer: B

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2. 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. $11A$

C. 4.4 A

D. $11\sqrt{2}A$

Answer: A

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3. Out of the following options which one one can be used to produce a propaagating electromagnetic wave?

A. An accelerating charge

B. A charge moving at constant velocity

C. A stationary charge

D. A chargeless particle

Answer: A

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4. The energy of the EM waves is of the order of $15keV$. To which of the spectrum does it belong?

A. γ- rays

B. X- rays

C. Infra-red rays

D. Ultraviolet rays

Answer: B

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

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

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

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

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

Answer: C

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6. Light with an energy flux of $25 \times 10^4 Wm^{-2}$falls on a perfectly refecting surface at normal incidnce. If thesurface are is $15cm^2$, the averge force exerted on the

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

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

B. Microwaves are heat waves, so always produce heating

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

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

Answer: D

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8. The electric field associated with an electromagnetic wave in vacuum is given by

$\vec{E} = 40\cos\left(kz - 6 \times 10^8 t\right)\hat{i},$

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

A. $6m^{-1}$

B. $3m^{-1}$

C. $2m^{-1}$

D. $0.5m^{-1}$

Answer: C

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9. The ratio of amplitude of magnetic field to the amplitude of electric field for an electromagnetic wave

propagating in vacuum 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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10. The electric and the magnetic field, associated with an electromagnetic wave, propagating along the Z-axis

can be represented by

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

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

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

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

Answer: B

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

A. Infrared, microwave, ultraviolet, gamma rays

B. Microwave , infrared, ultraviolet, gamma rays

C. Gamma rays, ultraviolet, infrared, microwaves

D. Microwaves, gamma rays, infrared, ultraviolet

Answer: D

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

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

B. Both electric and magnetic field vectors attain the maxima and minima at the same place and same time

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

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

Answer: D

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13. The electric field of an electromagnetic wave in free space is given by – $\overrightarrow{E} = 10\cos\left(10^7 t + kx\right)\hat{j}V/m$, where t and x are in seconds and metres respectively. It can be inferred that -

(a) The wavelength λ is 188.4 m

(b) The wave number k is 0.33 rad / m

(c) The wave amplitude is 10 V / m

(d) The wave is propagating along + x direction Which one of the following pairs of statements is correct ?

A. (c) & (d)

B. (a) & (b)

C. (b) & (c)

D. (a) & (c)

Answer: D

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14. The electric field part of an electromagnetic wave in a medium is represented by $E_x = 0$,

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

$E_z = 0$. The wave is

A. Moving along x-direction with frequency 10^6 Hz and wavelength 100 m

B. Moving along x-direction with frequency 10^6 Hz and wavelength 200 M

C. Moving along -x-direction with frequency 10^6 Hz and wavelength 200 m

D. Moving along y-direction with frequency $2\pi \times 10^6$ Hz and wavelength 200 m

Answer: B

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15. The velocity of electromagnetic radiation in a medium of permittivity ε_0 and permeability μ_0 is given by:

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

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

C. $\sqrt{\mu_0 \varepsilon_0}$

D. $\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

Answer: D

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16. The electric and magnetic field of an electromagnetic wave are:-

A. In opposite phase and perpendicular to each other.

B. In opposite phase and parallel to each other

C. In phase and perpendicular to each other

D. In phase and parallel to each other

Answer: C

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17. If λ_v, λ_x and λ_m represent the wavelength of visible light , x-rays and microwaves respectively , then -

A. $\lambda_m > \lambda_x > \lambda_v$

B. $\lambda_v > \lambda_m > \lambda_x$

C. $\lambda_m > \lambda_v > \lambda_x$

D. $\lambda_v > \lambda_x > \lambda_m$

Answer: C

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18. The velocity of electromagnetic radiation in a medium of permittivity ε_0 and permeability μ_0 is given by:

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

B. $\sqrt{\mu\varepsilon}$

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

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

Answer: C

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19. Which of the following electromagnetic waves has smallest wavelength?

A. X-rays

B. γ- rays

C. UV waves

D. Microwaves

Answer: B

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20. If ε_0 and μ_0 are, respectively, the electric permittivity and magnetic permeability of free space, ε and μ the corresponding quantities in a medium, the index of refraction of the medium in terms of the above parameters is _____.

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

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

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

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

Answer: B

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21. Greenhouse Effect

A. Infra-red rays

B. Ultraviolet rays

C. X-rays

D. Radiowaves

Answer: A

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22. The velocity of electromagnetic wave is along the direction of

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

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

C. $\overline{E}$

D. $\overline{B}$

Answer: B

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Assignment Section D Assertion Reason Type Questions

1. A : Different electromagnetic waves differ considerably in their mode of interaction with matter.

R : Different electromagnetic waves have different wavelength or frequency.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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2. A : All electromagnetic waves travel through vacuum with same speed but they have different wavelength or frequency.

R : The wavelength of the electromagnetic waves is often correlated with and characteristic size of the system that produces and radiates them.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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3. A : High frequency electromagnetic waves are detected by some means based on physical effects they produce on interacting with matter.

R : The oscillating fields of an electromagnetic wave can accelerate charges and can produce oscillating currents therefore, an apparatus designed to detect EM waves is based on this fact.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion,

then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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4. A : infrared waves are often called heat waves.

R : Infrared waves vibrate not only the electrons, but entire atoms or molecules of a substance which

increases the internal energy and temperature of the substance.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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5. A : The centre of sensitivity of our eyes coincides with the centre of the wavelength distribution of the sun.

R : Humans have evolved with visions most sensitive to the strongest wavelength from the sun.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion,

then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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6. A : Long distance radio broadcasts use short-wave bands.

R : Ionosphere reflects waves in these bands.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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7. A : It is necessary to use satellites for long distance TV transmission.

R : Television signals are not properly reflected by the ionosphere therefore, reflection is effected by satellites.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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8. A : Optical and radio telescopes are built on the ground but X-ray astronomy is possible only from satellites orbiting the earth.

R : Atmosphere absorbs X-rays, while visible and radiowaves can penetrate it.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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9. A : If the earth did not have an atmosphere, its average surface temperature would have been lower.

R : In the absence of atmosphere, the green house effect will be absent.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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10. A : It has been predicted that a global nuclear war on the earth would be followed by a severe 'nuclear winter' with a devastating effect on life on earth.

R : The clouds produced by global nuclear war would perhaps cover substantial parts of the sky preventing

solar light from reaching many parts of the globe causing winter.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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11. A : In an EM wave the magnitude of the electric field vector is more than the magnitude of the magnetic field vector.

R : Energy of the EM wave is shared equally between the electric and magnetic fields.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: B

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12. A : The displacement current goes through the gap between the plates of a capacitor when the charge on the capacitor does not change.

R : Displacement current arises only when the electric field is constant.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: D

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13. As the frequency of an ac circuit increases, the current first increases and then decreases. What combination the circuit elements is most likely to comprise the circuit ?

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: C

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14. A : When cooking in microwave ovens, metal containers are used.

R : Energy of the microwaves can be easily transferred to the food through metal.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: D

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15. A : Food is cooked faster by microwaves than by conventional gas burner.

R : Microwaves have more energy than heat waves.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: C

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16. A : Microwaves are commonly used in radar to locate flying objects.

R : Microwaves have-smaller wavelength than radiowaves.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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17. A : Environmental damage has depleted the ozone layer in the atmosphere.

R : Increase in ozone decreases the amount of UV radiation to earth.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: B

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18. A: The electrical. Conductivity of the Earth's atmosphere does not change with altitude.

R : Cosmic rays from outer space entering the earth's atmosphere do not affect it.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: D

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19. A : Static crashes are heard on a radio when a lightening flash occurs.

R : Light and radiowaves are EM waves and they interfere.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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20. A : TV signals are affected if a low flying aircraft passes by or a petrol vehicle is started next to it.

R : Aircraft signals or vehicle's spark plug generate interfering EM waves.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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21. A : Light waves can be polarised.

R : All electromagnetic waves move with same speed in vacuum.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: B

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22. A : In an electromagnetic wave the energy density in electric field is equal to energy density in magnetic field.

R : Electromagnetic waves are transverse in nature.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: B

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23. A : The poynting vector given as $\overline{S} = \frac{\overline{E} \times \overline{B}}{\mu_0}$ represents the instantaneous intensity at a point.

R : The velocity of an electromagnetic wave is in the direction of the vector $\overline{E} \times \overline{B}$.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion,

then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: B

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24. A : The radiation pressure due to light waves is maximum when the surface is a perfect reflector.

R : The momentum transfer by the photons to a perfectly reflecting surface is maximum.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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25. A : In a material medium the speed of a particle can be more than the speed of light in that medium.

R : In the phenomenon of green house effect, low wavelength radiation is allowed to pass but high wavelength radiation is not allowed to pass.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion,

then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If assertion is true statement but Reason is false, then mark (3)

D. If both Assertion and Reason are false statements, then mark (4)

Answer: B

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