PHYSICS

FOR IIT JEE ASPIRANTS OF CLASS 12

FOR PHYSICS

ELECTRO MAGNETIC WAVES

Example

1. A circular parallel plate capacitor with plate radius R is charged by means of a cell, at time

$t = 0$. The initial conduction current is i_0. Consider a circular area of radius $R/4$ coplanar with the capacitor plates and located symmetrically between them. Find the time rate of electric flux change through this area after one time constant.

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2. What is the instantaneous displacement current in space between plates of parallel

plate capacitor of capacitor $1\mu F$, which is charging at rate of $10^6 V / S$

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3. 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.

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4. Suppose that the electric field amplitude of an electromagnetic wave us $E_0 = 120N/C$ and that its frequency is $50.0MHz$.

(a) Determine B_0, ω, k and λ,

(b) find expressions for E and B.

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5. The electric field in an electromagnetic wave is given by $E = \left(50N\left(C^{-1}\right)\right)\sin\omega\left(t - \frac{x}{c}\right)$. Find the energy contained in a cylinder of

cross section $10cm^2$ and length 50 cm along the x- axis.

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6. Light with an energy flux of $18W/cm^2$ falls on a non-reflecting surface at normal incidence. If the surface has an area of $20cm^2$, find the average force exerted on the surface during a 30 minute time span.

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7. 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

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CUQ

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

A. $\overrightarrow{E}$

B. $\overrightarrow{B}$

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

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

Answer: C

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2. The electromagnetic waves do not transport

A. energy

B. charge

C. momentum

D. information

Answer: B

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3. A capcitor is connected in an electric circuit with an open key, immediately after pressing the key, the current in the circuit is-

A. zero

B. maximum

C. any transient value

D. depends on capacitor used

Answer: B

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4. Displacement current is continuous-

A. when electric field is changing in the circuit

B. when magnetic field is changing in the circuit

C. in both types of fields.

D. through wire and resistance only

Answer: A

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

A. $A.C.$ only

B. $D.C.$ only

C. both $A.C$ and $D.C$

D. neither for $A.C.$ nor for $D.C.$

Answer: B

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6. The maxwells four equations are written as

$(i)\ \oint \overrightarrow{E} \,.\, \overrightarrow{dS} = \frac{q_0}{\varepsilon_0}$

$(ii)\ \oint \overrightarrow{B} \,.\, \overrightarrow{dS} = 0$

$(iii)\ \oint \overrightarrow{E} \,.\, \overrightarrow{dl} = \frac{d}{dt} \oint \overrightarrow{B} \,.\, \overrightarrow{dS}$

$(iv)\ \oint \overrightarrow{B} \,.\, \overrightarrow{dl} = \mu_0 \varepsilon_0 \frac{d}{dt} \oint \overrightarrow{E} \,.\, \overrightarrow{dS}$

The equations which have sources of $\overrightarrow{E}$ and $\overrightarrow{B}$ are

A. (i), (ii), (iii)

B. (i), (ii)

C. (i) and (iii) only

D. (i) and (iv) only

Answer: D

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7. Out of the above four equations, the equations which do not contain source field are-

A. (i) and (ii)

B. (ii) only

C. all of four

D. (iii) only

Answer: B

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8. Out of the four Maxwell's equations above, which one shows non-existence of monopoles?

A. (i) and (iv)

B. (ii) only

C. (iii) only

D. none of these

Answer: B

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9. Can electric field lines of force form closed loops ? Give reason for your answer.

A. (i) only

B. (ii) only

C. (iii) only

D. (iv) only

Answer: A

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

A. electric field only

B. magnetic field only

C. equally with electric and magnetic fields.

D. average energy density is zero.

Answer: C

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

A. becomes zero

B. has assumed a constant value

C. is increasing with time

D. decreasing with time

Answer: C

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12. Select wrong statement from the following

- Electomagnetic waves

A. are transverse

B. travel with same speed in all media

C. travel with the speed of light

D. are produced by accelerating charge.

Answer: B

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13. The waves related to telecommuni-cation are-

A. infra red

B. visible light

C. microwaves

D. ultraviolet rays

Answer: C

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14. The nature of electromagnetic wave is-

A. longitudinal

B. longitudinal stationary

C. transverse

D. transverse stationary

Answer: C

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15. The frequencies of X-rays, γ-rays and ultraviolet rays are respectively a, b and c .Then

A. $a < b, b < c$

B. $a > b, b > c$

C. $a > b, b < c$

D. $a < b, b > c$

Answer: D

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16. The electromagnetic wave of frequency 2 MHz to 30 MHz are

A. Radiowave

B. $X - rays$

C. Ultraviolet

D. Microwave

Answer: D

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17. Maxwell's equations describe the fundamental laws of

A. eletricity only

B. magnetism only

C. mechanics only

D. both 1 and 2

Answer: D

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18. Which of the following statements is not correct?

A. photographic plates are sensitive to infrared rays

B. photographic plates are sensitive to ultraviolet rays

C. Infra-red-rays are invisible but can cast shadows like visible light

D. infrared photons have more energy then phtotons of visible light

Answer: D

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19. Radio waves and visible light in vacuum have

A. same velocity but different wavelength

B. continuous emission specturm

C. band absorption spectrum

D. line emission spectrum

Answer: A

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20. Energy stored in electromagnetic osicllations is in the form of

A. electrical energy

B. magnetic energy

C. both 1 and 2

D. neither of the above

Answer: C

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21. Which of the following is not an electromagnetic wave?

A. micro

B. radio

C. $X - ray$

D. audio

Answer: D

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22. Total energy of EM waves in free space is given by

A. $\frac{E^2}{2\varepsilon_0} + \frac{B^2}{2\mu_0}$

B. $\frac{\varepsilon_0 E^2}{2} + \frac{\mu_0 B^2}{2}$

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

D. $\frac{\varepsilon_0 E^2}{2} + \frac{B^2}{2\mu_0}$

Answer: D

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

A. Ultraviolet rays

B. I.R. rays

C. UV rays

D. radio waves

Answer: D

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24. Electrimagnetic waves are transverse is nature is evident by

A. polarization

B. interference

C. reflection

D. diffraction

Answer: A

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25. Which of the following are not electromagnetic waves ?

A. Radio waves

B. gamma rays

C. $\beta - rays$

D. $X - rays$

Answer: C

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26. Let $\overrightarrow{E}$, $\overrightarrow{B}$ and $\overrightarrow{C}$ represent the electric field, magnetic field and velocity of an electromagnetic wave respectively. Their directions, at any instant point along the unit

vectors given below in order. Which of the following cannot be true?

A. $\hat{k}, \hat{i}, \hat{j}$

B. $\hat{k}, \hat{j}, -\hat{i}$

C. $\hat{i}, \hat{j}, \hat{k}$

D. $-\hat{j}, \hat{k}, -\hat{i}$

Answer: D

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

A. E/C

B. $2E/C$

C. EC

D. E/C^2

Answer: B

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28. An em wave going through vacuum is described by $E = E_0 \sin(kx - \omega t)$

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

A. $E_0 = B_0$

B. $E_0\omega = B_0 k$

C. $E_0 B_0 = \omega k$

D. $E_0 k = B_0 \omega$

Answer: D

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29. The frequency of visibile light is of the order of

A. $10^{15} Hz$

B. $10^{10} Hz$

C. $10^{6} Hz$

D. $10^{4} Hz$

Answer: A

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30. Which of the following wavelenght falls in X-rays region?

A. $1A^0$

B. $10^{-2}A^0$

C. $10^{-3}A^0$

D. $10^{-4}A^0$

Answer: A

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31. An electromagnetic wave in vacuum has the electric and magnetic field $\overrightarrow{E}$ and $\overrightarrow{B}$, which are always perpendicular to each other. The direction of polarization is given by $\overrightarrow{X}$ and that of wave propagation by $\overrightarrow{K}$. Then

A. $\overrightarrow{X} \parallel \overrightarrow{B}$ and $\overrightarrow{K} \parallel \overrightarrow{B} \times \overrightarrow{E}$

B. $\overrightarrow{X} \parallel \overrightarrow{E}$ and $\overrightarrow{K} \parallel \overrightarrow{E} \times \overrightarrow{B}$

C. $\overrightarrow{X} \parallel \overrightarrow{B}$ and $\overrightarrow{K} \parallel \overrightarrow{E} \times \overrightarrow{B}$

D. $\overrightarrow{X} \parallel \overrightarrow{E}$ and $\overrightarrow{K} \parallel \overrightarrow{B} \times \overrightarrow{E}$

Answer: B

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Level I C W

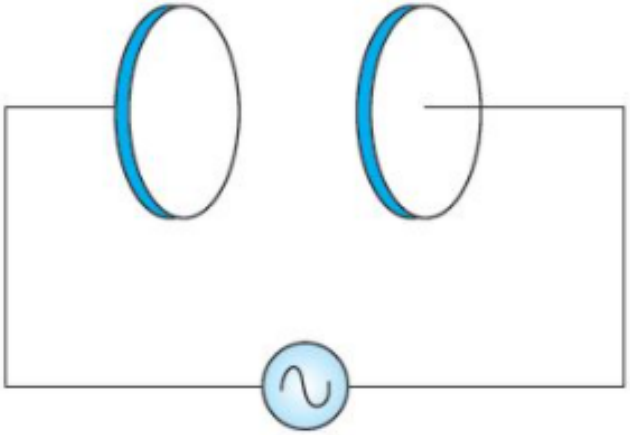
1. A parallel plate capacitor made of circular plates each of radius $R = 6.0$ cm has a capacitance $c = 100pF$. The capacitor is connected to a $230VAC$ supply with a (angular) frequency of $300rad/s$

(a) What is the rms value of the conduction current ?

(b) Is the conduction current equal to the

displacement current?

(c) Determine the amplitude of B at a point $3.0cm$ from the axis between the plates.



A. $6.9\mu A$

B. $2.3\mu A$

C. $9.2\mu A$

D. $9.2\mu A$

Answer: A

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2. A parallel plate capacitor of plate separation $2mm$ is connected in an electric circuit having source voltage $400V$. If the plate area is $60cm^2$, then the value of displacement current for 10^{-6} sec will be

A. $1.062amp$

B. $1.062 \times 10^{-2}amp$

C. $1.062 \times 10^{-3} amp$

D. $1.062 \times 10^{-4} amp$

Answer: B

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3. The magnetic field between the plates of a capacitor when $r > R$ is given by-

A. $\frac{\mu_0 I_D r}{2\pi R^2}$

B. $\frac{\mu_0 I_D}{2\pi R}$

C. $\frac{\mu_0 I_D}{2\pi r}$

D. zero

Answer: C

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4. A condenser is charged using a constant current. The ratio of the magnetic field at a distance of $\frac{R}{2}$ and R from the axis of condenser (R is the radius of plate) while charging is

A. $1:1$

B. $2:1$

C. $1:2$

D. $1:4$

Answer: C

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5. The magnetic field between the circulate plates of radius $12cm$ separted by distance of $4mm$ of a parallel plate capacitor of

capacitance $100pF$. Along the axis of plates having conduction current of $0.15A$ is

A. zero

B. $1.5T$

C. $15T$

D. $0.15T$

Answer: A

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6. The wave function (in $S.Iunit$) for an electromagnetic wave is given as-

$\psi(x,t) = 10^3 \sin\pi\left(3 \times 10^6 x - 9 \times 10^{14} t\right)$

The speed of the wave is

A. $9 \times 10^{14} m/s$

B. $3 \times 10^8 m/s$

C. $3 \times 10^6 m/s$

D. $3 \times 10^7 m/s$

Answer: B

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7. The velocity of all radiowaves in free space is $3 \times 10^8, /s,$ the frequency of a wave of wavelength $150m$ is

A. $45MHz$

B. $2MHz$

C. $2KHz$

D. $20KHz$

Answer: B

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8. The relative permeability of glass is $3/8$ and the dielectric constant of glass is 8. The refractive index of glass is

A. 1.5

B. 1.1414

C. 1.732

D. 1.6

Answer: C

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

A. Wave length doubled and frequency remains unchanged

B. wave length is doubled and frequency becomes half

C. wave length is halved and frequency remains unchanged

D. wave length and frequency both remain unchanged

Answer: C

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10. In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of $2.5 \times 10^{10} Hz$ and amplitued

$480V/m$. The amplitude of oscillating magnetic field will be

A. $\frac{1}{16} \times 10^{-8} Wb/m^2$

B. $16 \times 10^{-8} Wb/m^2$

C. $12 \times 10^{-7} Wb/m^2$

D. $\frac{1}{12} \times 10^{-7} Wb/m^2$

Answer: B

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11. In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of $2 \times 10^{10} Hz$ and amplitude $48V/m$. The wavelength of the wave will be-

A. $1.15m$

B. $66.6m$

C. $1.5cm$

D. $66.6cm$

Answer: C

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12. 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. $6 \times 10^{-8} T$

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

C. $9 \times 10^{-8} T$

D. $7.0 \times 10^{-8} T$

Answer: B

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13. The amplitude of the sinusodially oscillating electric field of a plane wave is $60V/m$. Then the amplitude of the magnetic field is

A. $12 \times 10^7 T$

B. $6 \times 10^7 T$

C. $6 \times 10^{-7} T$

D. $2 \times 10^{-7} T$

Answer: D

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14. Light with energy flux of $18 W / cm^2$ falls on a non reflecting surface of area $20 cm^2$ at normal incidence the momentum delivered in $30 \text{ min } utes$ is

A. $1.2 \times 10^{-6} kgms^{-1}$

B. $2.16 \times 10^{-3} kgms^{-1}$

C. $1.18 \times 10^{-3} kgms^{-1}$

D. $3.2 \times 10^{-3} kgms^{-1}$

Answer: B

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15. Light with energy flux of $24 Wm^{-2}$ is incident on a well polished disc of radius $3.5 cm$ for one hour. The momentum transferred to the disc is

A. $1.1\mu kgms^{-1}$

B. $2.2\mu kgms^{-1}$

C. $3.3\mu kgms^{-1}$

D. $4.4\mu kgms^{-1}$

Answer: B

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16. The maximum electric field of a plane electromagnetic wave is $88V/m$. The average energy density is

A. $3.4 \times 10^{-8} Jm^{-3}$

B. $13.7 \times 10^{-8} Jm^{-3}$

C. $6.8 \times 10^{-8} Jm^{-3}$

D. $1.7 \times 10^{-8} Jm^{-3}$

Answer: C

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17. The rms value of electric field of a plane electromagnetic wave is $314 V/m$.The average

energy density of electric field and the average energy density are

A. $4.3 \times 10^{-7} Jm^{-3}, 2.15 \times 10^{-7} Jm^{-3}$

B. $4.3 \times 10^{-7} Jm^{-3}, 8.6 \times 10^{-7} Jm^{-3}$

C. $2.15 \times 10^{-7} Jm^{-3}, 4.3 \times 10^{-7} Jm^{-3}$

D. $8.6 \times 10^{-7} Jm^{-3}, 4.3 \times 10^{-7} Jm^{-3}$

Answer: B

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18. The magnetic of poynting vector and electric field vector are respectively S and E, then

A. $S = E^2\sqrt{\frac{\varepsilon_0}{\mu_0}}$

B. $S = E^2\sqrt{(\varepsilon_0\mu_0)}$

C. $S = E^2\sqrt{\frac{\mu_0}{\varepsilon_0}}$

D. $S^2 = \frac{E^2}{\mu_0}$

Answer: A

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19. If the source of power $4kW$ product 10^{20} photons //second , the radiation belongs to a part spectrum called

A. $X - rays$

B. Ultraviolet rays

C. microwaves

D. $\gamma - rays$

Answer: A

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20. The intensity of electromagnetic wave at a distance of $1Km$ from a source of power $12.56Kw$. Is

A. $10^{-3}Wm^{-2}$

B. $4 \times 10^{-3}Wm^{-2}$

C. $12.56 \times 10^{-3}Wm^{-2}$

D. $1.256 \times 10^{-3}Wm^{-2}$

Answer: A

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21. The sun delivers $10^3 W/m^2$ of electromagnetic flux to the earth's surface.The total power that is inclident on a roof of dimensions $8m \times 20m$, will be

A. $6.4 \times 10^3 W$

B. $3.4 \times 10^4 W$

C. $1.6 \times 10^5 W$

D. $3.2 \times 10^5 W$

Answer: C

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Level Ii C W

1. A parallel plate capacitor consists of two circular plates each of radius $2cm$, separated by a distance of $0.1mm$. Ifvoltage across the plates is varying at the rate of $5 \times 10^{13} V/s$, then the value of displacement current is :

A. $5.50A$

B. $5.56 \times 10^2 A$

C. $5.56 \times 10^3 A$

D. $2.28 \times 10^4 A$

Answer: C

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2. A parallel plate capacitor consists of two circular plates each of radius $12cm$ and separated by $5.0mm$. The capacitor is being charge by an external source. The charging current is constant and is equal to 0.15 A. The

rate of change of potential difference between the plate will be

A. $1 \times 10^9 Vs^{-1}$

B. $2 \times 10^{10} Vs^{-1}$

C. $3 \times 10^{12} Vs^{-1}$

D. $2 \times 10^9 Vs^{-1}$

Answer: D

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3. A condenser has two conducting plates of radius $10cm$ separated by a distance of $5mm$. It is charged with a constant current of $0.15A$. The magnetic field at a point $2cm$ from the axis in the gap is

A. $1.5 \times 10^{6}T$

B. $3 \times 10^{-8}T$

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

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

Answer: C

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4. An $ACrms$ voltage of $2V$ having a frequency of $50KHz$ is applied to a condenser of capacity of $10\mu F$. The maximum value of the magnetic field between the plates of the condenser if the radius of plate is $10cm$ is

A. $0.4p\mu$

B. $4\pi\mu T$

C. $2\mu T$

D. $40\pi\mu T$

Answer: C

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5. The wave emitted by any atom or molecule must have some finitetotal length which is known as the choherence length. For sodium light, this length is $2.4cm$. The number of oscillations in this length will be Given $\lambda = 5900A^{\circ}$

A. $4.068 \times 10^5 Hz$

B. $4.068 \times 10^4 Hz$

C. $4.068 \times 10^6 Hz$

D. $4.068 \times 10^8 Hz$

Answer: B

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6. 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. 3776Ω

D. 1883Ω

Answer: D

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

A. $6V/m$

B. $9V/m$

C. $12V/m$

D. $3V/m$

Answer: A

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8. A plane e.m. wave of wave intensity $6W/m^2$ strikes a small mirror of area $30cm^2$, held perpendicular to the approaching wave. The momentum transfered in $kgms^{-1}$ by the wave to the mirror each second will be

A. $6.4 \times 10^{-7} kg - m/s$

B. $4.8 \times 10^{-8} kg - m/s$

C. $3.2 \times 10^{-9} kg - m/s$

D. $1.6 \times 10^{-10} kg - m/s$

Answer: D

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9. In the above question the radiation force on the mirror will be

A. $6.4 \times 10^{-7} N$

B. $4.8 \times 10^{-8} N$

C. $3.2 \times 10^{-9} N$

D. $1.6 \times 10^{-10} N$

Answer: D

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10. A point source of electromagnetic radiation has an average power output of $800W$. The maximum value of electric field at a distance $3.5m$ from the source will be $62.6\frac{V}{m}$, the energy density at a distance $3.5m$ from the source will be- (in joule/m^3)

A. 1.73×10^{-5}

B. 1.73×10^{-6}

C. 1.73×10^{-7}

D. 1.73×10^{-8}

Answer: D

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11. An electromagnetic radiation has an energy $14.4KeV$. To which region of elctromagnetic spectrum does it belong?

A. Infra red region

B. Visible region

C. $X - rays$ region

D. $\gamma - ray$ region

Answer: D

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12. A lamp radiates power P_0 uniformly in all directions, the amplitude of elctric field strength E_0 at a distance r from it is

A. $E_0 = \frac{P_0}{2\pi\varepsilon_0 cr^2}$

B. $E_0 = \sqrt{\frac{P_0}{2\pi\varepsilon_0 cr^2}}$

C. $E_0 = \sqrt{\frac{P_0}{4\pi\varepsilon_0 cr^2}}$

D. $E_0 = \sqrt{\frac{P_0}{8\pi\varepsilon_0 cr^2}}$

Answer: B

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13. A laser beam can be focussed on an area equal to the square of its wavelength. A

$He - Ne$ laser radiates energy at the rate of $1mW$ and its wavelength is $600nm$. The intensity of focussed beam will be

A. $3.2 \times 10^9 W/m^2$

B. $2.8 \times 10^{13} W/m^2$

C. $2.7 \times 10^9 W/m^2$

D. $3.2 \times 10^{13} W/m^2$

Answer: C

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14. The intensity of solar radiation of the earths surface is $1KWm^{-2}$. The power entering the pupil of an eye of diameter $0.5cm$ is

A. $39.2mw$

B. $19.6mw$

C. $9.8mw$

D. $4.9mw$

Answer: B

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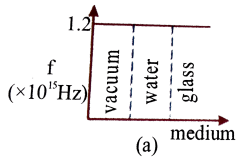
15. Electromagnetic waves of frequency $1.2 \times 10^{15} Hz$ enters into water and subsequently into glass from vacuum. Which of the following graphs correctly represent the variation of frequency f with medium? (Given that indices of refraction for water and glass are $4/3$ and $3/2$ respectively).

A.



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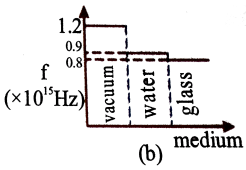

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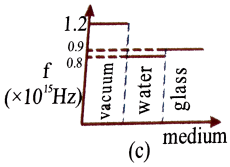

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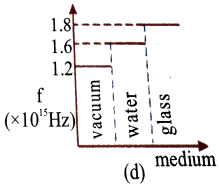

Answer: A

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Level Iii

1. A parallel plate capacitor of plate separation $2mm$ is connected in an electric circuit having source voltage $400V$. If the plate area is $60cm^2$, then the value of displacement current for 10^{-6} sec will be

A. $1.062amp.$

B. $1.062 \times 10^{-2}amp$

C. $1.062 \times 10^{-3}amp$

D. $1.062 \times 10^{-4}amp$

Answer: B

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2. A long straigth wire of resistance R, radius a and length l carries a constant current I.The poynting vector for the wire will be

A. $\frac{IR}{2\pi al}$

B. $\frac{IR^2}{al}$

C. $\frac{I^2R}{al}$

D. $\frac{I^2R}{2\pi al}$

Answer: D

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3. To establish an instantaneous displacement current of $2A$ in the space between two parallel plates of $1\mu F$ capacitor, the potential difference across the capacitor plates will have to be changed at the rate of

A. $4 \times 10^4 V/s$

B. $4 \times 10^6 V/s$

C. $2 \times 10^4 V/s$

D. $2 \times 10^6 V / s$

Answer: D

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4. The sun delivers $10^3 W / m^2$ of electromagnetic flux to the earth's surface.The total power that is inclident on a roof of dimensions $8m \times 20m$, will be

A. $6.4 \times 10^3 W$

B. $3.4 \times 10^4 W$

C. $1.6 \times 10^5 W$

D. none of these

Answer: C

Watch Video Solution

5. The sun delivers $10^3 W / m^2$ of electromagnetic flux to the earth's surface. The total power that is incident on a roof of

dimensions $8m \times 20m$ is $1.6 \times 10^5 W$, the radiation force on the roof will be-

A. $3.33 \times 10^{-5} N$

B. $5.33 \times 10^{-4} N$

C. $7.33 \times 10^{-3} N$

D. $9.33 \times 10^{-2} N$

Answer: B

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6. An electruc field of $300V/m$ is confined to a circular area $10cm$ in diameter. If the field is increasing at the rate of $20V/m-s$, the magnitude of magnetic field at a point $15cm$ from the centre of the circle will be-

A. $1.85 \times 10^{-15}T$

B. $1.85 \times 10^{-16}T$

C. $1.85 \times 10^{-17}T$

D. $1.85 \times 10^{-18}T$

Answer: D

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7. 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 $10m$ from the lamp will be

A. $1.34V/m$

B. $2.68V/m$

C. $5.36V/m$

D. $9.37V/m$

Answer: A

Watch Video Solution

8. A flood light is covered with a fitter than transmits red light. The electric field of the emerging beam is represented a sinusolidal plane wave

$E_x = 36\sin\left(1.20 \times 10^7 z - 3.6 \times 10^{15} t\right) V/m$

The average intensity of beam is $\text{watt}/(\text{metre})^2$ will be

A. $0.86W/m^2$

B. $1.72W/m^2$

C. $3.44W/m^2$

D. $6.88W/m^2$

Answer: B

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9. A plane electromagnetic wave of frequency $40MHz$ travels in free space in the X-direction. At some point and at some instant, the electric field $\overrightarrow{E}$ has its maximum value of $750N/C$ in Y- direction. The wavelength of the wave is-

A. $3.5m$

B. $5.5m$

C. $7.5m$

D. $9.5m$

Answer: C

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10. A plane electromagnetic wave propagating in the x-direction has wavelength of 60 mm. The electric field is in the y-direction and its maximum magnitude is $33V/m^{-1}$.The equation for the electric field as function of x and t is:

A. $11\sin\pi(t-x/c)$

B. $33 \sin \pi \times 10^{10}(t - x/c)$

C. $33 \sin \pi(t - x/c)$

D. $11 \sin \pi \times 10^{10}(t - x/c)$

Answer: B

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Ncert Based

1. One requires $11eV$ of energy to dissociate a carbon monoxide molecule into carbon and

oxygen atoms. The minimum frequency of the appropriate electromagnetic radiation to achieve the dissociation lies in.

A. Visible region

B. infrared region

C. Ultraviolet region

D. microwave region

Answer: C

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2. A linearly polarised electromagnetic wave given as $E = E_0 \hat{i} \cos(kz - \omega t)$ is incident normally on a perfectly reflecting wall $z = a$. Assuming that the material of the optically inactive, the reflected wave will be give as

A. $E_r = E_0 \hat{i}(kz - \omega t)$

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

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

D. $E_r = E_0 \hat{i} \sin(kz + \omega t)$

Answer: B

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3. Light with an energy flux$20W/cm^2$ falls on a non-reflecting surface at normal incidence. If the surface has an area of $30cm^2$. the total momentum delivered (for complete absorption)during 30 minutes is

A. $36 \times 10^{-5} kg - m/s$

B. $36 \times 10^{-4} kg - m/s$

C. $108 \times 10^{4} kg - m/s$

D. $1.08 \times 10^{7} kg - m/s$

Answer: B

 Watch Video Solution

4. The electric field intensity produced by the radiations coming from 100W bulbs at a 3m distance is E. The electric field intensity produced by the radiations coming from 50W bulb at the same distance is

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

B. $2E$

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

D. $\sqrt{2}E$

Answer: C

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

A. $\overrightarrow{E}$

B. $\overrightarrow{B}$

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

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

Answer: D

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6. The ratio of contributions made by the eletric field and magnetic field components to the intensity of an EM wave is.

A. $c:1$

B. $c^2:1$

C. $1:1$

D. $\sqrt{c}:1$

Answer: C

Watch Video Solution

7. An EM wave radiates out wards from a dipole antenna with E_0 as the amplitude of its electric filed vector. The electric field E_0 which

transports significant energy from the source

falls off as

A. $\frac{1}{r^3}$

B. $\frac{1}{r^2}$

C. $\frac{1}{r}$

D. remains constant

Answer: C

Watch Video Solution

8. The charge on a parallel plate capacitor varies as $= q_0 \cos 2\pi ft$. The plates are very large and close together (area=a,separation=d). Neglecting the edge effects, find the displacement current through the capacitor.

A. $I_d = -2\pi v q_0 \sin 2\pi vt$

B. $I_d = 2\pi v q_0 \sin 2\pi vt$

C. $I_d = 2\pi v q_0 \cos 2\pi vt$

D. $I_d = -2\pi v q_0 \cos 2\pi vt$

Answer: A

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Level V

1. A photon of light enters a block of glass after travelling through vaccum. The energy of the photon on entering the glass block

A. increases because its associated wavelength decreases

B. Decreases because the speed of the radiation decreases

C. Stays the same because the speed of the radiation and the associated wavelength do not change

D. Stays the same because the frequency of the radiation does not change

Answer: D

Watch Video Solution

2. Radiation pressure on any surface (for given intensity):

A. is dependent on wavelength of the light used

B. is dependent on nature of surface and intensity of light used

C. is dependent on frequency and nature of surface

D. depends on the nature of source from which light is coming and on nature of

surface on which it is falling.

Answer: B

 Watch Video Solution

3. A parallel be beam of radiation of intensity $10W$ and of area of cross section $1cm^2$ is falling on a plane surface at an angle 60° with normal to the surface. The surface is partially reflecting with reflection coefficient 0.5 and

absobing the remaining. Choose the incorrect option of the following:

A. Force on the surface normal to it is $2.5 \times 10^{-12} N$

B. Force on the surface parallel to it is $\frac{2.5}{\sqrt{3}} \times 10^{-12} N$

C. Net force on the surface $= \frac{5}{\sqrt{3}} \times 10^{-12} N$

D. Net force on the surface acts at an angle 60° with normal to the surface

Answer: D

Watch Video Solution

4. A parallel beam of monochromatic light of wavelength 663 nm is incident on a totally reflection plane mirror. The angle of incidence is 60° and the number of photons striking the mirror per second is 1.0×10^{19}. Calculate the force exerted by the light beam on the mirror.

A. $10nN$

B. $1000pN$

C. $10\sqrt{3}nN$

D. $100\sqrt{3}\mu N$

Answer: A

Watch Video Solution

Level Vi

1. The radiation force experienced by body exposed to radiation of intensity I, assuming

surface of body to be perfectly absorbing is:

A. $\frac{\pi R^2 I}{c}$

B. $\frac{\pi RHI}{c}$

C. $\frac{IRH}{2c}$

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

Answer: D

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2. A sphere of radius R is exposed to a parallel beam of radiation of intensity I as shown in figure. Choose the correct option (s) of the following.

A. If the surface of the sphere is completely reflecting, radiation force in the sphere is $\frac{2I\pi R^2}{c}$

B. If surface of the sphere is completely absorbing, radiation force on the sphere is $\frac{I\pi R^2}{c}$

C. If surface of the sphere is completely reflecting, radiation force on the sphere is $\frac{I\pi R^2}{2c}$

D. If surface of the sphere is partially reflecting with reflection coefficent 0.3 and absorbing coefficent 0.7, the radiation force in the sphere is $\frac{1.71\pi R^2}{c}$

Answer: B

View Text Solution

3. A point source of radiation power P is placed on the axis of an ideal plane mirror. The distance between the source and the mirror is n times the radius of the mirror. The force that light exerts on the mirror is $\dfrac{P}{xc(n^2+y)}$

A. $x - y = 3$

B. $x + y = 3$

C. $xy = 3$

D. $x / y = 3$

Answer: B

Watch Video Solution

4. A point source of radiation of power P is placed on the axis of completely absorbing disc. The distance between the source and the disc is 2times the radius of the disc. The force that light exerts on the disc is $\frac{Px}{40c}$. Then the value of x

A. 1

B. 2

C. 3

D. 4

Answer: B

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5. Assuming a particle to have the form of a sphere and to absorb all incident light, the radius (in mm) of a particle for which its gravitational attraction to the Sun is

Counterbalanced by the force that light exerts on it is------. The power of light radiated by the sun equals $P = 4 \times 10^{26} W$ and the density of the particle is $r = 1.0 g / cm^3$. Use $G = \frac{20}{3} \times 10^{-11} Nm^2 / kg^2$, $\pi = \frac{25}{8}$ and mass of the sun $= 2 \times 10^{30} kg$

A. 0.8

B. 0.6

C. 0.1

D. 0.4

Answer: B

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Level I H W

1. The voltage between the plates of a parallel plate condenser of capacity $2.0\mu F$ is charging at a rate of $10Vs^{-1}$. The displacement current

A. $2mA$

B. $2\mu A$

C. $20\mu A$

D. $2A$

Answer: C

Watch Video Solution

2. A parallel plate condenser of capacity $10\mu F$ is charged with a constant charging current of $0.16A$. The displacement current is

A. $0.16\mu A$

B. $0.16A$

C. $0.96A$

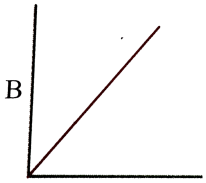
D. $9.6A$

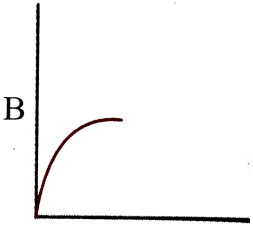
Answer: B

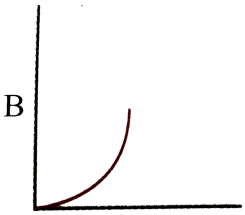
Watch Video Solution

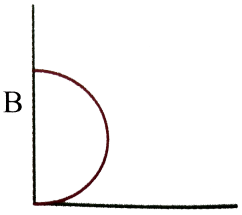
3. The graph representing the variation of induced magnetic field in the gap of the condenser plates during its charging with the distance from the axis of the gap is

1)

A. 

B. 

C. 

D. 

Answer: A

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4. The electrical field in the gap of a condenser charges as $10^{12} Vm^{-1}s^{-1}$. If the radius of each plate of the condenser is $3cm$, the magnetic field at the edge of plate in the gap is

A. $1.67mT$

B. $0.167\mu T$

C. $0.5\mu T$

D. $5\mu T$

Answer: B

Watch Video Solution

5. An LC current contains inductance $L = 1\mu$ H and capacitance $C = 0.01\mu F$. The wavelength of electromagnetic wave generated is nearly:

A. $0.5m$

B. $5m$

C. $188m$

D. $30m$

Answer: C

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6. The wave length of the Green light of mercury is $550nm$. If the refractive index of the glass is 1.5, the time period of the electrical vector in glass nearly ($C_0 = 3 \times 10^8 mS^{-1}$)

A. $1.8 \times 10^{-9} S$

B. $3.6 \times 10^{-15} S$

C. $9 \times 10^{-15} S$

D. $2.75 \times 10^{-15} S$

Answer: D

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7. The all India Radio, station at Vijayawala transmits its signals at $840 KC / s$. The wave length of the radio wave is

A. $35.7m$

B. $357m$

C. $35.7m$

D. $3.57m$

Answer: B

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8. A point source of electromagnetic radiation has an average power output of $800W$. The maximum value of electric field at a distance

$3.5m$ from the source will be $62.6\frac{V}{m}$, the energy density at a distance $3.5m$ from the source will be- (in joule/m^3)

A. $2.09 \times 10^{-5}T$

B. $2.09 \times 10^{-6}T$

C. $2.09 \times 10^{-7}T$

D. $2.09 \times 10^{-8}T$

Answer: C

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9. A plane $E.M.$ wave of frequency $40MHz$ travels along X-axis. At same point at same instant, the electric field E has maximum value of $750N/C$ in Y- direction. The magnitude and direction of magnetic field is

A. $2.5\mu T$ along $X-$ axis

B. $2.5\mu T$ along $Y-$ axis

C. $2.5\mu T$ along $Z-$ axis

D. $5\mu T$ along $Z-$ axis

Answer: C

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

A. $4.2 \times 10^{-8}\hat{k}T$

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

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

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

Answer: B

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11. Light with energy flux $36w/cm^2$ is incident on a well polished metal square plate of side $2cm$. The force experienced by it is

A. $0.96\mu N$

B. $0.24\mu N$

C. $0.12\mu N$

D. $0.36\mu N$

Answer: A

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

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

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

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

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

Answer: B

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13. In an electromagnetic wave, the amplitude of electric firld is $1\frac{V}{m}$. The frequency of wave is $5 \times 10^{14} Hz$. The wave is propagating along z-axis. The average energy density of electric field, in joule/m^3,will be

A. 1.1×10^{-11}

B. 2.2×10^{-12}

C. 3.3×10^{-13}

D. 4.4×10^{-14}

Answer: B

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14. 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. $0.4W/m^2$

B. $0.5W/m^2$

C. $0.6W/m^2$

D. $0.8W/m^2$

Answer: A

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15. The sun radiates electromagnetic energy at the rate of $3.9 \times 10^{26} W$. Its radius is $6.96 \times 10^{8} m$. The intensity of sun light at the solar surface will be (in W / m^{2})

A. 1.4×10^{4}

B. 2.8×10^{5}

C. 64×10^{6}

D. 5.6×10^{7}

Answer: C

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16. The intensity of TV broad cast station of $E = 800\sin\left(10^9 t - kx\right) V/M$ is.....and the wave length in meter is.....

A. $850 wm^{-2}, 0.6\pi$

B. $425 wm^{-2}, 0.6\pi$

C. $850 wm^{-2}, 0.3\pi$

D. $425 wm^{-2}, 0.3\pi$

Answer: A

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Level Ii H W

1. The area of each plate of parallel plated condenser is $144cm^2$. The electrical field in the gap between the plates changes at the rate of $10^{12}Vm^{-1}s^{-1}$. The displacement current is

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

B. $\frac{0.4}{\pi}A$

C. $\frac{40}{\pi}A$

D. $\frac{1}{10\pi}A$

Answer: B

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2. A condenser having circular plates having radius $2cm$ and separated by a distance of $3mm$. It is charged with a current of $0.1A$. The rate at which the potential difference between the plates change is

A. $9 \times 10^{10} V / S$

B. $1.8 \times 10^{10} V / S$

C. $2.7 \times 10^{6} V / S$

D. $2.7 \times 10^{10} V / S$

Answer: D

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3. An AC source having a frequency of $50 Hz$ and voltage supply of $300 v$ is applied directly to the condenser of capacity $100 \mu F$. The peak and rms values of displacement current are

A. $9.42A, \frac{9.42}{\sqrt{2}}A$

B. $\frac{9.42}{\sqrt{2}}A, 9.42\sqrt{2}A$

C. $9.42\sqrt{2}A, 9.42A$

D. $9.42A, 9.42A$

Answer: C

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4. The capacity of a parallel plate condenser is $50pF$. A magnetic field of $4 \times 10^{-7}T$ is

produced at a distance of $10cm$ from the axis of the gap. The charging current is

A. $0.1A$

B. $0.2A$

C. $0.3A$

D. $0.15A$

Answer: B

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5. The diameter of the condenser plate is $4cm$. It is charged by an external current of $0.2A$ .The maximum magnetic field induced in the gap

A. $2\mu T$

B. $4\mu T$

C. $6\mu T$

D. $8\mu T$

Answer: A

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6. A condenser of capacity $50pF$ is connected to an AC supply of $220V50Hz$. The rms value of magnetic field at a distance of $5cm$ from the axis is

A. $22\pi \times 10^{-1}T$

B. $22\pi \times 10^{-12}T$

C. $44\pi \times 10^{-13}T$

D. $\frac{11}{5}\pi \times 10^{-12}T$

Answer: B

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7. 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. 1.5

C. $4/9$

D. $2/3$

Answer: A

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8. In a plane electromagnetic wave, the electric field oscillates sinnusoidally at a frequency of $2 \times 10^{10} Hz$ and amplitude $48 V/m$. The amplitude of oscillating magnetic field will be

A. $\frac{1}{16} \times 10^{-8} Wb/m^2$

B. $16 \times 10^{-8} Wb/m^2$

C. $12 \times 10^{-7} Wb/m^2$

D. $\frac{1}{12} \times 10^{-7} Wb/m^2$

Answer: B

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9. 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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10. Light with energy flux $36 W m^{-3}$ is incident on a circular part of radius $1.4 m$ of a perfectly balck body. The force experienced by the body

and the momentum delivered in $10\ \min utes$ are

A. $2.2\mu N, 7.2\mu kgms^{-1}$

B. $3.5\mu N, 7.4\mu kgms^{-1}$

C. $0.74\mu N, 444\mu kgms^{-1}$

D. $7.4\mu N, 2.2\mu kgms^{-1}$

Answer: C

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11. Light with energy flux $18wcm^{-2}$ is incident on a mirror of size $2cm \times 2cm$ normally. The force experienced by it and momentum delivered in one minute are

A. $0.48\mu N, 28.8\mu kgms^{-1}$

B. $48\mu N, 2.88\mu kgms^{-1}$

C. $28.8\mu N, 4.8\mu kgms^{-1}$

D. $0.24\mu N, 28.8\mu kgms^{-1}$

Answer: A

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12. Electromagnetic radiation with energy flux $50Wcm^{-2}$ is incident on a totally absorbing surface normally for $1hour$: If the surface has an area of $0.05m^2$, then the avergae force due to the radiaton pressure, on it is,

A. $8.3 \times 10^{-7}N$

B. $8.3 \times 10^{-5}N$

C. $1.2 \times 10^{-7}N$

D. $1.2 \times 10^{-5}N$

Answer: B

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13. In an electromagnetic wave in vacuum. The electrical and magnetic fields are $40\pi V/m$ and $0.4 \times 10^{-7} T$. The poynting vector

A. $4.4 W m^{-1}$

B. $0.44 W m^{-1}$

C. $5.65 W m^{-1}$

D. $4.0 W m^{-1}$

Answer: D

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14. The amplitude of magnetic field at a region carried by an electromagnetic wave is $0.1\mu T$. The intensity of wave is

A. $4\mu Wm^{-2}$

B. $1.2Wm^{-2}$

C. $4Wm^{-2}$

D. $1.2\mu Wm^{-2}$

Answer: B

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