ETERNAL CAREER CLASSES

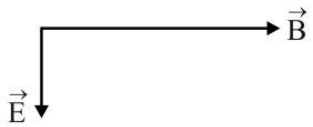
SUBJECT : PHYSICS | CLASS : XII | FULL MARKS : 40

NAME : …….. | BOARD TEST : 20 | DATE : 27.12.2024

SECTION - A

Single answer type question. Attempt any Fourteen question :- **Marks : 1**× 14 = 14

1. The diagram below shows the electric field (E) and magnetic field (B) components of an electromagnetic wave at a certain time and location.



The direction of the propagation of the electromagnetic wave is
(a) perpendicular to E and B and out of plane of the paper
(b) perpendicular to E and B and into the plane of the paper
(c) parallel and in the same direction as E
(d) parallel and in the same direction as B

2. A linearly polarised electromagnetic wave given as $E = E_0\hat{i}\cos(kz - \omega t)$ is incident normally on a perfectly reflecting infinite wall is optically inactive, the reflected wave will be given as
(a) $E_r = -E_0\hat{i}\cos(kz - \omega t)$ (b) $E_r = E_0\hat{i}\cos(kz + \omega t)$
(c) $E_r = -E_0\hat{i}\cos(kz + \omega t)$ (d) $E_r = E_0\hat{i}\sin(kz - \omega t)$
3. Which of the following statement is NOT true about the properties of electromagnetic waves?
(a) These waves do not require any material medium for their propagation
(b) Both electric and magnetic field vectors attain the maxima and minima at the same time
(c) The energy in electromagnetic wave is divided equally between electric and magnetic fields
(d) Both electric and magnetic field vectors are parallel to each other
4. Radiations of intensity 0.5 Wm^{-2} are striking a metal plat. The pressure on the plate is
(a) 0.166 x 10^{-8} Nm^{-2} (b) 0.332 x 10^{-8} Nm^{-2}
(c) 0.111 x 10^{-8} Nm^{-2} (d) 0.083 x 10^{-8} Nm^{-2}
5. The electromagnetic radiations used for water purification and eye surgery is
(a) Infrared (b) Microwave (c) X-rays (d) None of these
6. Which one of the following statements are correct?
(a) X-rays are suitable for radar system and aircraft navigation.
(b) Water molecules readily absorb infrared radiation and their thermal motion increases
(c) Microwaves are produced in Coolidge tube
(d) Gamma radiations generate due to electron transitions between upper and lower energy levels of heavy element when excited by electron bombardment.
7. One requires 11 eV 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.
8. Light with an energy flux of 20 W/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 x 10^{-5} kg m/s. (b) 36 x 10^{-4} kg m/s.
(c) 108 x 10^4 kg m/s. (d) 1.08 x 10^7 kg m/s.

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

(a) $\frac{E}{2}$ (b) 2E (c) $\frac{E}{\sqrt{2}}$ (d) $\sqrt{2E}$

10. An electromagnetic wave is produced by a charge

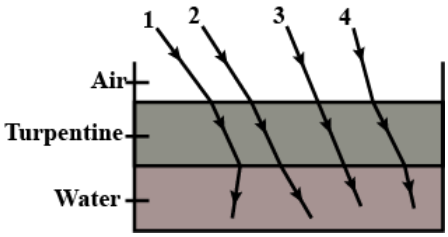
(a) moving with constant velocity (b) moving with a constant speed parallel to a magnetic filed

(c) moving with an acceleration (d) at rest

11. An object 2 cm high is placed at a distance of 16 cm from a concave mirror, which produces a real image 3 cm high. What is the focal length of the mirror?

(a) –9.6 cm (b) –3.6 cm (c) –6.3 cm (d) –8.3 cm

12. The optical density of turpentine is higher than that of water while its mass density is lower. Figure shows a layer of turpentine floating over water in a container. For which one of the four rays incident on turpentine in Figure, the path shown in correct?



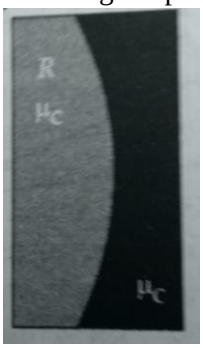
(a) 1 (b) 2 (c) 3 (d) 4

13. The relationship between angle of incidence i, prism of angle A and angle of minimum deviation for a triangular prism is

(a) $A+\delta_m = i$ (b) $A+\delta_m = 2i$ (c) $\frac{2A+\delta_m = i}{2}$ (d) $2A+\delta_m = i$

14. A plano-convex lens of refractive index μ_c =1.7 and a plano-concave lens of refractive index μ_d =1.5, are combined as shown so as to construct a plane glass plate.

If the radius of curvature of the curved side of both the lenses is the same, which of the following will the glass plate function as ?



(a) Convergent system with positive focal length

(b) Divergent system with negative focal length

(c) Plane glass slab with zero focal length

(d) Plane glass slab with infinite focal length

15. The final image formed in an astronomical refracting telescope with respect to the object is

(a) Real and inverted (b) Real and erect

(c) Virtual and erect (d) Virtual and inverted

16. A ray of light incident at an angle θ on a refracting face of a prism emerges from the other normally. If the angle of the prism is 5^o and the prism is made of a material of refractive index1.5, the angle of incidence is:

(a) 7.5^o (b) 5^o (c) 15^o (d) 2.5^o

17. An object approaches convergent lens from the left of the lens with a uniform speed 5 m/s and stops at the focus. The image
    (a) moves away from the lens with an uniform speed 5 m/s
    (b) moves away from the lens with an uniform acceleration.
    (c) moves away from the lens with a non-uniform acceleration.
    (d) moves towards the lens with a non-uniform acceleration.
18. The phenomena involved in the reflection of radio waves by ionosphere are similar to
    (a) reflection of light by a plane mirror.
    (b) total internal reflection of light in air during a mirage.
    (c) dispersion of light by water molecules during the formation of a rainbow
    (d) scattering of flight by the particles of air
19. A ray of light travels a distance of 12.0 m in a transparent sheet in 60 ns. The refractive index of the sheet is
    (a) 1.33 (b) 1.50 (c) 1.65 (d) 1.75
20. A biconcave lens of power P vertically splits into two identical plano concave parts. The power of each part will be
    (a) 2P (b) P / 2 (c) P (d) $P/\sqrt{2}$

SECTION - B

Short answer type question. Attempt any four question :- **Marks : 4 × 3 = 12**

21. Write 3 characteristics of electromagnetic wave .
22. Show that the magnetic field B at a point in between the plates of a parallel-plate capacitor during charging is $\frac{\mu_r \varepsilon_r}{2}\frac{dE}{dt}$ (symbols having usual meaning).
23. A concave mirror and a convex mirror of focal lengths 10 cm and 20 cm respectively are placed coaxially as shown. The distance of separation between the two mirrors is 40 cm.
24. Monochromatic light of wavelength 589 nm is incident from air on a water surface. If μ for water is 1.33, find the wavelength, frequency and speed of the refracted light.

Long answer type question. Attempt any four question :- **Marks : 4 × 5 = 20**

25. A plano concave lens forms a virtual image at a distance of 5 cm in front of the lens of an object placed in front of it.
    The image formed is ½ times the size of the object.
    If the speed of light in the Plano concave lens is2/3 times the speed of light in air, then find
    (a) the refractive index of the lens.
    (b) the radius of curvature of the curved surface of the lens.
26. Answer the following questions.
    (i) Name the electromagnetic eaves which are used for the treatment of certain forms of cancer. Write their frequency range.
    (ii) Thin ozone layer on top of stratosphere is crucial for human survival. Why?
    (iii) Why is the amount of the momentum transferred by the electromagnetic waves incident on the surface so small?
27. A parallel plate capacitor made of circular plates each of radius R = 6.0 cm has a capacitance C = 100 pF. The capacitor is connected to a 230 v ac supply with a (angular) frequency of 300 rad s^{-1}.

(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 3.0 cm from the axis between the plates.

28. A plane EM wave travelling along z-direction is described by $E = E_0 \sin(kz - \omega t)\hat{i}$ and $B = B_0 \sin(kz - \omega t)\hat{j}$. Show that

(a) the average energy density of the wave is given by $u_{av} = \frac{1}{4}\varepsilon_0 E^2{}_0 + \frac{1}{4}\frac{B^2{}_0}{\mu_0}$

(b) the time averaged intensity of the wave is given by $I_{av} = \frac{1}{2}c\varepsilon_0 E^2{}_0$

29. (a) State two main considerations taken into account while choosing the objective of astronomical telescope.
(b) Draw a ray diagram of reflecting type telescope. State its magnifying power.
(c) State the advantages of reflecting type telescope over the refracting type

30. Derive mirror equation for a convex mirror. Using it, show that a convex mirror always produces a virtual image, independent of the location of object.