Board Paper of Class 12 Physics Term-II 2022 Delhi(SET 1) - Solutions

Total Time: 120

Total Marks: 35.0

Section A

Q.No.1: With the help of a circuit diagram, explain briefly how a *p-n* junction diode works as a half-wave rectifier. **Marks:[2.00]**

Q.No.2: What results do you expect if α-particle scattering experiment is repeated using a thin sheet of hydrogen in place of a gold foil? Explain. (Hydrogen is a solid at temperature below 14 K)

OR

Why it is the frequency and not the intensity of light source that determines whether emission of photoelectrons will occur or not? Explain. **Marks:[2.00]**

Q.No.3: Why a photo-diode is operated in reverse bias whereas current in the forward bias is much larger than that in the reverse bias ?
Explain. Mention its two uses. **Marks:[2.00]**

Section B

Q.No.4: Draw a graph showing the variation of number of particles scattered (N) with the scattering angle θ in Geiger-Marsden experiment. Why only a small fraction of the particles are scattered at θ > 90º? Mention two limitations of Rutherford nuclear model of an atom. **Marks:[3.00]**

Q.No.5: (i) Draw V-I characteristics of a p-n Junction diode.

(ii) Differentiate between the threshold voltage and the breakdown voltage for a diode.
(iii) Write the property of a junction diode which makes it suitable for rectification of ac voltages. **Marks:[3.00]**

Q.No.6: In a fission event of $^{238}_{92}\mathrm{U}$ by fast moving neutrons, no neutrons are emitted and final products, after the beta decay of the primary fragments, are $^{140}_{58}\mathrm{Ce}$ and $^{99}_{44}\mathrm{Ru}$. Calculate Q for this process. Neglect the masses of electrons/positrons emitted during the intermediate steps.
Given : $\mathrm{m}\left(^{238}_{92}\mathrm{U}\right) = 238.05079\mathrm{u};\ \mathrm{m}\left(^{140}_{58}\mathrm{Ce}\right) = 139.90543\mathrm{u}$

$$\mathrm{m}\left(^{99}_{44}\mathrm{Ru}\right) = 98.90594\mathrm{u};\ \mathrm{m}\left(^{1}_{0}\mathrm{n}\right) = 1.008665\mathrm{u}$$ **Marks:[3.00]**

Q.No.7: How can you differentiate whether a pattern is produced by a single slit or double slits ? Derive the expression for the angular position of
(i) bright and
(ii) dark fringes produced in a single slit diffraction. **Marks:[3.00]**

Q.No.8: A slit of width 0.6 mm is illuminated by a beam of light consisting of two wavelengths 600 nm and 480 nm. The diffraction pattern is observed on a screen 1.0 m from the slit. Find:
(i) The distance of the second bright fringe from the central maximum pertaining to light of 600 nm.
(ii) The least distance from the central maximum at which bright fringes due to both the wavelengths coincide.

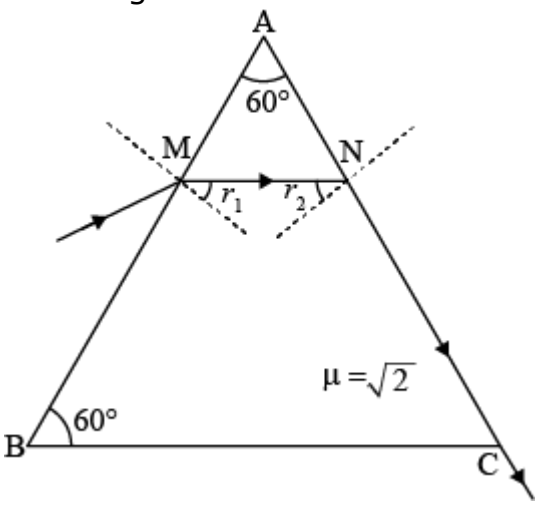
OR

(i) Define SI unit of power of a lens.
(ii) A plano convex lens is made of glass of refractive index 1.5. The radius of curvature of the convex surface is 25 cm.
(a) Calculate the focal length of the lens.
(b) If an object is placed 50 cm in front of the lens, find the nature and position of the image formed.

Marks:[0.00]

Q.No.9: (a) Calculate the energy and momentum of a photon in a monochromatic beam of wavelength 331.5 nm.
(b) How fast should a hydrogen atom travel in order to have the same momentum as that of the photon in part (a)? **Marks:[3.00]**

Q.No.10: A ray of light passes through a prism of refractive index $\sqrt{2}$ as shown in the figure. Find:



(i) The angle of incidence ($\angle r_2$) at face AC.
(ii) The angle of minimum deviation for this prism. **Marks:[3.00]**

Q.No.11: (i) Arrange the following electromagnetic radiation in the ascending order of their frequencies:

X-rays, microwaves, gamma rays, radio waves

(ii) Write two uses of any two of these radiation.

OR

With the help of a ray diagram explain the working of a reflecting telescope. Mention two advantages of a reflecting telescope over a refracting telescope.

Marks:[3.00]

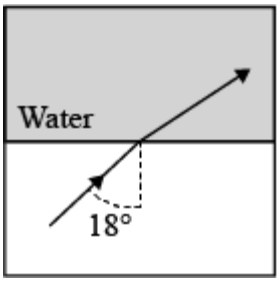
Section C

Q.No.12: A ray of light travels from a denser to a rarer medium. After refraction, it bends away from the normal. When we keep increasing the angle of incidence, the angle of refraction also increases till the refracted ray grazes along the interface of two media. The angle of incidence for which it happens is called critical angle. If the angle of incidence is increased further the ray will not emerge and it will be reflected back in the denser medium. This phenomenon is called total internal reflection of light.

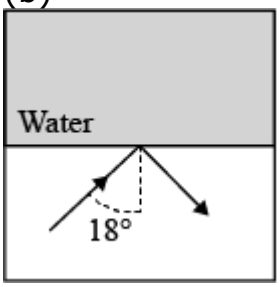
(i) A ray of light travels from a medium into water at an angle of incidence of 18°.

The refractive index of the medium is more than that of water and the critical angle for the interface between the two media is 20°. Which one of the following figures best represents the correct path of the ray of light?

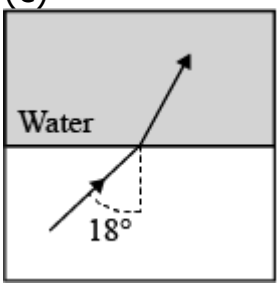
(a)



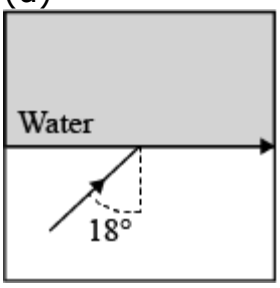
(b)



(c)



(d)



(ii) A point source of light is placed at the bottom of a tank filled with water, of refractive index μ, to a depth d. The area of the surface of water through which light from the source can emerge, is:

(a) $\frac{\pi d^2}{2(\mu^2-1)}$

(b) $\frac{\pi d^2}{(\mu^2-1)}$

(c) $\frac{\pi d^2}{\sqrt{2}\sqrt{\mu^2-1}}$

(d) $\frac{2\mu d^2}{(\mu^2-1)}$

(iii) For which of the following media, with respect to air, the value of critical angle is maximum?

(a) Crown glass

(b) Flint glass

(c) Water

(d) Diamond

(iv) The critical angle for a pair of two media A and B of refractive indices 2.0 and 1.0 respectively is:

(a) 0°
(b) 30°
(c) 45°
(d) 60°

(v) The critical angle of pair of a medium and air is 30°. The speed of light in the medium is:

(a) 1×10^8 ms^{-1}
(b) 1.5×10^8 ms^{-1}
(c) 2.2×10^8 ms^{-1}
(d) 2.8×10^8 ms^{-1}

Marks:[5.00]