CBSE EXAMINATION PAPER-2022

PHYSICS

(Solved)

Time allowed : 3 hours | Maximum Marks : 36

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **15 questions.** All questions are **compulsory.**

ii. This question paper is divided into **3 sections.**

iii. **Section A** – questions number **1 to 1** are case based questions

iv. **Section B** – questions number **2 to 5** are very short answer

v. **Section C** – questions number **6 to 15** are short answer

vi. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.

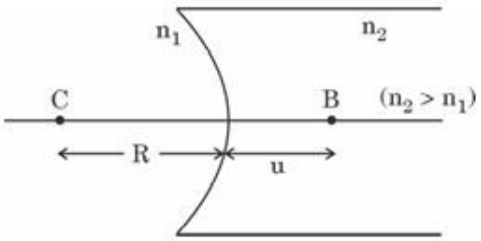
vii. Use of calculator is NOT allowed.

Section A

Question 1. Two transparent media of refractive indices n_1 and n_2 are separated by a spherical transparent surface. The rays of light incident on the surface get refracted into the medium on the other side. The laws of refraction are valid at each point of the spherical surface. A lens is a transparent optical medium bounded by two surfaces, at least one of which should be spherical. The focal length of a lens is determined by the radii of curvature (R_1 and R_2) of its two surfaces and the refractive index (n) of the medium of the lens with respect to the surrounding medium. Depending on R_1 and R_2, a lens behaves as a diverging or a converging lens. The ability of a lens to diverge or converge a beam of light incident on it defines its power.

(1)

An object is placed at the point B as shown in the figure. The object distance (u) and the image distance (v) are related as



(i) $\frac{1}{v} - \frac{1}{u} = \left(\frac{n_2 - n_1}{n_1}\right)\frac{1}{R}$

(ii) $\frac{1}{v} - \frac{1}{u} = \left(\frac{n_1 - n_2}{n_2}\right)\frac{1}{R}$

(iii) $\frac{n_2}{v} - \frac{n_1}{u} = \frac{(n_2 - n_1)}{R}$

(iv) $\frac{n_1}{v} - \frac{n_2}{u} = \frac{(n_1 - n_2)}{R}$

[1 Marks]

(2)

A point object is placed in air at a distance 'R' in front of a convex spherical refracting surface of radius of curvature R. If the medium on the other side of the surface is glass, then the image is : (i) real and formed in glass.

(ii) real and formed in air.

(iii) virtual and formed in glass.

(iv) virtual and formed in air.

[1 Marks]

(3)

An object is kept at 2F in front of an equiconvex lens. The image formed is :

(i) real and of the size of the object.

(ii) virtual and of the size of the object.

(iii) real and enlarged.

(iv) virtual and diminished.

[1 Marks]

(4)

A thin converging lens of focal length 10 cm and a thin diverging lens of focal length 20 cm are placed coaxially in contact. The power of the combination is :

(i) -5 D

(ii) + 5 D

(iii) + 15 D

(iv) -15 D

[1 Marks]

(5)

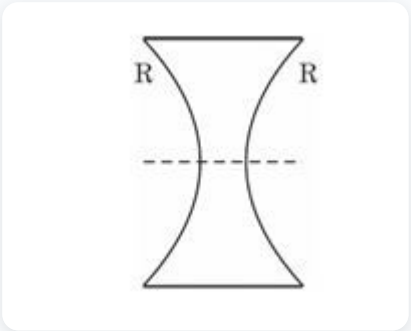
An equiconcave lens of focal length 'f' is cut into two identical parts along the dotted line as shown in the figure. The focal length of each part will be :

(i) f

(ii) f/4

(iii) f/2

(iv) 2f



[1 Marks]

Section B

Question 2.

What is meant by energy band gap in a solid? Draw the energy band diagrams for a conductor, an insulator and a semiconductor.

[2 Marks]

Question 3.

Name the spectral series for a hydrogen atom which lies in the visible region. Find the ratio of the maximum to the minimum wavelengths of this series.

[2 Marks]

Question 4. Name the device which converts electrical energy into light energy. Write three advantages of the device.

[2 Marks]

Question 5.

What are matter waves? A proton and an alpha particle are accelerated through the same potential difference. Find the ratio of the de Broglie wavelength associated with the proton to that with the alpha particle.

[2 Marks]

Section C

Question 6.

(a) Differentiate between nuclear fission and nuclear fusion.

(b) Deuterium undergoes fusion as per the reaction:

Find the duration for which an electric bulb of 500 W can be kept glowing by the fusion of 100 g of deuterium.

[3 Marks]

$$_{1}^{2}\mathrm{H} + {}_{1}^{2}\mathrm{H} \longrightarrow {}_{2}^{3}\mathrm{He} + {}_{0}^{1}\mathrm{n} + 3{\cdot}27\ \mathrm{MeV}$$

Question 7.

(a) The resistance of a p-n junction is low when it is forward biased and is high when it is reversed biased.

(b) Doping of intrinsic semiconductors is a necessity for making electronic devices.

(c) Photodiodes are operated in reverse bias.

[3 Marks]

Question 8.

(a) In Geiger-Marsden experiment, calculate the distance of closest approach for an alpha particle with energy 2.56×10^{-12} J. Consider that the particle approaches gold nucleus (Z = 79) in head-on position.

(b) If the above experiment is repeated with a proton of the same energy, then what will be the value of the distance of closest approach?

[3 Marks]

Question 9.

Briefly explain how bright and dark fringes are formed on the screen in Young's double slit experiment. Hence, derive the expression for the fringe width.

[3 Marks]

Question 10.

a) (i) Draw a labelled ray diagram showing the formation of the image at infinity by an astronomical telescope.

(ii) A telescope consists of an objective of focal length 150 cm and an eyepiece of focal length 6.0 cm. If the final image is formed at infinity, then calculate:

(I) the length of the tube in this adjustment, and

(II) the magnification produced.

[3 Marks]

Question 11.

(a) Use Einstein photoelectric equation to depict the variation of the maximum kinetic energy (E_k) of electrons emitted with the frequency (v) of the incident radiation.

(b) A photosensitive surface is illuminated with a beam of (i) yellow light, and (ii) red light, both of the same intensity. In which case will

(I) photoelectrons have more E_k?

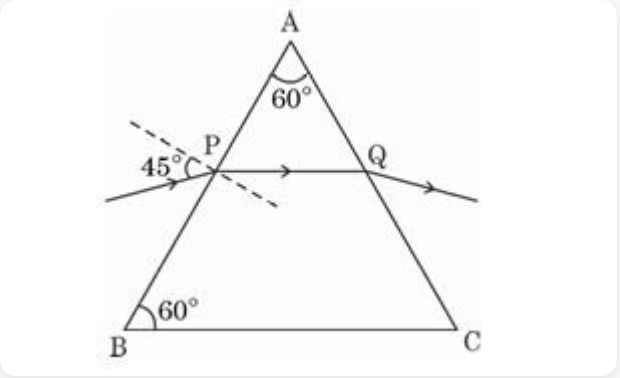
(II) more numbers of electrons be emitted?

Justify your answer in each case.

[3 Marks]

Question 12. A ray of light is incident on a prism at an angle of 45° and passes symmetrically as shown in the figure. Calculate the (a) angle of minimum deviation, (b) refractive index of the prism material, and (c) angle of refraction at point P.

[3 Marks]



Question 13.

(a) Identify electromagnetic waves which :

(i) are used in radar system.

(ii) affect a photographic plate.

(iii) are used in surgery.

Write their frequency range.

[3 Marks]

Question 14.

(i) Draw a labelled ray diagram showing the formation of the image at least distance of distinct vision by a compound microscope.

(ii) A small object is placed at a distance of 3.0 cm from a magnifier of focal length 4.0 cm.

Find:

(I) the position of the image formed, and

(II) the linear magnification produced.

[3 Marks]

Question 15.

(b) A plane wavefront is propagating from a rarer into a denser medium. Use Huygens principle to show the refracted wavefront and verify Snell's law.

[1 Marks]