UNIT-6 OPTICS

VERY SHORT ANSWER QUESTIONS (I Mark)

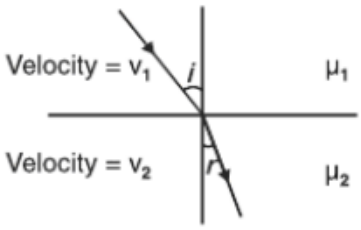
1. Write the value of angle of reflection for a ray of light falling normally on a mirror.

2. How does the dispersive power of glass prism change when it is dipped in water?

3. Light falls from glass to air. Find the angle of incidence for which the angle of deviation is 90°.

4. Name the phenomenon due to which one cannot see through fog.

5. What is the ratio of sin*i* and sin*r* in terms of velocities in the given figure.



6. What is the shape of fringes in young's double slit experiment?

7. A equiconcave lens of focal length 15 cm is cut into two equal halves along dotted line as shown in figure. What will be new focal length of each half.

8. For the same angle of the incidence the angle of refraction in three media A, B and C are 15°, 25° and 35° respectively. In which medium would the velocity of light be minimum?

9. What is the phase difference between two points on a cylindrical wave front?

10. What is the 'power' of plane glass plate.

11. Show with the help of diagram, why a beam of white light passing through a hollow prism does not give spectrum.

12. How does focal length of lens change when red light incident on it is replaced by violet light?

13. A myopic person prefers to remove his spectacles while reading a book. Why?

14. Lower half of the concave mirror is painted black. What effect will this have on the image of an object placed in front of the mirror?

Ans. : The intensity of the image will be reduced (in this case half) but no change in size of the image

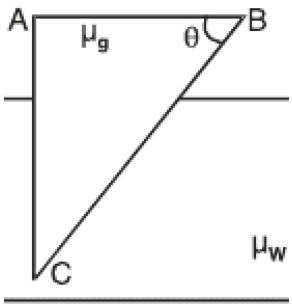
SHORT ANSWER QUESTIONS (2 Marks)

1. A near sighted person can clearly see objects up to a distance of 1.5m. Calculate power of the lens necessary for the remedy of this defect. (P = – 0.67D)

2. A person can adjust the power of his eye lens between 50D and 60D. His far point is infinity. Find the distance between retina and eye lens.

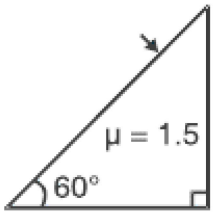
3 Calculate the value of θ, for which light incident normally on face AB grazes along the face BC.

$\mu_{glass} = 3/2$ $\mu_{water} = 4/3$



4. Name any two characteristics of light which do not change on polarisation.

5. Complete the path of light with correct value of angle of emergence.



6. Define diffraction. What should be the order of the size of the aperture to observe diffraction.

7. Show that maximum intensity in interference pattern is four times the intensity due to each slit if amplitude of light emerging from slits is same.

8. Two poles-one 4m high and the other is 4.5 m high are situated at distance 40m and 50m respectively from an eye. Which pole will appear taller?

9. S_1 and S_2 are two sources of light separated by a distance d. A detector can move along S_2P perpendicular to S_1S_2. What should be the minimum and maximum path difference at the detector?

10. If a jogger runs with constant speed towards a vehicle, how fast does the image of the jogger appear to move in the rear view mirror when

    (i) the vehicle is stationery

    (ii) the vehicle is moving with constant speed.

    Ans : The speed of the image of the jogger appears to increase substantially, though jogger is moving with constant speed.

    Similar phenomenon is observed when vehicle is in motion.

11. A person looking at a mesh of crossed wire is able to see the vertical wire more distinctly than the horizontal wire. Which defect he is suffering from? How can this defect be corrected?

12. Is optical density same as mass density? Give an example.

    Ans : Optical density is the ratio of the speed of light in two media whereas mass density e.g. mass per unit volume of a substance.

e.g. Mass density of turpentine oil in less than that of water but its optical density is higher.

13. When does (i) a plane mirror and (ii) a convex mirror produce real image of objects.

Ans : Plane and convex mirror produce real image when the object is virtual that is rays converging to a point behind the mirror are reflected to a point on a screen.

14. A virtual image cannot be caught on a screen. Then how do we see it?

Ans : The image is virtual when reflected or refracted rays divergent, these are converged on to the retina by convex lens of eye, as the virtual image serves as the object.

15. Draw a diagram to show the advance sunrise and delayed sunset due to atmospheric refraction. NCERT Pg 318

16. Define critical angle for total internal reflection. Obtain an expression for refractive index of the medium in terms of critical angle.

17. The image of a small bulb fixed on the wall of a room is to be obtained on the opposite wall 's' m away by means of a large convex lens. What is the maximum possible local length of the lens required.

Ans : For fixed distance 's' between object and screen, for the lens equation to give real solution for $u = v = 2f$, 'f' should not be greater than $4f = s$.

$$\therefore f = s/4$$

18. The angle subtended at the eye by an object is equal to the angle subtended at the eye by the virtual image produced by a magnifying glass. In what sense then does magnifying glass produce angular magnification?

Ans : The absolute image size is bigger than object size, the magnifier helps in bringing the object closer to the eye and hence it has larger angular size than the same object at 25 cm, thus angular magnification is achieved.

19. Obtain relation between focal length and radius of curvature of (i) concave mirror (ii) convex mirror using proper ray diagram.

20. Two independent light sources cannot act as coherent sources. Why?

21. How is a wave front different from a ray? Draw the geometrical shape of the wavefronts when.

    (i) light diverges from a point source,

    (ii) light emerges out of convex lens when a point source is placed at its focus.

22. What two main changes in diffraction pattern of single slit will you observe when the monochromatic source of light is replaced by a source of white light.

23. You are provided with four convex lenses of focal length 1cm, 3cm, 10cm and 100 cm. Which two would you prefer for a microscope and which two for a telescope.

24. Give reasons for the following

    (i) Sun looks reddish at sunset

    (ii) clouds are generally white

25. Using Huygens Principle draw ray diagram for the following

    (i) Refraction of a plane wave front incident on a rarer medium

    (ii) Refraction of a plane wave front incident on a denser medium.

SHORT ANSWER QUESTIONS (3 Marks)

1. Using mirror formula show that virtual image produced by a convex mirror is always smaller in size and is located between the focus and the pole.

2. Obtain the formula for combined focal length of two thin lenses in contact, taking one divergent and the other convergent.

3. Derive snell's law on the basis of Huygen's wave theory.

4. A microscope is focussed on a dot at the bottom of the beaker. Some oil is poured into the beaker to a height of '*b*' cm and it is found that microscope has to raise through vertical distance of 'a' cm to bring the dot again into focus. Express refractive index of oil is terms of a and b.

5. Define total internal reflection. State its two conditions. With a ray diagram show how does optical fibres transmit light.

6. A plane wave front is incident on (i) a prism (ii) A convex lens (iii) a concave mirror. Draw the emergent wavefront in each case.

7. Explain with reason, how the resolving power of a compound microscope will change when (i) frequency of the incident light on the objective lens is increased (ii) focal length of the objective lens is increased. (iii) asperture of objective lens is increased.

8. Derive Mirror formula for a concave mirror forming real Image.

9. Two narrow slits are illuminated by a single monochromatic sources.

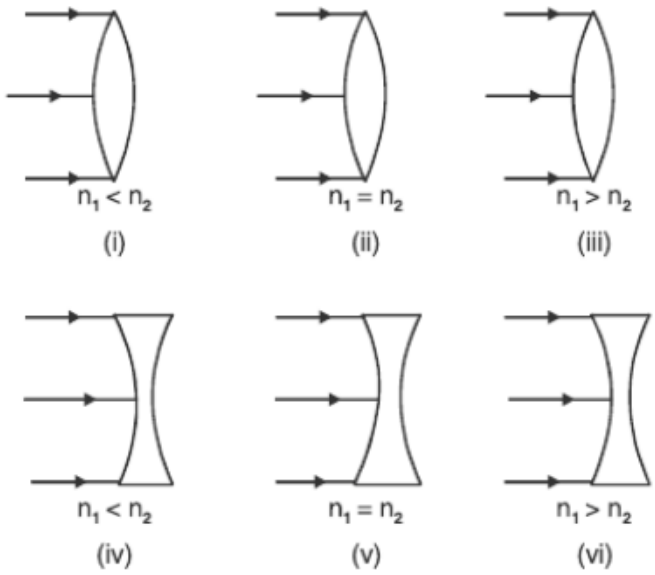
   (a) Draw the intensity pattern and name the phenomenon

   (b) One of the slits is now completely covered. Draw the intensity pattern now obtained and name the phenomenon.

10. Explain briefly (i) sparkling of diamond (ii) use of optical fibre in communication.

11. Using appropriate ray diagram obtain relation for refractive index of water in terms of real and apparent depth.

12. Complete the ray diagram in the following figure where, n_1, is refractive index of medium and n_2 is refractive index of material of lens.



LONG ANSWER QUESTIONS (5 MARKS)

1. With the help of ray diagram explain the phenomenon of total internal reflection. Obtain the relation between critical angle and refractive indices of two media. Draw ray diagram to show how right angled isosceles prism can be used to

   (i) Deviate the ray through 180°.

   (ii) Deviate the ray through 90°.

   (iii) Invert the ray.

2. Draw a labelled ray diagram of a compound microscope and explain its working. Derive an expression for its magnifying power.

3. Diagrammatically show the phenomenon of refraction through a prism. Define angle of deviation in this case. Hence for a small angle of incidence derive the relation $\delta = (\mu - 1) A$.

4. Name any three optical defects of eye. Show by ray diagram :

   (i) Myopic eye and corrected myopic eye.

   (ii) Hypermetropic eye and corrected hypermetropic eye.

5. Define diffraction. Deduce an expression for fringe width of the central maxima of the diffraction pattern, produced by single slit illuminated with monochromatic light source.

6. What is polarisation? How can we detect polarised light? State Brewster's Law and deduce the expression for polarising angle.

7. Derive lens maker formula for a thin converging lens.

8. Derive lens formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ for

   (a) a convex lens,

   (b) a concave lens

9. Describe an astronomical telescope and derive an expression for its magnifying power using a labelled ray diagram.

10. Draw a graph to show the angle of deviation with the angle of incidence i for a monochromatic ray of light passing through a prisin of refracting angle A. Deduce the relation

$$\mu = \frac{\sin(A + \delta_m)/2}{\sin A/2}$$

11. State the condition under which the phenomenon of diffraction of light takes place. Derive an expression for the width of the central maximum due to diffraction of light at a single slit. Also draw the intensity pattern with angular position.