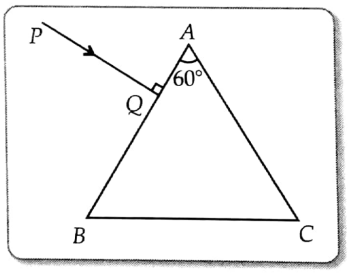
C→922. A biconvex lens made of a transparent material of refractive index 1.25 is immersed in water of refractive index
R.O. 1.33. Will the lens behave as a converging or a diverging lens? Justify your answer. $\frac{1}{f} = \left(\frac{\mu_m}{\mu_l} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)^2$

(b) A ray PQ is incident normally on the face AB of a 5 triangular prism of refracting angle 60° as shown in figure. The prism is made of a transparent material of refractive index $\frac{2}{\sqrt{3}}$. Trace the path of the ray as it passes through the prism. Calculate the angle of emergence and the angle of deviation. 5



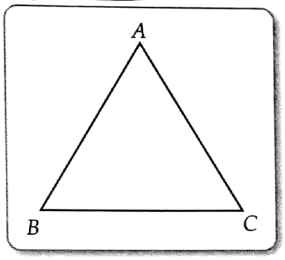
points of difference between an interference pattern and a diffraction pattern.

(b) (i) A ray of light incident on face AB of an equilateral glass prism, shows minimum deviation of 30°. Calculate the speed of light through the prism.

$_aμ_p = \frac{c}{v}$

$v = \frac{c}{\mu}$

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



$e = \delta = 90°$

(ii) Find the angle of incidence at face AB so that the emergent ray grazes along the face AC.

$\mu = \frac{1}{\sin i_c} \Rightarrow \sqrt{2} = \frac{1}{\sin i_c}$

$\sin i_c = \frac{1}{\sqrt{2}}$

$i_c = 45°$

Section – E

34. **Read the following paragraph and answer the questions.**

A number of optical devices and instruments have been designed and developed such as periscope, binoculars, microscopes and telescopes utilising the reflecting and refracting properties of mirrors, lenses and prisms. Most of them are in common use. Our knowledge about the formation of images by the mirrors and lenses is the basic requirement for understanding the working of these devices.

(i) Why the image formed at infinity is often considered most suitable for viewing. Explain 1

(ii) In modern microscopes multi-component lenses are used for both the objective and the eyepiece. Why? 1

(iii) Write two points of difference between a compound microscope and an astronomical telescope 2

OR

Write two distinct advantages of a reflecting type telescope over a refracting type telescope. 2

3. The radius of curvature of the curved surface of a plano-convex lens is 20 cm. If the refractive index of the material of the lens be 1.5, it will:

(A) act as a convex lens only for the objects that lie on its curved side.

(B) act as a concave lens for the objects that lie on its curved side.

(C) act as a convex lens irrespective of the side on which the object lies.

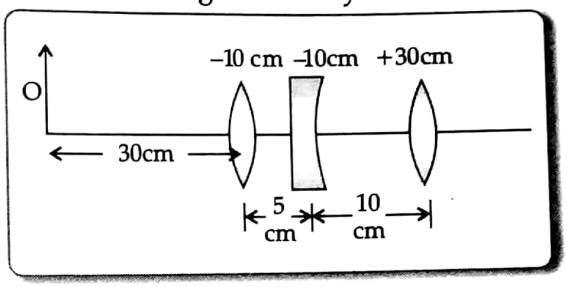
(D) act as a concave lens irrespective of side on which the object lies. **1**

5

OR

(a) Under what conditions is the phenomenon of total internal reflection of light observed? Obtain the relation between the critical angle of incidence and the refractive index of the medium.

(b) Three lenses of focal lengths + 10 cm, – 10 cm and + 30 cm are arranged coaxially as in the figure given below. Find the position of the final image formed by the combination.



plates of a parallel plate capacitor

C→9 **1.** For which position of object does a concave mirror always forms a **virtual and erect image?**

R.O

(A) Between centre of curvature and focus

(B) Beyond centre of curvature

(C) Between pole and focus

(D) At centre of curvature

C→g R.O.

13. A short pulse of white light is incident from air to a glass slab at normal incidence. After travelling through the slab, the first color to emerge is:

(A) blue
(B) green
(C) violet
(D) red

21. A small bulb (assumed to be a point source) is placed at the bottom of a tank containing water to a depth of 80 cm. Find out the area of the surface of water through which light from the bulb can emerge. Take the value of the refractive index of water to be $\frac{4}{3}$. **2**

OR

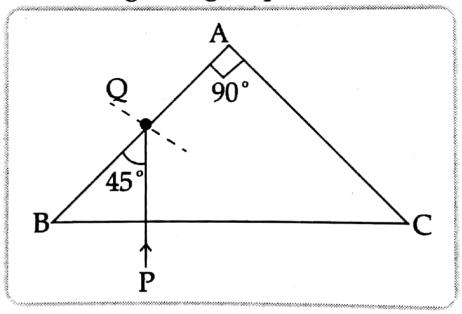
Calculate the radius of curvature of an equi-concave lens of refractive index 1.5, when it is kept in a medium of refractive index 1.4, have a power of –5D.

29. A triangular prism of refracting angle 60° is made of a transparent material of refractive index $\frac{2}{\sqrt{3}}$. A ray of light is incident normally on the face KL as shown in the figure. Trace the path of the ray as it passes through the prism and calculate the angle of emergence and angle of deviation.

OR

(a) Draw the ray diagram showing refraction of ray of light through a glass prism. Derive the expression for the refractive index μ of the material of prism in terms of the angle of prism A and angle of minimum deviation δ_m.

(b) A ray of light PQ enters an isosceles right-angled prism ABC of refractive index 1.5 as shown in figure.



(i) Trace the path of the ray through the prism.

(ii) What will be the effect on the path of the ray if the refractive index of the prism is 1.4 ?

C→9 R.O.

3. Magnifying power of a microscope depends on:

(A) colour of light.

(B) focal length of objective and colour of light.

(C) focal length of eyepiece and colour of light.

(D) focal length of eyepiece and objective.

11. Between the primary and secondary rainbows, there is a dark band known as Alexander's dark band. This is because:

(A) light compacted into this region interfere destructively.

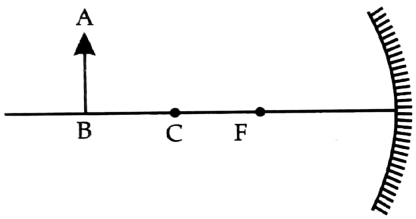
(B) there is no light scattered into this region.

(C) light is absorbed in this region.

(D) angle made at the eye by the scattered rays with respect to the incident light of the sun lies between approximately 42° and 50°. **1**

current I in an opposite sense. A simple amperian loop passes

22. An object AB is kept in front of a concave mirror as shown in the figure:



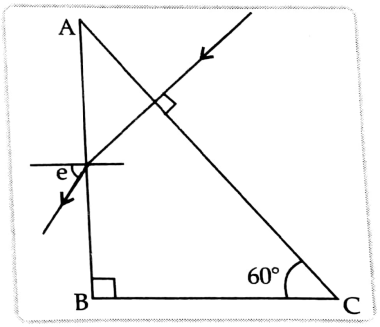
(a) Complete the ray diagram showing the image formation of the object.

(b) How will the position and intensity of the image be affected if the lower half of the mirror's reflecting surface is painted black ? **2**

OR

C→9 **(a)** Define the term 'focal length of a mirror. Give the relation between focal length and radius of curvature.

(b) Calculate the angle of emergence (e) of the ray of light incident normally on the face AC of a glass prism ABC of refractive index $\sqrt{3}$. How will the angle of emergence change qualitatively, if the ray of light emerges from the prism into a liquid of refractive index 1.3 instead of air ? A1



10. The radius of curvature of the curved surface of a plano-convex lens is 20 cm. If the refractive index of the material of the lens be 1.5, it will

(A) act as a convex lens only for the objects that lie on its curved side.

(B) act as a concave lens for the objects that lie on its curved side.

(C) act as a convex lens irrespective of the side on which the object lies.

(D) act as a concave lens irrespective of side on which the object lies. 1

11. The penetration of light into the region of geometrical shadow is known as:

(A) interference of light.

(B) diffraction of light.

(C) refraction of light.

(D) polarisation of light. 1

12. A magnifying glass is used, as the object to be viewed can be brought closer to the eye than the normal near point. This results in:

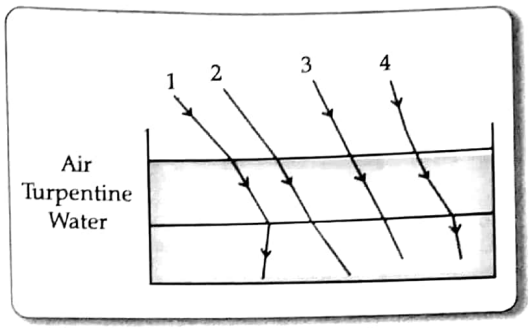
(A) a larger angle to be subtended by the object at the eye and hence, viewed in greater detail.

(B) the formation of a virtual and diminished image.

(C) increase in the field of view.

(D) infinite magnification at the near point.

14. 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 is correct?



(A) 1 (B) 2
(C) 3 (D) 4 **1**

15. A short pulse of white light is incident from air to a glass slab at normal incidence.

After travelling through the slab, the first colour to emerge is

(A) blue. (B) green.
(C) violet. (D) orange **1**

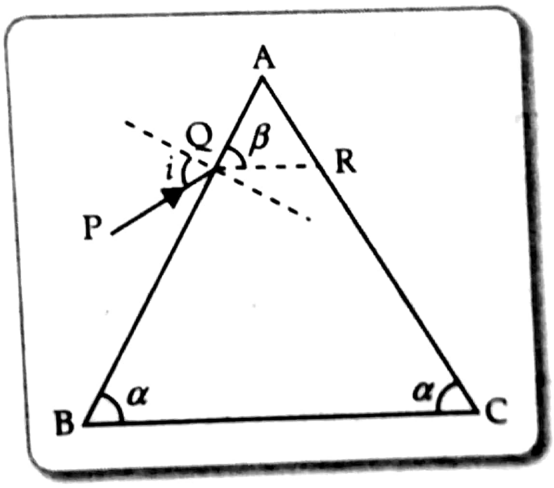
Assertion and Reason:

24. **(a)** Why does white light disperse when passed through a glass prism?

C→9

(b) Using lens maker's formula, show how the focal length of a given lens depends upon the colour of light incident on it. 2

29. A ray of light incident on the face AB of an isosceles triangular prism makes an angle of incidence (i) and deviates by angle β as shown in the figure. Show that in the position of minimum deviation $\angle\beta = \angle\alpha$. Also, find out the condition when the refracted ray QR suffers total internal reflection. 3



(C) 2.5 (D) None of these

C→9 **3.** An astronomical refractive telescope has an objective of focal length 20 m and an eyepiece of focal length 2 cm.

(A) The length of the telescope tube is 20.02 m.

(B) The magnification is 2000.

(C) The image formed is real.

(D) An objective of a larger aperture will increase the brightness and reduce chromatic aberration of the image.

AD 1

(D) electron can be emitted with energy, with a maximum of E_0.

13. **Radius of curvature of human eye is 0.78 cm. For an object at infinity, image is formed at 3 cm behind the refracting surface. The refractive index of eye is:**

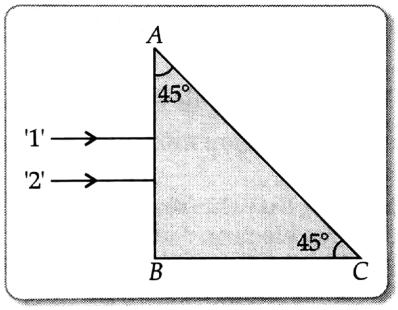
(A) 1.35 **(B)** 3

(C) 6.2 **(D)** 1

1

24. Two monochromatic rays of light are incident normally on the face AB of an isosceles right-angled prism ABC. The refractive indices of the glass prism for the two rays '1' and '2' are respectively 1.35 and 1.45. Trace the path of these rays after entering through the prism. **AI 2**

C→9



OR

An equilateral glass prism has a refractive index 1.6 in air. Calculate the angle of minimum deviation of the prism, when kept in a medium of refractive index $\frac{4\sqrt{2}}{5}$. **AI**

OR

C→9 A 4.5 cm needle is placed 12 cm away from a convex mirror of focal length 15 cm. Give the location of the image and the magnification. Describe what happens as the needle is moved farther from the mirror.

Section – E

15. A short pulse of white light is incident from air to a glass slab at normal incidence. After travelling through the slab, the last colour to emerge is

C→9

(A) blue.

(B) green.

(C) violet.

(D) red.

ASSERTION AND REASON

C→9 **17.** **Assertion (A):** If the objective lens and the eyepiece lens of a microscope are interchanged, it works as a telescope.

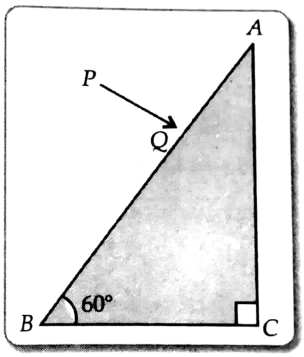
Reason (R): Objective lens of telescope require large focal length and eyepiece lens require small focal length. 1

18. Assertion (A): Kinetic energy of photoelectrons emitted by a photosensitive surface depends upon the intensity

$(I_1 < I_2)$.

potential for a radiation of frequency ν and intensities I_1 and I_2

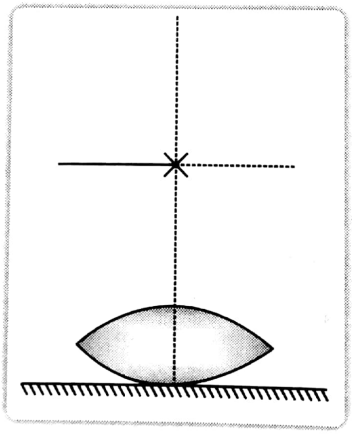
24. A ray PQ incident normally on the refracting face BA is refracted in the prism BAC made of material of refractive index 1.5. Complete the path of ray through the prism. From which face will the ray emerge? Justify your answer. **2**



OR

A beam of light converges at a point P. Draw ray diagrams to show where the beam will converge if **(i)** a convex lens, and **(ii)** a concave lens is kept in the path of the beam.

28. A symmetric biconvex lens of radius of curvature R and made of glass of refractive index 1.5, is placed on a layer of liquid placed on top of a plane mirror as shown in the figure. An optical needle with its tip on the principal axis of the lens is moved along the axis until its real, inverted image coincides with the needle itself. The distance of the needle from the lens is measured to be x. On removing the liquid layer and repeating the experiment, the distance is found to be y. Obtain the expression for the refractive index of the liquid in terms of x and y. AI 3



OR

(a) Define a wavefront.

(b) In a single slit diffraction experiment, the width of the slit is made double [illegible]

11. 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) $A + \frac{\delta}{2}$

(D) $2A + \delta_m = i$

1

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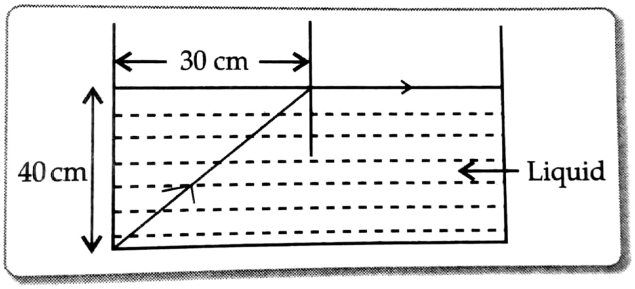
19. Draw the ray diagram of an astronomical telescope showing image formation in the normal adjustment position. Write the expression for its magnifying power. 2

24. **(i)** Define refractive index of a medium.

→ 9 **(ii)** In the following ray diagram, calculate the speed of light in the liquid of unknown refractive index.

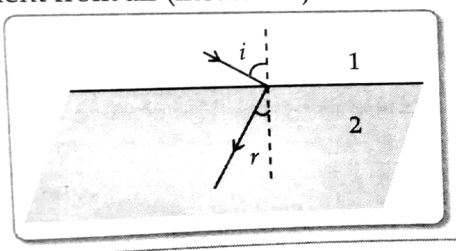


C→9 **(a)** Draw a labelled schematic ray diagram of astronomical telescope in normal adjustment.

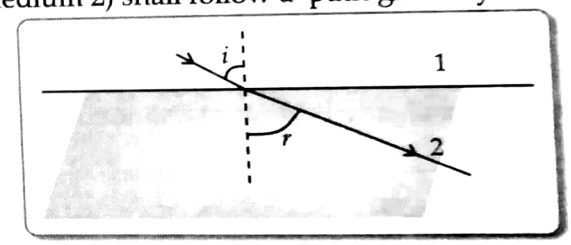
(b) Which two aberrations do objectives of refracting telescope suffer from? How are these overcome in reflecting telescope?

2. There are certain materials developed in laboratories which have a negative refractive index (figure). A ray C→9 incident from air (medium 1) into such a medium (medium 2) shall follow a path given by:

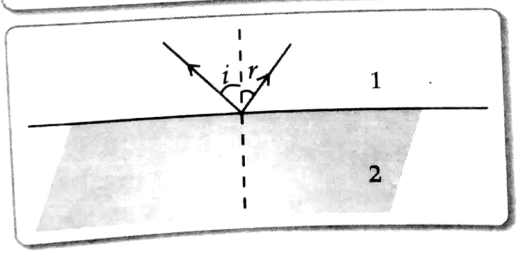
(A)



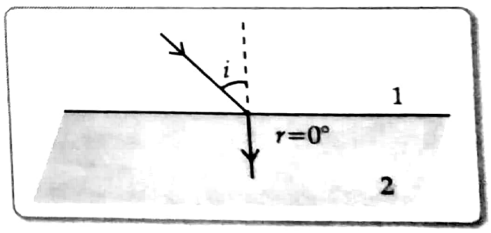
(B)



(C)



(D)



1

C→9 **12.** _____ mirror has real focus.

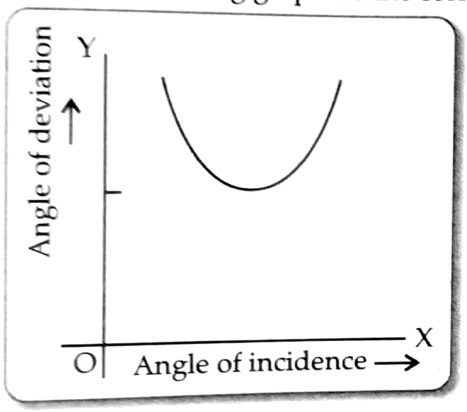
(A) Concave
(B) Convex
(C) Plane
(D) All of these

1

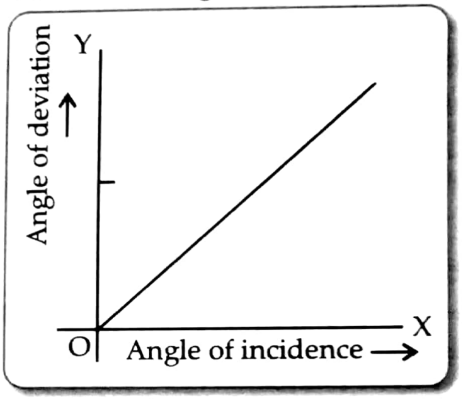
13. Which of the following graphs is the correct angle of incidence vs. angle of deviation graph?

C→9

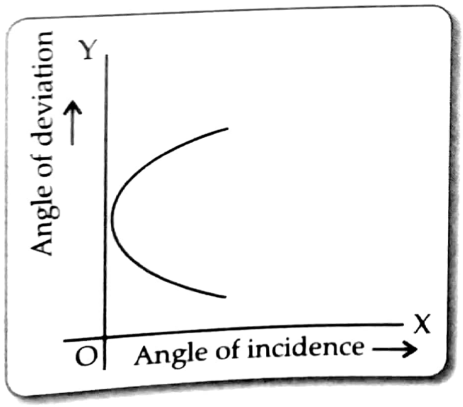
(A)



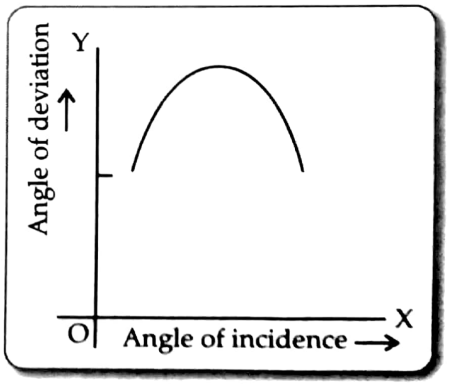
(B)



(C)



(D)



1

C→9 **18.** **Assertion (A):** It is helpful for a dentist to use a concave mirror instead of a plane mirror.

Reason (R): Dentist places the teeth of the patient in between the pole and the focus of the mirror so as to get a virtual, magnified and erect image of teeth for better diagnosis. **1**

C→g **24.** A concave (or convex mirror) is held under liquid having refractive index more than air and mirror. Will its focal length change? 2

C→9 Define the term, "refractive index" of a medium. Verify Snell's law of refraction when a plane wavefront is propagating from a denser to a rarer medium.

same frequency.

32. **(a)** Draw a ray diagram to show the image formation by a combination of two thin convex lenses in contact. Obtain the expression for the power of this combination in terms of the focal lengths of the lenses.

(b) A ray of light passing from air through an equilateral glass prism undergoes minimum deviation when the angle of incidence is $\frac{3}{4}^{th}$ of the angle of prism. Calculate the speed of light in the prism. **5**

OR

C→9 **(a)** Draw a labelled ray diagram showing the image formation of a distant object by a refracting telescope. Deduce the expression for its magnifying power when the final image is formed at infinity.

(b) The sum of focal lengths of the two lenses of a refracting telescope is 105 cm. The focal length of one lens is 20 times that of the other. Determine the total magnification of the telescope when the final image is formed at infinity.

(C) $E_r = -E_0 r \cos(kz+\omega t)$ (D) $E_r = E_0 r \sin(kz-\omega t)$

10. The direction of ray of light incident on a concave mirror is shown by PQ while directions in which the ray would travel after reflection is shown by four rays marked 1, 2, 3 and 4 (figure). Which of the four rays correctly shows the direction of reflected ray:

11. If m_1 and m_2 be the linear magnifications of the objective and eyepiece of a compound microscope, then the magnifying power of the compound microscope is:

C->9

(A) $m_1 + m_2$ **(B)** $m_1 - m_2$

(C) $m_1 \times m_2$ **(D)** $(m_1+m_2)/2$

1

21. (a) A concave (or convex mirror) is held under water. Will its focal length change?

C→9 (b) What will happen in case of concave (or convex lens)?

1

OR

29. An optical instrument uses an objective lens of power 100 D and an eyepiece of power 40 D. The final image is formed at infinity when the tube length of the instrument is kept at 20 cm.

C→9

(a) Identify the optical instrument.

(b) Calculate the angular magnification produced by the instrument.