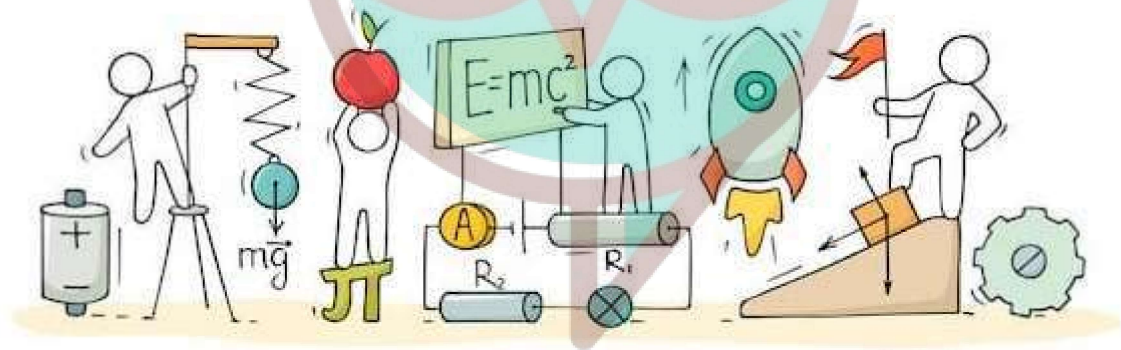


PHYSICS



Swotters

Important Questions

Multiple Choice questions-

- For a total internal reflection, which of the following is correct?
 - Light travels from rarer to denser medium.
 - Light travels from denser to rarer medium.
 - Light travels in air only.
 - Light travels in water only.
- Critical angle of glass is θ_1 and that of water is θ_2 . The critical angle for water and glass surface would be ($\mu_g = 3/2$, $\mu_w = 4/3$).
 - less than θ_2
 - between θ_1 and θ_2
 - greater than θ_2
 - less than θ_1
- Mirage is a phenomenon due to
 - refraction of light
 - reflection of light
 - total internal reflection of light
 - diffraction of light.
- A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then its focal length will
 - become zero
 - become infinite
 - become small, but non-zero
 - remain unchanged
- Which of the following forms a virtual and erect image for all positions of the object?
 - Concave lens
 - Concave mirror
 - Convex mirror
 - Both (a) and (c)
- Two lenses of focal lengths 20 cm and -40 cm are held in contact. The image of an object at infinity will be formed by the combination at
 - 10 cm
 - 20 cm
 - 40 cm
 - infinity

7. Two beams of red and violet color are made to pass separately through a prism (angle of the prism is 60°). In the position of minimum deviation, the angle of refraction will be
- 30° for both the colors
 - greater for the violet color
 - greater for the red color
 - equal but not 30° for both the colors
8. Which of the following colours of white light deviated most when passes through a prism?
- Red light
 - Violet light
 - Yellow light
 - Both (a) and (b)
9. An under-water swimmer cannot see very clearly even in absolutely clear water because of
- absorption of light in water
 - scattering of light in water
 - reduction of speed of light in water
 - change in the focal length of eye lens
10. An astronomical refractive telescope has an objective of focal length 20 m and an eyepiece of focal length 2 cm. Then
- the magnification is 1000
 - the length of the telescope tube is 20.02 m
 - the image formed of inverted
 - all of these

Very Short:

- When light undergoes refraction at the surface of separation of two media, what happens to its frequency/wavelength?
- Define the refractive index.
- What is the distance between the objective and eyepiece of an astronomical telescope in its normal adjustment?
- Name the phenomenon responsible for the reddish appearance of the sun at sunrise and sunset.
- What are the two main considerations that have to be kept in mind while designing the 'objective' of an astronomical telescope?
- Under what condition does a biconvex lens of glass having a certain refractive index act as a plane glass sheet when immersed in a liquid? (CBSE Delhi 2012)
- Write the relationship between the angle of incidence 'i', angle of prism 'A' and angle of minimum deviation for a triangular prism. (CBSE Delhi 2013)

8. Why can't we see clearly through the fog? Name the phenomenon responsible for it. (CBSE AI 2016)
9. How does the angle of minimum deviation of a glass prism vary if the incident violet light is replaced by red light? Give reason. (CBSE AI 2017)
10. The objective lenses of two telescopes have the same apertures but their focal lengths are in the ratio 1: 2. Compare the resolving powers of the two telescopes. (CBSE AI 2017C)

Short Questions:

1. The aperture of the objective lens of an astronomical telescope is doubled. How does it affect
 - (i) the resolving power of the telescope and
 - (ii) the intensity of the image? (CBSE Sample Paper 2018-19)
2. How does the resolving power of a compound microscope change on (a) decreasing the wavelength of light used, and (b) decreasing the diameter of the objective lens?
3. The layered lens shown in the figure is made of two kinds of glass. How many and what kinds of images will be produced by this lens with a point source placed on the optic axis? Neglect the reflection of light at the boundaries between the layers.
4. Monochromatic light is refracted from air into a glass of refractive index n . Find the ratio of wavelengths of the incident and refracted light.
5. Draw a labelled ray diagram to show the image formation in a compound microscope.
6. A ray of light while travelling from a denser to a rarer medium undergoes total internal reflection. Derive the expression for the critical angle in terms of the speed of light in the two media.
7. Draw a labelled diagram for a refracting type astronomical telescope. How will its magnifying power be affected by increasing for its eyepiece (a) the focal length and (b) the aperture? Justify your answer. Write two drawbacks of refracting type telescopes. (CBSE Sample Paper 2018-19)
8. Draw a labelled ray diagram of a Newtonian type reflecting telescope. Write any one advantage over refracting type telescope.

Long Questions:

1. Draw a labelled ray diagram to show the image formation in a refracting type of astronomical telescope. Obtain an expression for the angular magnifying power and the length of the tube of an astronomical telescope in its 'normal adjustment' position. Why should the diameter of the objective of a telescope be large?
2. Draw a ray diagram to show the formation of an erect image of an object kept in front of a concave mirror. Hence deduce the mirror formula. (CBSE 2019C)

Assertion and Reason Questions:

1. Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- Both A and R are true and R is the correct explanation of A.
- Both A and R are true but R is not the correct explanation of A.
- A is true but R is false.
- A is false and R is also false.

Assertion: If optical density of a substance is more than that of water, then the mass density of substance can be less than water.

Reason: Optical density and mass density are not related.

2. Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

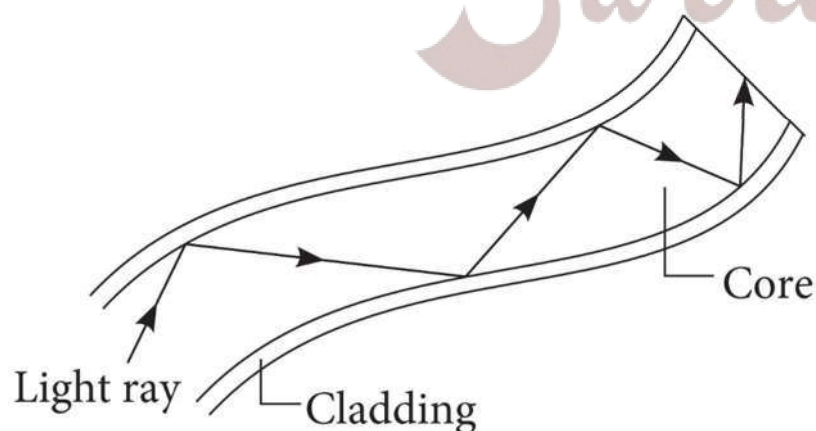
- Both A and R are true and R is the correct explanation of A.
- Both A and R are true but R is not the correct explanation of A.
- A is true but R is false.
- A is false and R is also false.

Assertion: A single lens produces a coloured image of an object illuminated by white light.

Reason: The refractive index of the material of lens is different for different wavelengths of light.

Case Study Questions:

1. An optical fibre is a thin tube of transparent material that allows light to pass through, without being refracted into the air or another external medium. It make use of total internal reflection. These fibres are fabricated in such a way that light reflected at one side of the inner surface strikes the other at an angle larger than critical angle. Even, if fibre is bent, light can easily travel along the length.



- Which of the following is based on the phenomenon of total internal reflection of light?
 - Sparkling of diamond.

- b. Optical fibre communication.
- c. Instrument used by doctors for endoscopy.
- d. All of these.

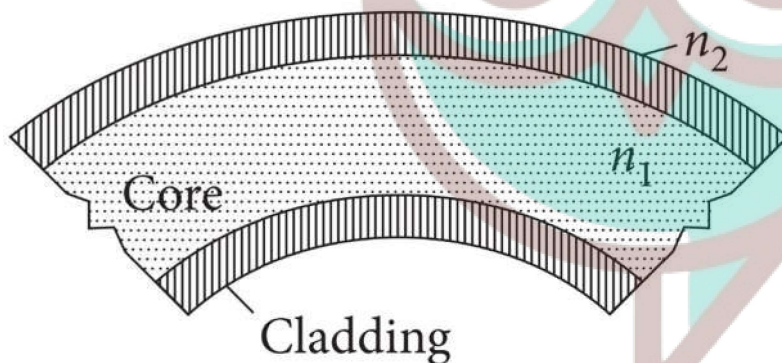
(ii) A ray of light will undergo total internal reflection inside the optical fibre, if it.

- a. Goes from rarer medium to denser medium.
- b. Is incident at an angle less than the critical angle.
- c. Strikes the interface normally.
- d. Is incident at an angle greater than the critical angle.

(iii) If in core, angle of incidence is equal to critical angle, then angle of refraction will be.

- a. 0°
- b. 45°
- c. 90°
- d. 180°

(iv) In an optical fibre (shown), correct relation for refractive indices of core and cladding is:



- a. $n_1 = n_2$
- b. $n_1 > n_2$
- c. $n_1 < n_2$
- d. $n_1 + n_2 = 2$

(v) If the value of critical angle is 30° for total internal reflection from given optical fibre, then speed of light in that fibre is:

- a. $3 \times 10^8 \text{ms}^{-1}$
- b. $1.5 \times 10^8 \text{ms}^{-1}$
- c. $6 \times 10^8 \text{ms}^{-1}$
- d. $4.5 \times 10^8 \text{ms}^{-1}$

2. An astronomical telescope is an optical instrument which is used for observing distinct images of heavenly bodies like stars, planets etc. It consists of two lenses. In normal adjustment of telescope, the final image is formed at infinity. Magnifying power of an astronomical telescope in normal adjustment is defined as the ratio of the angle subtended at the eye by the angle subtended at the eye by the final image to the angle subtended at the eye, by the object directly, when the final image and the object both lie at infinite distance from the

eye. It is given by, $m = \frac{f_0}{f_g}$. To increase magnifying power of an astronomical telescope in normal adjustment, focal length of objective lens should be large and focal length of eye lens should be small.

- (i) An astronomical telescope of magnifying power 7 consists of the two thin lenses 40cm apart, in normal adjustment. The focal lengths of the lenses are
- 5cm, 35cm
 - 7cm, 35cm
 - 17cm, 35cm
 - 5cm, 30cm
- (ii) An astronomical telescope has a magnifying power of 10. In normal adjustment, distance between the objective and eye piece is 22cm. The focal length of objective lens is:
- 25cm
 - 10cm
 - 15cm
 - 20cm
- (iii) In astronomical telescope compare to eye piece, objective lens has:
- Negative focal length.
 - Zero focal length.
 - Small focal length.
 - Large focal length.
- (iv) To see stars, use:
- Simple microscope.
 - Compound microscope.
 - Endoscope.
 - Astronomical telescope.
- (v) For large magnifying power of astronomical telescope.
- $f_0 \ll f_e$
 - $f_0 \ll f_e$
 - $f_0 \ll f_e$
 - None of these.

✓ Answer Key:

Multiple Choice Answers-

1. Answer: b
2. Answer: c
3. Answer: c
4. Answer: b
5. Answer: d
6. Answer: c
7. Answer: a
8. Answer: b
9. Answer: d
10. Answer: d

Very Short Answers:

1. Answer: There is no change in its frequency, but its wavelength changes.
2. Answer: The Refractive index of a medium is defined as the ratio of the speed of light in a vacuum to the speed of light in the given medium.
3. Answer: Distance between objective and eyepiece of telescope = $f_o + f_e$
4. Answer: Atmospheric refraction.
5. Answer: Two main considerations are
 - Large light gathering power
 - Higher resolution (or resolving power)
6. Answer: When the refractive index of the liquid is equal to the refractive index of a glass of which the lens is made.
7. Answer: $2i = A + \delta_m$
8. Answer: Because it scatters light. Scattering of light.
9. Answer: It decreases as $\delta_m \propto \frac{1}{\lambda}$
10. Answer: Same as resolving power does not depend upon the focal length of lenses.

Short Questions Answers:

1. Answer:

The resolving power of a telescope is given by the expression $\frac{D}{1.22\lambda}$.

(i) When the aperture of the objective lens is increased, the resolving power of the telescope increases in the same ratio.

(ii) The intensity of the image is given by the expression $\beta \propto D^2$, thus when the aperture is doubled, the intensity of the image becomes four times.

2. Answer:

The resolving power of a microscope is given by the expression $RP = \frac{2n \sin \theta}{\lambda}$

(a) If the wavelength of the incident light is decreased, the resolving power of the microscope increases.

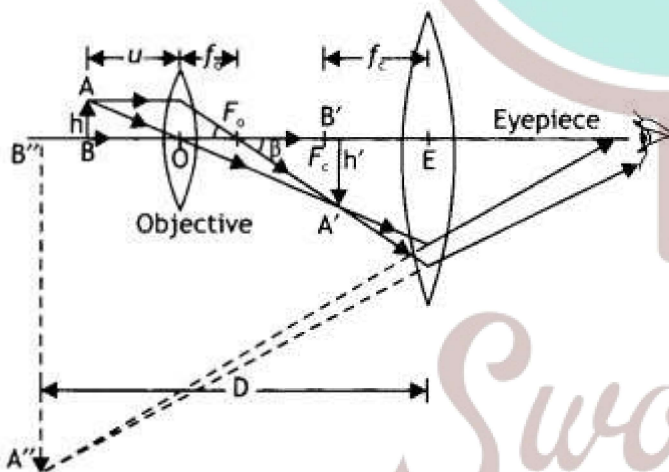
(b) There is no effect of the decrease in the diameter of the objective on the resolving power of the microscope.

3. Answer: Two images will be formed as the lens may be thought of, as two separate lenses of different focal lengths. The images will be surrounded by bright halos.

4. Answer: Using the relation $\lambda_1 n_1 = \lambda_2 n_2$ we have

$$\frac{\lambda_1}{\lambda_2} = n$$

5. Answer: The labelled diagram is as shown.



6. Answer:

Snell's law can be used to find the critical angle. Now Snell's law, when the ray moves from denser medium 'b' to rarer medium 'a', is given by

$${}_b n_a = \frac{\sin i_c}{\sin 90^\circ} \quad \dots(1)$$

$$\text{But } {}_a n_b = \frac{1}{{}_b n_a}$$

Therefore, the above equation can be

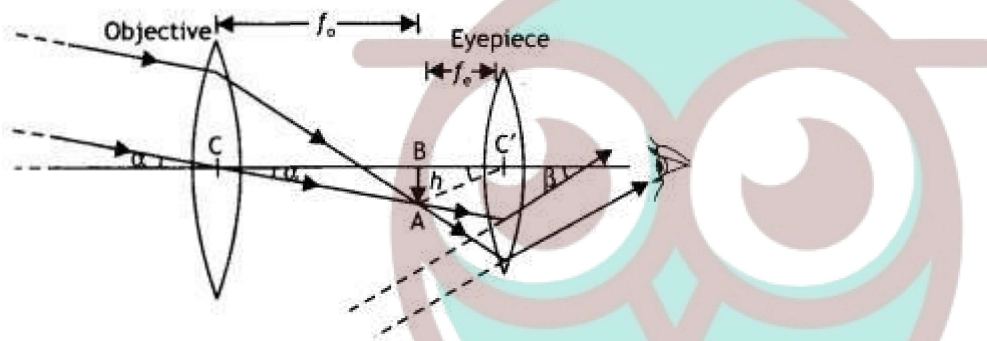
$$\text{written as } \frac{1}{{}_a n_b} = \frac{\sin i_c}{\sin 90^\circ} \quad \dots(2)$$

$${}_a n_b = \frac{1}{\sin i_c} \quad \dots(3)$$

Now we know that $n = \frac{c}{v}$, substituting in the above relation we have

$$\frac{c}{v} = \frac{1}{\sin i_c} \text{ or } \sin i_c = \frac{v}{c}$$

7. Answer: The labelled diagram of the telescope is as shown in the figure.



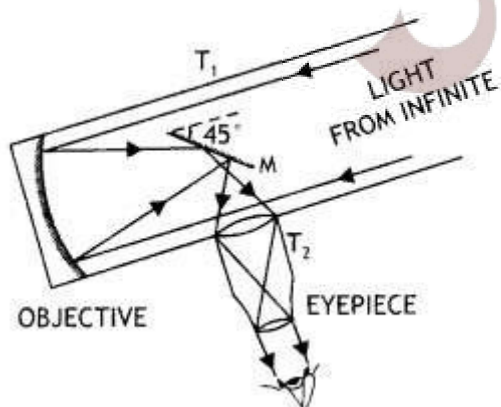
(a) The magnifying power of a telescope is given by $M = \frac{f_o}{f_e}$. If the focal length of the eyepiece is increased, it will decrease the magnifying power of the telescope.

(b) Magnifying power does not depend upon the aperture of the eyepiece. Therefore, there is no change in the magnifying power if the aperture of the eyepiece is increased.

Drawbacks:

- Large-sized lenses are heavy and difficult to support.
- Large-sized lenses suffer from chromatic and spherical aberration.

8. Answer: The labelled diagram is shown below.

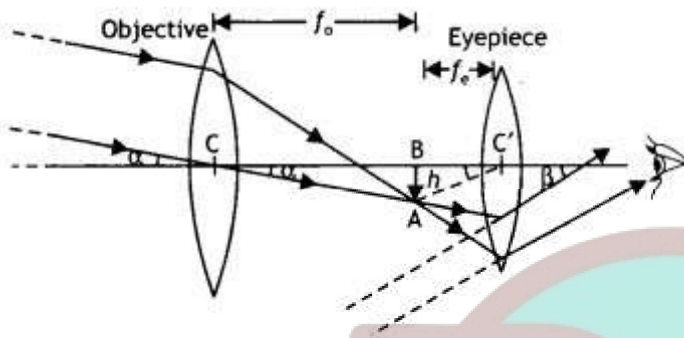


Due to the large aperture of the mirror as compared to a lens the image formed is much brighter than that formed by a refracting type of telescope.

Long Questions Answers:

1. Answer:

A labelled diagram of the telescope is shown in the figure.



The object subtends an angle at the objective and would subtend essentially the same angle at the unaided eye. Also, since the observer's eye is placed just to the right of the focal point f'_2 , the angle subtended at the eye by the final image is very nearly equal to the angle β .

$$\text{Therefore, } M = \frac{\beta}{\alpha} = \frac{\tan \beta}{\tan \alpha} \dots (1)$$

From right triangles ABC and ABC' as shown in figure, we have

$$\tan \alpha = \frac{AB}{CB} = \frac{-h}{f_o} \text{ and}$$

$$\tan \beta = \frac{AB}{C'A} = \frac{-h}{f_e}$$

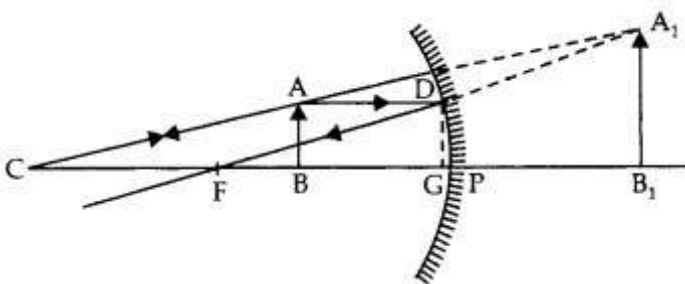
substituting the above two equations in equation (1), we have

$$M = \frac{\beta}{\alpha} = \frac{-h'}{f_e} \times \frac{f_o}{-h'} = \frac{f_o}{f_e}$$

The length of the telescope is the distance between the two lenses which is $L = f_o + f_e$. The diameter of the objective of a telescope should be large so that it can collect more light and image of distant objects is formed clear.

2. Answer:

An object AB is placed between P and F. The course of rays for obtaining erect image A₁B₁ of object AB is shown in the figure.



Draw $DG \perp$ on the principal axis.

Triangles DGF and A_1B_1C are similar

$$\therefore \frac{DG}{A_1B_1} = \frac{GF}{FB_1}$$

$$\text{or } \frac{AB}{A_1B_1} = \frac{GF}{FB_1} \quad [\because DG = AB] \quad \dots(i)$$

Again triangles ABC and A_1B_1C are similar

$$\therefore \frac{AB}{A_1B_1} = \frac{CB}{CB_1} \quad \dots(ii)$$

From Eqs. (i) and (ii), we have

$$\frac{GF}{FB_1} = \frac{CB}{CB_1}$$

Since Point G is close to P , so $GF = PF$

$$\therefore \frac{PF}{FB_1} = \frac{CB}{CB_1}$$

Using sign conventions, we get

$$\frac{PF}{PF + PB_1} = \frac{PC - PB}{PC + PB_1}$$

$$\text{or } \frac{-f}{-f + v} = \frac{-2f + u}{-2f + v}$$

Multiplying and dividing both sides by uvf , we get

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

Assertion and Reason Answers:

1. (a) Both A and R are true and R is the correct explanation of A.

Explanation:

Optical density and mass density are not related to each other. Mass density is mass per unit volume. It is possible that mass density of an optically denser medium be less than that of an optically rarer medium (optical density is the ratio of the speed of light in two media). e.g., turpentine and water. Mass density of turpentine is less than that of water but its optical density is higher.

2. (a) Both A and R are true and R is the correct explanation of A.

Explanation:

Due to the variation of the refractive index of the material of the lens, the focal length also varies accordingly. Now as white light is composed of different colours of light, each colour will

produce its own image based on the focal length for that colour. This particular phenomenon for a single lens is known as chromatic aberration.

Case Study Answers:

1. Answer :

(i) (d) All of these.

Explanation:

Total internal reflection is the basis for following phenomenon:

- Sparkling of diamond.
- Optical fibre communication.
- Instrument used by doctors for endoscopy.

(ii) (d) Is incident at an angle greater than the critical angle.

Explanation:

Total internal reflection (TIR) is the phenomenon that involves the reflection of all the incident light off the boundary. TIR only takes place when both of the following two conditions are met: The light is in the more denser medium and approaching the less denser medium.

The angle of incidence is greater than the critical angle.

(iii) (c) 90°

Explanation:

If incidence of angle, $i =$ critical angle C , then angle of refraction, $r = 90^\circ$

(iv)(b) $n_1 > n_2$

Explanation:

In optical fibres, core is surrounded by cladding, where the refractive index of the material of the core is higher than that of cladding to bound the light rays inside the core.

(v) (b) $1.5 \times 10^8 \text{ms}^{-1}$

Explanation:

From Snell's law, $\sin C = {}_1n_2 = \frac{v_1}{v_2}$

Where, $C =$ critical angle $= 30^\circ$ and v_1 and v_2 are speed of light in medium and vacuum, respectively. We know that, $v_2 = 3 \times 10^8 \text{ms}^{-1}$

$$\therefore \sin 30^\circ = \frac{v_1}{3 \times 10^8}$$

$$\Rightarrow v_1 = 3 \times 10^8 \times \frac{1}{2}$$

$$\Rightarrow v_1 = 1.5 \times 10^8 \text{ms}^{-1}$$

2. Answer :

i. (a) 5cm, 35cm

Explanation:

$$m = \frac{f_0}{f_e} = 7$$

$$f_0 = 7f_e$$

In normal adjustment, distance between the lenses,

$$f_0 + f_e = 40$$

$$7f_0 + f_e = 40 \Rightarrow f_e = \frac{40}{8} = 5\text{cm}$$

$$f_0 = 7f_e = 7 \times 5 = 35\text{cm}$$

ii. (d) 20cm

Explanation:

$$m = -10; L = 22\text{cm}$$

$$\text{As, } m = \frac{-f_0}{f_e} \Rightarrow -10 = -\frac{f_0}{f_e}$$

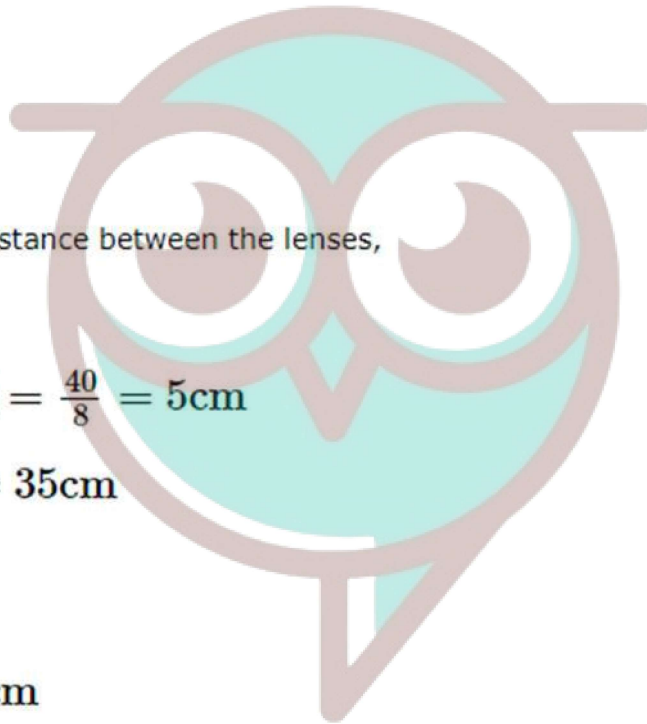
$$f_0 = 10f_e$$

$$\text{As, } L = f_0 + f_e$$

$$22 = 10f_e + f_e = 11f_e$$

$$\text{or } f_e = \frac{22}{11} = 2\text{cm}$$

$$f_0 = 10f_e = 20\text{cm}$$



Swotters

iii. (d) Large focal length.

Explanation:

Objective lens has larger focal length than eye-piece.

iv. (d) Astronomical telescope.

Explanation:

Astronomical telescope is used to see stars, sun etc.

v. (c) $f_0 \ll f_e$



Swotters