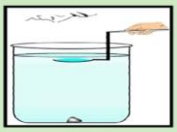
Chapter 4

Refraction of Light at Curved Surfaces



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Textual Questions

1. A man wants to get a picture of a zebra. He photographed a white donkey after fitting a glass, with black stripes on to the lens of his camera. What photo will he get? Explain. (AS1)

Ans: He will get a photograph of white donkey with low intensity. This is because the reflected light from the donkey enters the lens of the camera through the openings of the stripes and form the full image.

2. The focal length of a converging lens is 20cm. An object is 60cm from the lens. Where will the image be formed and what kind of image is it? (AS1)

Ans: Given u=60 cm f=20cm v=?

Lens formula of convex lens $\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$

$\frac{1}{v}=\frac{1}{20}-\frac{1}{60}=\frac{3-1}{60}=\frac{2}{60}=\frac{1}{30}$

v=30cm

The object is placed beyond C, hence real, inverted and diminished image

3. A double convex lens has two surfaces of equal radii 'R' and refractive index n = 15. Find the focal length 'f'. (AS1)

Ans: Given n=1.5

Focal length of symmetrical convergent lens $\frac{1}{f}=(n-1)\frac{2}{R}$

$\frac{1}{f}=(1.5-1)\frac{2}{R}=\frac{1}{2}x\frac{2}{R}=\frac{1}{R}$

f=R

4. Write the lens maker's formula and explain the terms in it. (AS1)

Ans: $\frac{1}{f}=(n-1)[\frac{1}{R1}-\frac{1}{R2}]$

f= Focal length of the lens

n=Refractive index of the lens

R_1,R_2= Radii of curvatures of two surfaces of the lens

5. How do you find the focal length of a lens experimentally? (AS1)

Ans:

Aim: Determination of focal length of bi-convex lens using UV method.

Material Required: V Stand, convex lens, light source, screen, meter scale.

Procedure: i) Take a v-stand and place it on a long table at the middle.

ii) Place a convex lens on the v-stand. Imagine the principal axis of the lens.

iii) Light a candle and ask your friend to take the candle far away from the lens along the principal axis.

iv) Adjust a screen (a sheet of white paper placed perpendicular to the axis) which is on other side of the lens until you get an image on it.

v) Measure the distance of the image from the v-stand of lens and also measure the distance between the candle and stand of lens.

vi) Record the values in a table

Object distance(u)	Image distance(v)	Focal length(f)

vii) Now place the candle at a distance of 60 cm from the lens, such that the flame of the candle lies on the principal axis of the lens.

viii) Try to get an image of the candle flame on the other side on a screen. Adjust the screen till you get a clear image. Measure the image distance (v) from lens and record the values of 'u' and 'v' in table.

ix) Repeat this for various object distances like 50 cm, 40 cm, 30 cm, etc. Measure image distances in all the cases and note them in table

x) Find 'f' values in all cases by using the formula of 1/f = 1/v-1/u

xi) We observe that f value is equal in all cases and this is focal length of a given lens

6. Harsha tells Siddhu that the double convex lens behaves like a convergent lens. But Siddhu knows that Harsha's assertion is wrong and corrected Harsha by asking some questions. What are the questions asked by Siddhu? (AS2)

Ans: a) In which situation, double convex lens behaves as divergent lens?

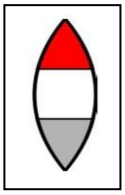
b) What happens to the rays when the object kept in between optic centre and focal point?

c) What type of images is formed by double convex lens?

d) How does air bubbles in water behaves?

(Write any two relevant questions)

7. A convex lens is made up of three different materials as shown in the figureQ-10. How many of images does it form? (AS2)



Ans: 3

8. Collect the information about the lenses available in an optical shop. Find out how the focal length of a lens may be determined by the given 'power' of the lens. (AS4)

Ans: The following lenses available in an optical shop

i) Double convex lenses ii) Plano convex lenses iii) Double concave lenses

iv) Plano concave lenses v) Concavo convex lenses vi) IR lenses

vii) UV lenses viii) Achromatic lenses ix) Aspheric lenses etc.

If power of lens is given, focal lengh of the lens(f) = 100/P (in cm)

9. Collect the information about lenses used by Galileo in his telescope. (AS4)

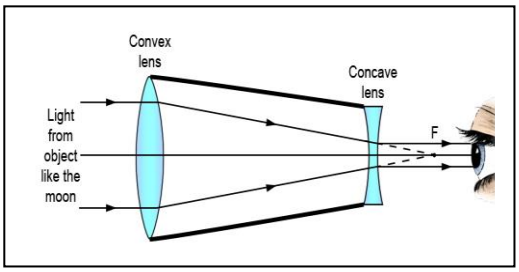
Ans: i) Galileo used one convex lens (it is used as objective lens) and one concave lens (it is used as eye lens).

ii) Convex lens form real, inverted image. This image act as a virtual image for eye lens.

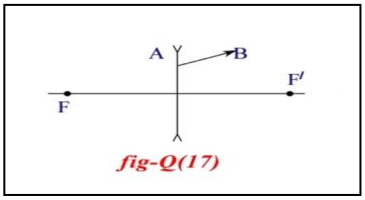
iii)Final image is formed at least distance of the clear vision.

iv)Magnification=Focal length of objective/Focal length of eyepiece

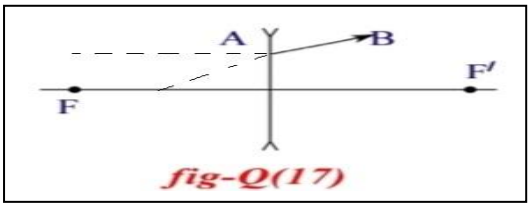
v) Galileo telescope is used to see terrestrial objects.



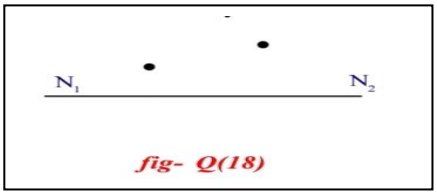
10.Figure Q-17 shows ray AB that has passed through a divergent lens. Construct the path of the ray up to the lens if the position of its foci is known. (AS5)



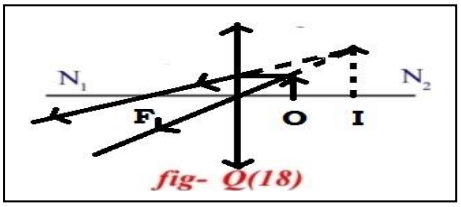
Ans:



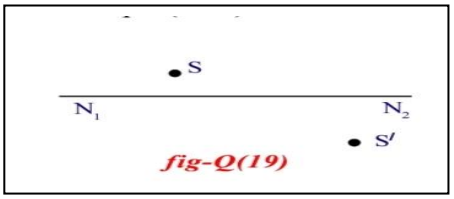
11. Figure Q-18 shows a point light source and its image produced by a lens with an optical axis N_1N_2 . Find the position of the lens and its foci using a ray diagram. (AS5)



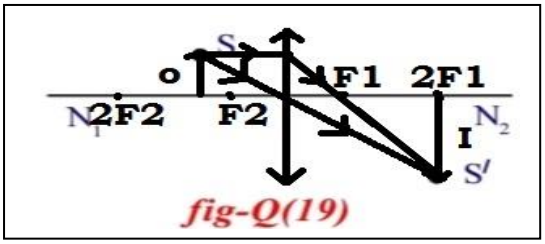
Ans:



12.Find the focus by drawing a ray diagram using the position of source S and the image S/ given in the figure Q-19. (AS5)



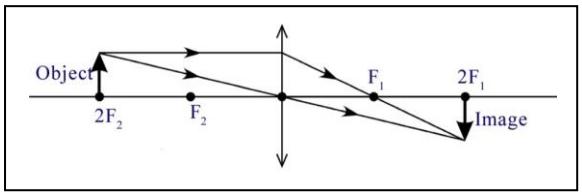
Ans:



13.Draw ray diagrams for the following positions and explain the nature and position of image.

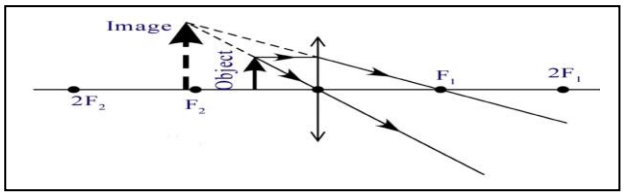
i. Object is placed at $2F_2$ ii. Object is placed between F_2 and optic centre P. (AS5)

Ans: i. Object is placed at $2F_2$



Real, inverted and same size of the object
Image formed at $2F_1$

ii. Object is placed between F_2 and optic centre P



Virtual, erected and magnified image
Image formed on he same side of the lens

14.Find the refractive index of the glass which is a symmetrical convergent lens if its focal length is equal to the radius of curvature of its surface. (AS6)

Ans: Given f=R

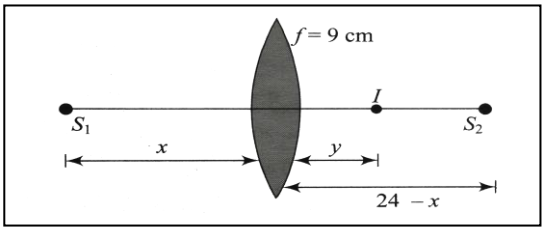
Focal length of symmetrical convergent lens $\frac{1}{f} = (n-1)\frac{2}{R} = (n-1)\frac{2}{f}$

n-1=1/2

n=3/2=1.5

15. The distance between two point sources of light is 24cm .Where should a convergent lens with a focal length of f=9cm be placed between them to obtain the images of both sources at the same point? (AS6)

Ans: The distance between two point sources of light = 24 cm
Focal length of the convergent lens = 9 cm
Radius of curvature(R) = 2f = 2x9 =18 cm
The distance between first source and lens= 18 cm
Then distance between lens and second source = 24-18 =6 cm



Fill in the blanks

1. The rays from the distant object, falling on the convex lens pass through .....

Ans: Principal axis

2. The ray passing through the ..... of the lens is not deviated.

Ans: Optic centre

3. Lens formula is given by .....

Ans: $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

4. The focal length of the plano convex lens is 2R where R is the radius of curvature of the surface. Then the refractive index of the material of the lens is.....

Ans: f = R/(n–1)

5. The lens which can form real and virtual images is .....

Ans: Convex lens

Multiple Choice Questions

1. Which one of the following materials cannot be used to make a lens? [ ]
   a) water b) glass c) plastic d) clay

Ans: d

2. Which of the following is true? [ ]
   a) The distance of virtual image is always greater than the object distance for convex lens
   b) The distance of virtual image is not greater than the object distance for convex lens
   c) Convex lens always forms a real image
   d) Convex lens always forms a virtual image

Ans: b

3. Focal length of the plano-convex lens is ..... when its radius of curvature of the surface is R and n is the refractive index of the lens. [ ]
   a) f = R b) f = R/2 c) f = R/(n–1) d) f = (n–1)/R

Ans: c

4. The value of the focal length of the lens is equal to the value of the image distance when the rays are [ ]
   a) passing through the optic centre b) parallel to the principal axis
   c) passing throught he focus d) in all the cases

Ans: b

5. Which of the following is the lens maker's formula [ ]

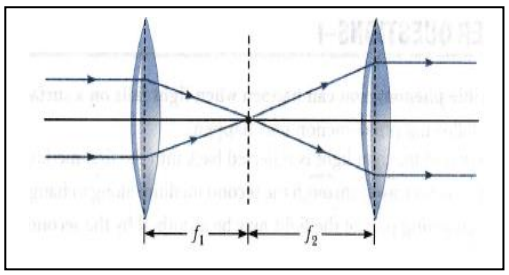
a) $1/f = (n-1)(1/R_1 + 1/R_2)$ b) $1/f = (n+1)(1/R_1 - 1/R_2)$

c) $1/f = (n-1)(1/R_1 - 1/R_2)$ d) $1/f = (n+1)(1/R_1 + 1/R_2)$

Ans: c

Try these

1. Two converging lenses are to be placed in the path of parallel rays so that the rays remain parallel after passing through both lenses. How should the lenses be arranged? Explain with a neat ray diagram. (AS1)



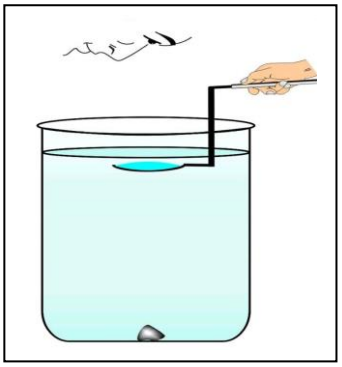
Ans: i) A parallel rays of light are converged at the focus of the first lens.

ii) The second lens is placed at the focus of first lens is coincides with the focus of second lens.

iii) So two lenses are arranged on a common principal axis such that their focal points coincide with each other.

iv) Two lenses should be kept at a distance equal to (f_1+f_2)

2. How do you verify experimentally that the focal length of a convex lens is increased when it is kept in water? (AS1)



Ans: i) Take a convex lens whose focal length is known.

ii) Take a cylindrical vessel such as glass tumbler. Its height must be four times of the focal length of lens.

iii) Keep a black stone inside the vessel at its bottom.

iv) Now pour water into the vessel up to a height such that the height of the water level from the top of the stone is greater than focal length of lens.

v) Now dip the lens horizontally using a circular lens holder as shown in the figure above the stone.

vi) Set the distance between stone and lens that is equal to or less than focal length of lens. Now look at the stone through the lens.

vii) You can see the image of the stone if the distance between lens and stone is less than the focal length of the lens.

viii) Now increase the distance between lens and stone until you cannot see the image of the stone.

ix) You have dipped the lens to a certain height which is greater than the focal length of lens in air. But you can see the image.

x) This shows that the focal length of lens has increased in water.

3. Assertion (A): A person standing on the land appears taller than his actual height to a fish inside a pond. (AS2)

Reason (R): Light bends away from the normal as it enters air from water.

Which of the following is correct? Explain.

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

b) Both A and R are true and R is not the correct explanation of A.

c) A is true but R is false.

d) Both A and R are false.

e) A is false but R is true.

Ans: a

Explanation: A light ray travels from rarer to denser medium, so refracted ray bends towards normal

4. Can a virtual image be photographed by a camera?(AS2)

Ans: Yes

5. You have a lens. Suggest an experiment to find out the focal length of the lens. (AS3)

Ans: Aim: Determination of focal length of bi-convex lens using UV method.

Material Required: V Stand, convex lens, light source, screen, meter scale.

Procedure: i) Take a v-stand and place it on a long table at the middle.

ii) Place a convex lens on the v-stand. Imagine the principal axis of the lens.

iii) Light a candle and ask your friend to take the candle far away from the lens along the principal axis.

iv) Adjust a screen (a sheet of white paper placed perpendicular to the axis) which is on other side of the lens until you get an image on it.

v) Measure the distance of the image from the v-stand of lens and also measure the distance between the candle and stand of lens.

vi) Record the values in a table

Object distance(u)	Image distance(v)	Focal length(f)

vii) Now place the candle at a distance of 60 cm from the lens, such that the flame of the candle lies on the principal axis of the lens.

viii) Try to get an image of the candle flame on the other side on a screen. Adjust the screen till you get a clear image. Measure the image distance (v) from lens and record the values of 'u' and 'v' in table.

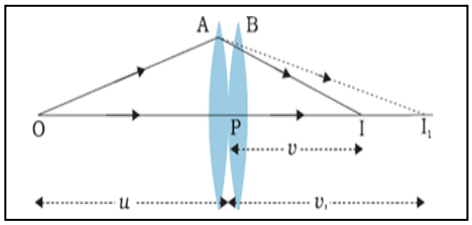
ix) Repeat this for various object distances like 50 cm, 40 cm, 30 cm, etc. Measure image distances in all the cases and note them in table

x) Find 'f' values in all cases by using the formula of 1/f = 1/v-1/u

xi) We observe that f value is equal in all cases and this is focal length of a given lens

6. Let us assume a system that consists of two lenses with focal length f_1 and f_2 respectively. How do you find the focal length of the system experimentally, when i) two lenses are touching each other ii) they are separated by a distance 'd' with common principal axis. (AS3)

Ans: Let us take two convex lenses made up of the same material so that their refractive index (n) is same.



i) Two lenses are touching each other

Now place a point object in front of the two lenses at a distance of u. Rays coming from the object after refraction from lens A forms an image I_1 at a distance v_1. Now this I_1 will act as an object for lens B and after refraction from the lenses will form an image I at distance v.

Using lens formula $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$

Lens A $\frac{1}{f1}=\frac{1}{v1}-\frac{1}{u}$ ---------(1)

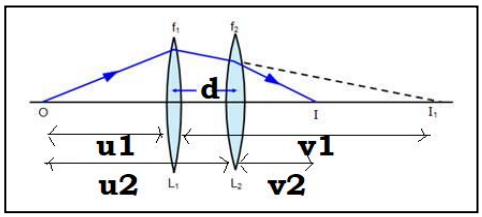
Lens B $\frac{1}{f2}=\frac{1}{v}-\frac{1}{v1}$ ---------(2)

Adding equation (1) & (2) we get, $\frac{1}{F}=\frac{1}{f1}+\frac{1}{f2}$

ii) They are separated by a distance 'd' with common principal axis

Let O be the point object placed at a distance u_1.

Rays from it after refraction from lens A alone will converge at I_1 at a distance v_1. But lens B will converge it before I_1 creating the actual image I at distance v.



Using lens formula $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$

Lens A $\frac{1}{f1}=\frac{1}{v1}+\frac{1}{u1}$ ---------(1)

Lens B $\frac{1}{f2}=\frac{1}{v2}-\frac{1}{u2}$ ---------(2)

$\frac{1}{F}=\frac{1}{f1}+\frac{1}{f2}$ ----------(3)

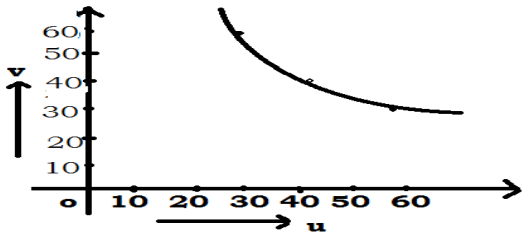
Solving (1),(2) & (3) we get, , $\frac{1}{F}=\frac{1}{f1}+\frac{1}{f2}-\frac{d}{f1f2}$

7. Use the data obtained by activity-2 in table-1 of this lesson and draw the graphs of u vs v and 1/ u vs 1/v. (AS5)

Ans: Take lens with focal length 20 cm

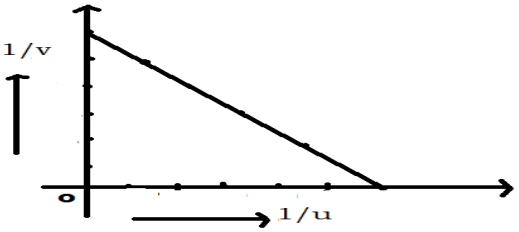
Object distance(u)	Image distance(v)	1/u	1/v	f
60 cm	30 cm	0.016	0.033	20 cm
40 cm	40 cm	0.025	0.025	20 cm
30 cm	60 cm	0.033	0.016	20 cm

i) Graph of u vs v



The slope of graph is hyperbola

ii) Graph of 1/u vs 1/v



The slope of graph is straight line

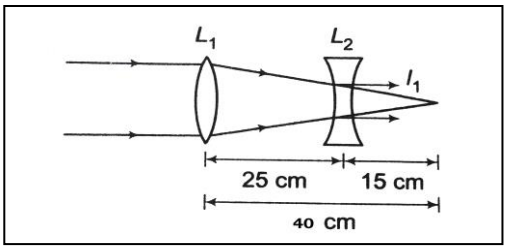
8. A parallel beam of rays is incident on a convergent lens with a focal length of 40cm. Where should a divergent lens with a focal length of 15 cm be placed for the beam of rays to remain parallel after passing through the two lenses? Draw a ray diagram. (AS5)

Ans: i) A parallel beam of rays are incident on a convergent lens, after refraction they meet at the focus.

ii) A Abeam of rays which is incident on a divergent lens, after refraction pass parallel to the principal axis.

iii) Hence the divergent lens should be kept at 25 cm distance from convergent lens.

40-15=25 cm



9. How do you appreciate the coincidence of the experimental facts with the results obtained by a ray diagram in terms of behaviour of images formed by lenses? (AS6)

Ans: (i) we can find the formation of images by microscope and telescopes by using ray diagrams.

(ii) We are able to find the characteristics of the images formed by ray diagrams without doing experiment.

(iii) If we know the focal length of a lens, we can tell where the image is formed and the properties of image for an object placed at different distances.

(iv) By the ray diagrams,we can easily find the values of object distance, image distance, focal length, radius of curvature, magnification etc.

So, I appreciate the ray diagrams.

10.Find the radii of curvature of a convexo –concave convergent lens made of glass with refractive index n=1.5 having focal length of 24cm. One of the radii of curvature is double the other. (AS6)

Ans: Given n=1.5 f= 24 cm

Let R_1= R

R_2= 2 R

We know that $\frac{1}{f} = (n-1)\left[\frac{1}{R1} - \frac{1}{R2}\right]$

$$\frac{1}{24} = (1.5-1)\left[\frac{1}{R} - \frac{1}{2R}\right]$$

$$\frac{1}{24} = 0.5\left[\frac{2R-R}{2R}\right]$$

$$\frac{1}{24} = \left(\frac{1}{2}\right)\left[\frac{R}{2R}\right]$$

$$R = 6$$

R_1= R = 6 cm

R_2= 2 R = 2x6 = 12 cm

11. Suppose you are inside the water in a swimming pool near an edge. A friend is standing on the edge. Do you find your friend taller or shorter than his usual height? Why?(AS6)

Ans: My friend appear to taller. Because light ray travels from rarer medium to denser medium, so light ray bends towards normal

Additional Questions

½ Mark Questions

1.What is lens formula and explain the terms in it ?

Ans: : $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

f= Focal length of the lens, u= Object distance v= Image distance

2.A convex lens is made up of 5 different materials. How many of images does it forms?

Ans: **5**

3. Which lens always form virtual and diminished image?

Ans: Concave lens

4. Which type of lens does the air bubble in water act as ?

Ans: Diverging lens

5.In below figure, how do we call the converging point?

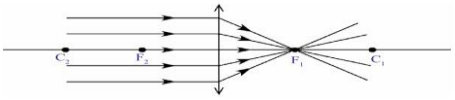


fig-8(c)

Ans: Focal point (or) Focus

6.What are the materials required to find out relation among image distance, object distance and focal length of biconvex lens?

Ans: Convex lens, V-stand, light in candle, Screen etc.

7. In an experiment of finding focal length of lens the observation are as shown in the table.

U (in cm)	**40**	**30**	**20**
V (in cm)	**24**	**30**	**38**

Which lens is used in this experiment?

Ans: Convex lens

8. Which lens can form Real and Virtual image ?

Ans: Convex lens

9. Draw the symbol of Convex lens?

Ans:

10. In which situation, the value of focal length of a convex lens is equal to the value of image distance

Ans: Object at infinite distance

11. What happens to the image distance when the object distance of biconvex lens is decreased?

Ans: Increased

12. Name the lens given in the figure ?

Ans: Plano-Convex lens

13. The Radius of curvature of plane surfaces_____

Ans: Infinity (or) R=∞

14. Where should we place an object before a convex lens to get real, inverted and diminished image?

Ans: Beyond C

15. What happens to the focal length of the convex lens when it is kept in water?

Ans: Increases

16. P: Light ray passing along the principal axis is un deviated.

Q: Light ray passing through the focus is un deviated.

A)P,Q both are correct B)P is correct, Q is incorrect

C)P in correct, Q is correct D)P,Q both are incorrect

Ans: B

17. Focal length of a convex lens is 25 cm. To get image of same size of an object, where should we kept the object before this convex lens on its principal axis?

Ans: 50 cm

18.In which situation, the value of focal length of the lens is equal to the value of the image distance?

Ans: Object at infinite distance

19. The lower half of a convex lens is blacked. What would be the nature of the image

Ans: Full image is formed, but low brightness

20. P: Light ray passing along the principal axis is undeviated

Q: Light ray passing through the focus is undeviated

A) P,Q both are correct B) P is correct,Q is incorrect

C) P is incorrect,Q is correct D) P,Q both are incorrect

Ans: B

21.Which lens is called converging lens?

Ans: Convex lens

22. Real, inverted and magnified image is formed by convex lens. Find the place of the object on the principal axis?

Ans: Between C and F

23.What we call when a line joins the centre of curvature and the pole of a curved surfaces?

Ans: Principal axis

24. An object is placed at the focus of a concave lens.Where will its image be formed

Ans: Between Optic centre and focus

25. Where do we place an object in front of convex lens in order to get virtual, erect and magnified image ?

Ans: Between Optic entre and Focus

26. Assertion (A):A person standing on the land appears taller than his actual height to a fish inside a pond
Reason (R):Light bends away from the normal as it enters air from water
Which of the following is correct?

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

b) Both A and R are true and R is not the correct explanation of A

c) A is true but R is false **d) A is false but R is true**

Ans: a

1 Mark Questions

1. Ammalu wants make a lens in the class room. Which formula she used to make a lens write it?

Ans: $\frac{1}{f} = (n-1)[\frac{1}{R1} - \frac{1}{R2}]$

2. What is a lens ?

Ans: A lens is formed when a transparent material is bounded by two surfaces of which one or both surfaces are spherical

3. Mention the position and nature of image formed by a concave lens when object is kept on its principle axis at certain distance other than infinity ?

Ans: Virtual, Erected and diminished image

4.'Radius of curvature of a lens is lies only on principal axis'. How can you support this statement?

Ans: I support this statement. To draw a ray diagrams easily, radius of curvature of a lens is lies only on principal axis.

5. Write the behavior of a light ray when it is passing through the optic centre of a convex lens

Ans: Undeviated

6. What is the distance between object and image, when object is kept in the front of convex lens at centre of curvature

Ans: 2R

7. Write the relation in between refractive indices of two media, object distance, image distance and radius of curvature?

Ans: $\frac{n2}{v} - \frac{n1}{u} = \frac{n2-n1}{R}$

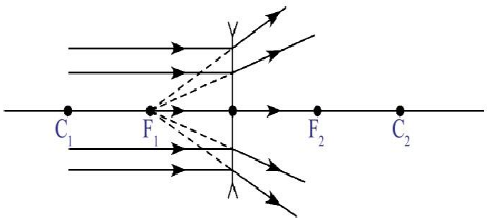
8. Can you find the minimum limiting object distance for obtaining a real image?

Ans: Yes, this minimum limiting object distance is called focal length

2 Marks Questions

1..Draw a ray diagrams for Concave lens

Ans:



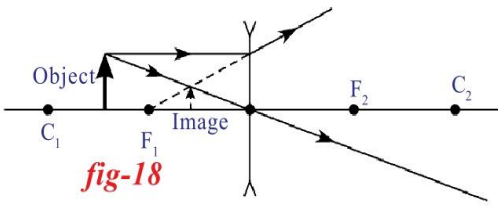


fig-18

2. Write the rules to draw ray diagrams for image formation by lenses.

Ans: i) Select a point on the object placed at a point on the principal axis. ii)Draw two rays that were chosen by you from rays mentioned. iii)Extend both rays to intersect at a point.This point gives position of the image.
iv)Draw a normal from point of intersection to the principal axis.
v)Length of this normal represents the size of the image.

3. **The Information given from the above figure, answer the following questions.**

1. **Write the nature of the image ?**
2. **What is the lens shown in the figure ?**

An

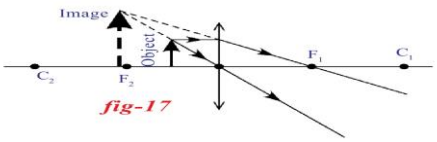


fig-17

2. Convex lens

4. Fill the following box, by given information.

S.NO	Place of Object	Place of Image	Size of Image
1	At C		
2		Infinite distance	

Ans:

S.NO	Place of Object	Place of Image	Size of Image
1	At C	At C	Same
2	At F	Infinite distance	Enlarged

5. Your friend is not able to distinguish between concave and convex lenses. Ask two suitable questions to understand the differences between the lenses?

Ans: a) Which lens behaves as converging lens?
b) Which lens behaves as diverging lens?
c) What type of images is formed by convex lens?
d) What type of images is formed by concave lens?
(Write any two relevant questions)

6. How does in behaves an air bubble inside water? Give reason.

Ans: An air bubble in water behaves like a divergent lens. Less refractive index of air bubble is kept in high refractive index of water

4 Marks Questions

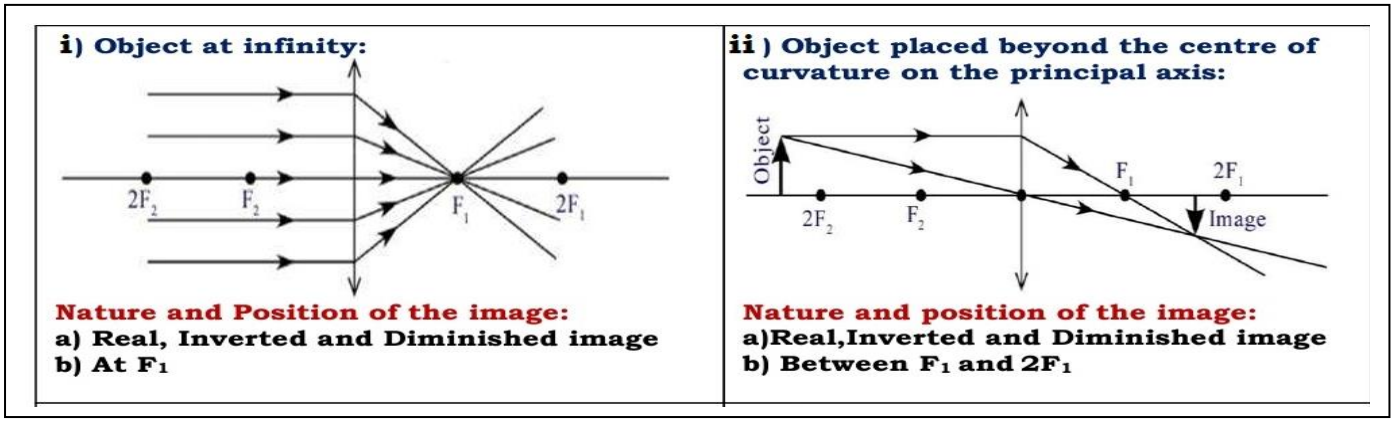
1. State any four differences between convex and concave lens.

Ans:

Convex lens	Concave lens
1.Convergent lens	**1.** .Divergent lens
2. Real and virtual images are formed by this lens	**2.** Always forms virtual images by this lens
3. Inverted and Erected images are formed	**3.** Always erected image is formed
4. Enlarge ,Diminish and Same size of images are formed	**4.** Always diminished image is formed
5. Focal length value always positive	**5.** Focal length value always negative
6. It is used to correct Hypermetropia	**6.** .It is used to correct Myopia

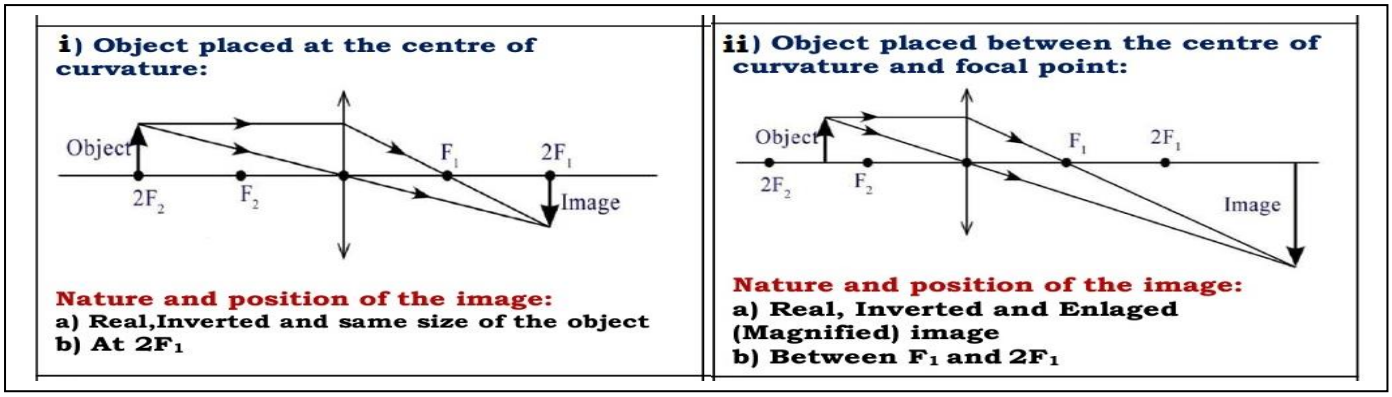
2. Draw the ray diagrams for the following situations. Explain the position and characteristics of image.
(i) Object is placed at infinity. (ii) When the object at beyond $2F_2$

Ans:



3. Draw the information of an image by image using the convex lens? Write nature of the image?
i) When the object is at F2.. ii) Object is placed between F and C.

Ans:



4. Draw various types of lenses

Ans:

fig-6(a): Biconvex

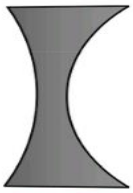


fig-6(b): Biconcave

fig-6(c): Plano-convex

fig-6(d): Plano-concave

fig-6(e): Concavo-convex

5. Fill the table following, which is related to convex lens

Position of the Object	Position of the Image	Real/Virtual image	Inverted/Erected image	Enlarged/Diminished image
Beyond 2F2			Inverted	Diminished
	At 2F1	Real		Enlarged
Between 2F2 and F2	Beyond 2F1	Real		
	Same side of the Object		Erected	Enlarged

Ans:

Position of the Object	Position of the Image	Real/Virtual image	Inverted/Erected image	Enlarged/Diminished image
Beyond 2F2	Between F_1 and $2F_2$	Real	Inverted	Diminished
At $2F_2$	At 2F1	Real	Inverted	Enlarged
Between 2F2 and F2	Beyond 2F1	Real	Inverted	Enlarged
Between O and F_2	Same side of the Object	Virtual	Erected	Enlarged

6. Student 'Bharath' conducted an experiment and find the focal length of symmetric convex lens

Object distance(u)	Image distance(v)
60 cm	20 cm
30 cm	30 cm
25 cm	37.5 cm
20 cm	60 cm

A) What is the focal length of the convex lens?

Ans: Consider any case

u=60 cm, v=20 cm, f=?

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u}=\frac{1}{20}+\frac{1}{60}=\frac{4}{60}=\frac{1}{15}$$

f=15 cm

From the second case, Object distance= Image distance
So R=30 cm then f=R/2=30/2=15 cm

B) What is the radius of curvature of the lens?

Ans: f=15 cm , R=2f=2x15=30 cm

C) To get virtual image, at what distance should keep the object from the lens?

Ans: Below 15 cm

D) When object distance is 10 cm, where will image formed?

Ans: u=10cm, f=15cm, v=?

$$\frac{1}{v}=\frac{1}{f}-\frac{1}{u}=\frac{1}{15}-\frac{1}{10}=-\frac{1}{30}$$

v=-30 cm

E) Find the magnification of the lens when object is kept at 20cm?

Ans: u=20cm, v=60cm

Magnification(m)=v/u=60/20=3

F) Which formula do you use to obtain focal length of the convex lens?

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

G) What are the characteristics of the image when object is placed at 30cm?

Ans: Real, Inverted and Same size of the object