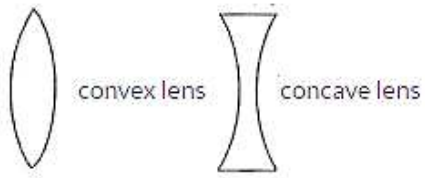
EXERCISE - 5 (A)

Question 1:
What is a lens?
Solution 1:
A lens is a transparent refracting medium bounded by two curved surfaces which are generally spherical.

Question 2:
Name the different kinds of lenses. Draw diagrams to illustrate them.
Solution 2:
Lenses are of two types :
(i) Convex or converging lens, and
(ii) Concave or diverging lens.

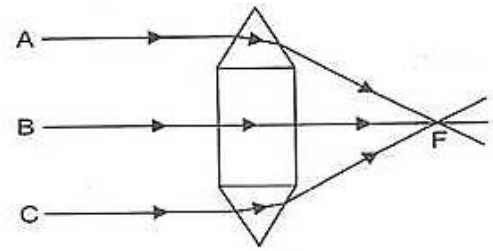


Question 3:
State two differences between a convex and a concave lens.
Solution 3:
Convex lens:
(i) It converge the incident rays towards the principal axis.
(ii) It has a real focus.
Concave lens:
(i) It diverges the incident rays away from the principal axis.
It has a virtual focus.

Question 4:
Which lens is converging: An equiconcave lens or an equiconvex lens.
Solution 4:
Equiconvex lens is converging.

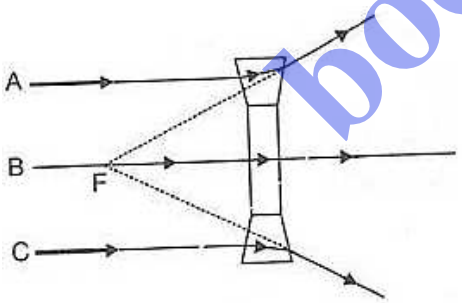
Question 5:
Out of the two lenses, one concave and the other convex, state which one will show the divergent action on a light beam.
Solution 5:
Concave lens will show the divergent action on a light beam.

Question 6:
Show by a diagram the refraction of two light rays incident parallel to the principal axis on a convex lens by treating it as a combination of a glass block and two triangular glass prisms.
Solution 6:



As shown in the figure the convex lens has two glass prisms and one glass block. One of the glass prisms is situated above the glass block and one below the block.

Question 7:
Show by a diagram, the refraction of two light rays incident parallel to the principal axis on a concave lens by treating it as a combination of a glass block and two triangular glass prisms.
Solution 7:

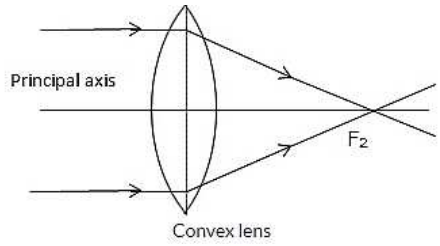


As shown in the figure the concave lens has two glass prisms and one glass block. One of the glass prisms is situated above the glass block and one below the block.

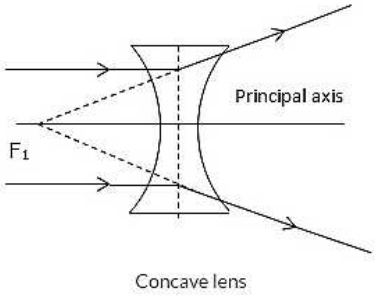
Question 8:
How does the action of a convex lens differ from that of a concave lens on a parallel beam of light incident on them? Draw diagram to illustrate your answer.

Solution 8:

If a parallel beam of light is incident on a convex lens then the upper part of the lens bends the incident ray downwards. The lower part bens the ray upwards while the central part passes the ray undeviated.



But in case of a concave lens the upper part of the lens bends the incident ray upwards and lower part bends the ray downwards while the central part passes the ray undeviated.



Question 9:

Define the term principal axis of a lens.

Solution 9:

It is the line joining the centers of curvature of the two surfaces of the lens.

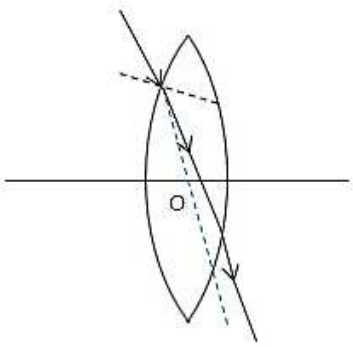
Question 10:

Explain optical centre of a lens with the help of proper diagram(s)

Solution 10:

It is point on the principal axis of the lens such that a ray of light passing through this point emerges parallel to its direction of incidence.

It is marked by letter O in the figure. The optical centre is thus the centre of the lens.



Question 11:

A ray of light incident at a point on the principal axis of a convex lens passes undeviated through the lens.

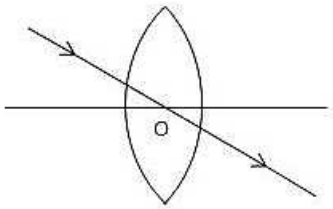
(a) What special name is given to this point on the principal axis?

(b) Draw a labelled diagram to support your answer in part (a)

Solution 11:

(a) This point is known as Optical centre.

(b)



Question 12:

State the condition when a lens is called an equi-convex or equi-concave

Solution 12:

A lens is called an equiconvex or equiconcave when radii of curvature of the two surfaces of lens are equal.

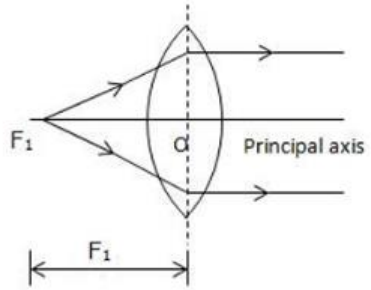
Question 13:

Define the term principal foci of a convex lens and illustrate your answer with the aid of proper diagrams.

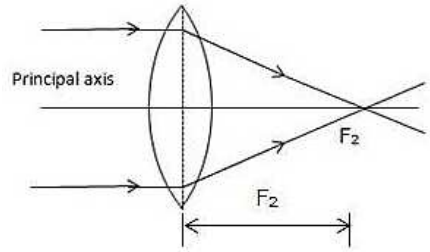
Solution 13:

A light ray can pass through a lens from either direction. Therefore, a lens has two principal foci.

For a convex lens, the first focal point is a point F_1 on the principal axis of the lens such that the rays of light starting from it or passing through it, after refraction through lens, become parallel to the principal axis of the lens.



The second focal point for a convex lens is a point F_2 on the principal axis such that the rays of light incident parallel to the principal axis, after refraction from the lens, pass through it.

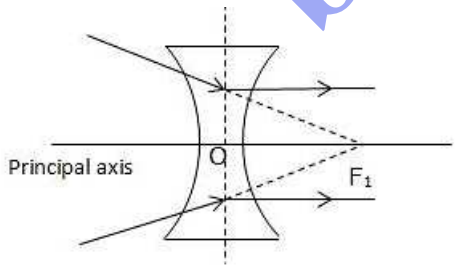


Question 14:

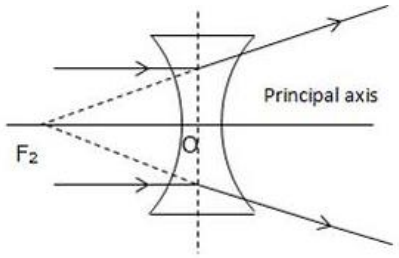
Define the term principal foci of a concave lens and show them with the help of proper diagrams.

Solution 14:

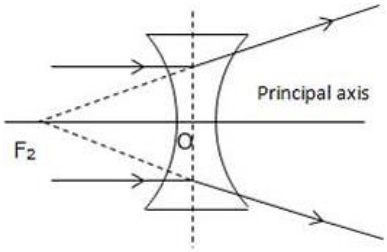
A light ray can pass through a lens from either direction. Therefore, a lens has two principal foci. For a concave lens, the first focal point is a point F_1 on the principal axis of the lens such that the incident rays of light appearing to meet at it, after refraction from the lens become parallel to the principal axis of the lens.



The second focal point for a concave lens is a point F_2 on the principal axis of the lens such that the rays of light incident parallel to the principal axis, after refraction from the lens, appear to be diverging from this point.

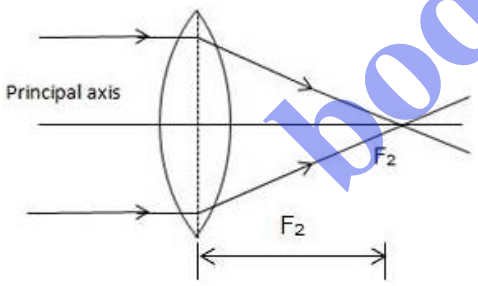


Question 15:
Draw a diagram to represent the second focus of a concave lens.
Solution 15:



Concave lens representing second focus

Question 16:
Draw a diagram to represent the second focus of a convex lens.
Solution 16:

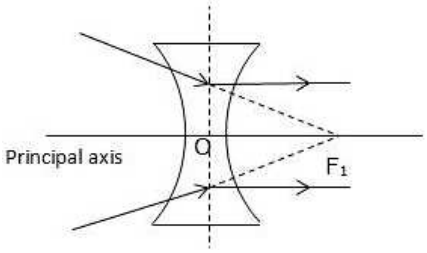


Convex lens representing second focus

Question 17:
A ray of light, after refraction through a concave lens emerges parallel to the principal axis. (a) draw a ray diagram to show the incident ray and its corresponding emergent ray. (b) The incident ray when produces meets the principal axis at a point. Name the point.

Solution 17:

(a)



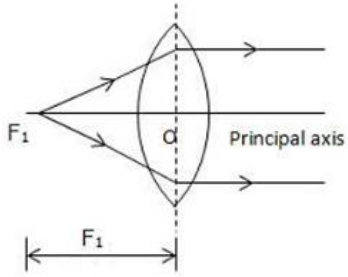
(b) The point where incident ray when produced meets the principal axis is called first focus.

Question 18:

A ray of light after refraction through a convex lens emerges parallel to principal axis. (a) Draw a ray diagram to show it. (b) The incident ray passes through a point on the principal axis. Name the point.

Solution 18:

(a)



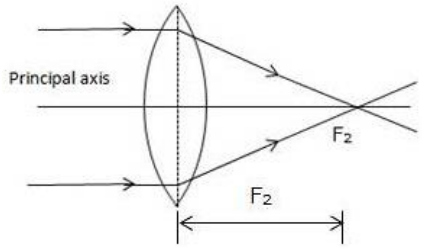
(b) The point where incident ray passes through a point on the principal axis is called first focus.

Question 19:

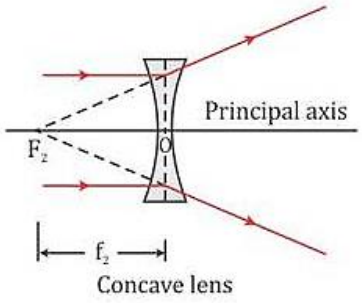
A beam of light incident on a convex lens parallel to its principal axis converges at a point on the principal axis. Name the point. Draw a ray diagram to show it.

Solution :

Such a point will be second focus.



Question 20:
A beam of light incident on a thin concave lens parallel to its principal axis diverges and appears to come from a point on the principal axis. Name the point. Draw a ray diagram to show it.
Solution 20:
It appears to come from 'Second Focus'.



Question 21:
Define the term focal length of a lens.
Solution 21:
The distance from the optical centre O of the lens to its second focal point is called the focal length of the lens.

Question 22:
What do you mean by focal plane of a lens?
Solution 22:
A plane passing through the focal point and normal to the principal axis of the lens is called the first focal plane.

Question 23:
State the condition for each of the following:
(i) a lens has both its focal lengths equal

(ii) a ray passes undeviated through the lens

Solution 23:

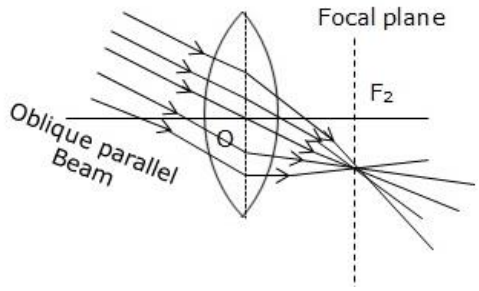
(i) If a lens has both its focal length equal medium is same on either side of lens.

(ii) If a ray passes undeviated through the lens it is incident at the optical centre of the lens.

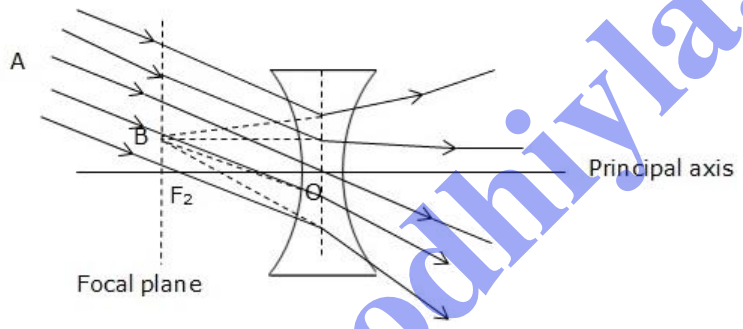
Question 24:

A parallel oblique beam of light falls on a (i) convex lens, (ii) concave lens. Draw a diagram in each case to show the refraction of light through the lens.

Solution 24:



Refraction of an oblique parallel beam by a convex lens.



Refraction of an oblique parallel beam by a concave lens

Question 25:

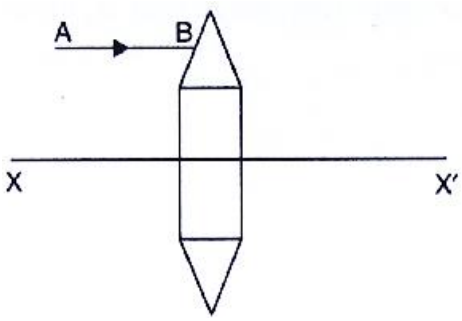
The diagram alongside shows a lens as a combination of a glass block and two prisms.

(i) Name the lens formed by the combination.

(ii) what is the rays the line XX' called?

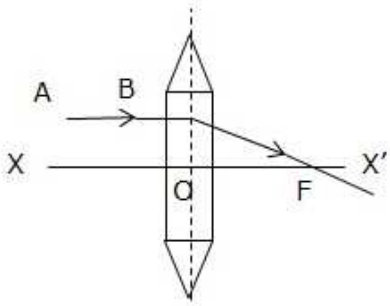
(iii) Complete the ray diagram and show the path of the incident ray AB after passing through the lens.

(iv) The final emergent ray will either meet XX' at a point or appear to come from a point on XX'. Label the point as F. What is this point called?



Solution 25:

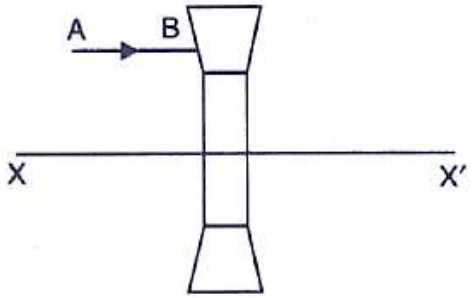
(i) The combination forms convex lens.
(ii) XX' is known as principal axis.
(iii) The complete diagram is



(iv) The point F is called as Focal point or focus.

Question 26:

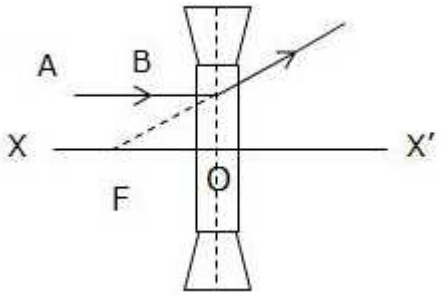
The diagram alongside shows a lens as a combination of a glass block and two prisms.
(i) Name the lens formed by the combination.
(ii) what is the line XX' called?
(iii) Complete the path of the incident ray AB after passing through the lens.
(iv) The final emergent ray either meets XX' at a point or appears to come from a point on XX' Label it as F. what is this point called?



Solution 26:

(i) The combination forms concave lens.

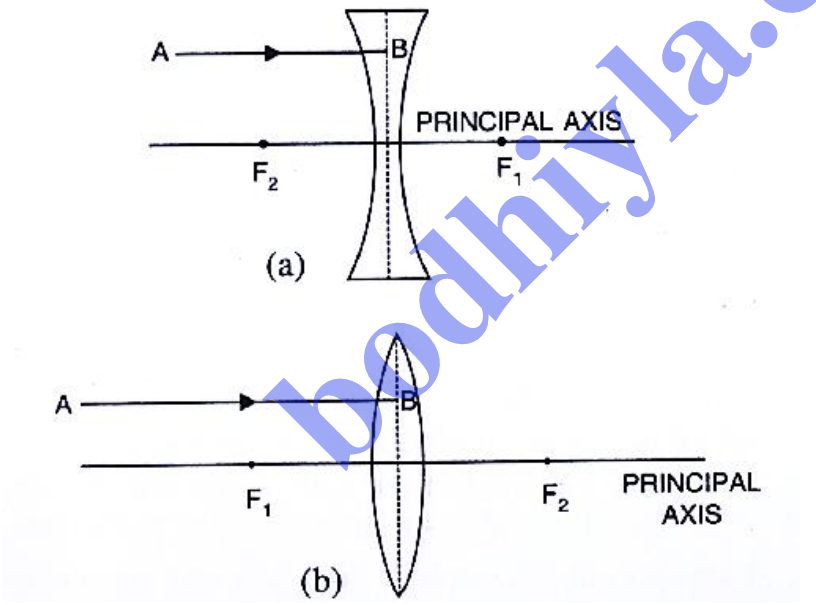
(ii) XX' is known as principal axis.
(iii) Complete diagram is drawn as



(iv) The point F is called as Focal point or focus.

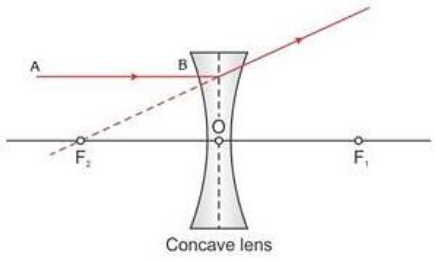
Question 27:

In Fig. 5.17, F_1 and F_2 are the positions of the two foci of the thin lenses shown in diagram (a) and (b) draw accurately the path taken by the light ray AB after it emerges from the lens in each diagram (a) and (b).

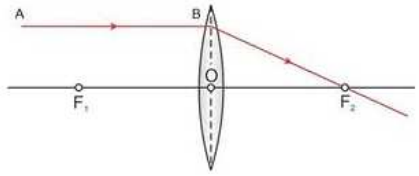


Solution 27:

(a)

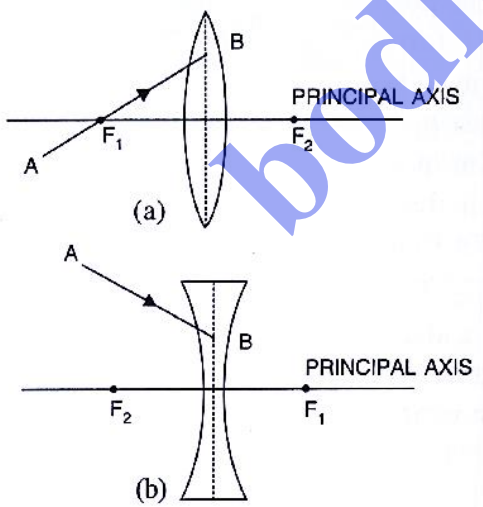


(b)



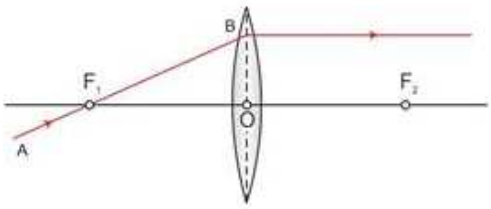
Question 28:

In Fig 5.18, F_1 and F_2 are the two foci of the thin lenses shown in diagram (a) and (b) and AB is the incident ray. Compete the diagram to show the path of the ray AB after refraction through the lens in each diagram (a) and (b).

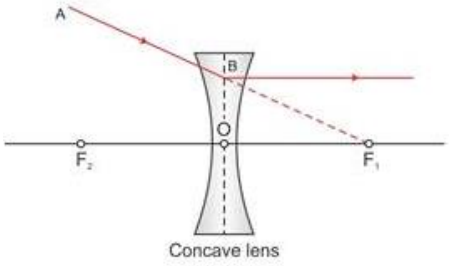


Solution 28:

(a)



(b)



Question 29:

Complete the following sentences:

(a) If half part of a convex lens is covered, the focal length …… change, but the intensity of image …….

(b) A convex lens is placed in water. Its focal length will …….

(c) The focal length of a then convex lens is …….. than that of a thick convex lens.

Solution 29:

(a) If half part of a convex lens is covered, the focal length does not change, but the intensity of image decreases.

(b) A convex lens is placed in water. Its focal length will increase.

(c) The focal length of a thin convex lens is more than that of a thick convex lens.

MULTIPLE CHOICE TYPE:

Question 1:

A ray of light after refraction through a lens emerges parallel to the principal axis of the lens. The incident ray either passes through or appears to meet at:

(a) optical centre

(b) first focus

(c) Second focus

(d) centre of curvature of the first surface.

Solution 1:

(b) First focus

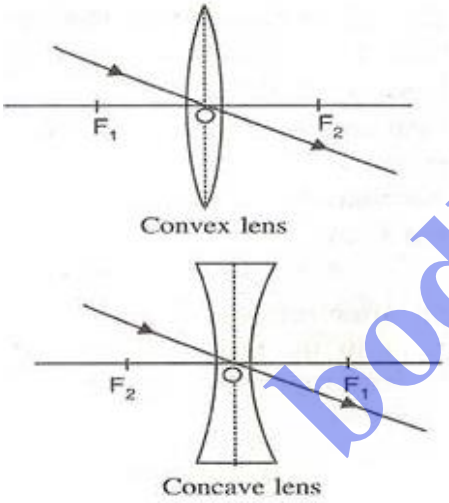
Question 2:
A ray of light incident on a lens parallel to its principal axis, after refraction passes through or appears to come from:
(a) its first focus
(b) its optical centre
(c) its second focus
(d) the centre of curvation of its second surface

Solution 2:
(d) its second focus

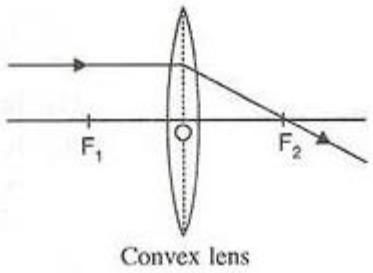
EXERCISE – 5(B)

Question 1:
What are the three principal rays that are drawn to construct the ray diagram for the image formed by a lens? Draw diagrams to support your answer.

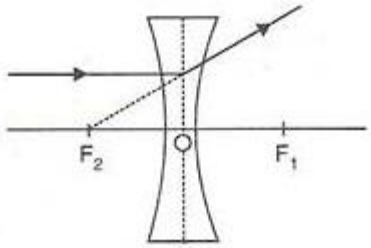
Solution 1:
(i) A ray of light incident at the optical centre O of the lens passes undeviated through the lens.



(ii) A ray of light incident parallel to the principal axis of the lens, after refraction passes through the second focus F_2 (in a convex lens) or appears to come from the second focus F_2 (in a concave lens).

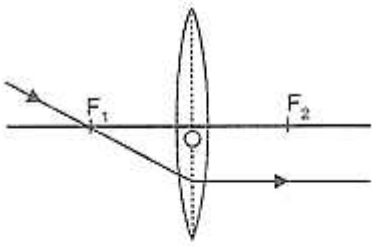


Convex lens

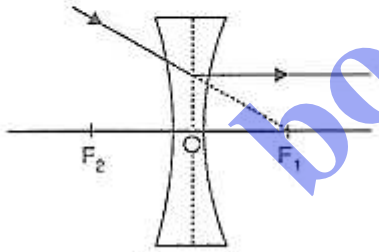


Concave lens

(iii) A ray of light passing through the first focus F_1 (in a convex lens) or directed towards the first focus F_1 (in a concave lens), emerges parallel to the principal axis after refraction.



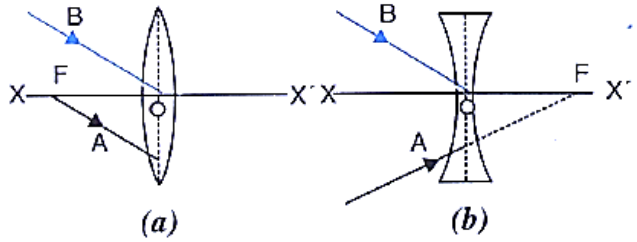
Convex lens



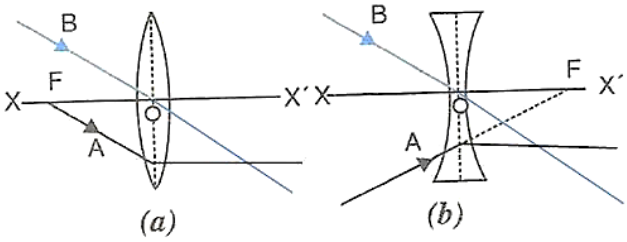
Concave lens

Question 2:

In the diagram below, XX' represents the principal axis, O the optical centre and F the focus of the lens. Complete the path of rays A and B as they emerge out of the lens.



Solution 2:



Question 3:

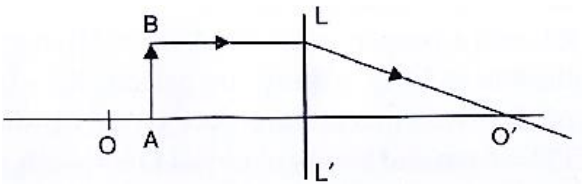
Distinguish between a real and a virtual image.

Solution 3:

Real image	Virtual image
1. A real image is formed due to actual intersection of refracted (or reflected) rays.	1. A virtual image is formed when the refracted (or reflected) rays meet if they are produced backwards.
2. 2 A real image can be obtained on a screen.	2. 2. A virtual image cannot be obtained on a screen.
3. 3. A real image is inverted with respect to the object.	3. 3. A virtual image is erect with respect to the object.

Question 4:

Study the diagram (Fig. 5.55) given below.



(a) Name the lens LL'
(b) What are the points O and O' called?
(c) Complete the diagram to form the image of the object AB.
(d) state the three characteristics of the image.

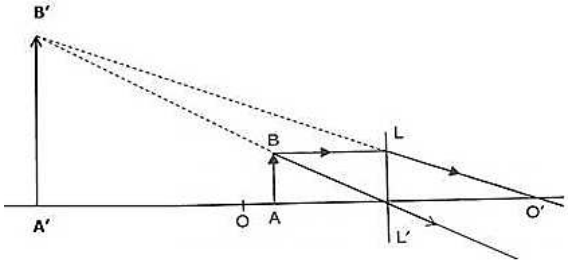
(e) Name a device in which this action of lens is used.

Solution 4:

(a) LL' lens is convex lens.

(b) O and O' are known as first and second focal points respectively.

(c)

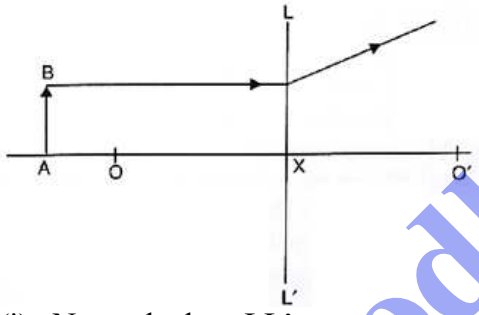


(d) The image formed will be magnified, virtual and upright.
O and

(e) Such action of lens is used in a magnifying glass.

Question 5:

Study the diagram (Fig. 5.54) below.



(i) Name the lens LL'

(ii) what are the points O, O' called?

(iii) Complete the diagram to form the image of the object AB.

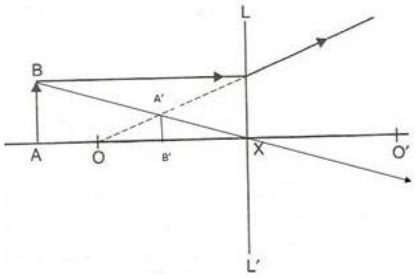
(iv) State three characteristics of the image.

Solution 5:

(i) LL' is concave lens.

(ii)The points O and O' are called second and first focal points respectively.

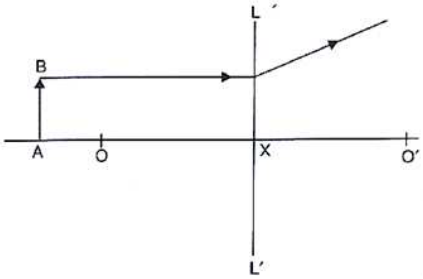
(iii)



(iv)The three characteristics of the image are:
Virtual
Erect
Diminished

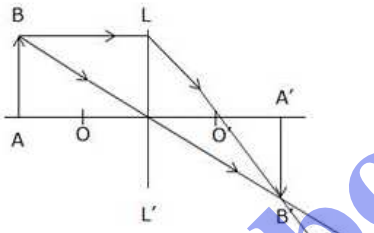
Question 6:

Study the diagram shown in Fig. 5.56
(a) Complete the diagram to show the formation of image A'B' of the object AB of same size.
(b) Name the lens LL' and draw its outline.
(c) what are the points O and O' called?
(d) where is the object located?
(e) Where is the image formed?
(f) what are the two other characteristics of the image?



Solution 6:

(a) Complete diagram for the formation of A'B'.



(b) LL' is a convex lens which is drawn as

(c) O and O' are called as first and second focal points respectively.
(d) Object is located at a distance twice of first focal length.
(e) Image is formed at a distance twice of second focal length.

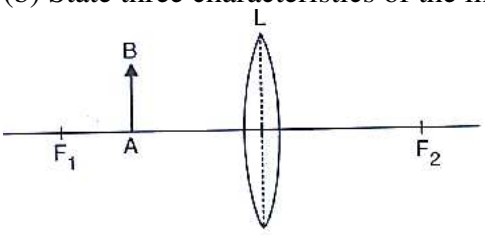
(f) The image formed is real and inverted.

Question 7:

The following diagram in Fig. 5.57 shows an object AB and a converging lens L with foci F_1 and F_2.

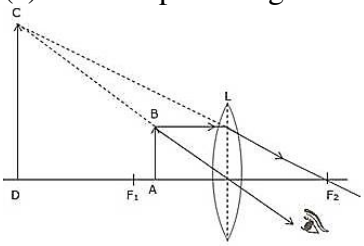
(a) Draw two rays from the object and complete the diagram to locate the position of the image. Mark the image CD. Clearly mark on the diagram the position of the eye from where the image can be viewed.

(b) State three characteristics of the image in relation to the object.



Solution 7:

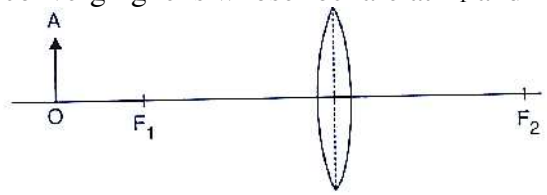
(a) The complete diagram is



(b) The image formed will be magnified, virtual and upright.

Question 8:

The diagram given below in Fig. 5.58 shows the position of an object OA in relation to a converging lens whose foci are at F_1 and F_2.



(i) draw two rays to locate the position of the image.

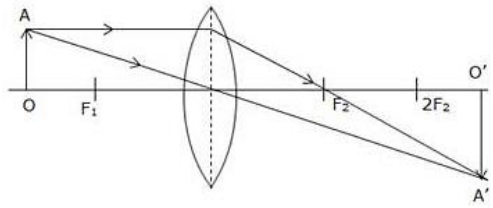
(ii) State the position of image with reference to the lens.

(iii) Describe three characteristic of the image.

(iv) Describe how the distance of the image from the lens and the size of the image change as the object is moved towards F_1.

Solution 8:

(a)



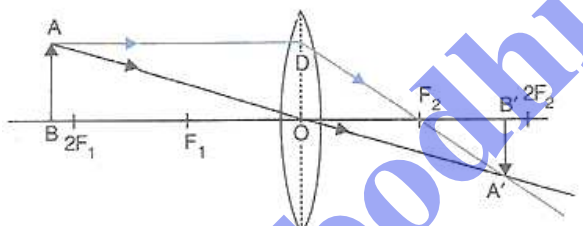
(b) The position of the images will be more than twice the focal length of lens.
(c) The image will be magnified, real and inverted.
(d) As the object move towards F_1 the image will shift away from F_2 and it is magnified. At F_1 the image will form at infinity and it is highly magnified. Between F_1 and optical centre, the image will form on the same side of object and will be magnified.

Question 9:

A converging lens forms the image of an object placed in front of it beyond $2F_2$ of the lens. (a) Where is the object placed? (b) Draw a ray diagram to show the formation of image. (c) Where is the image formed? (d) State three characteristics of the image.

Solution 9:

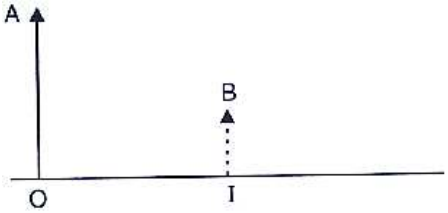
(a) The object is placed beyond $2F_1$.
(b)



(c) The image is formed beyond $2F_2$.
(d) The image will be diminished, real and inverted.

Question 10:

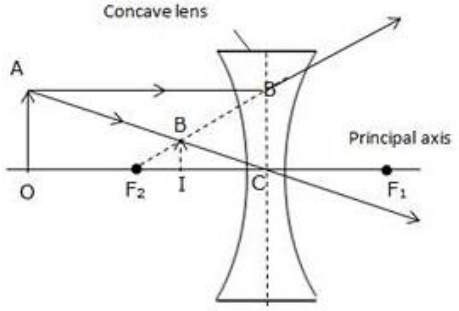
The following diagram in given below shows an object OA and its virtual image IB formed by a lens.



Solution 10:

(a)The lens is concave lens.

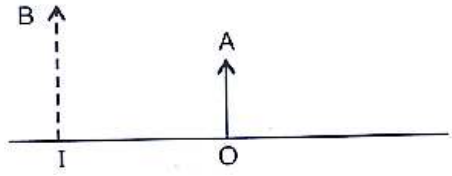
(b)The required diagram is



(c)The focal length is measured from optical centre C to F_2.

Question 11:

The given below figure shows an object OA and its image IB formed by a lens.



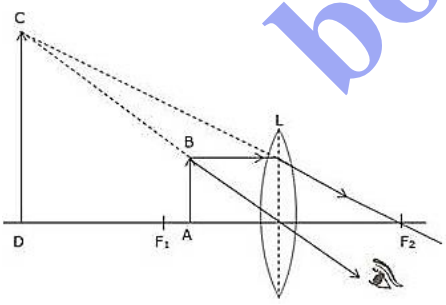
(a) name the lens and show it in the diagram

(b) draw suitable rays to locate the lens and its focus.

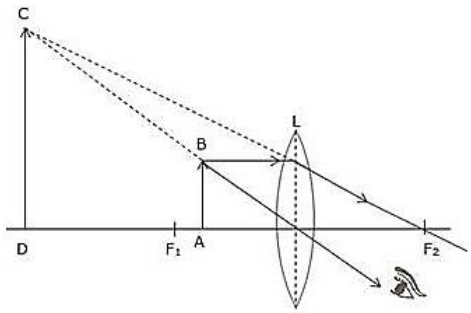
(c) State three characteristics of the image.

Solution 11:

(a) Convex lens and it is shown in the diagram below.



(b)



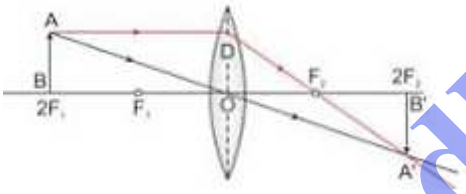
(c) Three characteristics of the image are
(i) Magnified
(ii) Virtual
(iii) Upright

Question 12:

A convex lens forms an image of an object equal to the size of the object.
(a) Where is the object placed in front of the lens?
(b) draw a diagram to illustrate it.
(c) state two more characteristics of the image.

Solution 12:

(a) The object is placed at the centre of curvature.
(b)



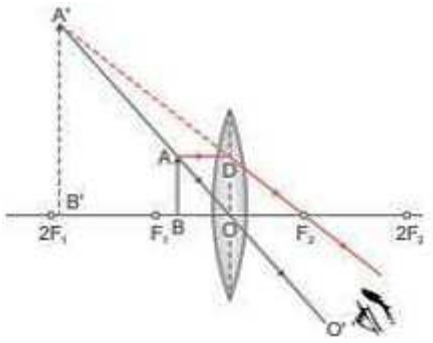
(c) The image formed is real and inverted.

Question 13:

A lens forms an erect, magnified and virtual image of an object.
(a) name the type of lens.
(b) Where is the object placed in relation to the lens?
(c) Draw a ray diagram to show the formation of image.
(d) name the device which uses this principle.

Solution 13:

(a) Convex lens
(b) The object is placed between the lens and focus (F_1).
(c)



(d) 'Magnifying glass' uses this principle.

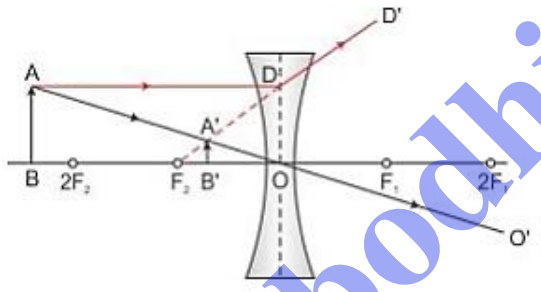
Question 14:

An object is placed on the axis of a lens. An image is formed by refraction in the lens. For all positions of the object on the axis of the lens, the positions of the image are always always between the lens and the object. (a) name the lens. (b) Draw a ray diagram to show it. (c) State three characteristics of the image.

Solution 14:

(a) Concave lens

(b)



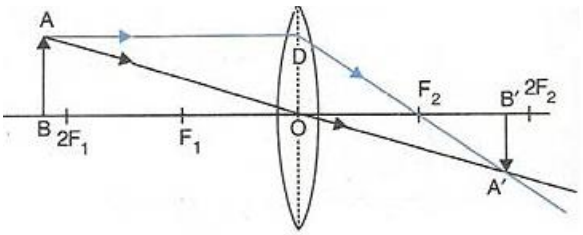
(c) The image formed is virtual, upright and diminished.

Question 15:

Classify as real or virtual, the image of a candle flame formed on a screen by a convex lens. Draw a ray diagram to illustrate how the image is formed.

Solution 15:

Let the candle is placed beyond $2F_1$ and its diminished image which is real and inverted is formed between F_2 and $2F_2$.

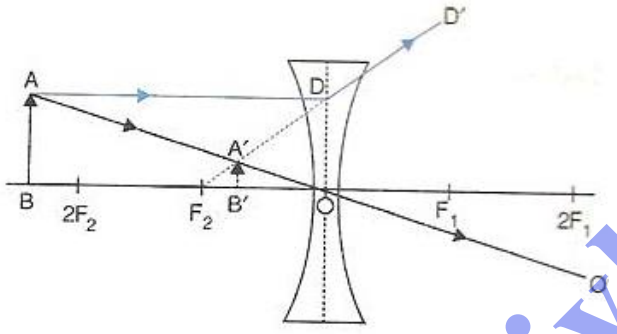


Here the candle is AB and its real and inverted image is formed between F_2 and $2F_2$.

Question 16:

Show by a ray diagram that a diverging lens cannot form a real image of an object placed anywhere on its principal axis.

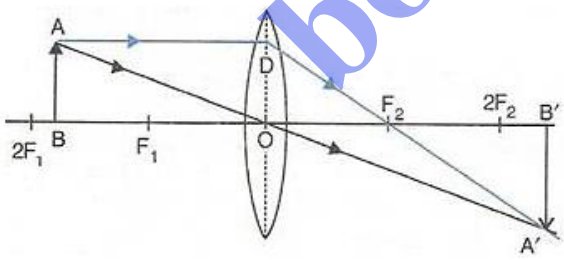
Solution 16:



Question 17:

Draw a ray diagram to show how a converging lens can form a real and enlarged image of an object.

Solution 17:



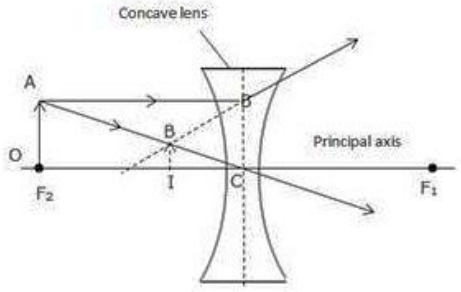
The image formed in above diagram is real, enlarged and inverted.

Question 18:

Where will the image be formed if an object is kept in front of a concave lens at a distance equal to its focal length? Draw a ray diagram to illustrate your answer.

Solution 18:

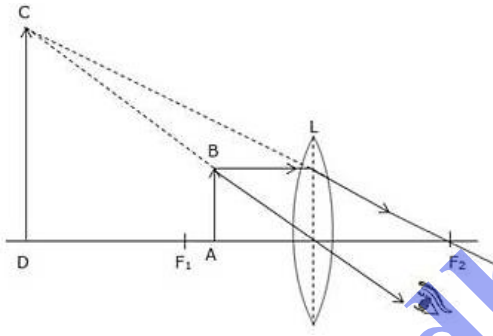
The image will form between the focus and optical centre, on the same side of the lens as the object.



Question 19:

Draw a ray diagram to show how a converging lens is used as a magnifying glass to observe a small object. Mark on your diagram the foci of the lens and the position of the eye.

Solution 19:



The object is placed between focal point F_1 and convex lens and its image is formed at the same side of the lens which is enlarged.

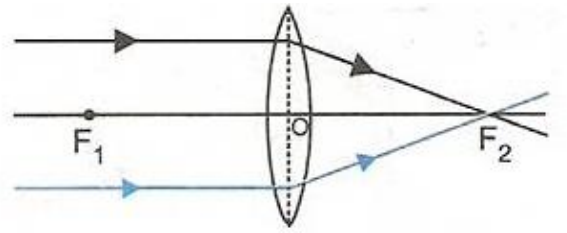
So this lens can be used as a magnifying lens.

Question 20:

Draw a ray diagram to show how a converging lens can form an image of the sun. Hence give a reason for the term 'burning glass' for a converging lens used in this manner.

Solution 20:

The sun is at infinity so convex lens forms its image at second focal point which is real and very much diminished in size.



While using the convex lens as burning glass, the rays of light from the sun (at infinity) are brought to focus on a piece of paper kept at the second focal plane of the lens. Due to sufficient heat of the sun rays, the paper burns. Hence this lens is termed as 'burning glass'.

Question 21:

A lens forms an inverted image of an object.
(a) what kind of lens is this?
(b) what is the nature of the image real or virtual?

Solution 21:

(a)This is convex lens.
(b)The nature of the image is real.

Question 22:

A lens forms an upright and magnified image of an object.
(a) name the lens
(b) State whether the image is real or virtual

Solution 22:

(a)Convex lens.
(b)Virtual.

Question 23:

(a) name the lens which always forms an erect and virtual image.
(b) state whether the image in part (a) is magnified or diminished.

Solution 23:

(a) Concave lens
(b) Image is diminished

Question 24:

A lens forms an upright and diminished image of an object irrespective of its position. What kind of lens is this?

Solution 24:

Concave lens

Question 25:

Give two characteristic of the image formed by a concave lens.

Solution 25:

Image formed by a concave lens is virtual and diminished.

Question 26:

Give two characteristic of the virtual image formed by a convex lens.

Solution 26:

The virtual image formed by a convex lens will be magnified and upright.

Question 27:

In each of the following cases, where must an object be placed in front of a convex lens so that the image formed is

(a) at infinity,

(b) of same size as the object,

(c) inverted and enlarged,

(d) upright and enlarged image?

Solution 27:

(a) at focus,

(b) at 2F,

(c) between F and 2F,

(d) between optical centre and focus.

Question 28:

Complete the following table:

Type of lens	Position of object	Nature of image	Size of image
Convex	Between optic centre and focus		
Convex	At focus		
Concave	At infinity		
Concave	At any distance		

Solution 28:

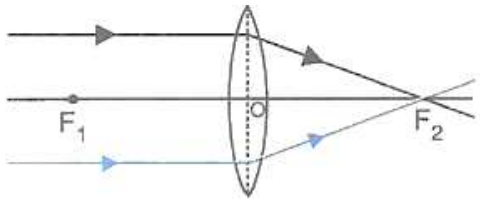
Type of lens	Position of object	Nature of image	Size of image
Convex	Between optic centre and focus	Virtual and upright	Magnified
Convex	At focus	Real and inverted	Very much magnified
Concave	At infinity	Virtual and upright	Highly diminished
Concave	At any distance	Virtual and upright	Diminished

Question 29:

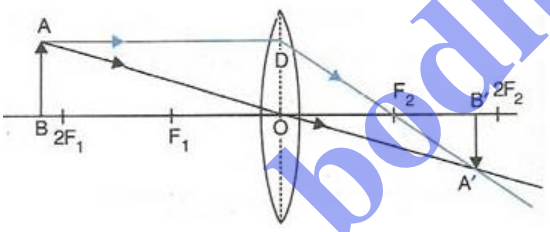
State the changes in the position, size and nature of the image of an object when brought from infinity up to a convex lens. Illustrate your answer by drawing ray diagrams.

Solution 29:

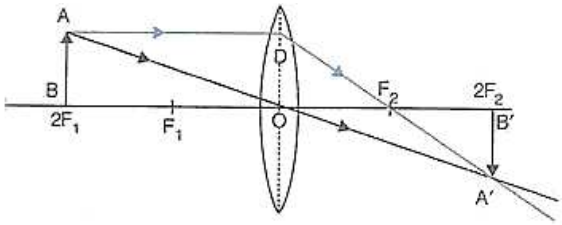
(i) When the object is situated at infinity, the position of image is at F_2, it is very much diminished in size and it is real and inverted.



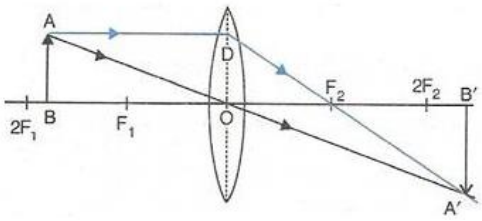
(ii) When the object (AB) is situated beyond $2F_1$, the position of image (A'B') is between F_2 and $2F_2$, it is diminished in size and real and inverted.



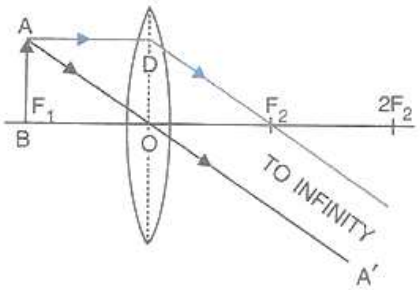
(iii) When the object (AB) is situated at $2F_1$, the position of image (A'B') is at $2F_2$, it is of same size as the object and real and inverted.



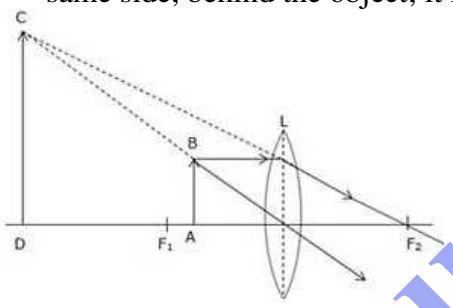
(iv) When the object (AB) is situated between $2F_1$ and F_1, the position of image (A'B') is beyond $2F_2$, it is magnified in size and real and inverted.



(v) When the object (AB) is situated at F_1, the position of image is at infinity; it is very much magnified in size and real and inverted.



(vi) When the object (AB) is situated between lens and F_1, the position of image (CD) is on the same side, behind the object; it is magnified in size and virtual and upright.

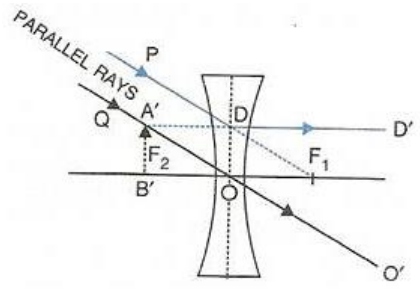


Question 30:

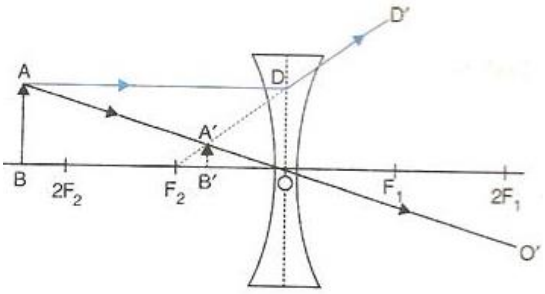
State the changes in the position, size and nature of the image of an object when brought from infinity up to a concave lens. Illustrate your answer by drawing ray diagrams.

Solution 30:

(i) When object (AB) is situated at infinity then parallel rays from object appears to fall on concave lens. Due to which image forms at focus. This image is highly diminished in size and virtual and upright.



(ii) When object (AB) is situated at any point between infinity and optical centre of the lens then image forms between focus and optical centre. This image is diminished in size and virtual and upright.



Question 31:

Complete the following sentences:

(a) An object is placed at a distance of more than 40 cm from a convex lens of focal length 20 cm. The image formed is real, inverted and …….

(b) an object is placed at a distance 2f from a convex lens of focal length f. The size of image formed is …….. that of the object.

(c) an object is placed at a distance 5 cm from a convex lens of focal length 10 cm. The image formed is virtual, upright and …….

Solution 31:

(a) An object is placed at a distance of more than 40 cm from a convex lens of focal length 20 cm. The image formed is real, inverted and **diminished**.

(b) An object is placed at a distance 2f from a convex lens of focal length f. The image formed is **equal to** that of the object.

(c) An object is placed at a distance 5 cm from a convex lens of focal length 10 cm. The image formed is virtual, upright and **magnified.**

Question 32:

State whether the following statements are 'true' or 'false' by writing T/F against them.

(a) A convex lens has a divergent action and a concave lens has a convergent action.

(b) A concave lens, if kept at a proper distance from an object, can form its real image.

(c) A ray of light incident parallel to the principal axis of a lens, passes undeviated after refraction.
(d) A ray of light incident at the optical centre of lens, passes undeviated after refraction.
(e) A concave lens forms a magnified or diminished image depending on the distance of object from it.

Solution 32:

(a) False
(b) False
(c) False
(d) True
(e) False

MULTIPLE CHOICE TYPE:

Question 1:

For an object placed at distance 20 cm in front of a convex lens, the image is at distance 20 cm behind the lens. The focal length of convex lens is:
(a) 20 cm (b) 10 cm (c) 15 cm (d) 40 cm.

Solution 1:

The focal length of the convex lens is 10 cm.

Hint: As the object distance = image distance, the object must be kept at 2f.
Therefore, 2f = 20 cm or f = 10 cm.

Question 2:

For the object placed between optical centre and focus of a convex lens, the image is:
(a) real and enlarged
(b) real and diminished
(c) virtual and enlarged
(d) virtual and diminished

Solution 2:

Virtual and enlarged.

Explanation: When the object is kept between optical centre and focus of a convex lens, the image is formed on the same side, behind the object. The image thus formed is virtual, enlarged and erect.

Question 3:

A concave lens forms the image of an object which is:
(a) virtual, inverted and diminished.

(b) virtual, upright and diminished.
(c) virtual, inverted and enlarged.
(d) virtual, upright and enlarged.

Solution 3:

Virtual, upright and diminished

Hint: Concave lens forms virtual, upright and diminished image for all positions of the object.

EXCERSICE. 5 (C)

Question 1:

Define the term power of a lens. In what unit is it expressed?

Solution 1:

The power of a lens is a measure of deviation produced by it in the path of rays refracted through it.
Its unit is Dioptre (D).

Question 2:

How is the power of a lens related to its focal length?

Solution 2:

Power of lens (in D) = $\frac{1}{\text{focal length (in metre)}}$

Question 3:

How does the power of a lens change is its focal length is doubled?

Solution 3:

If focal length of a lens doubled then its power gets halved**.**

Question 4:

How is the sign (+ Or -) of power of a lens related to its divergent or convergent action?

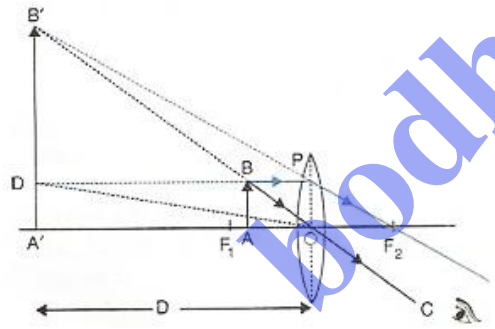
Solution 4:

The sign of power depends on the direction in which a light ray is deviated by the lens. The power could be positive or negative. If a lens deviates a ray towards its centre (converges), the power is positive and if it deviates the ray away from its centre (diverges), the power is negative.

Question 5:
The power of a lens is negative. State whether it is convex or concave?
Solution 5:
It is a concave.

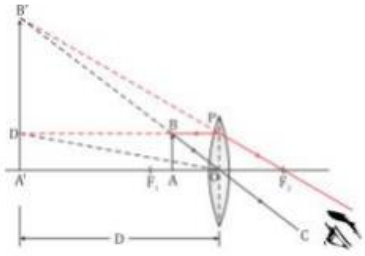
Question 6:
What is magnifying glass? State its two uses.
Solution 6:
Magnifying glass is a convex lens of short focal length. It is mounted in a lens holder for practical use.
It is used to see and read the small letters and figures. It is used by watch makers to see the small parts and screws of the watch.

Question 7:
Draw a neat labelled ray diagram to show the formation of image by a magnifying glass. State three characteristics of the image.
Solution 7:
Let the object (AB) is situated between focal length and optical centre of a convex lens then its image (A'B') will form on the same side of lens.



The image formed will be virtual, magnified and erect.

Question 8:
Where is the object placed in reference to the principal focus of a magnifying glass, so as to see its enlarged image? Where is the image obtained?
Solution 8:
The object is placed between the lens and principal focus.
The image is obtained between the lens and principal focus.



Question 9:

Define magnifying power of a simple microscope. How can it be increased?

Solution 9:

The magnifying power of the microscope is defined as the ratio of the angle subtended by the image at the eye to the angle subtended by the object (assumed to be placed at the least distance of distinct vision D = 25 cm) at the eye, i.e.,

Magnifying power = $1 + \frac{D}{F}$

Where F is the focal length of the lens.

The magnifying power of a microscope can be increased by using the lens of short focal length. But it cannot be increased indefinitely.

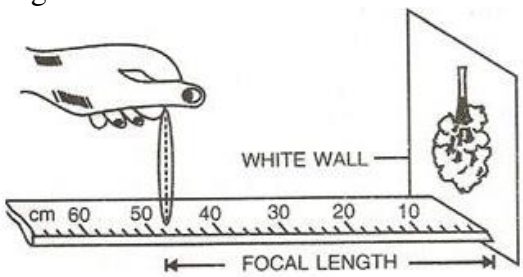
Question 10:

Describe in brief how would you determine the approximate focal length of a convex lens.

Solution 10:

The approximate focal length of a convex lens can be determined by using the principle that a beam of parallel rays incident from a distant object is converged in the focal plane of the lens.

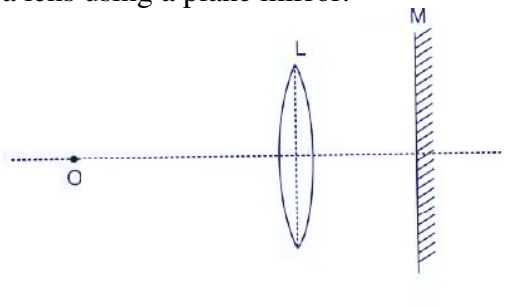
In an open space, against a white wall, a metre scale is placed horizontally with its 0 cm end touching the wall.



By moving the convex lens to and fro along the scale, focus a distant object on wall. The image which forms on the wall is very near to the focus of the lens and the distance of the lens from the image is read directly by the metre scale. This gives the approximate focal length of the lens.

Question 11:

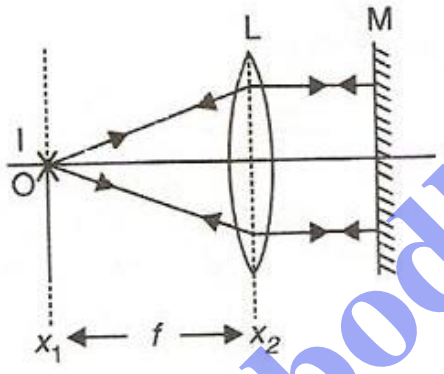
The diagram in Fig 5.68 shows the experimental set up for the determination of focal length of a lens using a plane mirror.



(i) draw two rays from the point O of the object to show the formation of image I at O itself.
(ii) What is the size of the image I?
(iii)State two more characteristics of the image I.
(iv) Name the distance of the objects O from the optical centre of the lens.
(v) To what point will the rays return if the mirror is moved away from the lens by a distance equal to the focal length of the lens?

Solution 11:

(i)



(ii) The size of the image will be same as that of object.
(iii) The image formed will be real and inverted.
(iv) The distance of object O from optical lens will be equal to the focal length of the lens.
(iv) The position of the mirror from lens does not affect the formation of image as long as the rays from the lens fall normally on the plane mirror M.
(v)

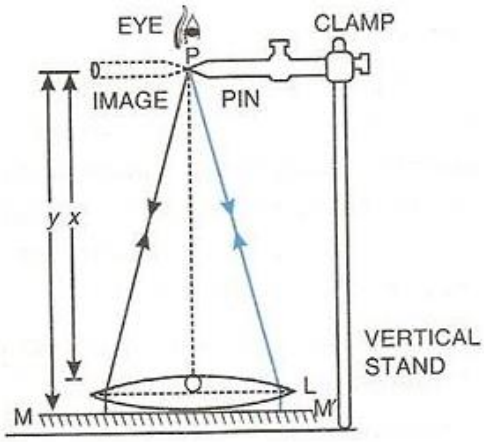
Question 12:

Describe how you would determine the focal length of a converging lens, using a plane mirror and one pin. Draw a ray diagram to illustrate your answer.

Solution 12:

To determine focal length by using plane mirror we need a vertical stand, a plane mirror, a lens and a pin.

Place the lens L on a plane mirror MM' horizontally. Arrange a pin P on the clamp of a vertical stand such that the tip of pin is vertically above the centre O of the lens.



Adjust the height of the pin until it has no parallax (i.e., when the pin and its image shift together) with its inverted image as seen from vertically above the pin.

Now measure the distance x of the pin from the lens and the distance y of the pin from the mirror, using a metre scale and a plumb line. Calculate the average of the two distances. This gives the focal length of the lens, i.e.,

$F = \frac{x + y}{2}$

Question 13:

State two applications each of a convex lens and a concave lens.

Solution 13:

The two applications of a convex lens are:-

(i) It is used as an objective lens in a telescope, camera, slide projector, etc.

(ii) With its short focal length it is also used as a magnifying glass.

The two applications of a concave lens are:-

(i) A person suffering from short sightedness or myopia wears spectacles having concave lens.

(ii) A concave lens is used as eye lens in a Galilean telescope to obtain an erect final image of the object.

Question 14:
How will you differentiate between a convex and a concave lens by looking at (i) a distant object, (ii) a printed page?
Solution 14:
(i) On seeing a distant object through the lens, if its inverted image is seen, then the lens is convex, and if the upright image is seen, then the lens is concave.
(ii) On keeping the lens near a printed page, if the letters appear magnified, then the lens is convex, and if the letters appear diminished, then the lens is concave.

MULTIPLE CHOICE TYPE:

Question 1:
On reducing the focal length of a lens, its power:
(a) decreases
(b) increases
(c) does not change
(d) first increases then decreases
Solution 1:
Increases

Hint: Power (in Diopter) = $\frac{1}{\text{Focal length (in m)}}$

Question 2:
A magnifying glass forms:
(a) a real and diminished image
(b) a real and magnified image
(c) a virtual and magnified image
(d) a virtual and diminished image
Solution 2:
A virtual and magnified image

Hint: A magnifying glass forms a virtual, magnified and upright image on the same side as the object.

NUMERICALS:

Question 1:
The power of a lens is + 2.0 D. Find its focal length and state the kind of the lens.
Solution 1:
P = +2.0D
P = $\frac{1}{\text{F(In metre)}}$

$\Rightarrow F = \frac{1}{P} = \frac{1}{2}$
F = 0.5 m or 50 cm

Question 2:
Express the power (with sign) of a concave lens of focal length 20 cm.
Solution 2:
$P = \frac{1}{\text{F(In metre)}}$
$\Rightarrow P = \frac{1}{0.2\ m} = 5\ D$
As it is a concave lens so power is negative
i.e. P $= -5$ D