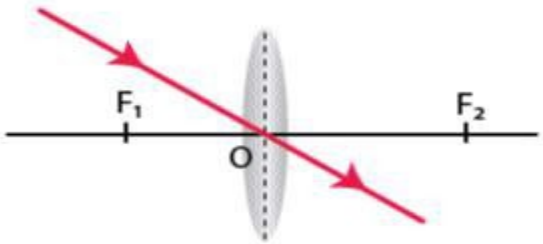
EXERCISE 5(B)

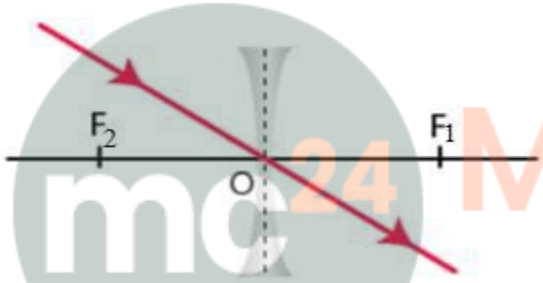
Solution:

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



Convex lens

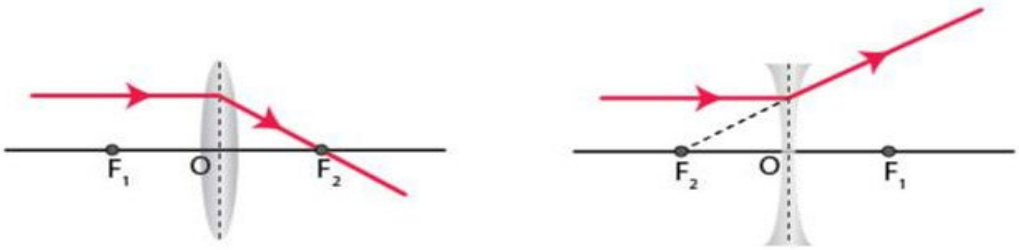
(a)



Concave lens

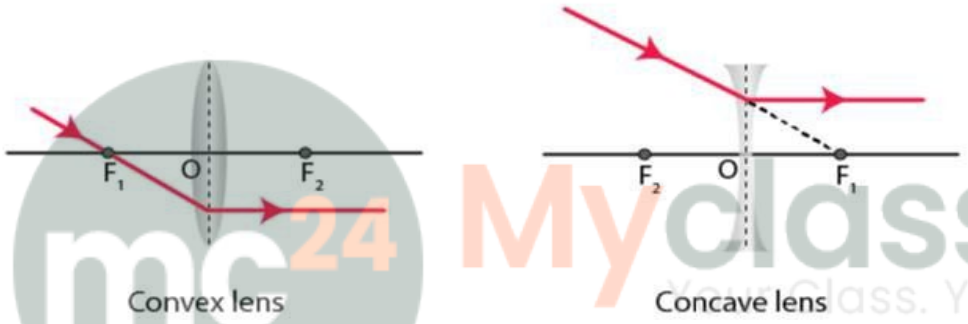
(b)

(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)



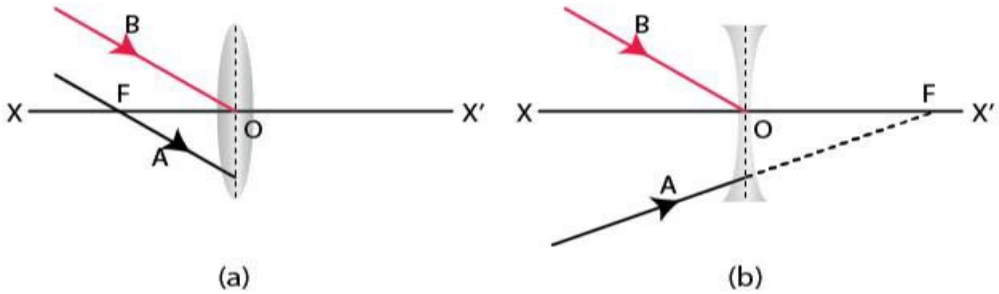
Convex lens Concave lens

(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



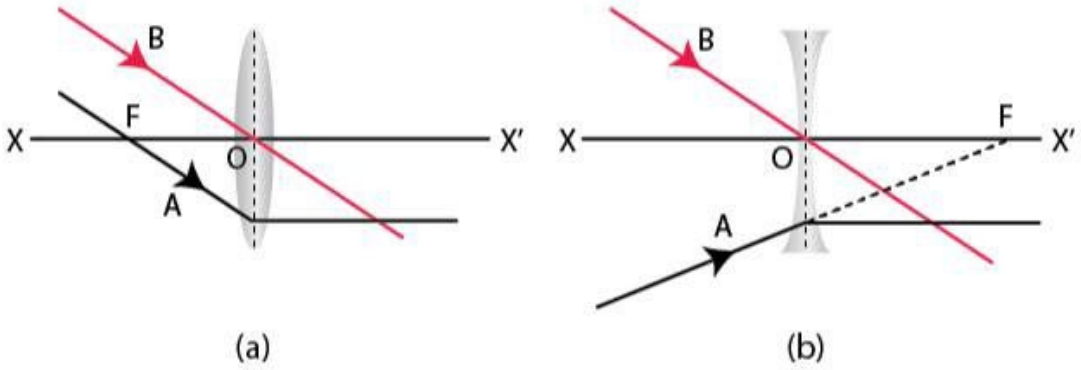
Convex lens Concave lens

Question: 2



(a) (b)

Solution:



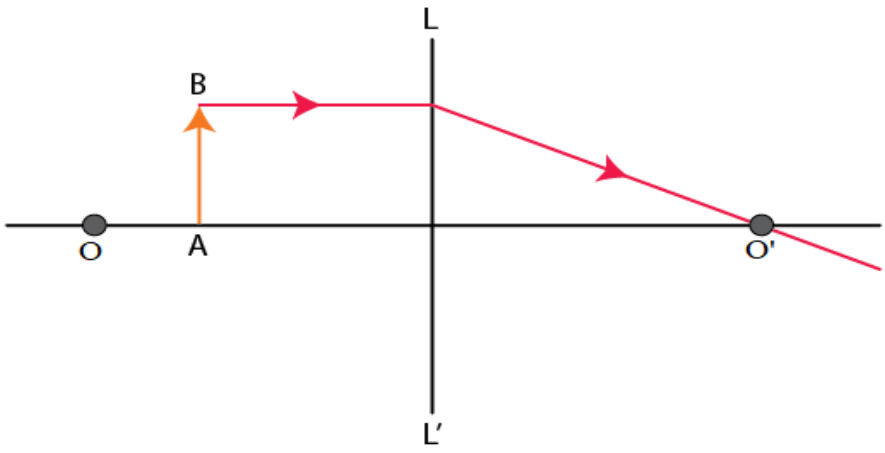
Solution:
The rays of light after being refracted through the convex lens obtain a parallel beam of light when a source of light is placed at the first focal point i.e the focal point on the left of the optical centre of the convex lens.

Question: 4
Distinguish between a real and a virtual image.
Solution:

Real image	Virtual image
A real image is formed due to actual intersection of the rays refracted by the lens	A virtual image is formed when the rays refracted by the lens appear to meet if they are produced backwards
A real image can be obtained on a screen	A virtual image cannot be obtained on a screen
A real image is inverted with respect to the object	A virtual image is erect with respect to the object

Question: 5
Study the diagram 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.

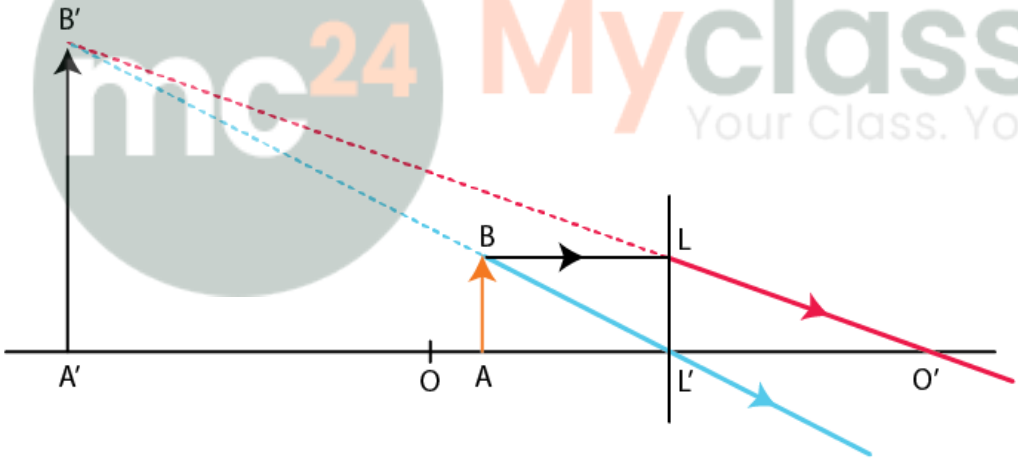


Solution:

(a) LL' is a convex lens

(b) O and O' are called as first and second focal points

(c) The complete diagram is shown below

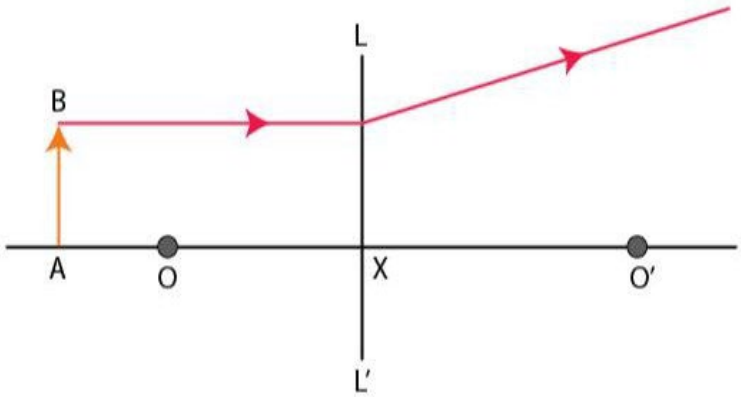


(d) The three characteristics of the image are magnified, virtual and upright.

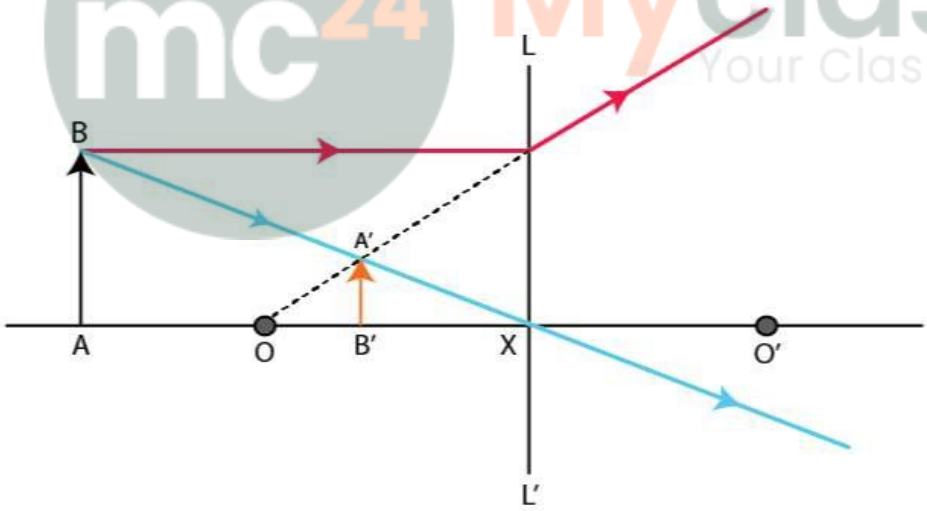
(e) This action of lens is used in magnifying glass

Question: 6

Study the diagram below.

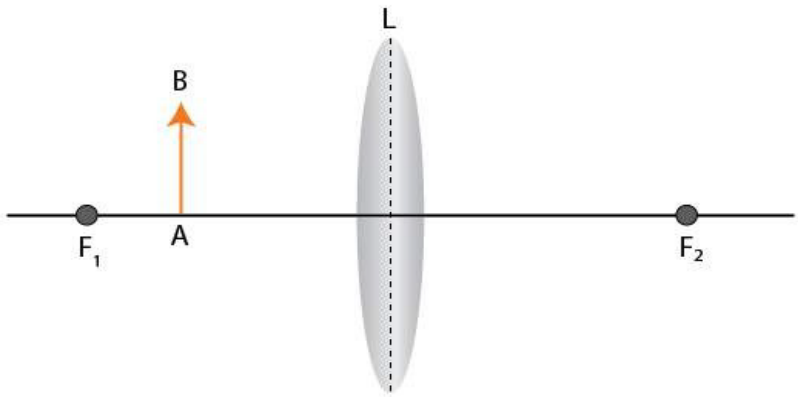


(i) Name the lens LL'.
(ii) What are the points O and O' called?
(iii) Complete the diagram to from the image of the object AB.
(iv) State three characteristics of the image.
Solution:
(i) LL' is a concave lens
(ii) The points O and O' are called second and first focal point.
(iii)

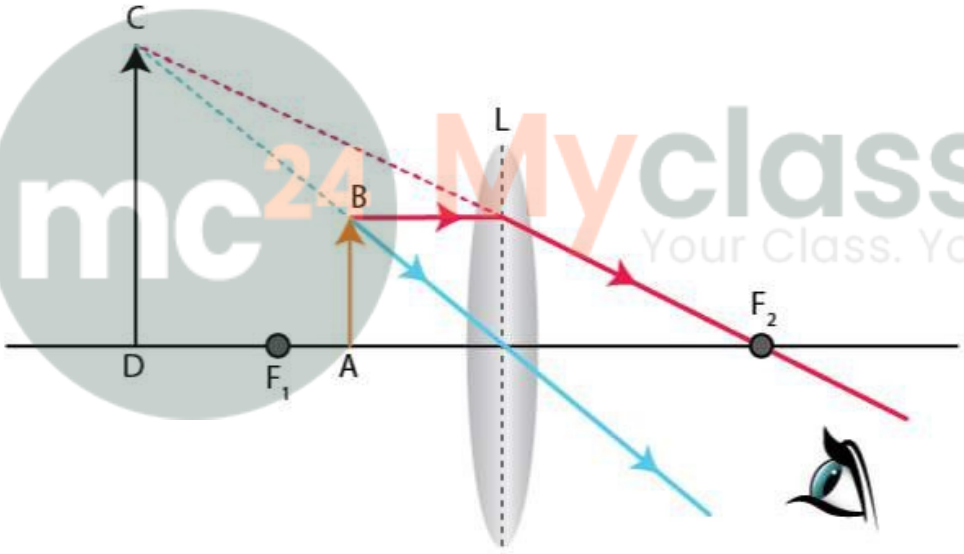


(iv) The three characteristics of the image are virtual, erect and diminished.

Question: 7
The following diagram in Fig. shows an object AB and a converging lens L with foci F_1 and F_2.
(a) Draw two rays from the object AB and complete the diagram to locate the position of the image CD. Also mark on the diagram the position of eye from where the image can be viewed.

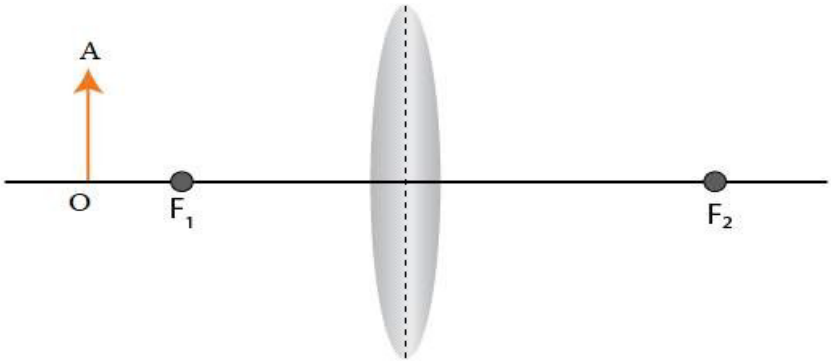


(b) State three characteristics of the image in relation to the object.
Solution:
(a) The complete diagram is

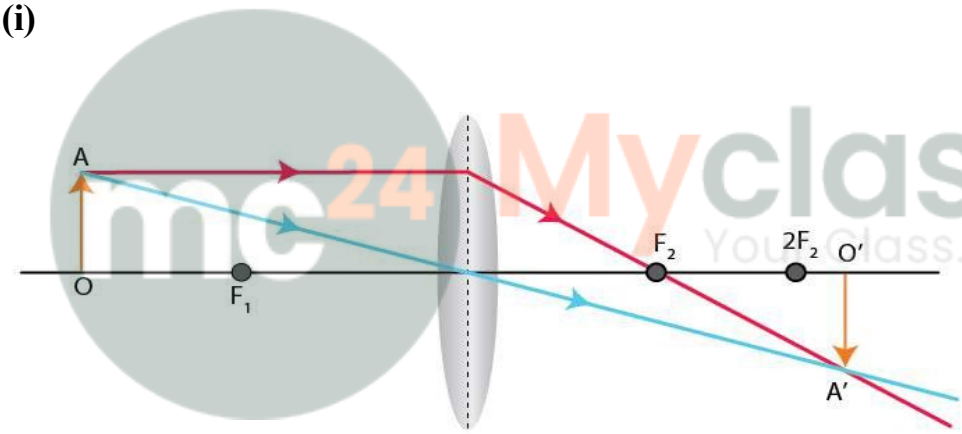


(b) The three characteristics of the image are magnified, virtual and upright.

Question: 8
The diagram given below in fig. shows the position of an object OA in relation to a converging lens L whose foci are at F_1 and F_2.

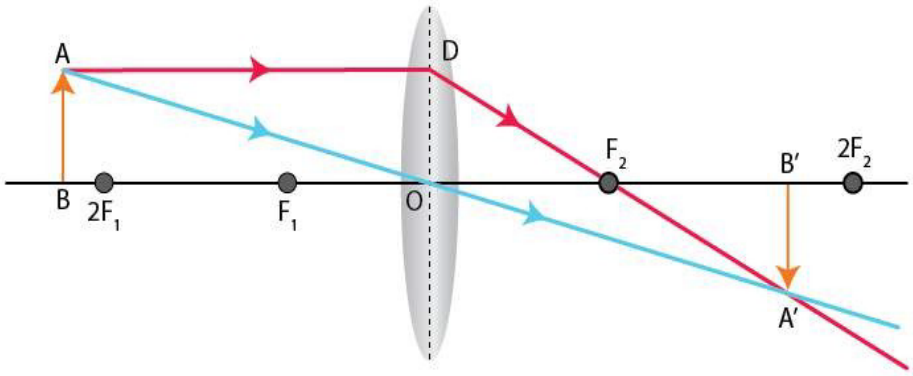


(i) Draw two rays to locate the position of the image.
(ii) State the position of image with reference to the lens.
(iii) Describe the three characteristics of the image.
(iv) Describe how the distance of the image from the lens and the size of the image change as the object move towards F_1.
Solution:
(i)



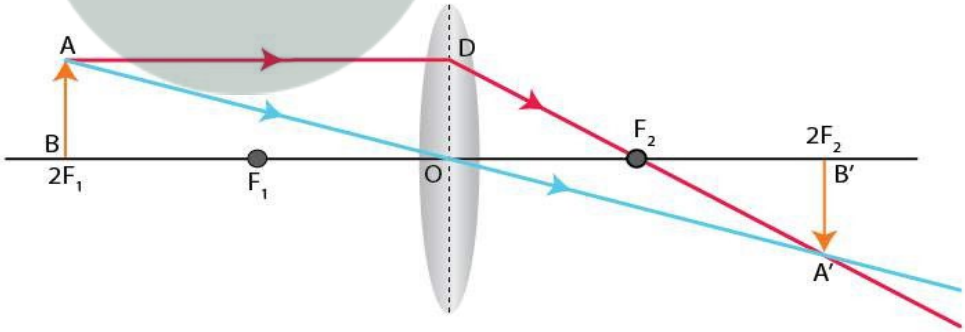
(ii) Images position will be more than twice the focal length of lens
(iii) The three characteristics of this image are magnified, real and inverted.
(iv) The image will shift away from F_2 as the object move towards F_1 and it is magnified. The image will form at infinity and it is highly magnified at F_1. 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) State its three characteristics of the image.
Solution:
(a) The object is placed beyond $2F_1$
(b)



The image is formed beyond $2F_2$
(c) The three characteristics of the image is real, inverted and diminished.

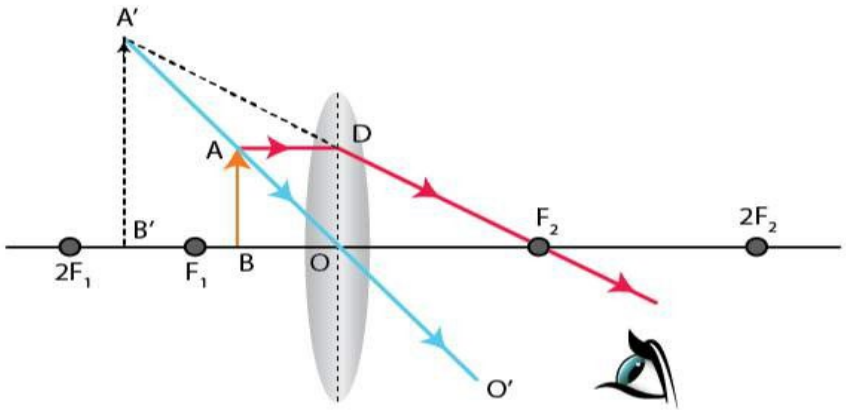
Question: 10
A convex lens forms an image of an object equal to the size of the object. (a) Where is the object placed in front of the lens? (b) Draw a diagram to illustrate it. (c) State two more characteristics of the image.
Solution:
(a) The object is placed at a distance equal to twice the focal length of the lens.
(b)



(c) The image formed is real and inverted

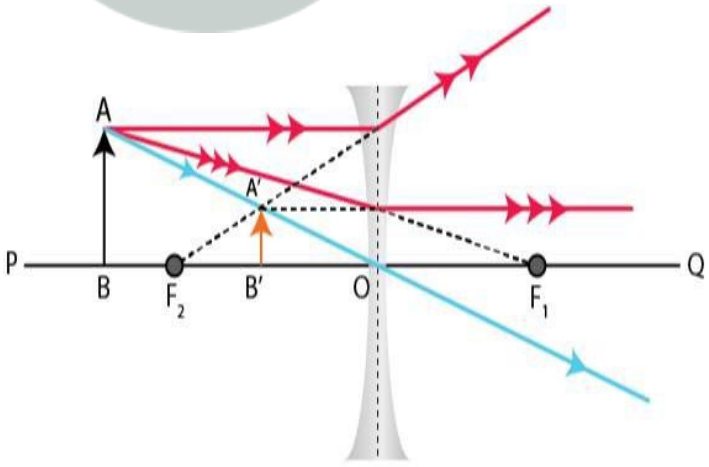
Question: 11
A lens forms an erect, magnified and virtual image of an object.
(a) Name the kind of lens.
(b) Where is the object placed in relation to the lens?
(c) Draw a ray diagram to show the formation of image.
(d) Name the device which uses this principle.
Solution:

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



(d) The device which uses this principle is magnifying glass

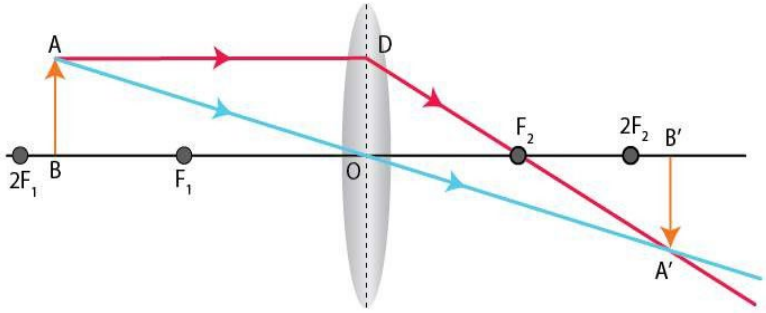
Question: 12
A lens always forms an image between the object and the lens. (a) name the lens. (b) Draw a ray diagram to shown the formation of such image. (c) state three characteristics of the image.
Solution:
(a) The lens that forms the image between the object and itself is concave lens.
(b) The below figure shows the ray diagram



(c) The three characteristics of the image are virtual, erect and diminished.

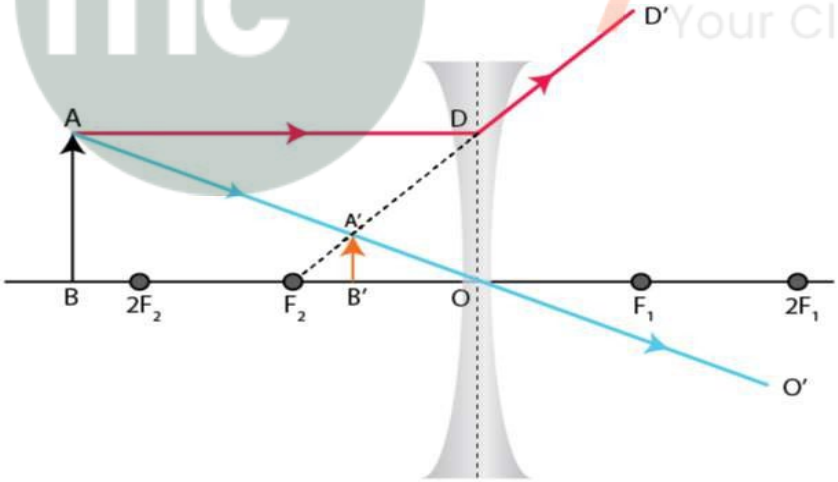
Question: 13
Classify as real or virtual, the image of a candle flame formed on a screen by a

convex lens. Draw a ray diagram to illustrate how the image is formed.
Solution:
Let the object is placed beyond $2F_1$ and its diminished image formed between F_2 and $2F_2$ which is real and inverted.

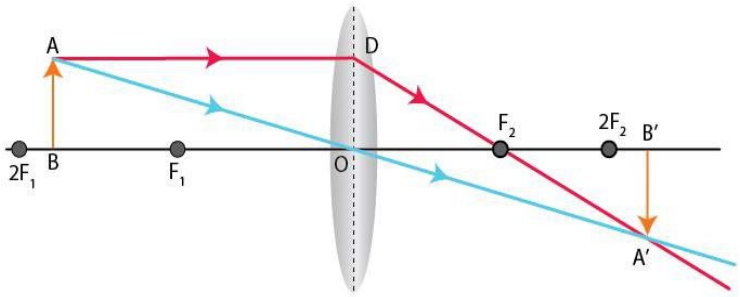


Here the object is AB and its real and inverted image is formed between F_2 and $2F_2$

Question: 14
Show by a ray diagram that a diverging lens cannot form a real image of an object placed anywhere on its principal axis.
Solution:



Question: 15
Draw a ray diagram to show how a converging lens can form a real and enlarged image of an object.
Solution:



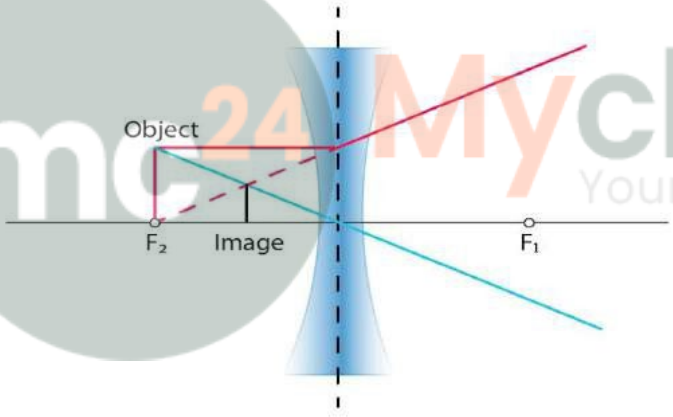
The above figure shows the image formed is real, enlarged and inverted.

Question: 16

A lens forms an upright and diminished image of an object placed at its focal point. Name the lens and draw a ray diagram to show the formation of image.

Solution:

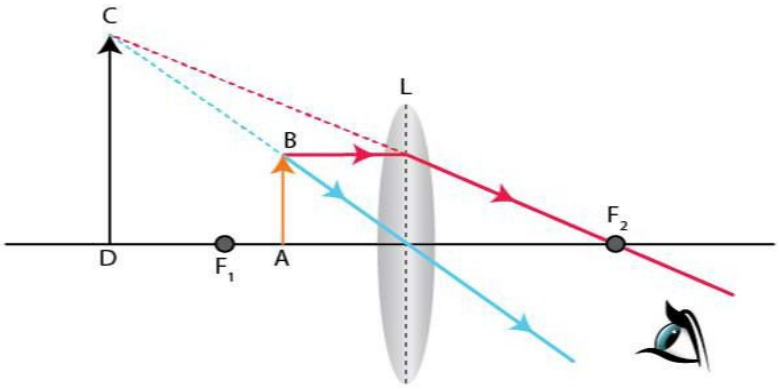
In a concave lens, the lens forms an upright and diminished image of an object placed at its focal point.



Question: 17

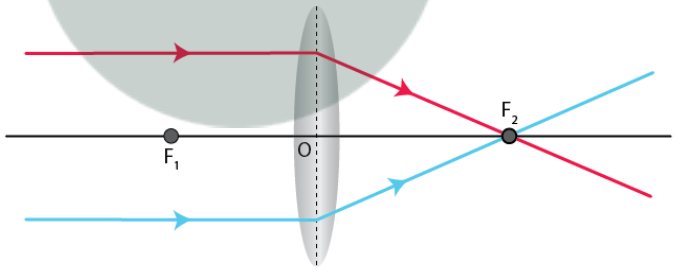
Draw a ray diagram to show how a converging lens is used as a magnifying glass to observe a small object. Mark on your diagram the foci of the lens and the position of the eye.

Solution:



The object is placed between the focal point F_1 and convex lens and its image is formed at the same side of the lens which is enlarged.
Hence, this lens can be used as a magnifying lens.

Question: 18
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:
The Sun is at infinity so convex lens forms its image at second focal point which is real and very much diminished in size.

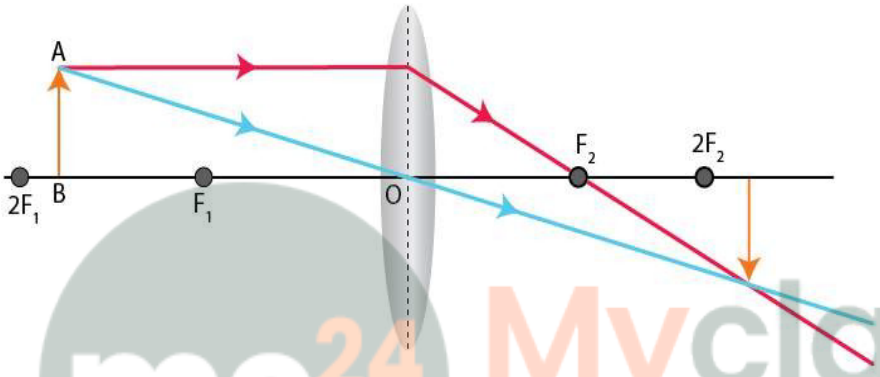


The rays of light from the sun converge to a single point called the focus of the lens. This concentrated image of the Sun burns the paper kept below the lens. Hence, the term burning glass is used for the lens.

Question: 19
A lens forms an inverted image of an object.
(a) Name the kind of lens.
(b) State the nature of the image whether real or virtual?
Solution:
(a) This lens is a convex lens

(b) The nature of the imaged is real

Question: 20
A lens forms an upright and magnified image of an object.
(a) Name the lens.
(b) Draw a labelled ray diagram to show the image formation.
Solution:
(a) The lens used here is a convex lens
(b)



Question: 21
(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:
(a) The lens used here is concave lens
(b) The image is diminished

Question: 22
Can a concave lens form an image of size two times that of the object? Give reason?
Solution:
No, concave lens cannot form an image of size two times that of the object because it diverges the rays incident on it and only produces a diminished image.

Question: 23
Give two characteristics of the image formed by a concave lens.
Solution:
The image formed by a concave lens is virtual and diminished.

Question: 24
Give two characteristics of the virtual image formed by a convex lens.
Solution:
The virtual image formed by a convex lens will be erect and magnified.

Question: 25
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?
Solution:
(a) At focus,
(b) At 2F,
(c) Between F and 2F,
(d) Between optical centre and focus.

Question: 26
Complete the following table:

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

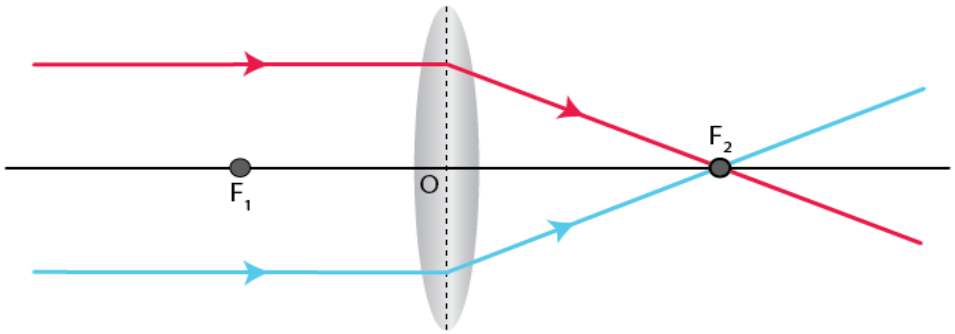
Solution:

Type of lens	Position of object	Nature of image	Size of image
Convex	Between optical 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

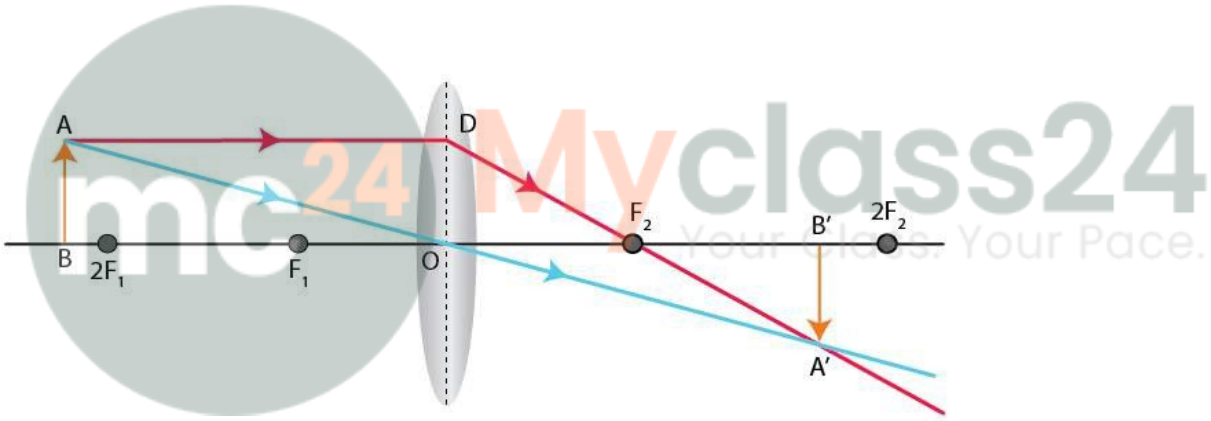
Question: 27
State the changes in the position, size and nature of the image when the object is brought from infinity up to the convex lens. Illustrate your answer by drawing the ray diagrams.

Solution:

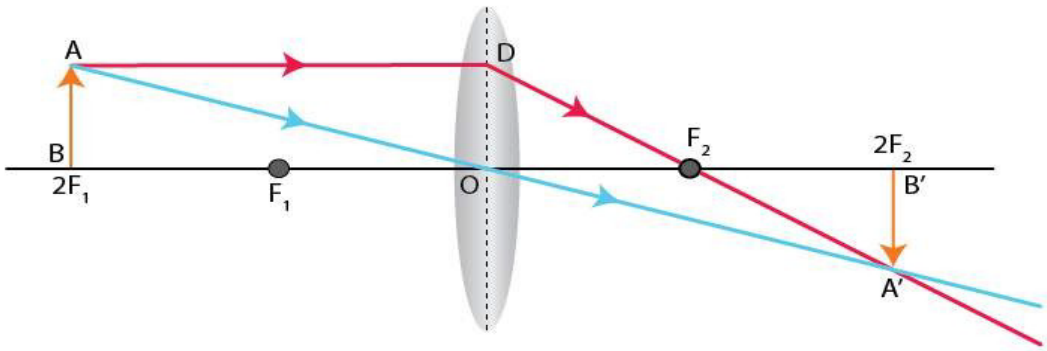
(i) The position of image is at F_2 when the object is situated at infinity. It is very much diminished in size and it is real and inverted.



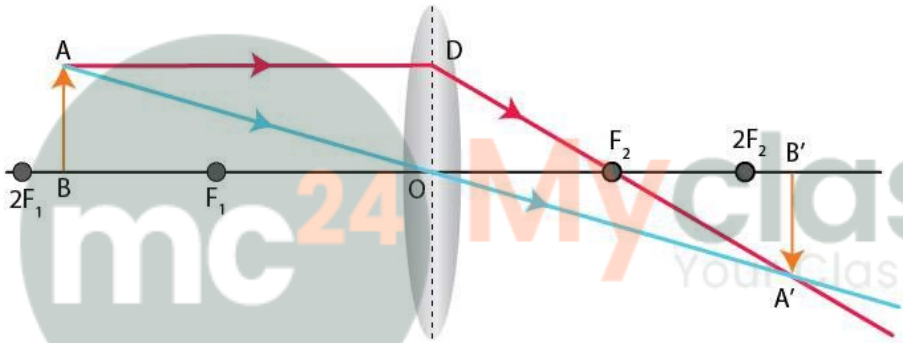
(ii) The position of image (A'B') is between F_2 and $2F_2$ when the object (AB) is situated beyond $2F_1$. It is diminished in size and real and inverted



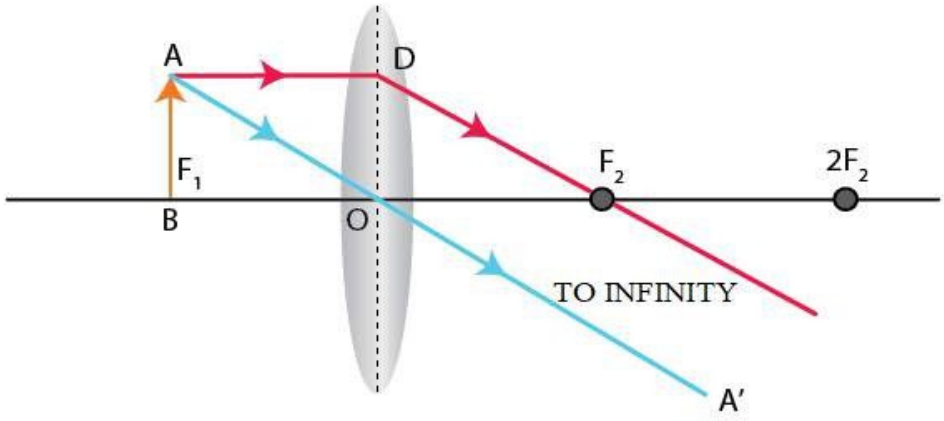
(iii) The position of image (A'B') is at $2F_2$ when the object (AB) is situated at $2F_1$. It is of same size as the object and real and inverted.



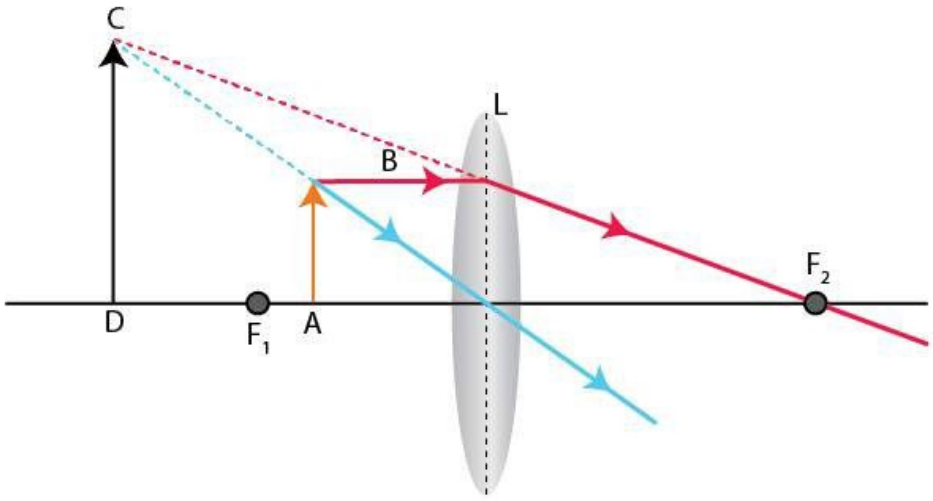
(iv) The position of image (A'B') is beyond $2F_2$ when the object (AB) is situated between $2F_1$ and F_1. It is magnified in size and real and inverted.



(v) The position of image is at infinity when the object (AB) is situated at F_1. It is very much magnified in size and real and inverted.



(vi) The position of (CD) is on the same side when the object (AB) is situated between lens and F_1. It is magnified in size and virtual and upright.

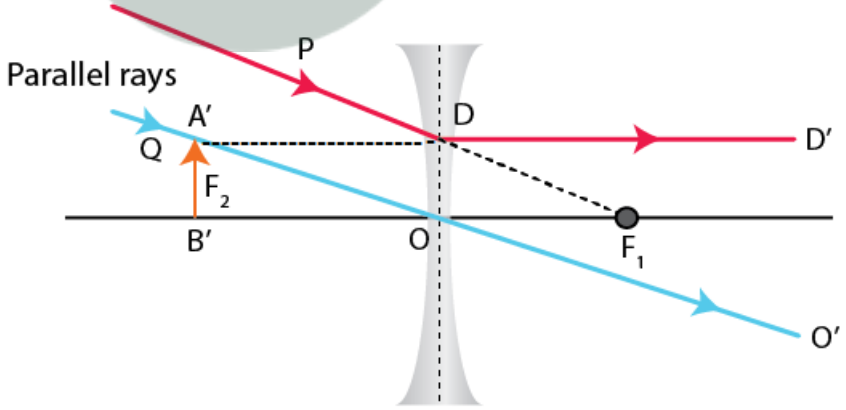


Question: 28

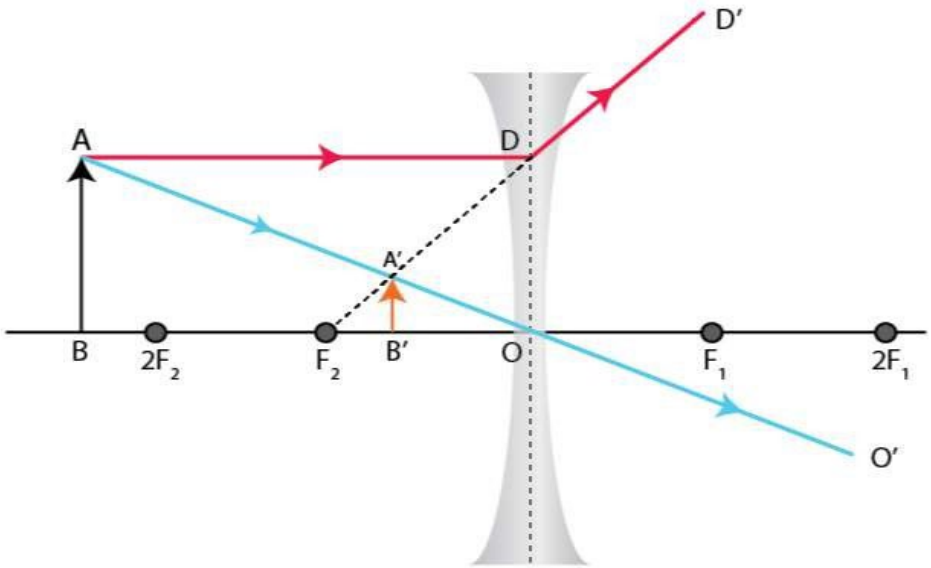
State the changes in the position, size and nature of the image When the object is brought from infinity up to a concave lens. Illustrate your answer by drawing diagrams.

Solution:

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



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



Question: 29

Complete the following sentence

(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 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:

(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: 30

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

MULTIPLE CHOICE TYPE
Question: 1
For an object placed at a distance 20 cm in front of a convex lens, the image is at a 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:
The focal length of a convex lens is 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:
The image is virtual and enlarged

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:
A concave lens forms the image of an object which is virtual, upright and diminished