Exercises.

1.) Which one of the following materials cannot be used to make a lens?
(a) Water (b) Glass (c) Plastic (d) Clay.

A-) (d) Clay.

2.) The image formed by a concave mirror is observed to be virtual, erect & larger than the object. Where should be the position of the object?
(a) Between the Principal focus & the centre of curvature.
(b) At the centre of curvature.
(c) Beyond the centre of curvature.
(d) Between the pole of the mirror & its Principal focus.

A-) (d) Between the Pole of the mirror & it's Principal focus.

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3.) Where should an object be placed in front of a convex lens to get a real image of the size of the object?
(a) At the Principal focus of the lens.
(b) At twice the focal length.
(c) At infinity.
(d) Between the optical centre of the lens & its Principal focus.

A.) (b) At twice the focal length.

4.) A spherical mirror & a thin Spherical lens have each a focal length of -15 cm. The mirror & the lens are likely to be.
(a) Both Concave.
(b) Both Convex.
(c) the mirror is Concave & the lens is Convex.
(d) the mirror is Convex, but the lens is Concave.

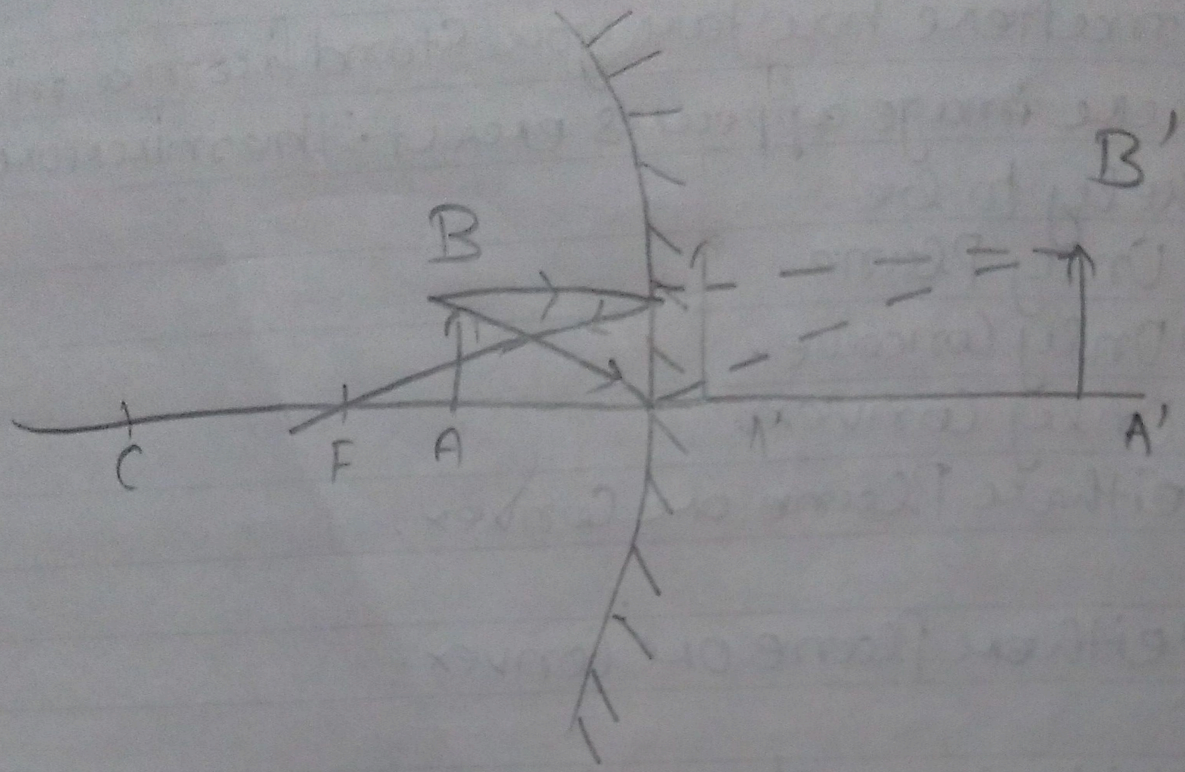
A.) (a) Both Concave.

5.) No matter how far you stand from a mirror, your image appears erect. The mirror is likely to be.
(a) Only Plane.
(b) Only Concave.
(c) Only Convex.
(d) either Plane or Convex.

A.) (d) either Plane or Convex.

6.) Which of the following lenses would you prefer to use while reading small letters found in a dictionary?
(a) A Convex lens of focal length 50 cm.
(b) A Concave lens of focal length 50 cm.
(c) A Convex lens of focal length 5 cm.
(d) A Concave lens of focal length 5 cm.

(c) A convex lens of focal length 5 cm.


B'
B
C
F
A
A'

7.) We wish to obtain an erect image of an object, using a concave mirror of focal length 15cm. What should be the range of distance of the object from the mirror? What is the nature of the image? Is the image larger or smaller than the objects? Draw a ray diagram to show the image formation in this case.

A-) Object distance should be less than the focal length for the formation of an erect image. Hence, the range of distance of object from the mirror should be less than 15cm i.e. from 0 to 15cm in the front of mirror from the pole. The nature of image so formed will be virtual and erect. Ray diagram is attached as image to the question. 1

8.) Name the type of mirror used in the following situations.

(a) Headlights of a car.
(b) Side/rear-view mirror of a ~~vehicle~~ vehicle.
(c) Solar furnace.

A-) (a) Concave mirror.
(b) Convex mirror.

(C) Concave mirrore.

9.) One-half of a Convex lens is Covereed with a bleack Papere. Will this lens Preoduce a Complete image of thee object? Vereify youre answeere expereimendally. Explain yoeee obseervations.

Ans) Even if one half of a Convex lens will be Covereed with a bleack Papere, it would still Preodeece thee Complete image but thee image will be a bit faintere.

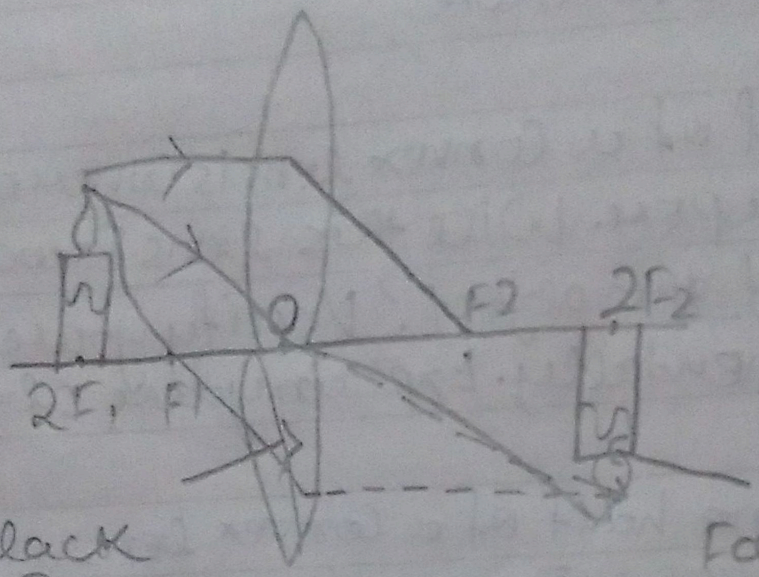
Expereiment:

We follow theese steps.

1.) Take a Candle & a Convex lens.

2.) Adjust thee Position of lens until a Sheareep image of Candle is obseerved.

3.) We will obseerve theat thee image formee is reeal, invereted & sharep.



Convex Mirror half covered with black Paper.

4.) Note down the Position of the Convex lens.

5.) Now, Covere the lowere half of the Convex lens with black Papere.

6.) And Pleece the Convex lens at the Same Position.

7.) We will obsereve that the image Preodeeced will be Compleete.
But the imeage obsereved now will be faintere.

Obserevation.

Even when half of the mirerore is covereed with black Papere, it would still Preoduce a Compleete imeage but the imeage Preodeeced wooeld be feeintere (of lesseke intensity) than the imeage Preodeeced when half mirerore was not covereeed.

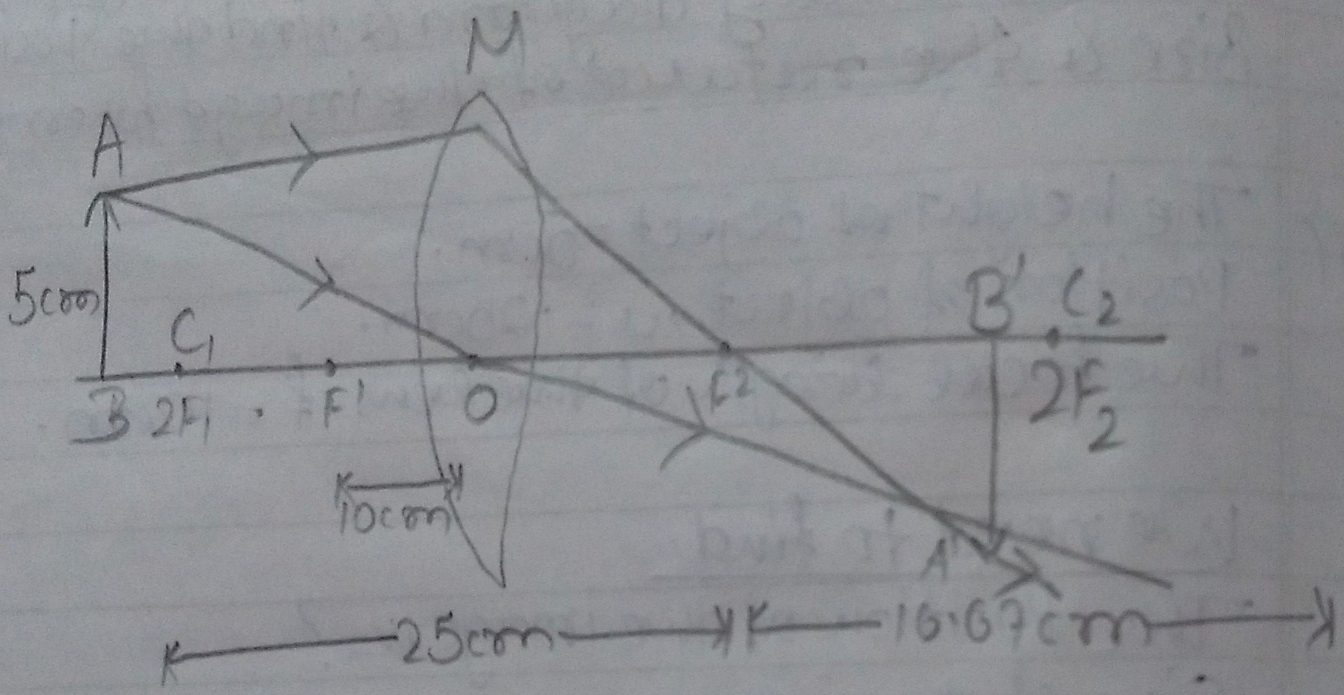
10) An object 5cm in length is held 25cm away from a converging lens of focal length 10cm. Draw the ray diagram & find the position, size & the nature of the image formed.

Ans) The height of object = 5cm.
Position of object, u = -25cm.
The focal length of the lens, f = 10cm.

We need to find.
The position of the image, v = ?
Size of the image.
Nature of the image.

Formula.
We know that
$1/v \pm 1/u = 1/f$.

Substituting the known values in the above equation. we get,
$1/v + 1/25 = 1/10$.
$\Rightarrow 1/v = 1/10 - 1/25$
$\Rightarrow 1/v = (5-2)/50$.


M
A
5cm
C1
B
2F1
F'
O
F2
B'
C2
2F2
10cm
A'
25cm
16.67cm

Hence, 1/v = 3/50.
So, v = 50/3 = 16.66cm.

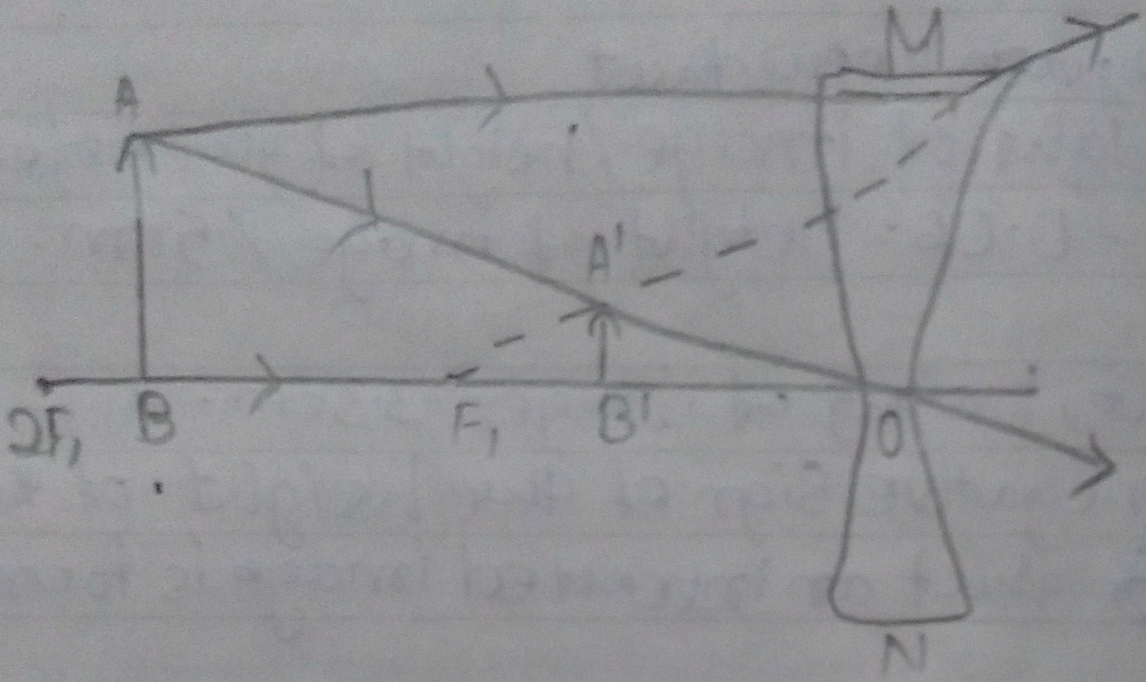
Also, we know that
m = height of image / height of the object.
Or, -0.66 = height of image / 5cm.

Hence, height of image = -3.3cm.
The negative sign of the height of the image depicts that an inverted image is formed.

So, the Position of image = -3.3cm at the opposite Side of the lens.
Nature of image - Real & inverted.

11.) A concave lens of focal length 15cm forms an image 10cm from the lens. How far is the object Placed from the lens? Draw the ray diagram.

A.) Focal length (f) = -15cm.
Distance of image (v) = -10cm.


M
A
A'
2F1
B
F1
B'
O
N

$1/u = -(1/10) - (1/-15)$

$1/u = 1/15 - 1/10$.

$u = -30\,cm$.

So, the object is Placed 30 cm away from the concave lens.

12) An object is Placed at a distance of 10 cm forms a convex mirror of focal length 15 cm. Find the Position & nature of the image.

A:) Given that.

$u = -10\,cm$.

$f = 15\,cm$.

Find out.

We need to find v.

Formula.

We know that formula.

$1/f = 1/v + 1/u$.

Therefore, $1/u = 1/f - 1/u$.

Substituting the known values in the above equation we get,

$1/v = 1/15 + 1/10$.

$1/v = (2+3)/30$ (cm)

Hence $v = 5/30 = 6$ cm.

$V = 6$ cm.

Nature of the image: The image is formed behind the mirror & it is virtual & erect.

13) The magnification produced by a plane mirror is +1. What does this mean?

-) The magnification produced by a plane mirror is +1 means then the size of the image is equal to the size of the object. If ~~the~~ ~~object~~ has a magnitude greater than 1 the image is larger than the object, & an image with a magnitude less than 1 means the image is smaller than the object.

An object 5.0 cm in length is placed at a distance of 20 cm in front of a convex mirror of radius of curvature 30 cm. Find the position of the image, its nature & size.

→ $u = -20\,cm$

$h_o = 5\,cm.$

$R = +30\,cm$ (Convex mirror)

$f = \frac{R}{2} = \frac{30}{2} = +15\,cm$ (Convex mirror).

From the mirror formula, We get.

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

$$\Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u}.$$

$$\Rightarrow \frac{1}{v} = \frac{1}{15} - \frac{1}{-20}.$$

$$\Rightarrow v = 8.57\,cm.$$

The image is formed at a distance of 8.57 cm behind the convex mirror. Thus, it is virtual & erect.

$m = -\frac{v}{u}$.

$m = \frac{8.75}{-20} = 0.4$.

Also,

$m = \frac{h_1}{h_0}$.

$0.4 = \frac{h'}{5}$.

$h_i = 0.4 \times 5 = 2\text{cm}$.

Thus, the height of an image is 2cm.

Thus, we can say that the image is diminished

15.) An object of size 7.0cm is placed at 27cm in front of a concave mirror of focal length 18cm. At what distance from the mirror should a screen be placed, so that a sharp focussed image can be obtained? Find the size & the nature of the image.

A.) Given that.

$u = -27\text{cm}$.

$f = -18\text{cm}$.

$h_o = 7.0\,cm$.

We need to find out size & nature of image.

Formula :

$1/v = 1/f - 1/u$

$1/v = -1/18 + 1/27 = -1/54$.

$v = -54\,cm$.

The Screen must be Placed at a distance of 54cm from the mirror in front of it.

$h_i/h_o = v/u$.

$h_i/h_o = v/u$.

$h_i/7 = +54/-27$ $h_i = 2 \times 7 = +14\,cm$

Thus, the image is of 14cm length & is inverted image.

16.) Find the focal length of a lens of Power −2.0 D. What type of lens is this?

A.) Power of lens (P) = 2.0 D.
P = 1/f or f = 1/m.
f = 1/−2.0 = −0.5 m.

A negative sign of focal length means that the lens is Concave.

17.) A doctor has Prescribed a Corrective lens of Power +1.5 D. Find the focal length of the lens. Is the Prescribed lens diverging or Converging?

A) P = +1.5 D.
Solution.
f = 1/P.
Where,
f is the focal length.

P is Power.

$f = 1/P$.

$= 1/+1.5 = 0.67\,m$.

As the Power of the lens is (+ve), the lens is converging.