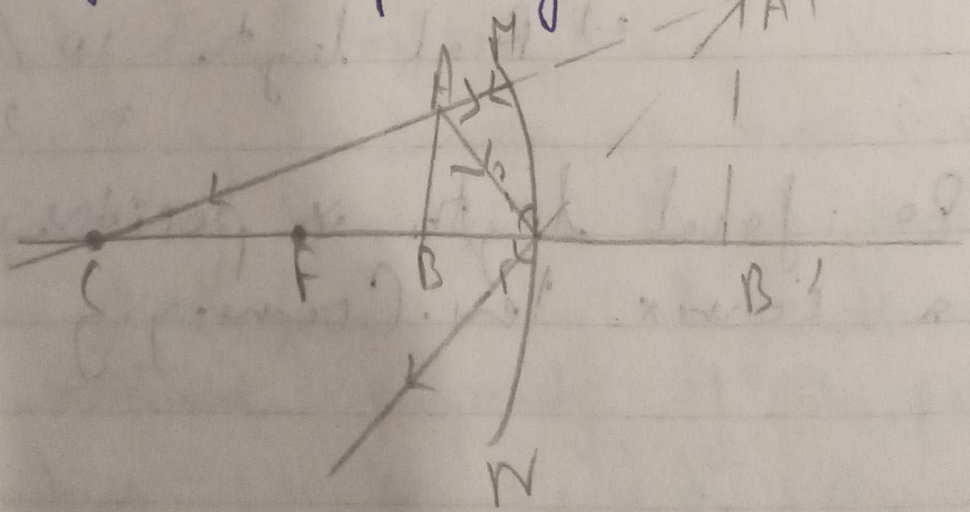
Hw1

Exercise

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

A Here the focal length of concave mirror is 15 cm. To obtain an erect image of an object with a concave mirror. The object should be placed between the pole and focus i.e., within 15 cm from the pole of the mirror.



8. Name the type of mirror used in the following situation. Give reason
(a) Headlights of a car - Concave mirror
(b) Side / rear view mirror of vehicle - Convex Mirror because of its largest field of view Mirror
(c) Solar furnace - Concave because it concentrates the parallel rays of sun at principle focus

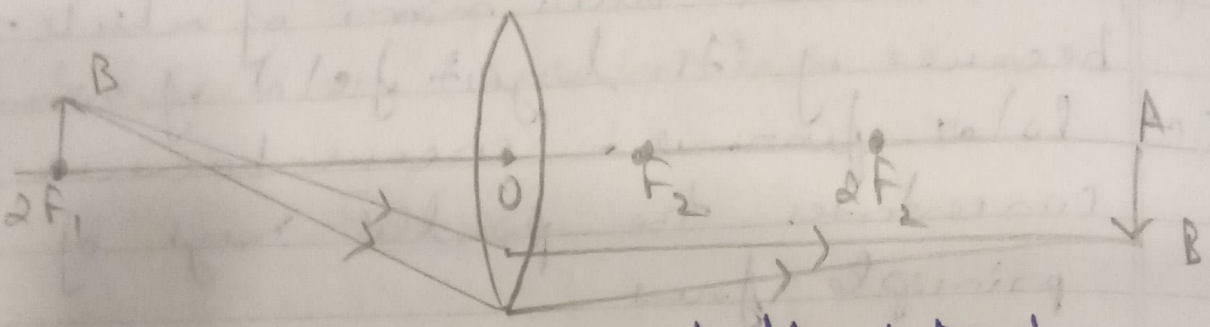
(a) Because concave mirror can produce powerful parallel beam of light when the light source is placed at their principle focus.

9. One half of a convex lens is covered with a black paper. Will this lens produce a complete image of the object? Verify your answer experimentally. Explain your observation.

A. A convex lens form complete image of an object even if it is one half is covered with black paper. It can be explained by considering following two cases:-

Case I: When the upper half of the lens is covered In this case, a ray of light coming from the object will be refracted by the lower half of lens. These rays meet at the other

side of lens to form the image of given object



Case 2: When the lower half of the lens is covered. In this case, a ray of light coming from the object is refracted by the upper half of the lens. This rays meet at the other side of the lens to form the image.

10. ~~An object 5cm in length is held 25cm away from a converging lens of focal length 10cm. Draw a ray diagram to find position, size & nature of image formed. A converging lens of focal length 15cm forms a image 10cm from the lens. How far is the object placed from the lens? Draw the ray diagram~~

A Height of object = 5cm , Distance = -25cm

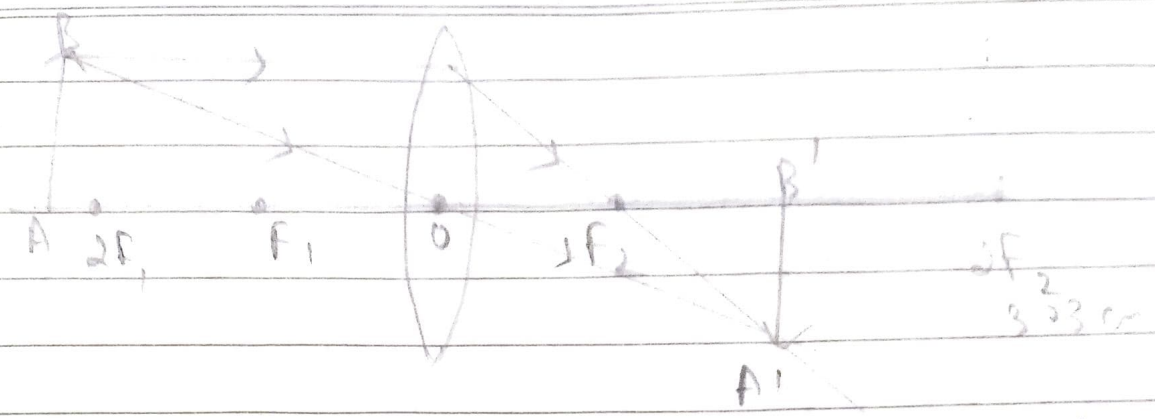
Focal length of a converging lens = f = 10cm

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} = \frac{1}{f} + \frac{1}{u} \Rightarrow \frac{1}{10} - \frac{1}{25} = \frac{15}{250}$$

$$v = \frac{13}{250} = 16.66\text{cm}$$

For converging lens : $\frac{h_i}{h_o} = \frac{v}{u}$

$$h_i = \frac{v}{u} \times h_o = \frac{50 \times 5}{3 \times (-25)} = \frac{10}{-3} = -3.3\text{cm}$$



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

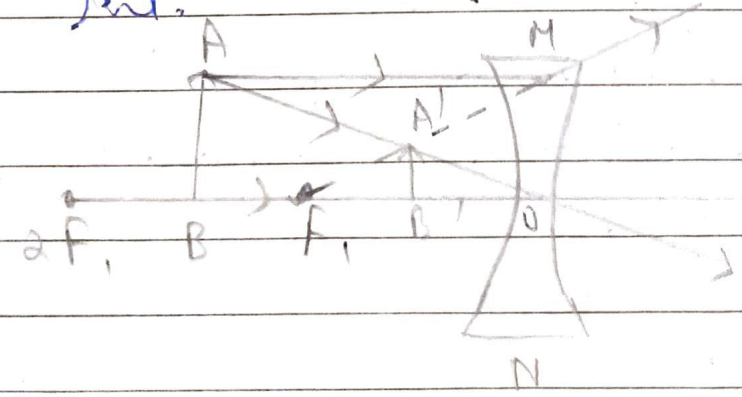
A. Focal length (f) = -15cm

Distance of image = -10cm

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{u} = \left(\frac{-1}{10}\right) - \left(\frac{1}{-15}\right)$$

$$\Rightarrow \frac{1}{u} = \frac{1}{15} - \frac{1}{10} \Rightarrow \frac{1}{u} = -0.033 \Rightarrow u = -30cm$$

So, The object is placed 30cm away from concave lens.



12. An object is placed at a distance of 10cm from a convex mirror of focal length 15cm. Find the position & nature of the image.

A. $F = 19cm$
$U = 10cm$
For mirror we have
$$\frac{1}{f} = \frac{1}{U} + \frac{1}{V}$$
$$\Rightarrow \frac{1}{V} = \frac{1}{f} - \frac{1}{U} = \frac{1}{19} - \frac{1}{-10}$$
$$\frac{1}{V} = \frac{10 + 19}{190} \quad \frac{29}{190}$$
$$\Rightarrow V = \frac{190}{25} \quad 6cm.$$
The image is virtual & erect

13. The magnification produced by a plane mirror is +1, what does this mean?
A. This mean that size of the image is equal to the size of the object

14. An object ~~is placed 50~~ 5cm in length is placed at a distance of 20cm in front of a convex mirror of radius of curvature 30cm. Find the position of image, its nature & size.
A. $h = 5.0cm$, $U = -20cm$
$f = \frac{R}{2} = 15cm$
Using mirror formula, $\frac{1}{f} = \frac{1}{V} + \frac{1}{U}$, we get
$$\frac{1}{V} = \frac{1}{f} - \frac{1}{U} = \frac{1}{15} - \frac{1}{-20}$$

$\Rightarrow \frac{20+15}{300} = \frac{35}{300} \Rightarrow \frac{300}{35} = \frac{60}{7} = 8.57\text{cm}$

$m = \frac{-v}{u} = m = \frac{h_i}{h_o} = \frac{h_i}{5} = \frac{8.57}{20} = 0.428$

$h_i = 0.428 \times 5 = 2.14\text{cm}$

Position of image : Behind the mirror

Nature - Virtual & Erect

Size of image : 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 mirror should a screen be placed, so that a sharp focused image can be obtained ? And the size & nature of image

A object size, $h = 7.0\text{cm}$, object distance, $u = -27\text{cm}$

focal length $= -18\text{cm}$, Image distance, $v = ?$

Image size, $h' = ?$

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

$\Rightarrow \frac{1}{-18} - \frac{1}{-27} = \frac{-3+2}{54} = \frac{-1}{54} \Rightarrow v = -54\text{cm}$

The screen should be placed at distance of 54cm on object side of mirror to obtain a sharp image

$m = \frac{h'}{h} = \frac{-v}{u}$

Image size, $h' = -\frac{vh}{u} = -\frac{(-54)\times(7)}{-27} = -14\text{cm}$