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Chapter-9

Light - Reflection and Refraction

Question Bank - Oswal

1.) Both are Concave mirror and Concave lens.

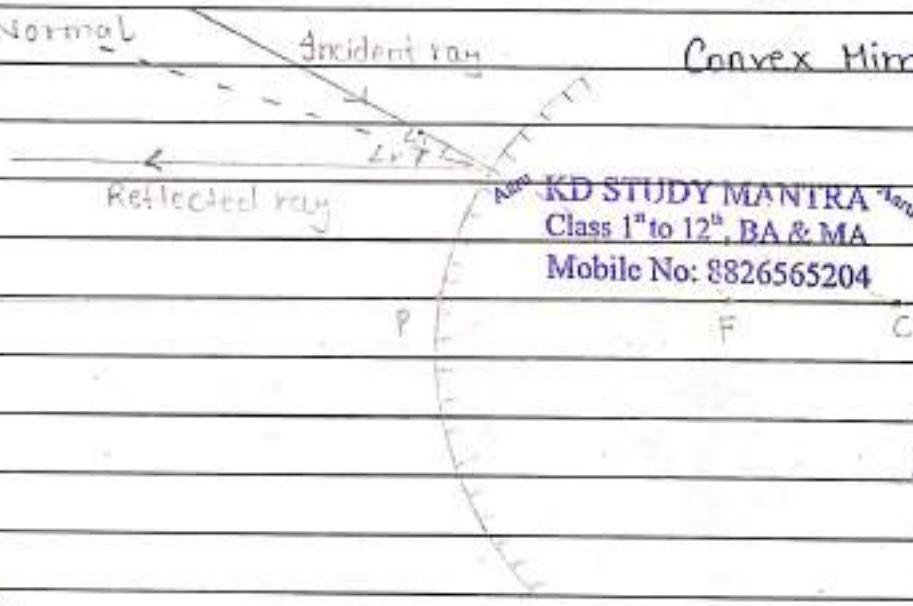
2.) The object is placed between the principal focus and the center of Curvature.

3.) Infinitely light rays from the point P on the candle flame can be drawn to the corresponding point on the image P'.

4.) Due to its wide field of view.

5.) The magnification of a plane mirror is +1 because In Plane mirror the size of the object is equals to the size of the image.

6.)



Convex Mirror

$\angle i$ = Angle of Incidence
$\angle r$ = Angle of Reflection

The ray which is directed towards the principal focus in Convex mirror will goes parallel to the principal axis after reflection.

7.) The diagram of refraction on glass slab are as follows:-

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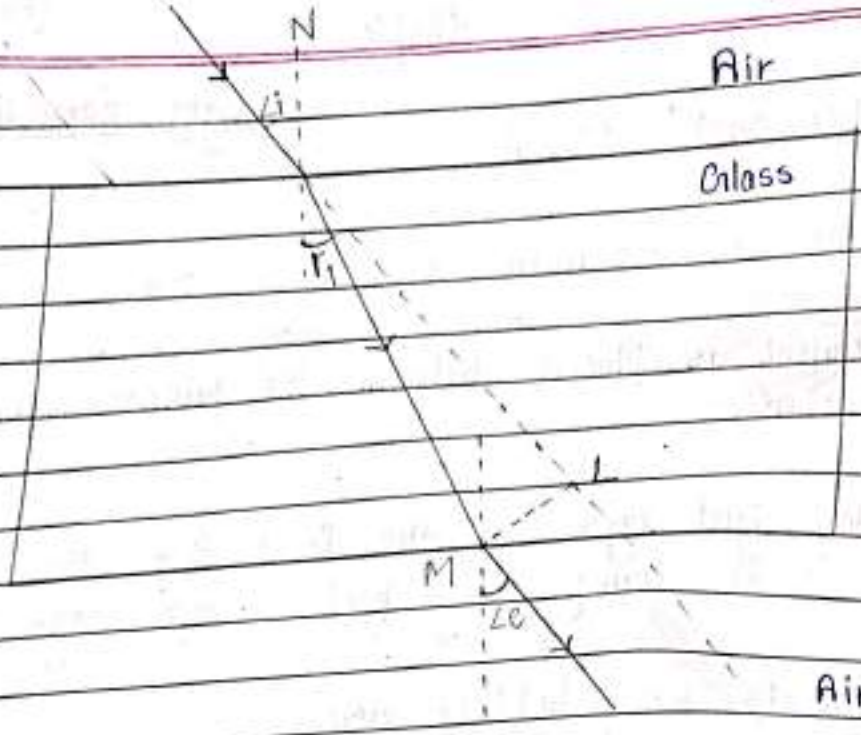
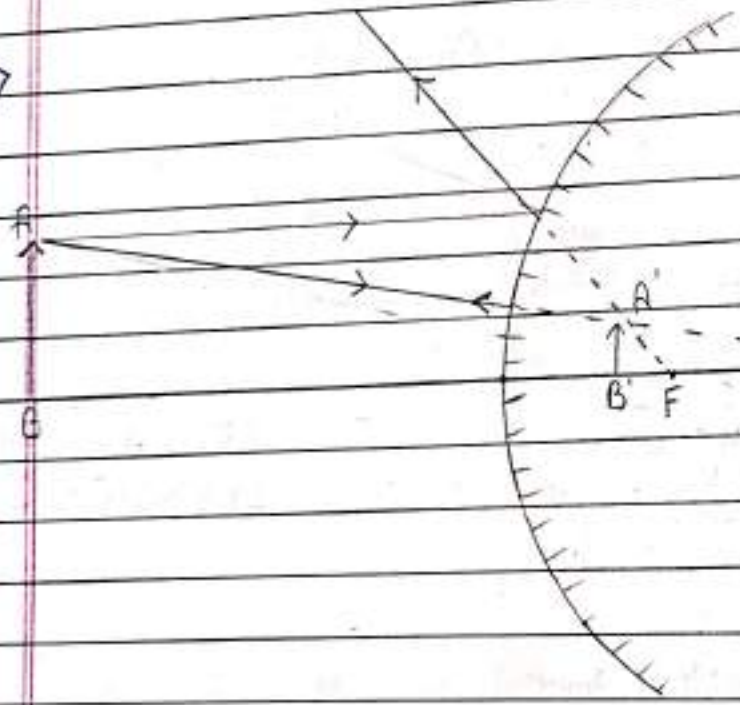


Now,
r_1 = Angle of Refraction
$\angle e$ = Angle of emergence
ML = Lateral displacement

8.)



A' B' - Virtual and erect image formed between pole and foci of Convex mirror.

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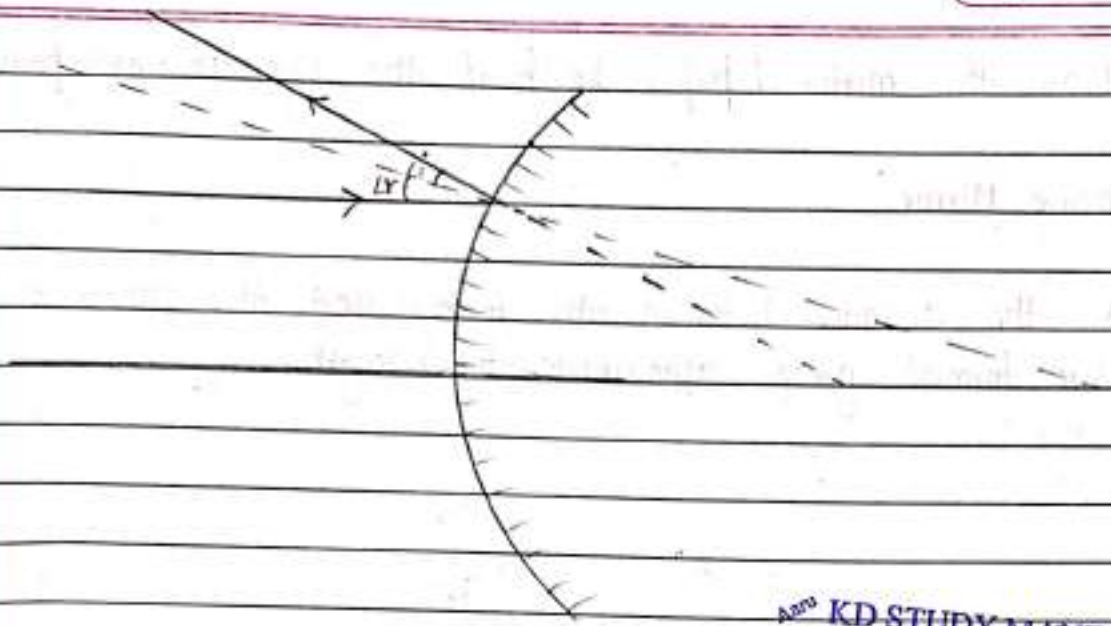
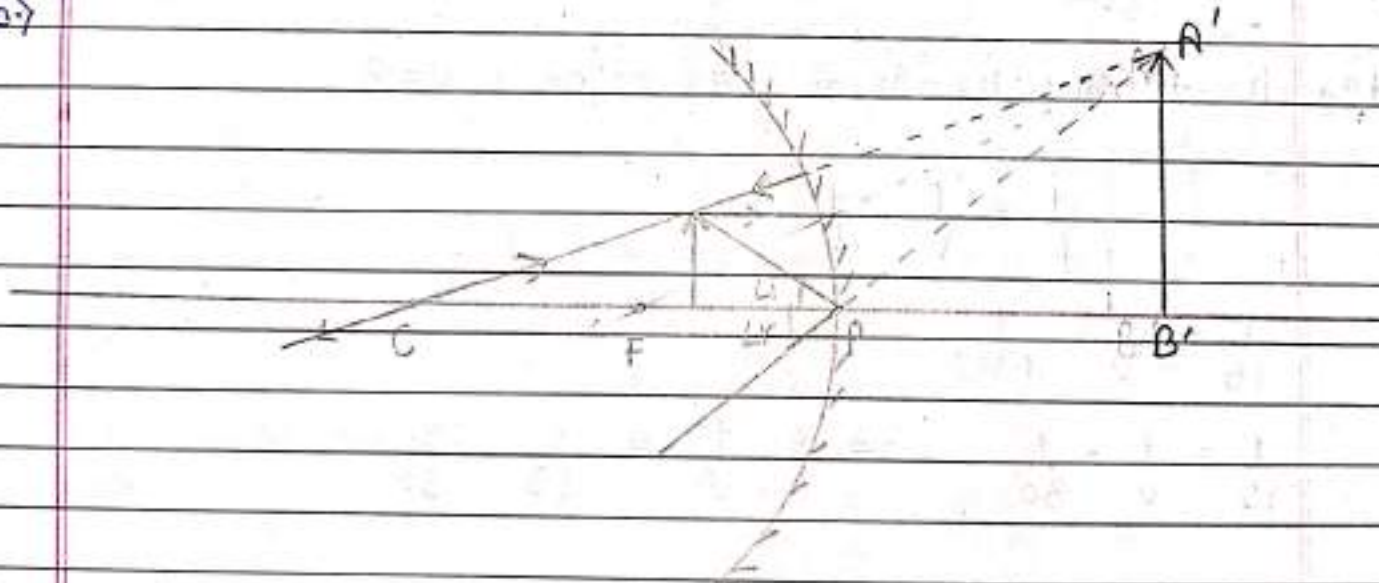
9.)



$\angle i$ = Angle Of Incidence
$\angle r$ = Angle of Reflection

10.) a.) The object has to placed between the range of 0-40 cm. Because In a Concave mirror if the object is placed between Pole and focus the image is formed behind the mirror which is virtual and erect.

b.)



c.) Used in shaving mirror or used by dentists to get enlarged image of teeth.

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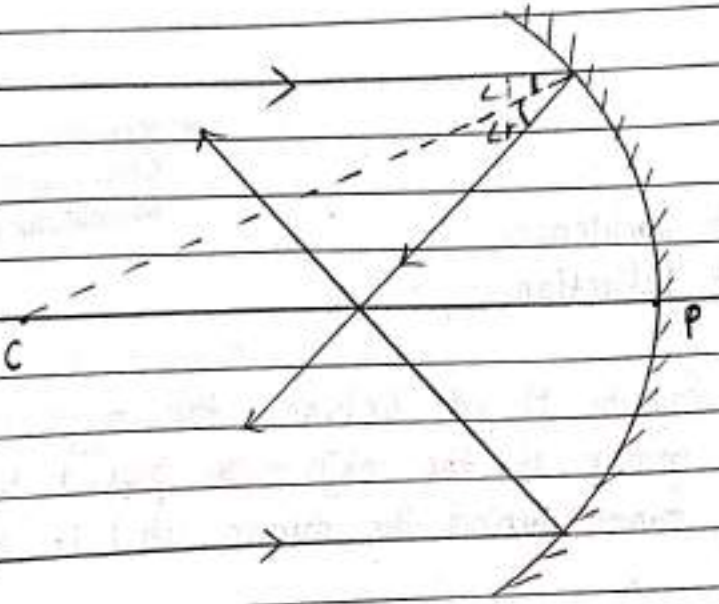
11) a) Move the mirror / paper to focus the rays at one point.

b) Concave Mirror

c) Yes, the distance between the mirror and the sharp focused image of sun formed gives approximate focal length.



12) $h = +5\,cm$; $u = -30\,cm$; $f = +15cm$; $v = ?$

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

$$\frac{1}{15} = \frac{1}{v} + \frac{1}{(-30)}$$

$$\frac{1}{15} = \frac{1}{v} - \frac{1}{30} \Rightarrow \frac{1}{v} = \frac{1}{15} + \frac{1}{30}$$

$$\frac{1}{v} = \frac{2+1}{30} \Rightarrow \frac{1}{v} = \frac{1}{10} \therefore \Rightarrow v = +10\ cm$$

$$\frac{h_1}{h_2} = \frac{-v}{u} \therefore \Rightarrow \frac{5}{h_2} = \frac{-10}{-30}$$

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$h_2 = \frac{1}{3} \times 5 \Rightarrow h_2 = \frac{5}{3}$

$h_2 = +1.67\,cm$

Nature:- Virtual and Erect

13) $h_1 = +4cm$; $u = -15cm$; $f = -10cm$; $v = ?$; $h_2 = ?$

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

$$\therefore \frac{1}{-10} = \frac{1}{v} - \frac{1}{15}$$

$$\frac{1}{v} = \frac{1}{-10} + \frac{1}{15}$$

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

$$\frac{1}{v} = \frac{-1}{30}$$

$v = -30\,cm$

$$\frac{h_2}{h_1} = \frac{-v}{u}$$

$$\therefore \frac{h_2}{4} = \frac{-(-30)}{-15}$$

$h_2 = -2 \times 4$

$\therefore h_2 = -8$

14) The nature of the mirror is Concave since the image formed is real.

Given :- $u = -30cm$; $v = -60cm$; $h = 2.4cm$

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Using mirror formula

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

$$\frac{1}{f} = \frac{1}{-60} + \frac{1}{(-30)}$$

$$\frac{1}{f} = \frac{1+1}{(-60)(-30)}$$

$$\frac{1}{f} = \frac{1+(+2)}{-60}$$

$$\frac{1}{f} = \frac{3}{-60} \Rightarrow \frac{1}{-20}$$

$\therefore$ $f = -20$ cm

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

$$m = \frac{-(-60)}{-30} = \frac{-h'}{2.4}$$

$$h' = -2 \times 2.4$$

$$h' = -4.8 \text{cm}$$

The required height of the image is -4.8cm

And, the image formed is inverted.

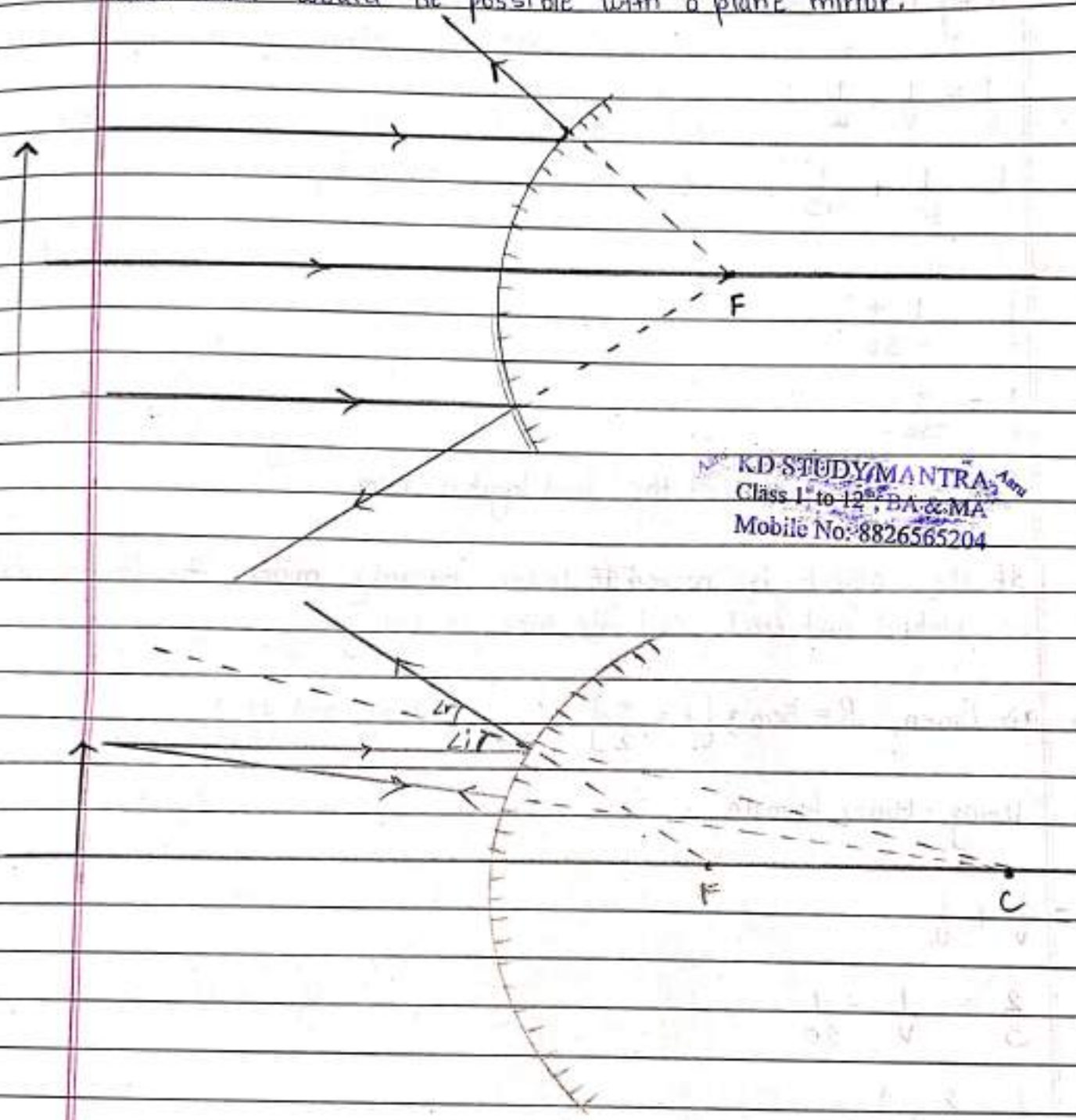
15) In Convex or Diverging Mirror for all positions of the object placed in front of it is always virtual and diminished.

Uses:-

i) It is used in the side mirrors of the car.

ii) It has a wide field of view which enables up to see much larger

area than would be possible with a plane mirror.



16) $m = -2\,cm$; $v = -30cm$; $u = ?$

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

$$-2 = \frac{-(-30)}{u} \Rightarrow u = -\frac{(-30)}{2} \Rightarrow u = -15cm$$

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Using Mirror Formula

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

$$\frac{1}{f} = \frac{1}{-30} + \frac{1}{-15}$$

$$\frac{1}{f} = \frac{1+2}{-30}$$

$$\frac{1}{f} = \frac{3}{-30}$$

$f = -10\,cm$ Hence the focal length is 10cm

If the object is moved 10 cm towards mirror, the image will be virtual and erect and the size is enlarged.

17.) a.) Given, $R = 5cm$; $\{f = \frac{5}{2}cm\}$; $u = -20m$ and $v = ?$

Using Mirror formula

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

$$\frac{2}{5} = \frac{1}{v} - \frac{1}{20}$$

$$\frac{1}{v} = \frac{2}{5} + \frac{1}{20}$$

$$\frac{1}{v} = \frac{8+1}{20}$$

$$\frac{1}{v} = \frac{9}{20}$$

$$v = \frac{20}{9} \quad \therefore v = 2.2m$$

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Nature of the image = Virtual and erect
Size of the image = Diminished image

b) Mirror used by dentist is :- Concave Mirror
Reason :- To get enlarged image of teeth.

18.) Given :- $h = 6cm$; $f = -30cm$; $u = -45$; $v = ?$; $m = ?$ and $h_2 = ?$

Using mirror formula

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

$$\frac{1}{-30} = \frac{1}{v} - \frac{1}{45}$$

$$\frac{1}{v} = \frac{1}{-30} + \frac{1}{45}$$

$$\frac{1}{v} = \frac{-3+2}{90}$$

$$v = \frac{-1}{90}$$

$$v = -90\ cm$$

Now, $m = \frac{-v}{u}$

$$= \frac{-(-90)}{-45}$$

$$= m = -2$$

$$m = \frac{h^2}{h_1}$$

$$h_2 = -2 \times 6$$

$$h_2 = -12$$

Hence the image is real, inverted and enlarged.

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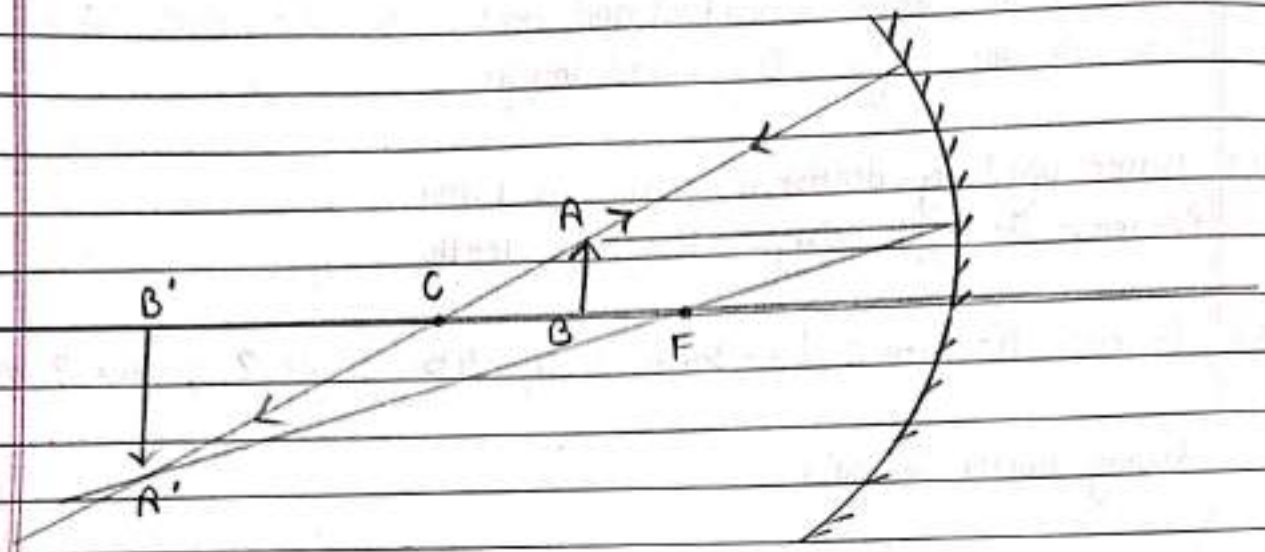
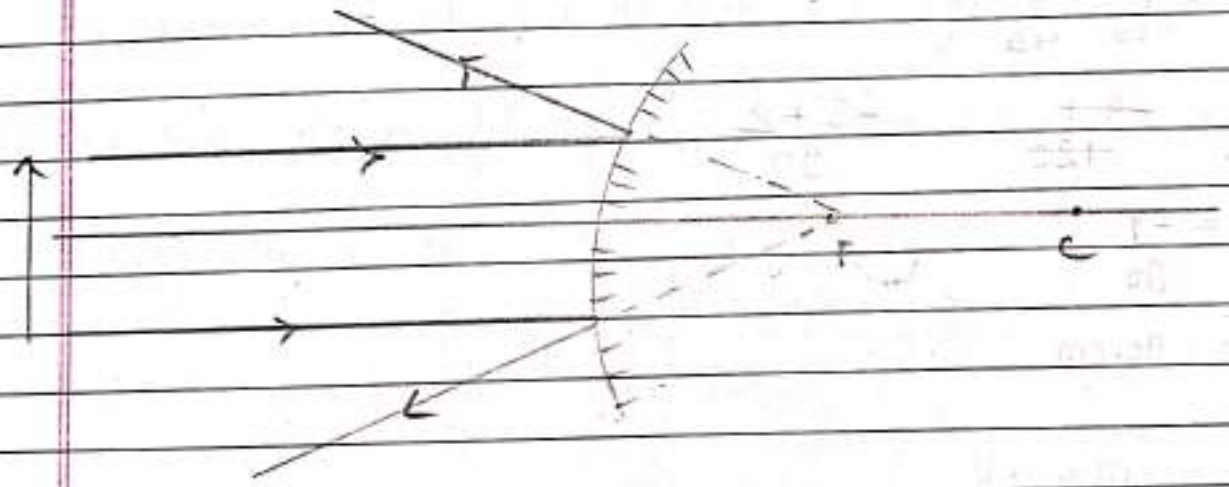
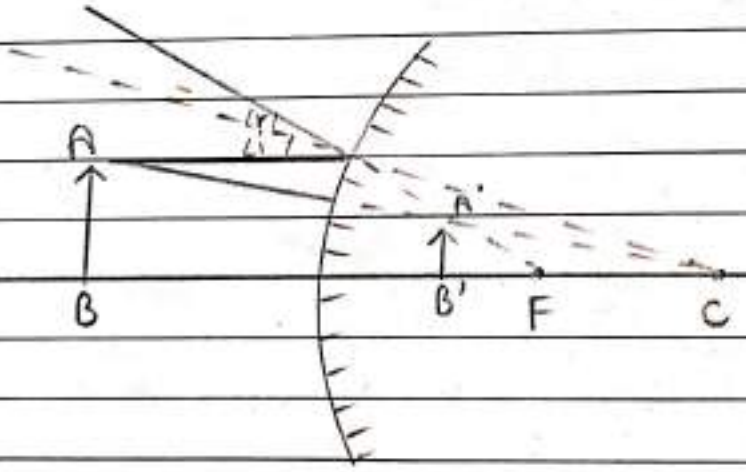


19.(a) If object is placed at any finite distances from a convex mirror, image is virtual, erect and diminished.





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b.) Radius of Curvature is the radius of sphere (imaginary) of which spheric mirror is a part. It is Represented by R

Given: $R = +24cm$

$\therefore$ It is a convex mirror

$f = \frac{R}{2} \Rightarrow f = \frac{24}{2}$

$f = +12cm$

20.) The ability of a lens to converge or diverge the rays of light, is called power of a lens. It is equal to the reciprocal of the focal length (i.e. $P = \frac{1}{f}$)

21.) Optical Center.

22.) When the object is brought from infinity closer to a convex lens, the image size increase, after a certain position, the image of size is magnified as compared to the size of the object.

23.) The refractive index of a diamond is 2.42 which suggest that the speed of light is slow inside the diamond as compared to the air due to its density.

24.) c.) (20cm, 20cm) and (real and inverted) is correct as the focal length remains the same.

The convex lens and Concave mirror always form real and inverted images except some rare cases.

As the object is a distant one, the image obtain will be formed on the focus therefore the focal length remains same.

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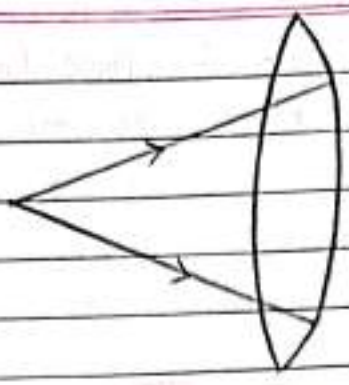
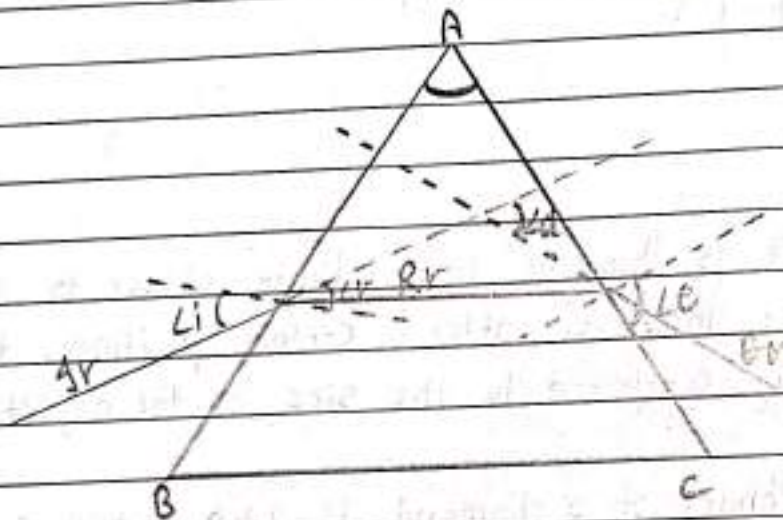
25.) 

Liquid of R.I. = 1.5

As the refractive index of material of lens and the liquid is same therefore the light rays don't undergo refraction and the light ray comes back to the liquid.

26.) 

Labelling of $\angle i$, $\angle e$, $\angle r$ and $\angle D$

27.) $P = +5D$

$f = 1/P = 100/5 = 20\,cm$

Nature of lens = Convex (Converging)

Distance is 40cm (at C)

28.) Speed in X > Speed in Y > Speed in Z

As per Snell's law :- $\frac{\sin i}{\sin r} = n$

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Since, the angle of incidence is minimum in block X, the refractive index of material of block X is minimum.

Since The refractive index of block X is minimum, the ~~spp~~ speed of light is maximum in block X.

$$R.I. \propto \frac{1}{\text{Speed of light}}$$

29) Concave lens

$u = -30\ cm$

$f = -15\ cm$

Using lens formula

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

$$\frac{1}{-15} = \frac{1}{v} + \frac{1}{30}$$

$$\frac{1}{v} = \frac{1}{-15} - \frac{1}{30}$$

$$\frac{1}{v} = \frac{-2-1}{30}$$

$$\frac{1}{v} = \frac{-3}{30}$$

$$v = -10\ cm$$

Now, $m = \frac{mv}{u}$

$$m = \frac{m(-10)}{-30}$$

$$m = \frac{1}{3}\ cm \text{ or } 0.3\ cm$$

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Since object is placed at a finite distance from Concave lens
Therefore :-

i) Image is virtual and erect.
ii) Image is diminished
iii) Image is formed on the same side of lens.
iv) It is formed 10cm in front of lens.

30) a) Converging lens or Convex lens.

b) Telescope and microscope.

c) Characteristics of Image :-
i) virtual image.
ii) Magnified image.
iii) Same side of the lens.

31) Power of lens :- Ability to converge / diverge light rays passing through it / reciprocal of the focal length in meters $\frac{1}{f}$ (in m).

SI unit of Power is Dioptre.

→ Power of $P_1 = \frac{100}{f} = \frac{100}{40} = +2.5\,D$

Nature :- Converging or Convex lens

→ Power of $P_2 = \frac{100}{f} = \frac{100}{-20} = -5\,D$

Nature :- Diverging or Concave lens

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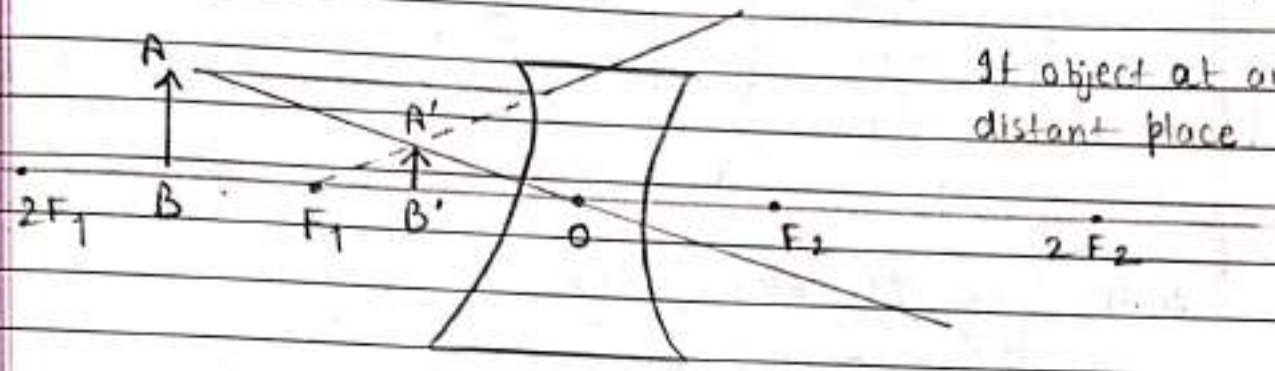
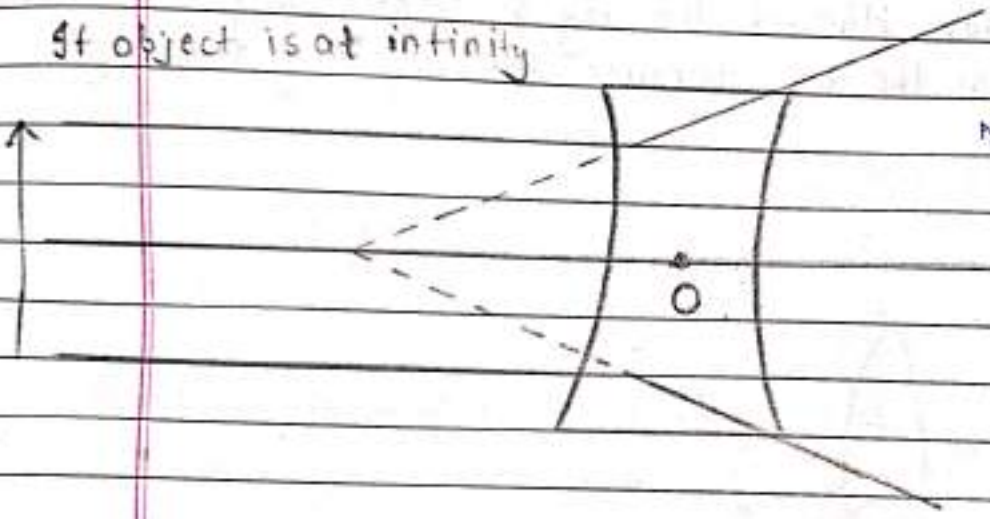
32) If the image formed by a lens is always erect and diminished for all values of 'u', therefore, the lens is Concave (diverging) lens.



If object at any distant place

If object is at infinity



We know that power of a Concave lens is negative

$$P = -10\,D$$

$$P = \frac{1}{f}$$

$$f = \frac{1}{P} \Rightarrow f = \frac{1}{-10}$$

$$f = -0.1\,m \text{ or } -10\,cm$$

33) a) The magnification of the given lens is negative which means that the lens is Convergin or Convex and form a real and inverted image.

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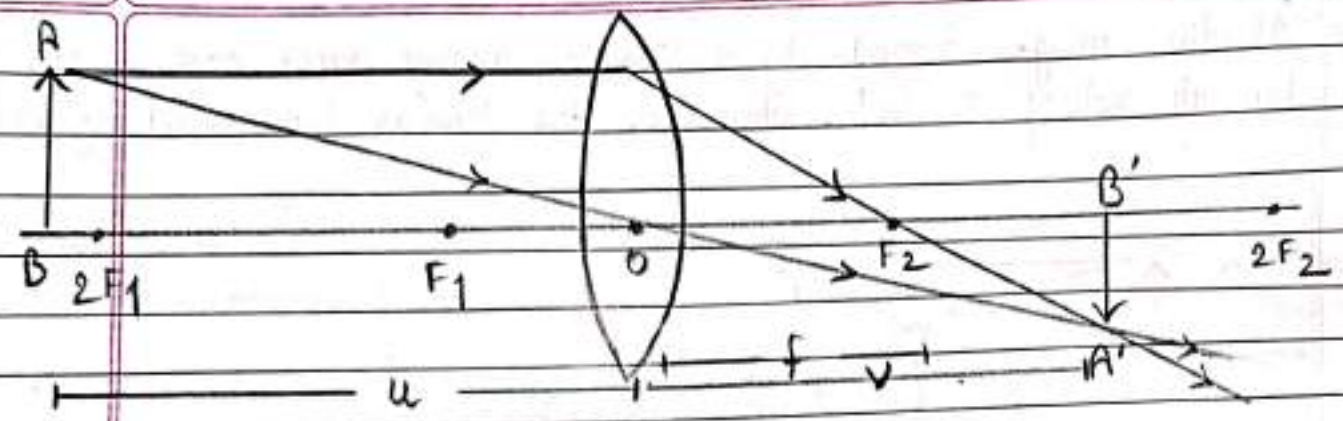
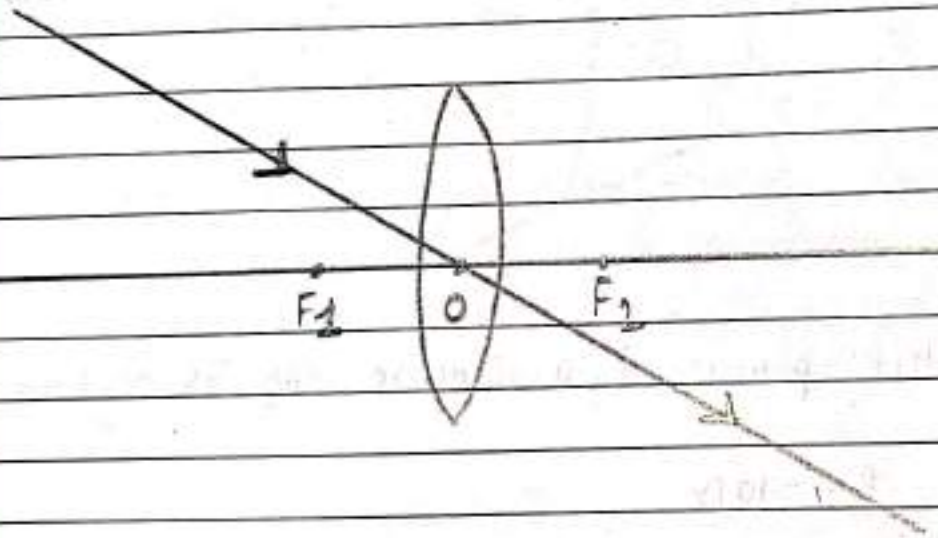


In the figure $OF_1 = OF_2 = 6cm$

b.) The girl must have directed the ray of light along the direction of optical center of the lens because the ray of light passes straight through it.



34.) a.) Nature of the lens is Convex. It is used to provide a magnified or enlarged image of the palm. It is a Converging lens. It can be provide magnified image in certain positions.

b.) The Palmist should hold the mirror between 2F and F to obtain a real and magnified image.

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c) $f = 10cm$ and $u = -5cm$

Using lens formula

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

$$\frac{1}{10} = \frac{1}{v} - \frac{1}{(-5)}$$

$$\frac{1}{v} = \frac{1}{10} - \frac{1}{5}$$

$$\frac{1}{v} = \frac{1-2}{10}$$

$$\frac{1}{v} = \frac{-1}{10}$$

$\therefore v = -10\,cm$

$\Rightarrow$ Image is formed at the focus on the same side of object (behind object).

- The image size is enlarged, $M = \frac{v}{u} = \frac{-10}{-5} = +2$.
- Image is twice the size of ~~object~~ palm (object), $h' = 2h$.
- Image is virtual and erect.

35) a) $u = -60cm$; $f = -30cm$; $v = ?$

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

$$\frac{1}{-30} = \frac{1}{v} + \frac{1}{60}$$

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$$\frac{1}{v} = \frac{1}{-30} - \frac{1}{60}$$

$$\frac{1}{v} = \frac{-2-1}{60}$$

$$\frac{1}{v} = \frac{-3}{60}$$

$\therefore$ $v = -20$ cm

$$m = \frac{v}{u} = \frac{-20}{-60} = \frac{1}{3}$$

Distance of the image will be 20 cm in front of lens.

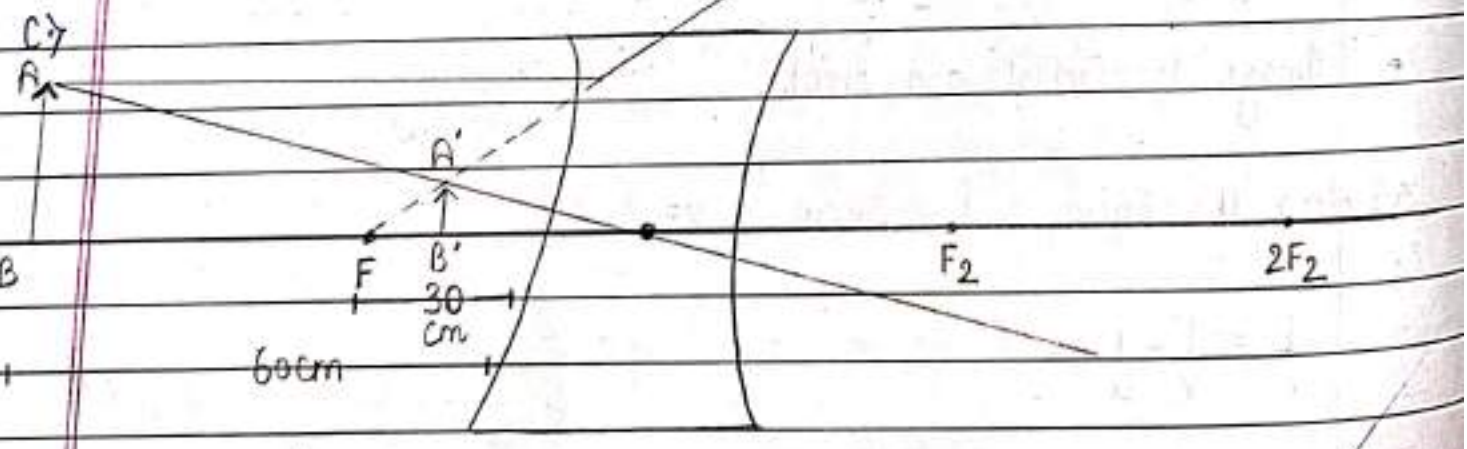
b) Nature :- Virtual

Position :- 20cm from lens on the same side as the object.

Size :- Diminished

Erect / inverted :- Erect

c)



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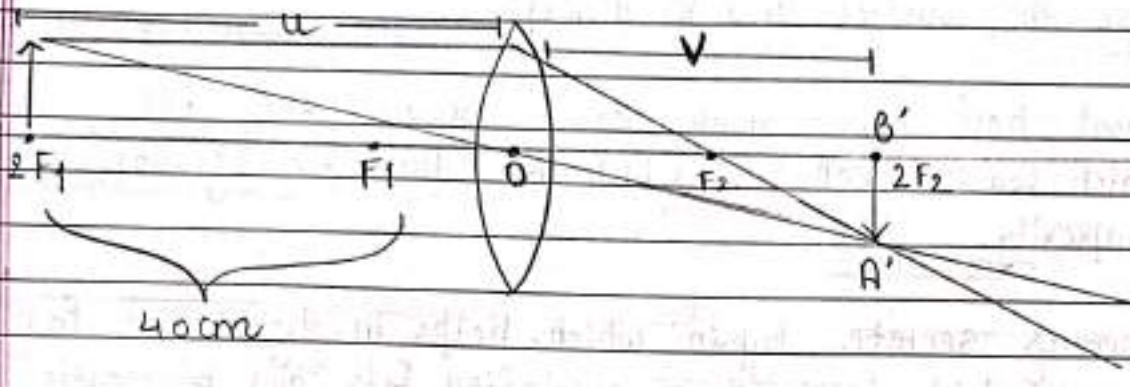
36.) a.) Focal length of convex lens will be 20cm.
By S.No.3 in the table, we get $u = v$ and this is possible when object is placed at $2F_1$ and

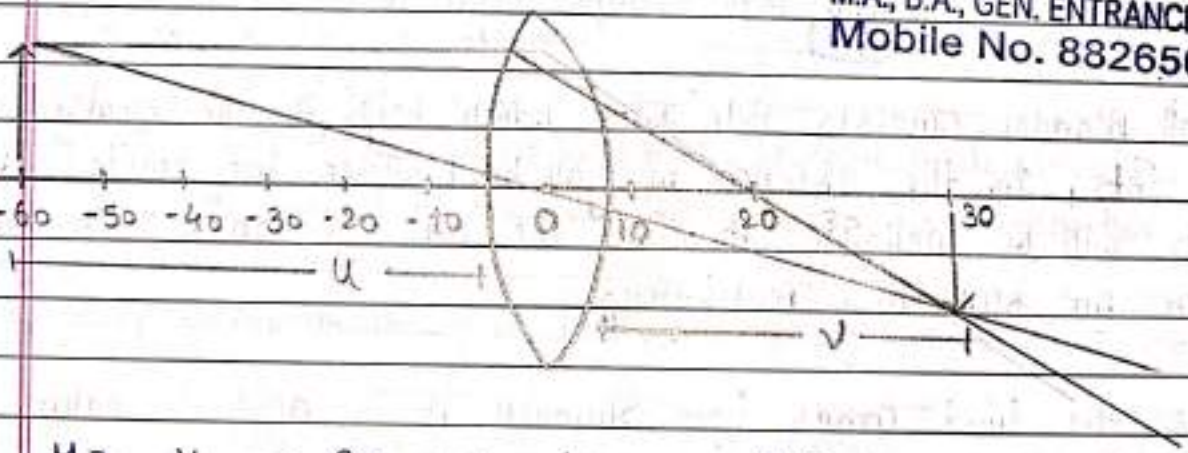
$\therefore$ $R = 40cm$

$f = R/2 = 40/2 = 20cm$



b.) S. NO. 6 is incorrect because the image is formed on the same side of lens ~~but~~ such that the image distance (v) should be in -ve but in table it is +ve.

c.) For S.NO. 2



$M = \frac{v}{u} = \frac{30}{-60} = \frac{1}{-2} = -0.5$

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Light - Reflection & Refraction

1.) Both Concave lens and Mirror form image on the left side ∴ the focal length will be -ve.

2.) Between Principal focus & Centre of Curvature.

3.) Outside the rays.

4.) Due to its wider field of view

5.) The magnification formed by Plane mirror is +1 because object and image are of same size.

6.) Concave Mirrors or Converging mirror is used to design solar furnaces, since it converge all the light rays on a single point therefore it resulted in increase in temperature.

7.) i.) The object should placed between 0-40cm This is because virtual & erect image is formed when object is placed between P & F.

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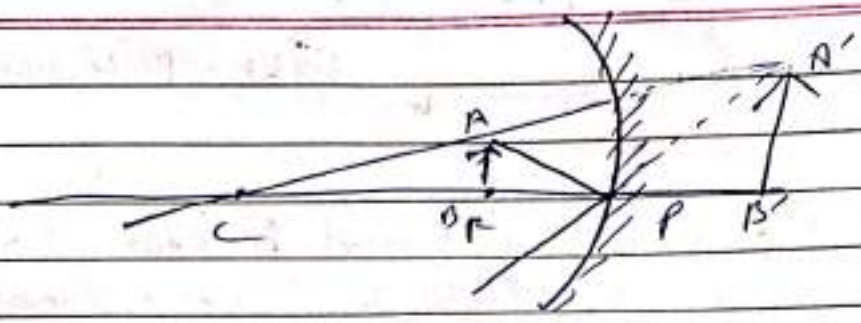


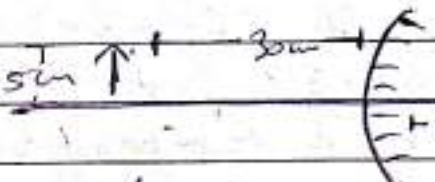
iii) It is used in headlights of car to get parallel beams.

8) i) Move the mirror/paper to focus the rays at one point.

ii) Converging mirror or Concave mirror.

iii) Yes, the distance between mirror & the point where sharp focussed image of sun is formed gives approximate focal length.

9)



$h_2 = +5$ cm, $u = -30$ cm & $f = 15$ cm, $v = ?$

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

$$\frac{1}{15} = \frac{1}{v} - \frac{1}{30}$$

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$\frac{1}{v} = \frac{1}{30} + \frac{1}{15}$

$\frac{1}{v} = \frac{1+2}{30}$

$v = 10$ cm

Now magnification $= \frac{-v}{u}$

$= \frac{(10)}{(30)}$

$= 0.3$

Hence, the image formed is virtual erect & point sized

$\therefore \frac{h_2}{h_1} = \frac{-v}{u}$

$\frac{h_2}{5} = \frac{-1}{3}$

$h_2 = \frac{5}{3}$ $\Rightarrow 1.67$ cm

0.33
3 | 10
9
1

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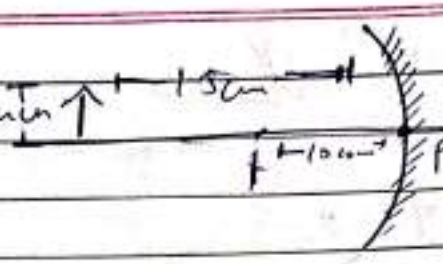
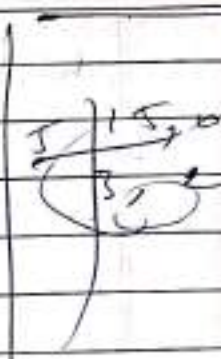
10.)



$h_2 = +4\,cm$, $u_2 = -15\,cm$, $f_2 = -10\,cm$

$v_2 = ?$



using, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$$\frac{1}{-10} = \frac{1}{v} - \frac{1}{15}$$

$$\frac{1}{15} - \frac{1}{10} = \frac{1}{v}$$

$$\frac{1}{v} = \frac{2+3}{30}$$

$$v = -30\,cm$$

using, $\frac{h_2}{h_1} = \frac{v}{u}$

$$\frac{h_2}{4} = \frac{-30}{-15}$$

$$h_2 = \frac{30 \times 4}{15} \quad (h_2 = 8\,cm)$$

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$\frac{h_2}{4} = \frac{30}{15}$

$h_2 = 2 \times 4$

$h_2 = 8\ cm$

11) $h_1 = 30\ cm$, $v = -60\ cm$, $h_2 = 2.4\ cm$, $h_1 = ?$

$f = ?$

Using, $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{f} = \frac{2}{-60} + \frac{1}{-30}$

$\frac{1}{f} = \frac{-1 + (-2)}{-60}$

$\frac{1}{f} = \frac{1}{-20} \Rightarrow f = -20\ cm$

$\frac{1}{f} = \frac{1}{-60} + \frac{1}{-30}$

$\frac{1}{f} = \frac{1+2}{-60} \Rightarrow f = \frac{3}{-60} \Rightarrow f = -20\ cm$

30	60, 30
	2, 1

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

$$m = -\frac{(-60)}{+30}$$

$$\boxed{m = -2}$$

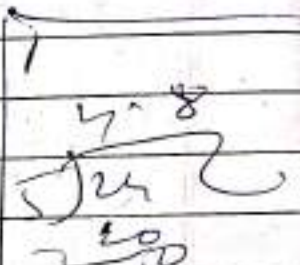
The image will be real & inverted.

$$\therefore \frac{h_2}{h_1} = \frac{-v}{u}$$

$$\frac{h_2}{2.4} = \frac{-(-60)}{+30}$$

$$\therefore h_2 = -2 \times 2.4$$

$$\boxed{h_2 = -4.8 \text{ cm}}$$



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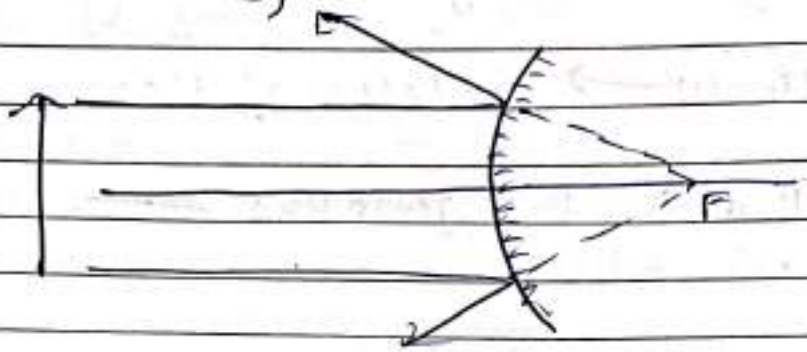
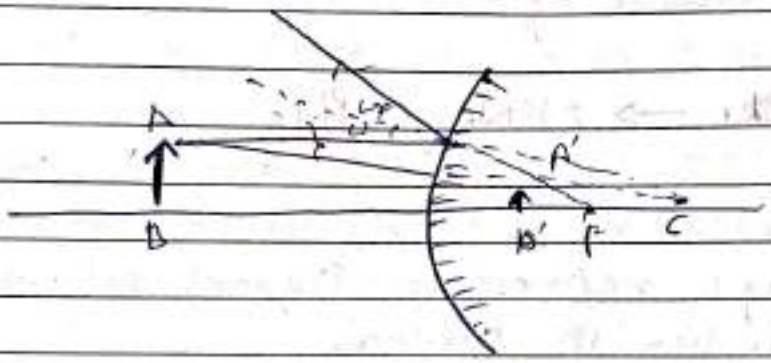
Page no.

12) Convex mirror is a type of mirror in which all images are formed virtual, erect & diminished

For instance,





these mirror are fitted in side view mirror to see larger images because of its wider field of view

13)