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JUNE
WEDNESDAY

Refra...

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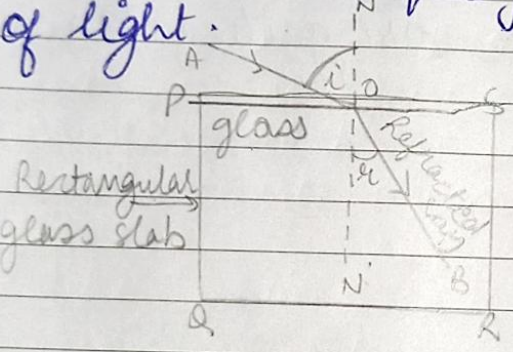
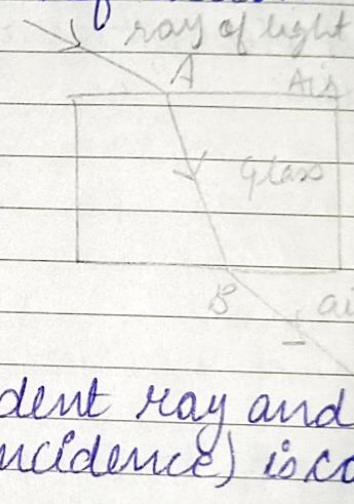
Chapter - Refraction of Light

The change in direction of light when it passes from one medium to another obliquely, is called refraction of light.

The bending of light when it goes from one medium to another obliquely is called refraction of light.





The angle between the incident ray and the normal (at the point of incidence) is called the angle of incidence.

The angle between the refracted ray and the normal (at the point of incidence) is called the angle of refraction.

In the refraction of light, the angle of refraction is usually not equal to the angle of incidence.

Cause of Refraction

The refraction of light is due to the change in the speed of light on going from one medium to another.

Light waves travels faster in air but slower in glass.

Optically rarer medium and optically denser medium.

A medium in which the speed of light is more is known as optically rarer medium.

A medium in which the speed of light is less is called optically denser medium.

1. When a ray of light goes from a rarer medium to a denser medium, it bends towards the normal.
2. When a ray of light goes from a denser medium to a rarer medium, it bends away from the normal.

The case of light going from air into glass and again into air.

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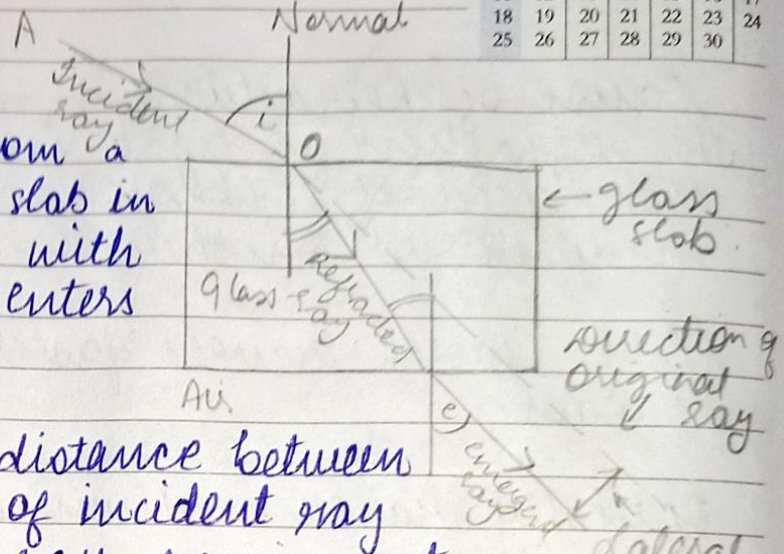


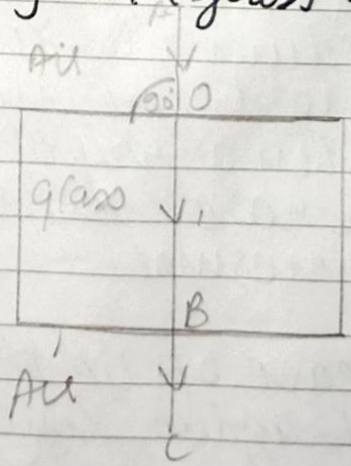
The light emerges from a parallel-sided glass slab in a direction parallel with that in which it enters the glass slab.

The perpendicular distance between the original path of incident ray and the emergent ray coming out of glass slab is called lateral displacement of emergent ray.

The angle which the emergent ray makes with the normal is called the angle of emergence.

The case of light falling Normally on a glass slab.

If the incident ray falls normally to the surface of a glass slab, then there is no bending of the ray of light, and it goes straight.



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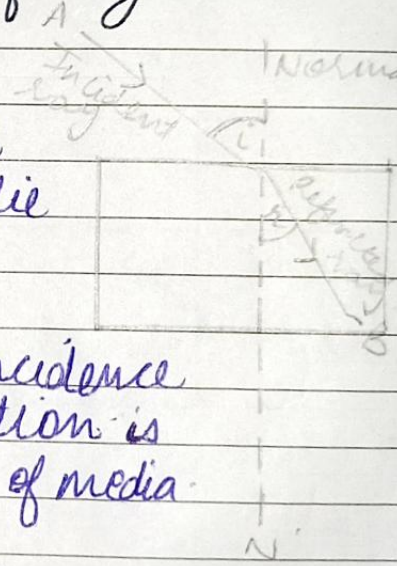
Effects of Refraction of light

(i) The stars appear to twinkle at night
(ii) An object placed under water appears to be raised.
(iii) A pool of water appears to be less deep than it actually is.

Laws of Refraction of light

★ The incident ray, the refracted ray and the normal at the point of incidence, all lie in the same plane.



★ The ratio of sine of angle of incidence to the sine of angle of refraction is constant for a given pair of media.

$$\frac{\text{Sine of angle of incidence}}{\text{Sine of angle of refraction}} = \text{constant}$$

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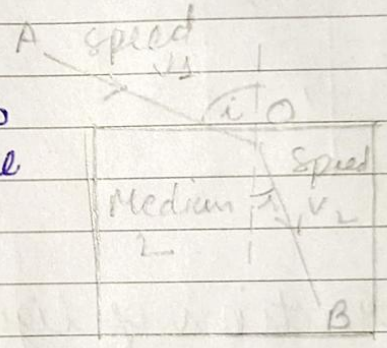
$$\frac{\sin i}{\sin r} = \text{constant}$$

The value of the constant $\frac{\sin i}{\sin r}$ for a ray of light passing from air to a particular medium is called the refractive index of

that medium.

Refractive index and speed of light

The refractive index can also be written as a ratio of speeds of light in the two media.



The refractive index of medium 2 with respect to medium 1 is equal to the ratio of speed of light in medium 1 to the speed of light in medium 2.

When light is going from one medium to another medium, then the value of refractive index is called the relative refractive index

When light is going from vaccum to another medium, then the value of refractive index is called the absolute refractive index.

A substance having higher refractive index is optically denser than another substance having lower refractive index.

Higher the refractive index of a substance, more it will change the direction of a beam

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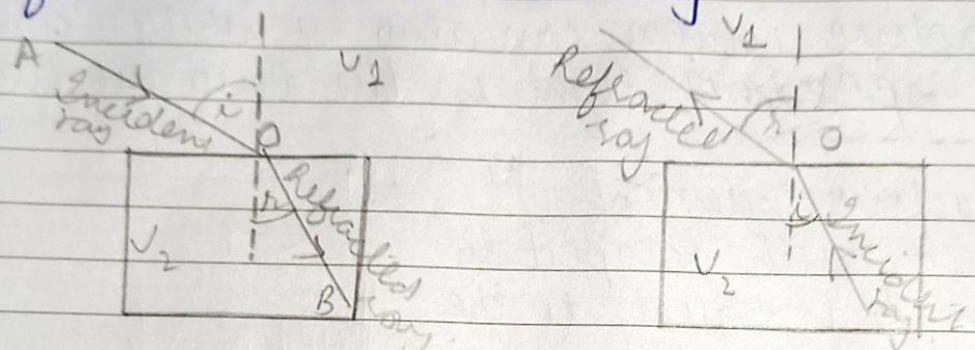
of light passing through it.

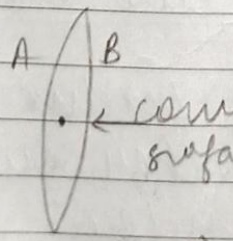
★ The optical density of a substance is different from it's mass density.



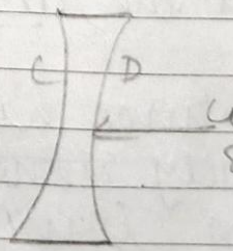
Refraction of light by spherical lenses.

The working of a lens is based on the refraction of light rays when they pass through it.

(i) A convex lens is thick at the centre but thinner at the edges.
(ii) A concave lens is thin in middle but thicker at the edges.

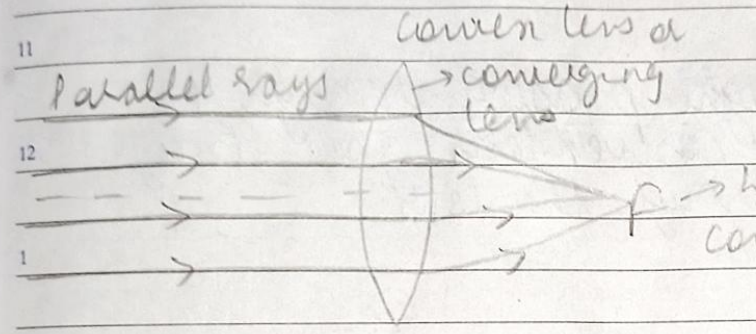


(convex lens)

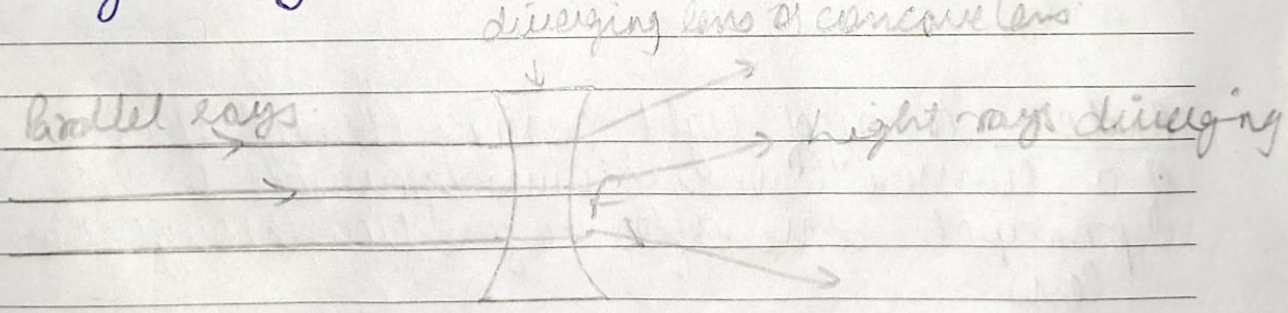


(concave lens)

A convex lens is also known as a converging lens because it converges a parallel beam of light rays passing through it.



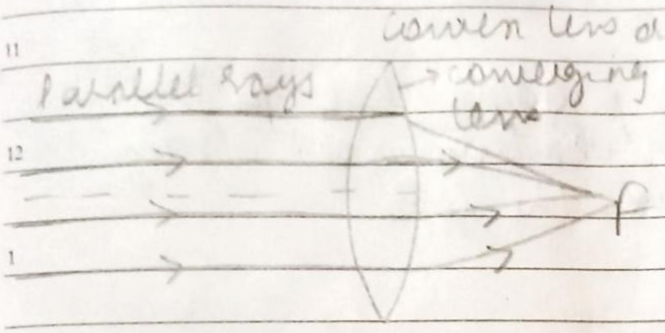
A concave lens is also known as a diverging lens because it diverges a parallel beam of light rays.



Rules for obtaining images formed by convex lens.

Rule 1 A ray of light which is parallel to principal axis of a convex lens, passes through its focus after refraction through the lens.

A convex lens is also known as a converging lens because it converges a parallel beam of light rays passing through it.



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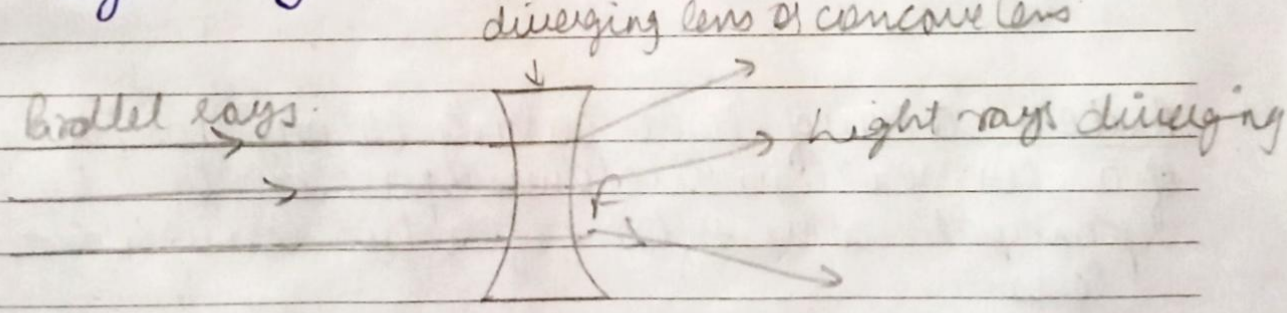
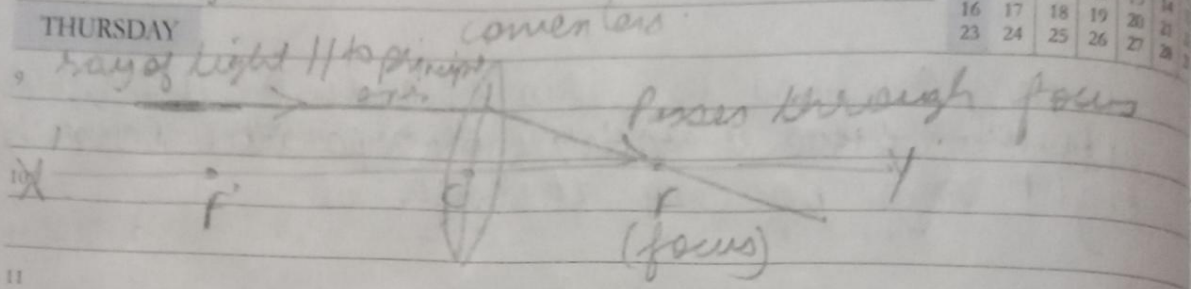
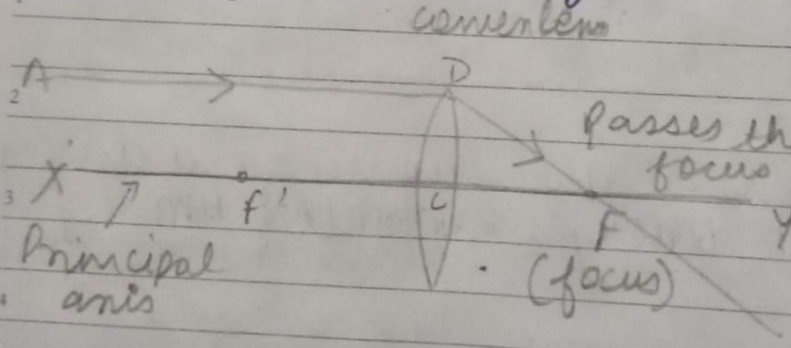


Rules for obtaining images formed by convex lens:

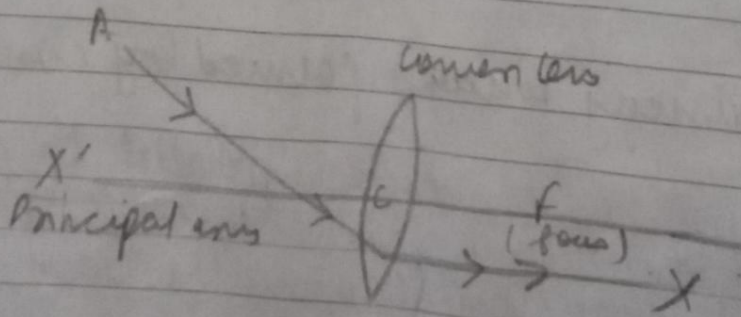
Rule 1 A ray of light which is parallel to principal axis of a convex lens, passes through its focus after refraction through the lens.



Rule 2 A ray of light passing through the optical centre of a convex lens goes straight after refraction through the lens.



Rule 3 A ray of light passing through the focus of a convex lens becomes parallel to its principal axis after refraction through the lens.



	Position of object	Position of img	Size of img	Nature of img
(i)	Between f & lens	same side as object	Enlarged	Virtual & erect
(ii)	At f	at infinity	Highly Enlarged	Real & inverted
(iii)	Between f & 2f	Beyond 2f	enlarged	Real & inverted
(iv)	At 2f	At 2f	same size as obj	Real & inverted
(v)	Beyond 2f	between f & 2f	diminished	Real & inverted
(vi)	At infinity	At f	Highly diminished	Real & inverted

Uses of convex lens

(i) Used in making a simple camera.
(ii) Used in spectacles to correct hypermetropia
(iii) Used in making magnifying glass.
(iv) Used in making microscopes.

Lens formula

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

v = image distance
u = object distance
f = focal length

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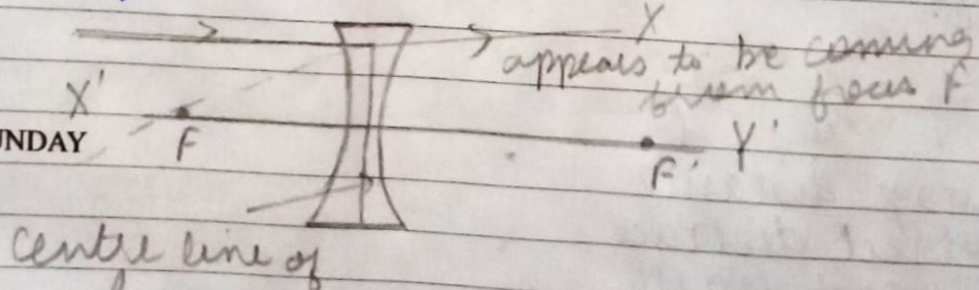
Magnification produced by lenses.
The linear magnification is the ratio of the height of the image to the height of object

$$\text{Magnification} = \frac{\text{height of image}}{\text{height of object}} = \frac{h_2}{h_1}$$

$$\text{Magnification} = \frac{\text{Image distance}}{\text{object distance}} = \frac{v}{u}$$

Rules for obtaining images formed by concave lenses.

Rule 1:- A ray of light which is parallel to the principal axis of a concave lens, appears to be coming from its focus after refraction through the lens.



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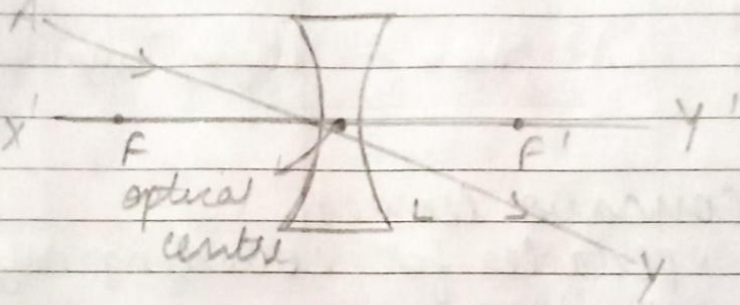
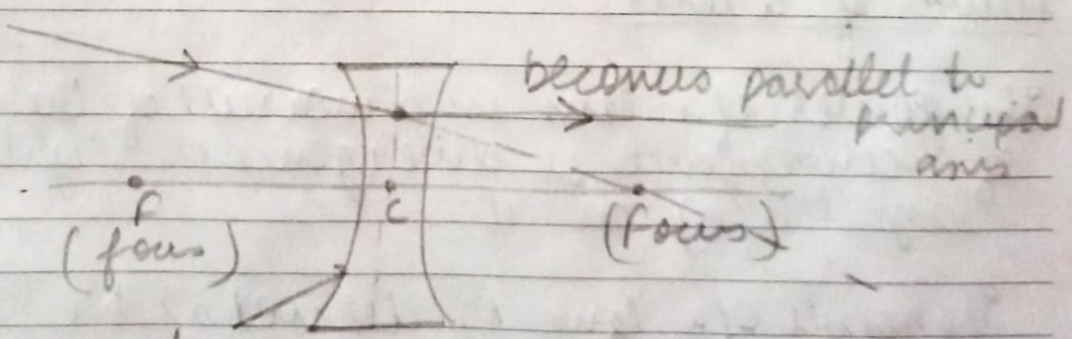
Rule 2 A ray of light passing through the optical centre of a concave lens goes straight after passing through the lens.



Rule 3 A ray of light passing towards the focus of a concave lens, becomes parallel to its principal axis after refraction through the lens



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Position of object	Position of image	Size of image	Nature of image
(i) Anywhere between C & infinity	Between C & F	diminished	V & E
(ii) At infinity	At focus F	highly diminished	V & E

Uses of concave lenses

(i) Used in spectacles for correcting myopia.
(ii) Used as eye lens.
(iii) used in wide-angle spyhole in doors.

Power of a lens

The power of a lens is a measure of the degree of convergence or divergence of light rays falling on it.

The power of a lens is defined as the reciprocal of its focal length in metres

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

P = power of lens
f = focal length of the lens.

A lens of short focal length has more power whereas a lens of long focal length has less power.

The unit of power of a lens is dioptre. one dioptre is the power of a lens whose focal length is 1 metre.

The power of a convex lens is positive & concave lens is negative