



eduresourceza.com

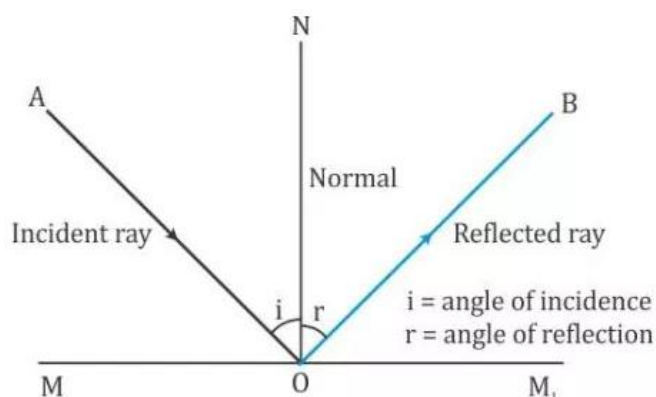
P13 Light

Downloaded from eduresourceza.com

P13.02 Reflecting light

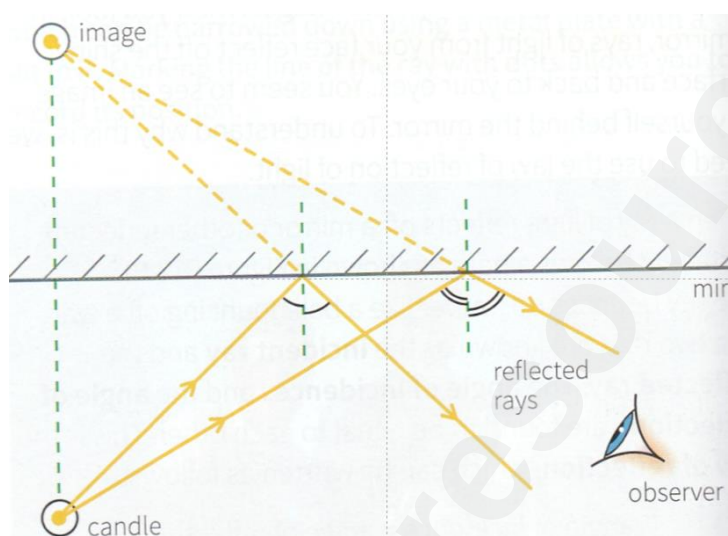
- light travels in straight line
- **reflection**: the change in direction of light by shiny surface, such as mirror
- direction can be recorded by a ray box

1. Looking in the mirror



- light bounces off when reflecting a mirror
- from **incident ray** to **reflected ray**
- normal - perpendicular line to the surface
- i = angle of incidence
- r = angle of reflection
- **$i = r$**

2. The image in a plane mirror



Process

1. rays from the object are reflected by reflection
2. the rays appear to be coming from a point behind the mirror

explanation of the image

- same size as the object
- mirror ~ image = candle ~ image
- left-right inverted
- virtual

2. Ray diagrams

1. draw the positions of the object
2. draw the rays of light
3. mark the position of the observer
4. rays are back, to show where they appear to be coming from
5. draw the **dashed line** - only used to show **virtual image**

Downloaded from eduresourceza.com

P13.03 Refraction of light

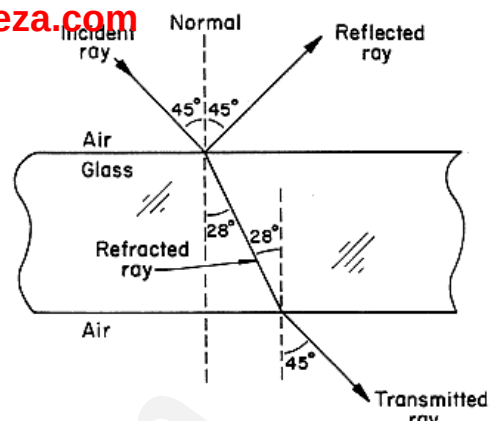
Downloaded from eduresourceza.com

refraction: the bending of light when they travel different material

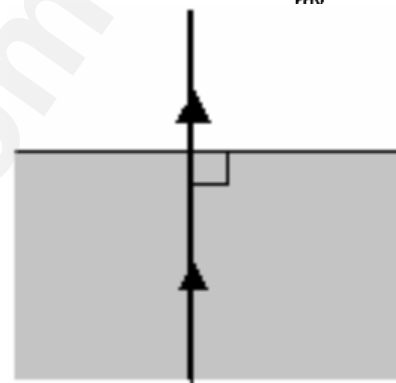
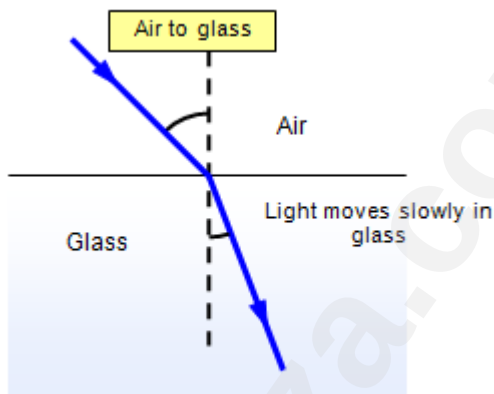
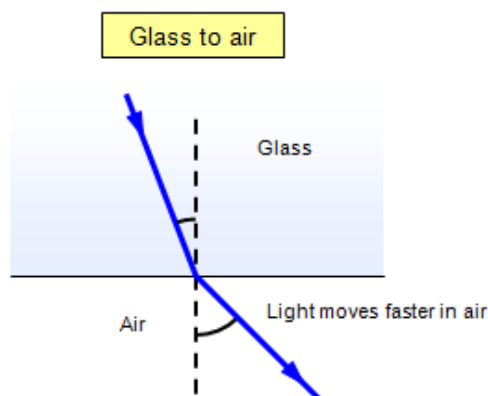
- bent only on the surface, otherwise always go straight
- the changes of material causes the bending

Air - glass - air

- the ray bends towards the normal when entering the glass
- the ray bends away from the normal when leaving the glass



1. Changing direction



- the angle of incidence i is measured from the ray to the normal
- the **refracted way** travels on at the **angle of refraction r** , also measured from the ray to the normal
- when a ray strikes the glass at 90° , it doesn't bend
- light travels fastest in a vacuum

일반화

- when light goes from slow speed to fast speed, its bent away from normal
- when light goes from fast speed to slow speed, its bent toward the normal

2. Refractive index

speed of light = $300,000,000\text{m/s} = 3 \times 10^8\text{m/s}$

$$\text{Refractive index: } n = \frac{\text{Speed of light in a vacuum}}{\text{Speed of light in the material}}$$

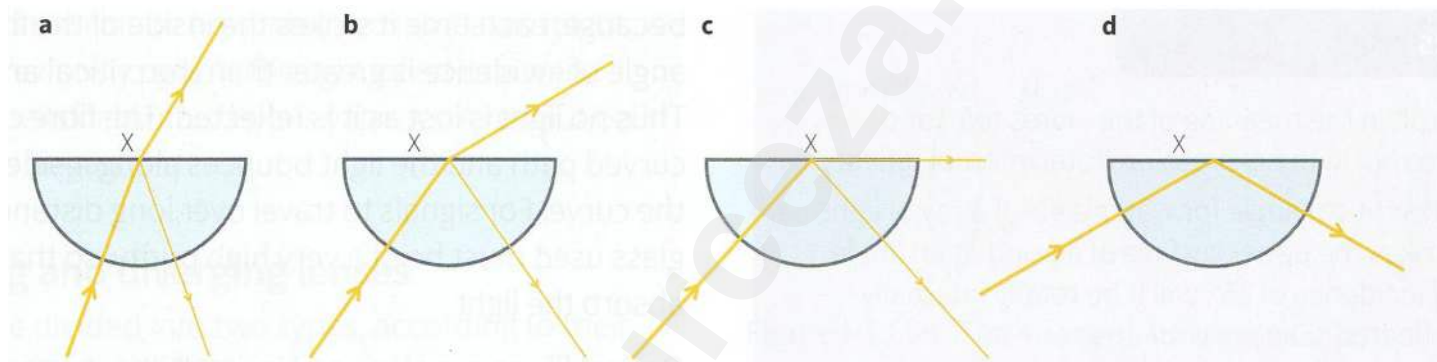
- light speed - vacuum > gas > liquid > solid

Downloaded from eduresourceza.com

$$n = \frac{\sin i}{\sin r}$$

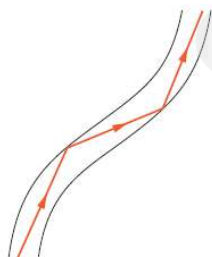
P13.04 total internal reflection

can make experiment using a ray of light and semi circular glass block



- If the angle of **incidence is small**, most of the light emerges from the block. There is a faint reflected ray inside the glass block. The refracted ray bends away from the normal.
- if the angle of **incidence is increased**, more light is reflected inside the block, the refracted ray bends even further away from the normal.
- total internal reflection**: At **critical angle**, the refracted ray emerges along and parallel to the surface of the block. Most of the light is reflected inside the block.
 - total because 100% of the light is reflected
 - internal because it happens inside the glass
 - reflection because the ray is entirely reflected
- At even **greater angle of incidence**, all of the light is reflected inside the block. No refracted ray emerges from point X.

1. Optical fibres

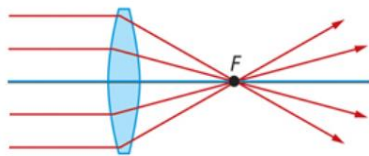


- each time it strikes the inside of the fiber, its angle of incidence is greater than the critical angle
- no light is lost because it is reflected
- by bouncing, fibre can follow a curved path

- Tv signals and internet signals are passed along fine glass fibres in the form of flashing laser light
- used in medicine - endoscope to see inside human's body

P13.05 Lenses Downloaded from eduresourceza.com

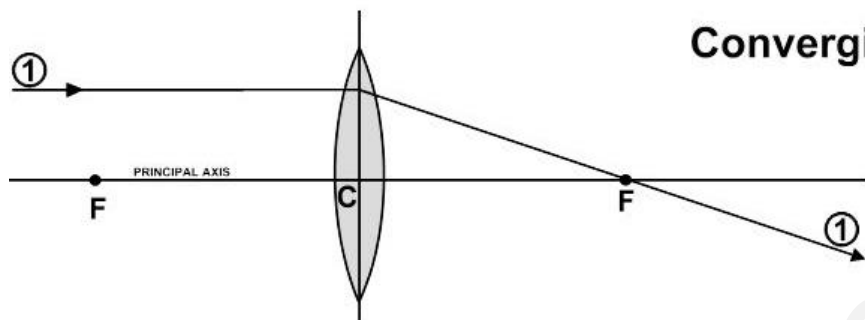
1. Converging lenses



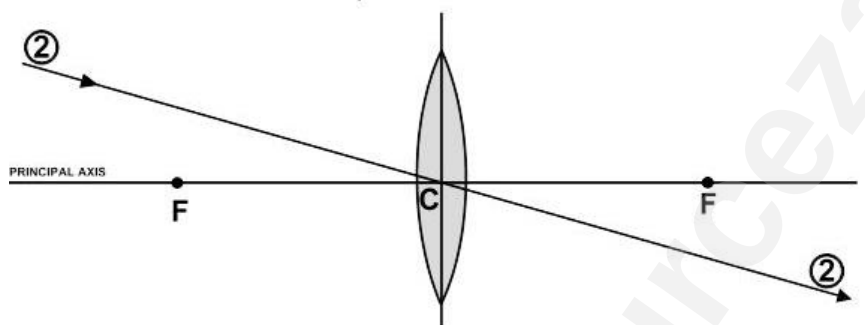
- rays are parallel to the **axis** of the lens
- they converge on **principal focus**
- **focal length** - distance from the centre of lens to the principal focus
- the fatter lens is, focal length is shorter
- Always bend all ways just enough for them to meet at the principal focus

2. Forming a real image

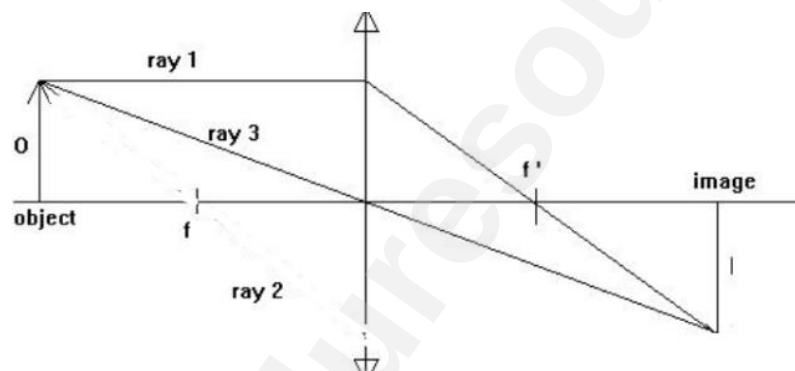
Converging lens ray diagrams



- ① rays parallel to the principal axis are refracted such that they pass through the principal focus (F)



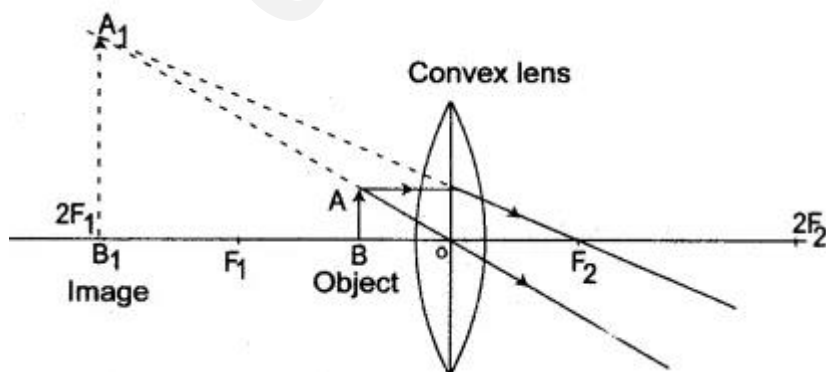
- ② rays passing through the optical centre (C) pass through the lens in a perfect straight line.



✂ image is **inverted**, **redcued** and **real**

3. Magnifying glasses

- image is closer to the lens than the principal focus
- image is **enlarged** and **virtual**



4. The feature of image **Downloaded from eduresourceza.com**

object - principal focus - lens

- inverted
- reduced
- nearer to the lens than the object
- real

principal focus - object - lens

- upright
- magnified
- further from the lens than the object
- virtual

eduresourceza.com