Notes - Reflection and Refraction

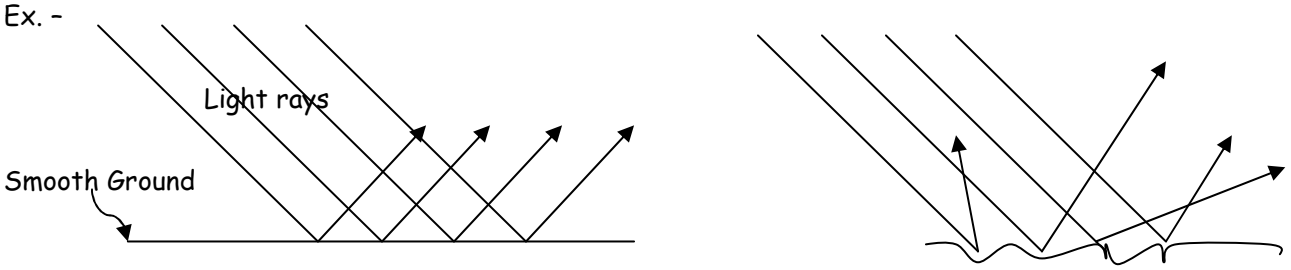
- Light often acts like a wave. The length of the wave defines what type of wave it is. Long, low energy waves are waves like radio waves and high energy, short waves are x-rays or gamma rays.

- Visible light is about the middle for length of the wave and the energy of the wave.

- The speed of light is dependent on the frequency multiplied by the wavelength. Light has different speeds as the frequency or wavelength changes. The medium light is travelling through changes these factors and ultimately the speed.

- When light strikes a surface the angle of reflection (r) is equal to the angle of incidence (i). That is the angle it strikes at is equal to the angle it reflects at. This is called regular reflection.

Ex. –



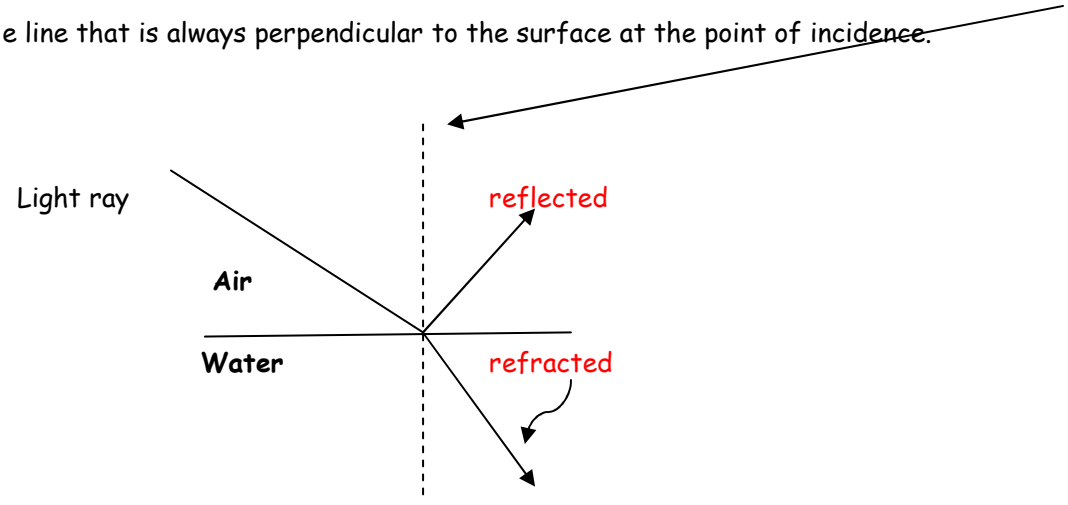
- Most objects have light reflect diffusely off of them. That is the light reflects in all directions as the object struck by the light really isn't smooth like we think.

- Light doesn't always travel the same speed. Light travelling through water is slower than through air. This is caused by the increased density of water over air. Water is said to be optically dense.

- Light also bends as it changes from one medium to another. This bending of light is called refraction.

- When light enters a more optically dense material the light is refracted (bends) **towards** the normal. If light moves into a less optically dense medium the light is refracted **away** from the normal. (The normal is an invisible line that is always perpendicular to the surface at the point of incidence.

Ex. –



- This relationship of bending light towards or away as it enters different media was discovered by Willebrord Snell (Dutch). He found there is a ratio between the angle of incidence and the angle of refraction. This ratio is a constant that is related to the **type** of medium. This value is called the <u>indices of refraction</u>.

- His equation is

$$\boldsymbol{n_i sin\theta_i = n_r sin\theta_r}$$

- where n_i is the index of refraction of the starting medium and n_r is the index of refraction for the second material.

- θ_I is the incident angle and θ_r is the refraction angle.

	Indices of Refraction		
Medium	**n**	**Medium**	**n**
Vacuum	1.00	Crown glass	1.52
Air	1.0003	Quartz	1.54
Water	1.33	Flint glass	1.61
Ethanol	1.36	Diamond	2.42

Practise

<u>Ex. 1</u> – A ray of light travelling through air is incident upon the surface of a glass of water at an angle of 30.00° . What is the angle of refraction?

<u>Ex. 2</u> – A block of unknown material is submerged in water. Light in the water is incident on the block at an angle of 31° . The angle of refraction in the block is 27° . What is the index of refraction for the unknown material?

- Refraction occurs because the speed of light changes with the medium. The amount light slows down (and subsequently bends) is the same for a given medium. The equation used to relate the speed of light in a certain substance compared to the refraction of the light as it entered is

$$\boldsymbol{n_s = \frac{c}{v_s}}$$

where n_s is the incidence of refraction, c is the speed of light, and v_s is the speed of light in the substance.