Chapter 29

- EM waves:

* Light is an electromagnatic wave, light is a self-propagating combination of oscillating eletric and magnetic field.

* travel through space at fixed speed known as C "the speed of light"

* The existence of EM waves was predicted by a set of eq developed by James Maxwell

- The constant speed of light:

→ in other types of wave motion, Some medium is required in which the waves are able to propagate.

→ light on the other hand is self propagating since it's an EM waves.

The self-supporting Process :- The oscillation of electric filed in this wave causes the oscillations of the magnatic filed.

→ and this process only happened when this EM wave propagates at a certain speed

$C = 299792458 \ m/s$ (in vacum)

→ The speed of light is unchanged by changes to either the velocity of the observer or the velocity of the light Source.

→ This strange fact of nature is described by (the special theory of relativity)

ave length and freq:

$v = f\lambda$

for EM waves

$\rightarrow c = f\lambda$

→ EM waves can have a Large range of λ and what human regard as (visible light) occupies only small peice of EM spectrum laying between (380 nm — 75nm)

→ Diffrent freq ranges in the spectrum are usually generated by diffrent physical processes, and interact diffrently with matter, So are given diffrent labels lik (X-rays or radio waves).. but they are all still EM waves

Reflection:

- when light hits the surface of almost any material, Some of the light bounces back off the surface This is called "Reflection"

- The law of reflection: the angle of incidence is equal to the angle of reflection

→ Reflection can be described as specular or diffuse

- specular reflection: is what happens when the light hits a very flat, reflective surface

- diffuse reflection: happen when the surface is rougher
∴ the light is reflected in a wide range of directions.

∴ this scattered light that allows us to see most objects.

Refraction:

- is the change in direction of a light ray at the interface between two media.. which occurs when there is a change in wave speed.

- The freq of the wave stays the same, but the wave length changes

$$V = \lambda f$$

change

remain the same.

would change.

$$n = \frac{c}{v}$$ → index of refraction

C: speed of light in vacume

V: " " " in medium.

isotropic material: material that are uniform and have the same propagating speed every where.

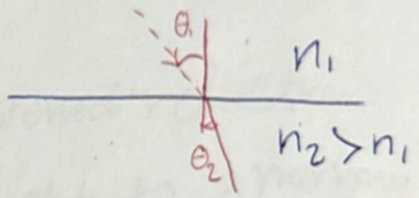
Snell's Law:-

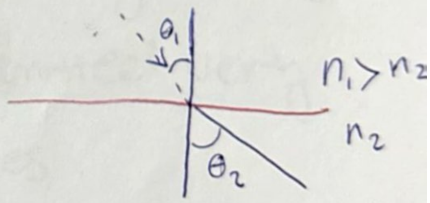
relates the angle of incidence and angle of refraction for wave propagation at the boundary between isotropic media.

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

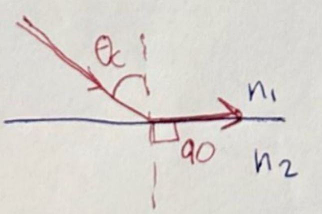
or

$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_2}{n_1} = \frac{V_1}{V_2}$$

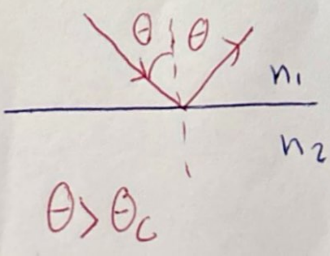




* Total Internal Reflection:



- the complete reflection of an incident light ray at a boundary with no transmittion.



- This phonemenon occurs only if ① $n_1 > n_2$

② $\theta > \theta_c$

Θ_c : the Critical angel.

$$\sin(\Theta_c) = \frac{n_2}{n_1}$$

→ in a water-air boundry , $\Theta_c = 48.6^\circ$

* The Total internal reflection is utilised in many optical devices.

- optical fibers :

used total internal reflection to confine light to a narrow glass rod, allowing the light to be transmitted very Long distances.

- The main loss is absorption in the glass, rather than loss through light leaving the fiber.

Dispersion:

- when we define the index of refraction, we said that n depend on the wavelength, since the speed of light changes and the freq remain the same $\therefore n(\lambda)$

- in the real material n is not constant for all colours and wavelengths of light.

See example 29.5