Chapter 23

*ray model of light: light travels in straight lines in uniform transporant media (like air and glass)

الاشعاعات بتبقى في خط مستقيم في نفس الوسط.

Geometric optics: light rays travel in straight lines at different angles.

Index of refraction:

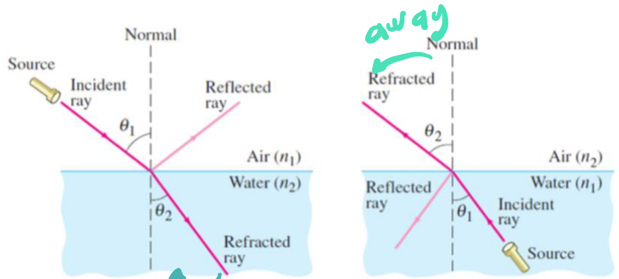
Light has the maximum speed in vacam $c = 3 \times 10^8$ m/s

$n = \frac{c}{v}$ → $c > v$, $n > 1$, $n = 1$ Vacuum

انكسار

Refraction: "Snell's Law"

away



(a) $n_2 > n_1$: Ray bends toward ⊥ (b) $n_1 > n_2$: Ray bends away from ⊥

closer to the normal

$n_2 > n_1$	$n_2 < n_1$
*air → water	water → air
$\theta_2 < \theta_1$	$\theta_2 > \theta_1$
it will bends towards	it will bend away from the normal.

Note:

- معامل الانكسار n لكل الاوساط دائماً اكبر من 1 لانه سرعة الضوء بالفراغ اسرع شي
- In Vacuum: $n = 1$ the lowest, $c = 3 \times 10^8$ the highest
- زاوية السقوط تساوية زاوية الانعكاس

Snell's law:

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

$\sin\theta_c = \frac{n_2}{n_1}$

If $n_1 < n_2$ → $\theta_1 > \theta_2$

If $n_1 > n_2$ → $\theta_1 < \theta_2$

انعكاس كلي لايوجد انكسار

Total internal reflection: "Fibre optics" انعكاس كلي

* when light passes from a medium of hight n to a lower n.
* θ_c: critical angle: Refracted ray travels parallel to the surface $\theta_2 = 90$
* $\theta_1 > \theta_c$: No light is refracted and all light is reflected. كل الشعاع ينعكس مابنكسر
* Fibre optics: Medical instrument
* Glass and plastic has a few (μm)

Thin Lenses, Ray Tracing:

Converging lenses عدسة محدبة	Disverging lenses عدسة مقعرة
converging	concave

* We call the lens is thin when the diameter of the lens is smaller than the radius of

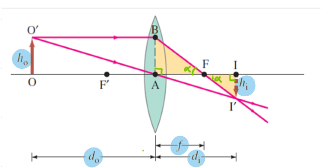
Lens Power:

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

$[P] = m^{-1} = \text{diopter}$

Thin Lens Equation:

Converging lens:



d_o < + for real obj / − for virtual obj

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

f +

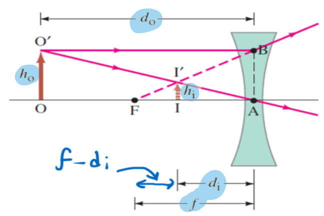
d_o + real obj

d_i < + $d_o > f$ / − $d_o < f$

h_o +

h_i < + $d_o < f$ / − $d_o > f$

Diverging lens:



$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

f −

d_o + real obj

d_i − virtual image

h_o +

h_i +

- Magnification (m):

$$m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$$

m + ⟶ upright . ⟶ real im.
m − ⟶ inverted . ⟶ virtual im.

- diverging lens can't form magnified images

Note:

- a diverging lens always produces upright virtual image regardless the value of d_o
- Converging lens:
  real inverted images
  virtual upright images

Chapter 30

● Structure and Properties of the Nucleus:

* atom made up of electrons orbiting the nucleus
* the nucleus is made up of protons and neutrons.
* neutrons and protons are called nucleons.
* Different nuclei are referred to nucleus

mass number: the sum of proton and neutron numbers in nucleus — A

N: neutron number

Z — Atomic number: number of protons in nucleus

$A = Z + N$

Note:

- $\rho_{nuc} \gg \rho_{atom}$
- $1eV = 1.6022 \times 10^{-19} J$

* The radius of nucleus:

$$R = 1.2 \times 10^{-15} A^{1/3}$$

mass number $A = Z + N$

$1 \text{ fermi} = 10^{-15} m$

* atomic mass unit (u)

on this scale ^{12}C has a mass of 12u

* Mass can also measured in units of energy.

Einstein's equation:

$$E = mc^2$$

$$\frac{N}{N_0} = \left(\frac{1}{2}\right)^n$$

● Radioactivity:

$$N = N_0 e^{-\lambda t}$$

N: remaining number of radioactive nuclei at time t

N_0: initial number of radioactive nuclei at time $t_0 = 0$

λ: decay constant $\frac{1}{\text{time}}$

* **half-life:** the time needed for the number of radioactive nuclei to become half the original number

$$t_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$$

large λ ⟶ small $t_{\frac{1}{2}}$ ⟶ fast decay

small λ ⟶ large $t_{\frac{1}{2}}$ ⟶ slow decay

Activity (A): number of decay per second

$[A] = decay/s = s^{-1}$ / Bq (Becquerel)

$1\,Ci = 3.7 \times 10^{10}\,Bq$

$$A = A_0 e^{-\lambda t}$$

$$A = N\lambda$$

Mean life (τ): average life time of all the radioactive nuclei of a given radioactive element.

$$\tau = \frac{1}{\lambda} = \frac{t_{\frac{1}{2}}}{\ln 2}$$

Chapter "31"

Absorbed Dose (AD):

The energy deposited per kg in any medium by any radiation type

$$AD = \frac{Energy}{mass}$$

*** units:**

1 Grey → 1 J/kg

1 rad → 0.01 J/kg

1 Gy = 100 rad

Effective Dose "ED"

$$ED = AD \times RBE$$

*RBE: relative biological effectiveness: the number of rads of X ray or γ that produces to the biological damage as one rad of given radiation

ليس لها وحدة

Radiation Type	RBE
X- and γ rays	1
β (electrons)	1
Protons	2
Slow neutrons	5
Fast neutrons	≈ 10
α particles and heavy ions	≈ 20

β (electrons) → B^+, B^-

the larger RBE the more dangerous

Note:

- α is the most dangerous radiation
- Xray & β are the lest dangerous radiation.
- RBE has no unit

[AD]	[ED]
Gray (Gy)	Sievert
Rad	rem

1 Gy = 100 rad

1 Sv = 100 rem

$$\frac{E_{worker}}{E_{total}} = \frac{A_{worker}}{A_{total}}$$

A_{total} → $4\pi r^2$

r → بعد worker عن المصدر

$$\text{Intensity of radiation} = \frac{Eenergy}{\text{unit area}}$$

$$E_{total} = E \times A \rightarrow J/s$$

شدة الاشعاع

Done

By

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