Session-25th - Ray Optics - optical Instruments

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- Recap
- Optics of eye
  - Visual angle, far pt, near pt.
  - Defects of vision
- Microscope
  - simple
  - compound.

Recap

1). $X_1 X_2 = f^2$

2). $LCA = -df = \omega f$

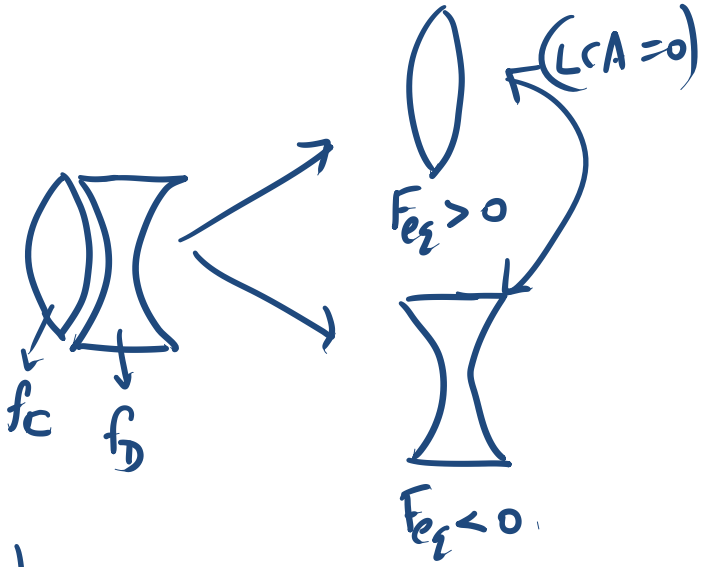
$\simeq f_V - f_R$

$\frac{\omega_1}{f_1} + \frac{\omega_2}{f_2} = 0$. | Condⁿ for achromatism

Condⁿ for convergent comb. (for achromatism)

$|f_C| < |f_D|$

$|\omega_C| < |\omega_D|$.



3). Structure of eye → Cornea, Iris, pupil, eyelens, Ciliarymuscles, Retina

(Max 1) (2.5cm - 2.2cm)

Optics of Eye → Visual angle, far pt, Near pt.

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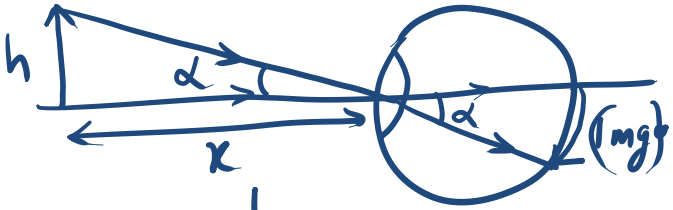
↳ Defects of vision & corrections.

Visual Angle (α).

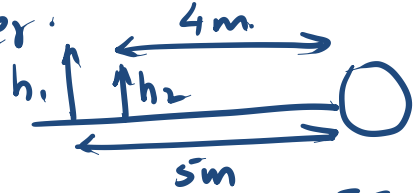
↳ Angle which an object subtends on eye.



$\alpha \sim \frac{h}{x}$

$\tan\alpha = h/x$

→ Nearby objects look bigger & far away obj. look smaller.



Ex. $h_1 = 55$ in.

$h_2 = 52$ in

Which person will look smaller to eye.

h_1 → smaller.

$\alpha_1 = \frac{h_1}{5} = \frac{55}{5} = 11$ in/m

$\alpha_2 = \frac{h_2}{4} = \frac{52}{4} = 13$ in/m.

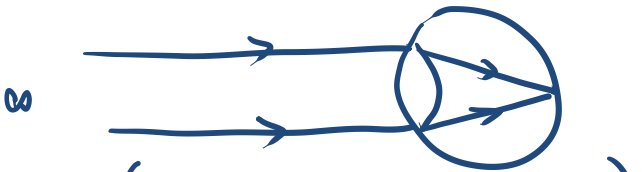
Far point → Max^m distance which eyes of a person can see.

(for healthy eyes, far pt → ∞).

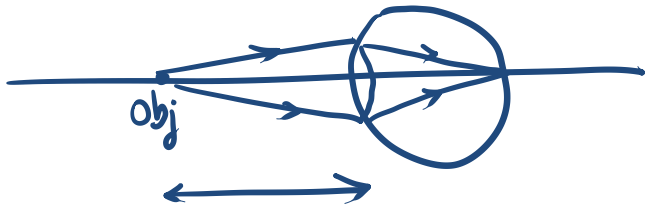
Near point → Min^m distance which eyes of a person can see.

for healthy eyes, near pt → 25 cm.

Least Distance of Distinct Vision (LDDV) = D = 25 cm



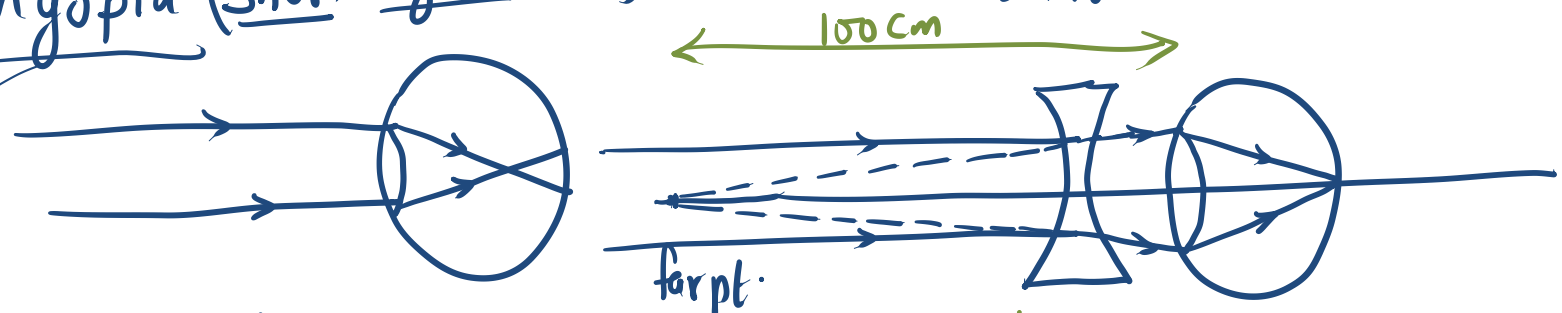
(Relaxed or normal eye)
(Normal condition)



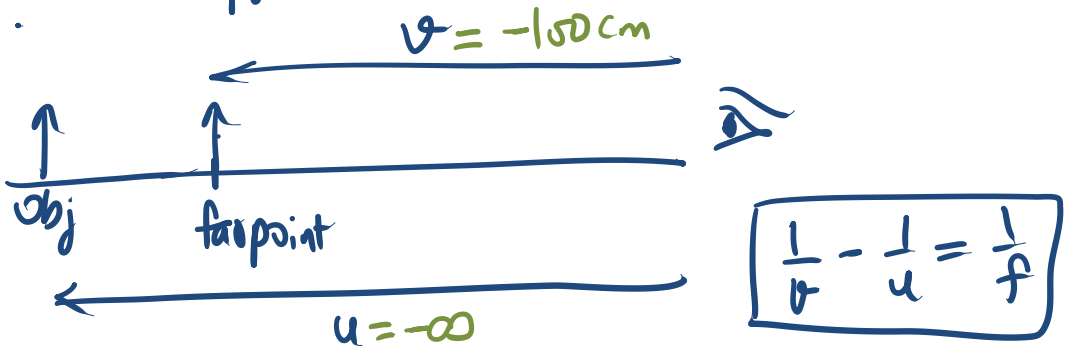
(Max^m strained eye).

Defects of Vision :-

1). Myopia (Short-sightedness) → Crutch (Correction) → thru a concave lens.



Eyes are'nt able to see beyond a distance (far point).



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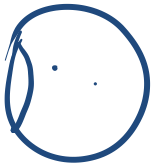
Ex.1 far pt. of a person → 100 cm.
Find power of lens req. (in D).



$u = -\infty$

$v = -100\,cm$

f ?

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

(in m).

$$\frac{1}{-100} - \frac{1}{-\infty} = \frac{1}{f}$$

$f = -100\,cm$

⇒ concave lens

$$P = \frac{1}{f} = \frac{1}{-100} \times 100 = \boxed{-1\,D}$$

Ex.2 what is approx. power of eye lens.

eye lens → relaxed eye; strained eye. ($D = 25\,cm$)

dist. b/w eye lens & retina = 2.5 cm

$u = -\infty$

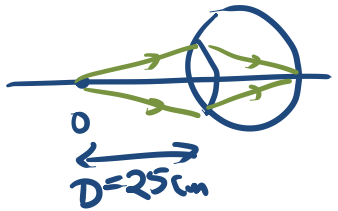
$v = +2.5\,cm$

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

$\Rightarrow f = 2.5\,cm$

$$P = \frac{1}{2.5} \times 100 = 40\,D$$

$$\boxed{P = +40\,D}$$



$P_{eq} = (40 - 1) \simeq 39\,D.$

for strained eye

$u = -25\,cm$

$v = +2.5\,cm$

$f = ?$

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

$$\frac{1}{2.5} - \frac{1}{-25} = \frac{1}{f}$$

$$f = \frac{25}{11} = 2.27\,cm$$

$$P_{strained} = +44\,D$$

for relaxed eye

$u = -\infty$

$v = 2.5\,cm$

$f = ?$

$f = 2.5\,cm$

$$P_{relaxed} = +40\,D$$

Defects of Vision

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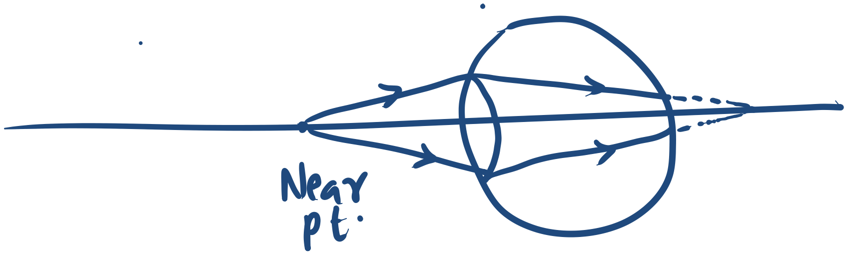
Hypermetropia (far sightedness)

Eyes are not able to see before a pt. (near point)

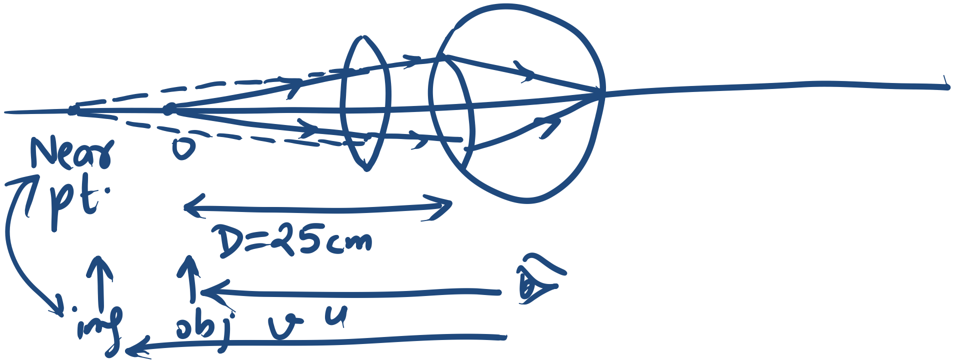


$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$u = -25\,cm$

$v = -(\text{near pt.})$

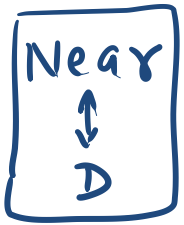
$f = ?$ ↳ +ve $P \rightarrow$ +ve.



Ex:1. Near pt. of a person = 60 cm

↳ he can't see clearly

Find power req. till 60cm.



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

$v = -60\,cm$

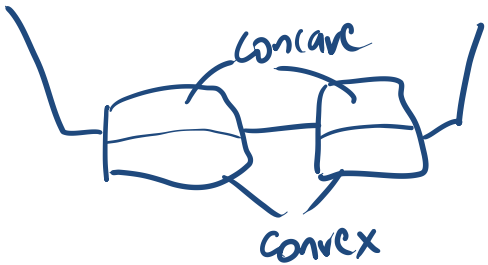
$u = -25\,cm.$

$\frac{1}{-60} - \frac{1}{-25} = \frac{1}{f}. \Rightarrow f = \frac{+25\times60}{35} = \frac{300}{7}\,cm.$

$P = +2.33\,D.$

Presbyopia → when eyes are not able to see beyond a pt. (far pt.) & also before a pt. (near pt.).

The corrective lens → bifocal lens.



f_1 (concave)
$u = -\infty$
$v = -$ far pt.
f_1 ?

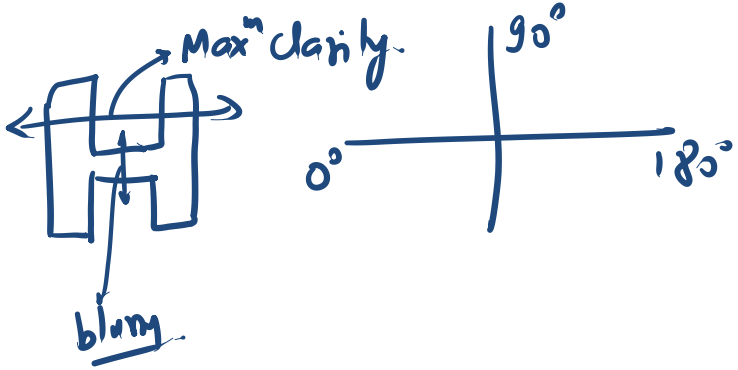
f_2 (convex)
$u = -25$ cm
$v = -$ near pt.
f_2 ?

Astigmatism :-

related

Spherical	Cylindrical	Axis
lens power (in D)	—	—
Concave (-ve)		180°
Convex (+ve).		

Eyes can see object in two orthogonal directions as most clear & most blurry.



Note → Upto -0.75D → considered normal.