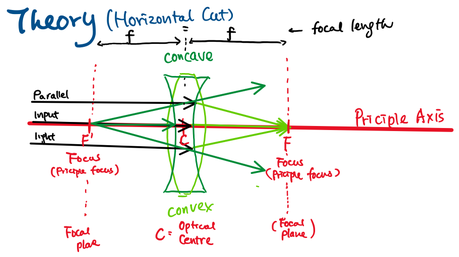
Ch19 Lenses

Monday, 7 December 2020 23:57

Theory (Horizontal Cut)



Abbv. usage

F/F' = focus pt. (usually on principle axis)

C = Optical Centre ⊥ w/ principle axis

f = focal length (length between C & F/F')

Focal length

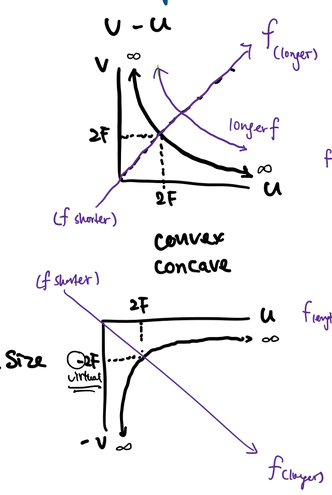
$f \propto \frac{1}{\text{curvature}}$ (reflect in dish; thickness)

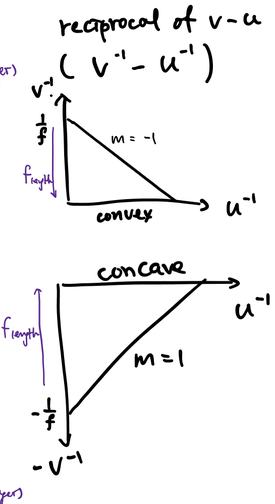
$$\frac{h_i}{h_o} = \frac{v}{u} = m$$

↑ Obj/Img Height ↑ length between i & C : v, O & C : u ↑ linear magnification (of Img)

Img **m**
- < 1 → Smaller than Obj
- = 1 → $h_o = h_i$ Same Size
- > 1 → larger than Obj

Graph





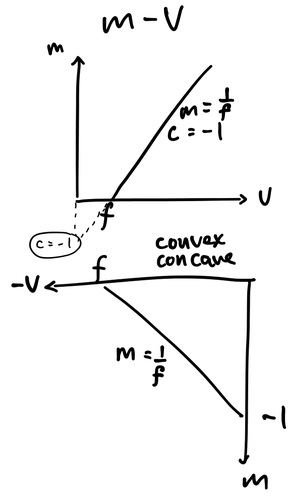


Image Nature (3 for each) Remember la!

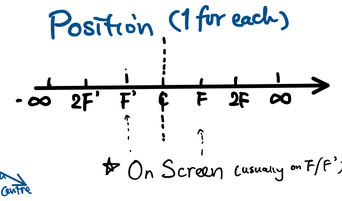
Real ↑↓ / Virtual ↑↑

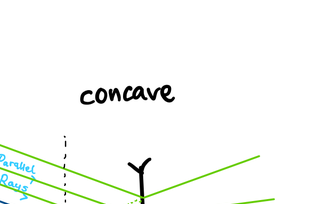
Erect ↑↑ / Invert ↓↓

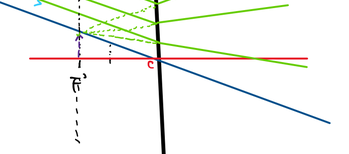
Magnified ↑! / Diminish !↓

Same Size ↑↑

Position (1 for each)







★ On Screen (usually on F/F')

Lens Formula

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

Sign of magitude

+f	↕ convex
-f	Y concave
+v	Real Img
-v	Virtual Img
u	Real Object

Cases

Sharp Img → v = u → f = 4F

Notes

$$m = \frac{|v|}{|u|}$$

Can't calculate?

Use conjucate

u = v'

v = u'

Why? Lens formula

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

$\Rightarrow \frac{1}{v} = -1 \times \frac{1}{u} + \frac{1}{f}$

$y = m \times + c$

m = -1

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

Why? Lens formula

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

$\Rightarrow \frac{v}{v} + \frac{v}{u} = \frac{v}{f}$ (multipy w/ v)

$\Rightarrow 1 + m = \frac{1}{f} \times v$

$\Rightarrow m = \frac{1}{f} \cdot v - 1$ (rearrange as $y = mx + c$)

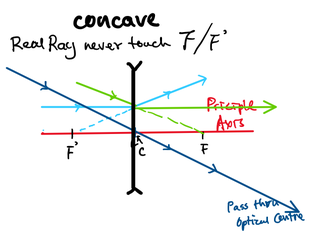
$y = m \cdot x + c$

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

c = -1

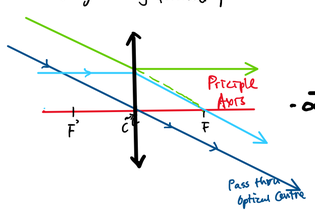
concave

Real Ray never touch F/F'



convex

only touching forward F



concave

- converging

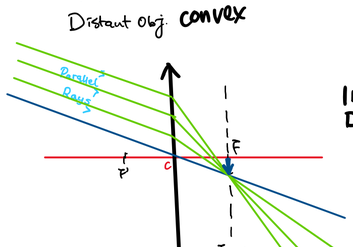
convex

- diverging

Images

properties w/ related lense

Distant Obj. convex



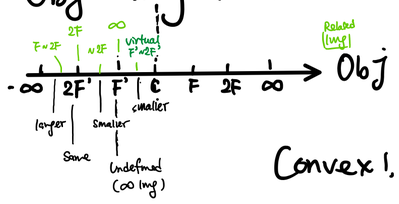
3N + 1Pos

Inverted	Erect
Diminish	Diminish
Real	Virtual
+	+
Screen F	Screen F'

concave

(image) on screen

Obj : Img Position



Convex !,

Obj → : Img →

~2F' : F ~ 2F

2F' : 2F

F'~2F' : ~2F

F' : ∞ (at F~C)

F~C : Virtual F~2F

Img : Virtual & Diminished — Real & Inverted

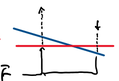
Obj : Real Obj (Always Real DSE)

Img Nature Seperate Line ④ at Inf Undetermined

Rmks: Experience from ∞/C&F
- Small Obj. Size
Attempt
- ∞ large
- Actual Size

Draw dist. Img

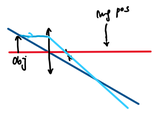
- Line thru Optical Centre
- Principle Axis
- Focus Screen F'/F



Near Img

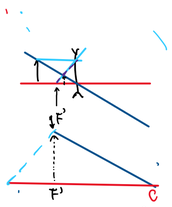
Real / Opposite

- Line thru C
- Principle Axis
- Obj head — hori to lens
  - pass thru Focus (Opposite)



Concave Near Img

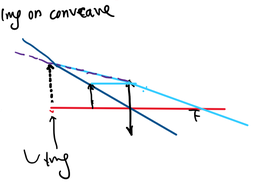
- Line thru C
- Principle Axis
- Obj head — hori to lens
  - pass back to F' (Same size)



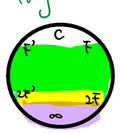
Img on concave

Convex Virtual ⑤

- Line thru C
- Principle Axis
- Obj head hori —
  - pass forward F
  - Bat back towards Line thru C



Img SIZE



Between F'(∞)/2F'(C) Img Larger $h_i > h_o$

At 2F/2F' Same $h_i = h_o$

Beyond 2F/2F' Img smaller $h_i < h_o$

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