$$\boxed{\text{ATTRACTIVE } \frac{1}{r^2} \text{ FORCE: } F = -\frac{\gamma}{r^2}\hat{r}}$$

eg gravity!

$$\boxed{u(\phi) = \frac{\mu\gamma}{L^2}\left(1 + \underline{\underline{e}}\cos\phi\right) = \frac{1}{r(\phi)}}$$

HWK → ELLIPSE!
with origin @ a FOCAL PT!

ORBIT SHAPES Path Equ!

$$u'' + u = -\frac{\mu F(1/u)}{L^2 u^2} = \frac{\mu\gamma u^2}{L^2 u^2}$$

CONST!

Homog: $u'' + u = 0 \rightarrow u^H = A\cos(\phi - \delta)$

Particular: $u'' + u = \frac{\mu\gamma}{L^2} \rightarrow u^P = \frac{\mu\gamma}{L^2}$

$$\rightarrow u(\phi) = \frac{\mu\gamma}{L^2} + \underline{\underline{A}}\cos(\phi - \cancel{\delta})$$

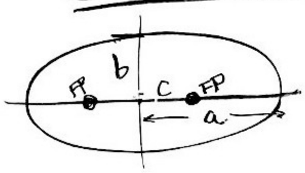
DROP (just sets +x axis)

CONIC SECTIONS

circle $e = 0$
ellipse $e < 1$
parabola: $e = 1$
hyperbola: $e > 1$

$e \equiv$ ECCENTRICITY

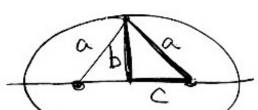
ELLIPSE ANATOMY



Completely described by $\underline{2}$ param.

- ECCENTRICITY e: $\boxed{c \equiv ae}$

- FOCAL DIST



2 pins & string
⇓
string length $= d + d' = 2a$

$$\boxed{c^2 = a^2 - b^2}$$

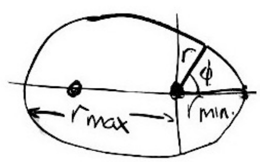
described by

$$\boxed{r(\phi) = \frac{b^2}{a(1 + e\cos\phi)}}$$

w origin at one focal point

Common form:

$$\boxed{r(\phi) = \frac{r_0}{1 + e\cos\phi}}$$



- APSIDAL DISTs

$$\left.\begin{aligned} r_{min} &= a - c \\ r_{max} &= a + c \end{aligned}\right\} a(1 \pm e)$$

$$\boxed{e = \frac{r_{max} - r_{min}}{r_{max} + r_{min}}}$$

- L: $\frac{1}{r(\phi)} = \frac{\mu\gamma}{L^2}(1 + e\cos\phi)$

from path equ @ top

$\frac{a}{b^2}$ from ellipse anatomy

$$\therefore \boxed{L^2 = \mu\gamma\frac{b^2}{a}}$$

L Equation

- E: @r_{min} & r_{max}, $\dot{r} = 0$

$$E = \cancel{\frac{1}{2}\mu\dot{r}^2}_{\rightarrow 0} + \left(\frac{L^2}{2\mu r_{min}^2} - \frac{\gamma}{r_{min}}\right)$$

use $\frac{1}{r_{min}} = \frac{\mu\gamma}{L^2}(1 + e)$

$$\Rightarrow \boxed{E = \frac{\gamma^2\mu}{2L^2}\left(e^2 - 1\right)}$$

E Equation

Also: use L Equ &

$$e^2 = \frac{c^2}{a^2} = 1 - \frac{b^2}{a^2}$$

$$\boxed{E = -\frac{\gamma}{2a}}$$

E Equation v2