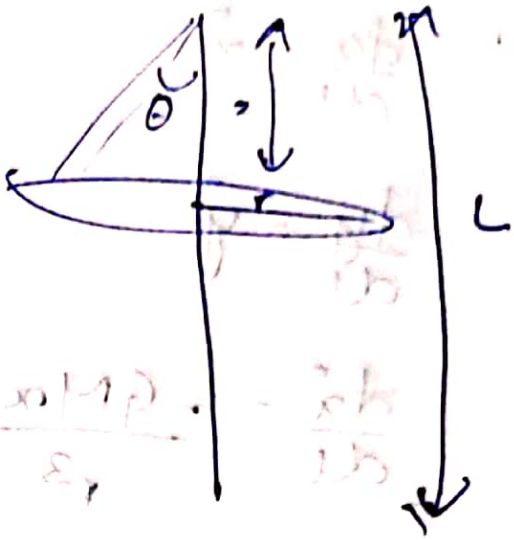
6. $r = \sqrt{x^2 + y^2}$



$$R = \sqrt{r^2 + z^2}$$

$$= \sqrt{x^2 + y^2 + z^2}$$

$$\sin\theta = \frac{\sqrt{x^2+y^2}}{\sqrt{R^2}}$$

$$F = \int_{-L/2}^{L/2} \frac{GMm}{R^2} \sin\theta \, dz$$

$$= \frac{GMm}{L} \sqrt{x^2+y^2} \int_{-L/2}^{L/2} \frac{dz}{(x^2+y^2+z^2)^{3/2}}$$

$$F = F_x \hat{x} + F_y \hat{y}$$

$$F_x = -F\cos\phi \qquad F_y = -F\sin\phi$$

$$\cos\phi = \frac{x}{L} \qquad \sin\phi = \frac{y}{L}$$

$$\ddot{x} = \frac{F_x}{m} = -\frac{GMx}{r^2\sqrt{r^2 + L^2/4}}$$

$$\ddot{y} = \frac{F_y}{m} = -\frac{GMy}{r^2\sqrt{r^2 + L^2/4}}$$

$\frac{dx}{dt} = \dot{x}$	$\frac{dy}{dt} = \dot{y}$	$\frac{d\dot{x}}{dt} = -\frac{GMx}{r^2\sqrt{r^2+L^2/4}}$	$\frac{d\dot{y}}{dt} = -\frac{GMy}{r^2\sqrt{r^2+L^2/4}}$ where $r = \sqrt{x^2+y^2}$