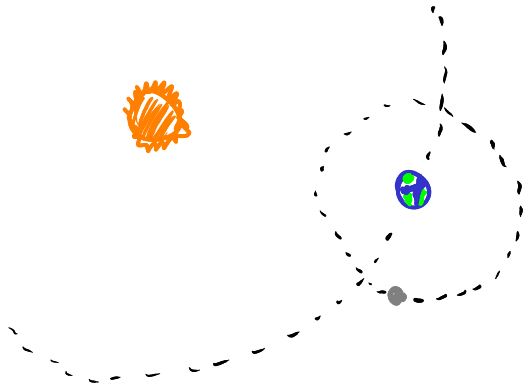
Aula 02

Mecânica Celeste

Órbitas



A Terra e os demais planetas **orbitam** o Sol.

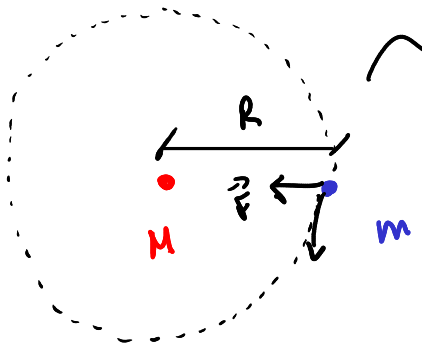
Assim como as luas **orbitam** seus planetas

↳ Formato das órbitas

↳ Parâmetros importantes

↳ Cálculo da velocidade, posição, etc.

↳ Órbitas Circulares



Movimento Circular Uniforme (MCU)

↳ P: Período

↳ R: Raio

↳ V: Velocidade

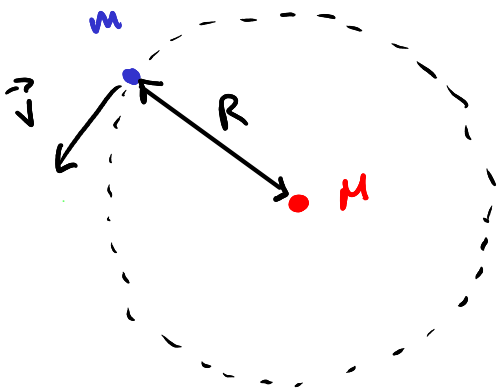
↳ ω: Velocidade Angular

↳ Velocidades

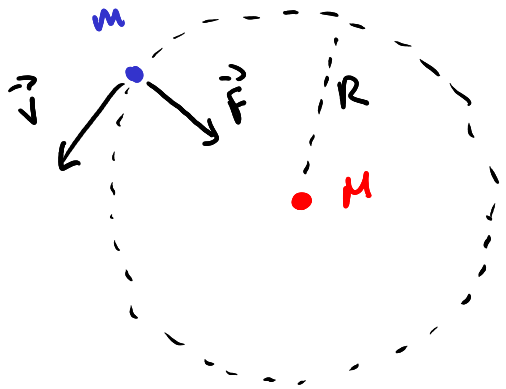
$$V = \frac{\Delta s}{\Delta t} \therefore V = \frac{2\pi R}{P}$$

$$\omega = \frac{\Delta \theta}{\Delta t} \therefore \omega = \frac{2\pi}{P}$$

$$V = \omega R$$



↳ Força Centrípeta

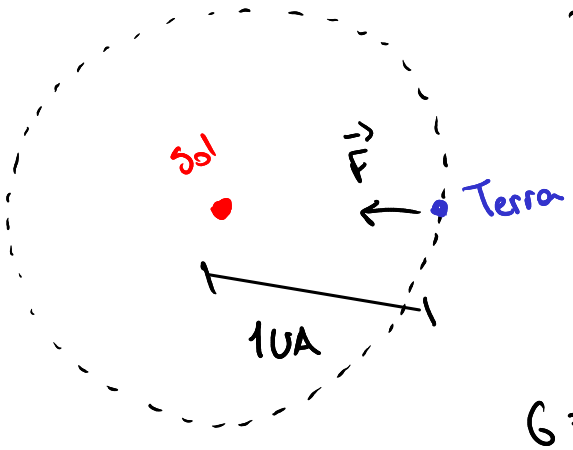


$$\left.\begin{aligned} F &= \frac{mV^2}{R} \\ F &= \frac{GMm}{R^2} \end{aligned}\right\} \frac{GMm}{R^2} = \frac{mV^2}{R}$$

$$V = \sqrt{\frac{GM}{R}}$$

Exemplo: Calcule a Velocidade da Terra

Órbita da Terra ≃ circular



$$\left.\begin{aligned} F &= \frac{mV^2}{R} \\ F &= \frac{GMm}{R^2} \end{aligned}\right\} V = \sqrt{\frac{GM}{R}}$$

$G = 6{,}67 \cdot 10^{-11}\ N\,m^2/kg^2$

$R = 1UA = 1{,}496 \cdot 10^{11}\ m$

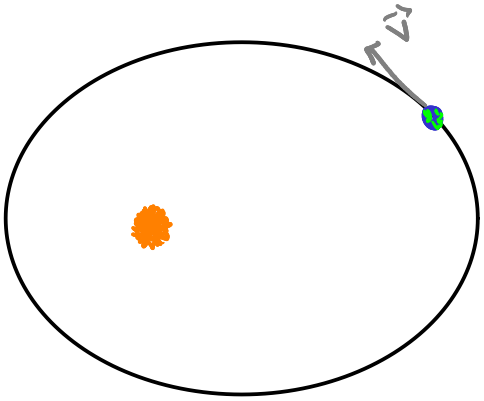
$M = 1{,}99 \cdot 10^{30}\ kg$

$$\boxed{V \simeq 29{,}8\ km/s}$$

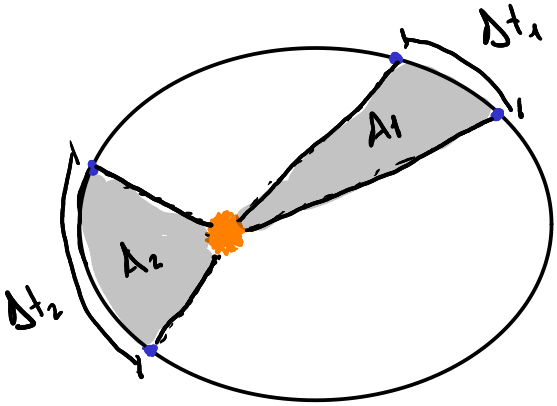
Leis de Kepler

As Leis de Kepler descrevem aspectos fundamentais das órbitas.

1ª Lei: As órbitas dos planetas são elipses, com o Sol em um dos focos.



2ª Lei: A "área varrida" pelo corpo por unidade de tempo é constante.



$$\frac{A_1}{\Delta t_1} = \frac{A_2}{\Delta t_2}$$

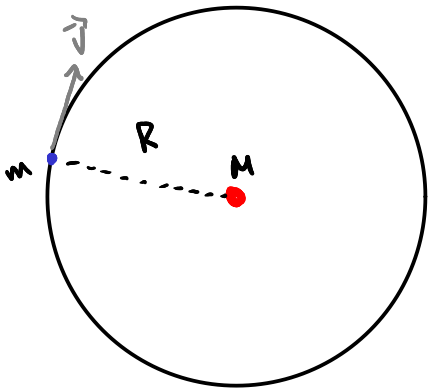
$$\frac{A_1}{\Delta t_1} \cdot \frac{A_2}{\Delta t_2} = cte$$

3ª Lei: O quadrado do período orbital dividido pelo cubo do raio da órbita é uma constante.

$$\frac{P^2}{R^3} = K$$

$$V = \sqrt{\frac{GM}{R}}$$

$$V = \frac{2\pi R}{P}$$



$$\sqrt{\frac{GM}{R}} = \frac{2\pi R}{P}$$

$$\frac{GM}{R} = \frac{4\pi^2 R^2}{P^2}$$

$$\boxed{\frac{P^2}{R^3} = \frac{4\pi^2}{GM}}$$