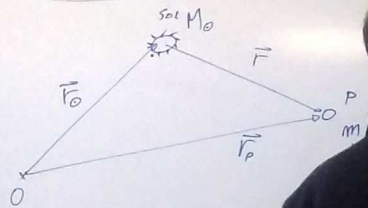
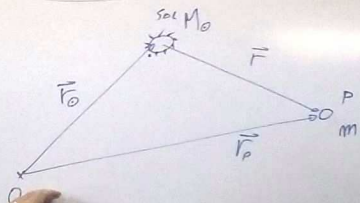


MOVIMIENTO Y CONFIGURACIONES PLANETARIAS



$$\ddot{\vec{r}}_p = -G \frac{M_0 m}{r^2}$$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS



$$M \ddot{\vec{r}}_p = -G \frac{M_0 m}{r^2} \hat{r}$$

$$M_0 \ddot{\vec{r}}_0 = +G \frac{M_0 m}{r^2} \hat{r}$$

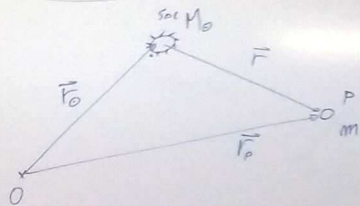
RESOL: $\ddot{\vec{r}}_p - \ddot{\vec{r}}_0 = -G \frac{(M_0 + m)}{r^2} \hat{r}$

$\ddot{\vec{r}}$

$$\ddot{\vec{r}} = -G \frac{(M_0 + m)}{r^2} \hat{r}$$

EC. MOV. RELATIVO

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS



$$m \ddot{\vec{r}}_p = -G \frac{M_0 m}{r^2} \hat{r}$$

$$M_0 \ddot{\vec{r}}_0 = +G \frac{M_0 m}{r^2} \hat{r}$$

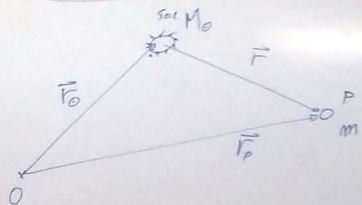
RESOL: $\ddot{\vec{r}}_p - \ddot{\vec{r}}_0 = -G \frac{(M_0 + m)}{r^2} \hat{r}$

$$\ddot{\vec{r}} = -G \frac{(M_0 + m)}{r^2} \hat{r}$$

EC. MOV. RELATIVO

$$\vec{r} \wedge \ddot{\vec{r}} = 0 \Rightarrow \text{INT.}$$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS



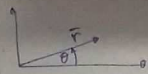
$$m \ddot{\vec{r}}_p = -G \frac{M_0 m}{r^2} \hat{r}$$

$$M_0 \ddot{\vec{r}}_0 = +G \frac{M_0 m}{r^2} \hat{r}$$

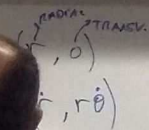
RESOL: $\ddot{\vec{r}}_p - \ddot{\vec{r}}_0 = -G \frac{(M_0+m)}{r^2} \hat{r}$

$$\ddot{\vec{r}} = -G \frac{(M_0+m)}{r^2} \hat{r}$$

EC. MOV. RELATIVO



"MOMENTO ANGULAR"

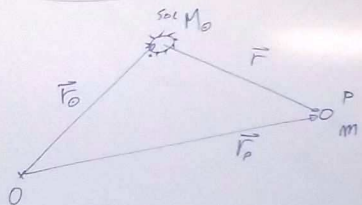


$$\vec{r} \wedge \ddot{\vec{r}} = 0 \Rightarrow \int \vec{r} \wedge \dot{\vec{r}} = \vec{cste} = \vec{h} = r^2 \dot{\theta} \hat{z}$$

INTEGRADO

$$\dot{\vec{r}} \wedge \dot{\vec{r}} + \vec{r} \wedge \ddot{\vec{r}} = 0$$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS



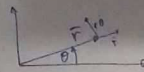
$$m \ddot{\mathbf{r}}_p = -G \frac{M_0 m}{r^2} \hat{\mathbf{r}}$$

$$M_0 \ddot{\mathbf{r}}_0 = +G \frac{M_0 m}{r^2} \hat{\mathbf{r}}$$

RESOL: $\ddot{\mathbf{r}}_p - \ddot{\mathbf{r}}_0 = -G \frac{M_0 + m}{r^2} \hat{\mathbf{r}}$

$$\ddot{\mathbf{r}} = -G \frac{(M_0 + m) \hat{\mathbf{r}}}{r^2}$$

EC. MOV. RELATIVO



$$\mathbf{r} = (r, \theta)$$

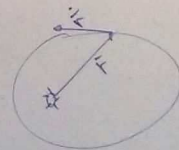
$$\dot{\mathbf{r}} = (\dot{r}, r\dot{\theta})$$

"MOMENTO ANGULAR"

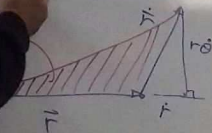
$$\mathbf{r} \wedge \ddot{\mathbf{r}} = 0 \Rightarrow \mathbf{r} \wedge \dot{\mathbf{r}} = \text{cte} = \vec{h} = r \cdot r\dot{\theta} \cdot \hat{\mathbf{z}}$$

INTEGRADO

$$\mathbf{r} \wedge \dot{\mathbf{r}} + \mathbf{r} \wedge \ddot{\mathbf{r}} = 0$$



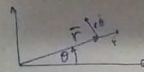
d.



MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

$$\ddot{\vec{r}} = -G \frac{(M_0 + m) \hat{r}}{r^2}$$

EC. MOV. RELATIVO



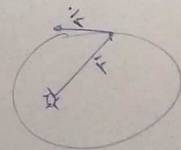
"MOMENTO ANGULAR"

$$\vec{r} = (r, 0)$$

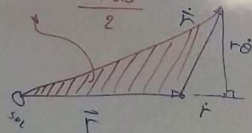
$$\dot{\vec{r}} = (\dot{r}, r\dot{\theta})$$

$$\vec{r} \wedge \ddot{\vec{r}} = 0 \Rightarrow \text{INTEGRADO } \vec{r} \wedge \dot{\vec{r}} = \text{cte} = \vec{h} = r \cdot r\dot{\theta} \cdot \hat{z}$$

$$\dot{\vec{r}} \wedge \dot{\vec{r}} + \vec{r} \wedge \ddot{\vec{r}} = 0$$



$$dA = \frac{r \cdot r d\theta}{2}$$



$$\Rightarrow \frac{dA}{dt} = \frac{r^2 \dot{\theta}}{2} \quad \text{VEL. AREOLAR} = \frac{|h|}{2} = \text{cte}$$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

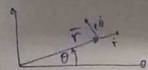
SOLUCIÓN
EC. MOV.
RELATIVO

$$r =$$

$$\mu = G(M_0 + m) \approx GM_0 = h^2$$

$$\ddot{\vec{r}} = -\frac{G(M_0 + m)\vec{r}}{r^3}$$

EC. MOV. RELATIVO



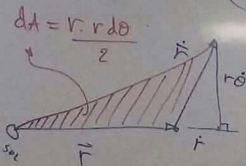
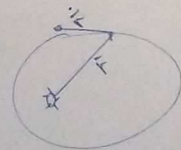
"MOMENTO ANGULAR"

$$\vec{r} = (r, \theta)$$

$$\dot{\vec{r}} = (\dot{r}, r\dot{\theta})$$

$$\vec{r} \wedge \ddot{\vec{r}} = 0 \Rightarrow \text{INTEGRADO } (\vec{r} \wedge \dot{\vec{r}}) = \text{cte} = \vec{h} = r \cdot r\dot{\theta} \cdot \hat{z}$$

$$\vec{r} \wedge \dot{\vec{r}} + \vec{r} \wedge \ddot{\vec{r}} = 0$$



$$dA = \frac{r \cdot r d\theta}{2}$$

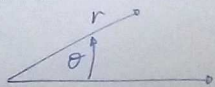
$$\Rightarrow \frac{dA}{dt} = \frac{r^2 \dot{\theta}}{2} \quad \text{VEL. AREOLAR} = \frac{|h|}{2} = \text{cte}$$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

SOLUCIÓN
EC. MOV
RELATIVO

$$r = \frac{h^2}{\mu(1 + e \cos \theta)}$$

C. PLANOS
(r, θ)



$$\mu = G(M_0 + m) \approx GM_0 = h^2$$

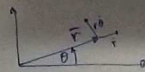
GAUSS

$$h^2 = GM_0 = (0.01720209895)^2$$

UA, días, M₀

$$\ddot{\vec{r}} = -\frac{G(M_0 + m)}{r^2} \hat{r}$$

EC. MOV. RELATIVO



"MOMENTO ANGULAR"

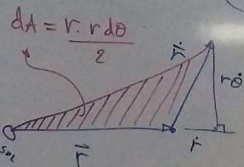
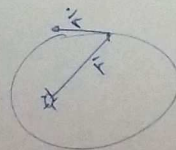
$$\vec{r} = (r, 0)$$

$$\dot{\vec{r}} = (\dot{r}, r\dot{\theta})$$

$$\vec{r} \wedge \ddot{\vec{r}} = 0 \Rightarrow \int \vec{r} \wedge \dot{\vec{r}} = \text{cte} = \vec{h} = r \cdot r\dot{\theta} \cdot \hat{z}$$

INTEGRAL

$$\vec{r} \wedge \dot{\vec{r}} + \vec{r} \wedge \ddot{\vec{r}} = 0$$



$$dA = \frac{r \cdot r d\theta}{2}$$

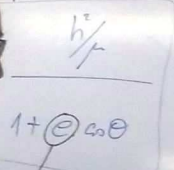
$$\Rightarrow \frac{dA}{dt} = \frac{r^2 \dot{\theta}}{2} \text{ VEL. AREOLAR} = \frac{|h|}{2} = \text{cte}$$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

1ª LEY KEPLER

SOLUCIÓN
EC. MOV
RELATIVO

C. PLANES
(r, θ)



EXCENTRICIDAD

$$\mu = G(M_0 + m) \approx GM_0 = h^2$$

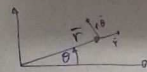
GAUSS

$$h^2 = GM_0 = (0.01720209895)^2$$

UA, días, M₀

$$\ddot{\vec{r}} = -\frac{G(M_0 + m)}{r^2} \hat{r}$$

EC. MOV. RELATIVO



"MOMENTO ANGULAR"

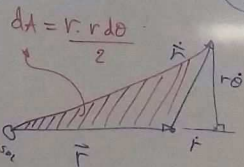
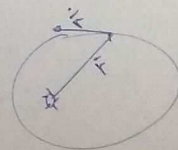
$$\vec{r} = (r, 0)$$

$$\dot{\vec{r}} = (\dot{r}, r\dot{\theta})$$

$$\vec{r} \wedge \ddot{\vec{r}} = 0 \Rightarrow \int \vec{r} \wedge \dot{\vec{r}} = \text{cte} = \vec{h} = r \cdot r\dot{\theta} \cdot \hat{z}$$

INTEGRADO

$$\cancel{\dot{\vec{r}} \wedge \vec{r}} + \vec{r} \wedge \ddot{\vec{r}} = 0$$



$$dA = \frac{r \cdot r d\theta}{2}$$

$$\Rightarrow \frac{dA}{dt} = \frac{r^2 \dot{\theta}}{2}$$

2ª LEY KEPLER

$$\text{VEL. AREOLAR} = \frac{|h|}{2} = \text{cte}$$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

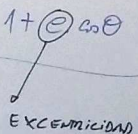
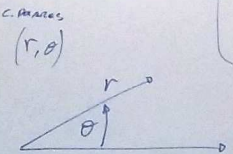
1ª LEY KEPLER

SOLUCIÓN
EC. MOV
RELATIVO

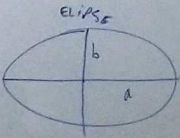
$$r = \frac{h^2}{\mu} \frac{1}{1 + e \cos \theta}$$

$$\frac{dA}{dt} = \text{cte} = \frac{a \cdot b \cdot \pi}{T} = \frac{a^2 \pi \sqrt{1-e^2}}{T}$$

PERÍODO ORBITAL



EXCENTRICIDAD



$$b = a \cdot \sqrt{1-e^2}$$

ELIPSE

$$\ddot{\vec{r}} = -\frac{G(M_0 + m)}{r^2} \hat{r}$$

EC. MOV. RELATIVO



"PROBLEMA ALGEBRA"

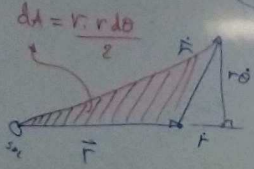
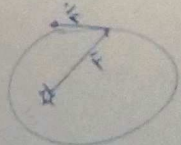
$$\vec{r} = (r, \theta)$$

$$\dot{\vec{r}} = (\dot{r}, r\dot{\theta})$$

$$\vec{r} \wedge \ddot{\vec{r}} = 0 \Rightarrow \int \vec{r} \wedge \dot{\vec{r}} = \text{cte} = \vec{h} = r \cdot r\dot{\theta} \cdot \hat{z}$$

INTEGRADO

$$\cancel{\dot{\vec{r}} \wedge \dot{\vec{r}}} + \vec{r} \wedge \ddot{\vec{r}} = 0$$



$$\Rightarrow \frac{dA}{dt} = \frac{r^2 \dot{\theta}}{2}$$

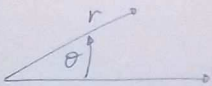
2ª LEY KEPLER

$$\text{VEL. AREOLAR} = \frac{|h|}{2} = \text{cte}$$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

SOLUCIÓN
EC. NAV
RELATIVAS

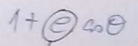
C. PLANAS
(r, θ)



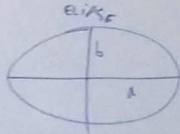
1ª LEY KEPLER

$$r = \frac{h^2}{\mu} \frac{1}{1 + e \cos \theta}$$

EXCENTRICIDAD



EXCENTRICIDAD

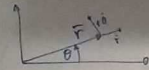


$$b = a \sqrt{1 - e^2}$$

$$\frac{dA}{dt} = CTE = \frac{a \cdot b \cdot \pi}{T} = \frac{a^2 \pi \sqrt{1 - e^2}}{T} = \frac{h}{2} = \frac{\sqrt{\mu \cdot a} \cdot \sqrt{1 - e^2}}{2}$$

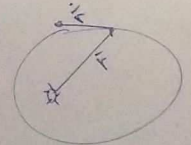
$$h = \sqrt{\mu a (1 - e^2)}$$

$$\frac{a^2 \pi}{T} = \sqrt{\mu}$$



$$\vec{r} = (r, \theta)$$

$$\dot{\vec{r}} = (\dot{r}, r\dot{\theta})$$



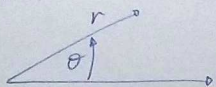
2ª LEY KEPLER

$$|EL. AREOLAR| = \frac{|h|}{2} = CTE$$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

SOLUCIÓN
EC. MOV
RELATIVO

C. PLANES
(r, θ)

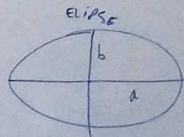


1ª LEY KEPLER

$$r = \frac{h^2}{\mu} \frac{1}{1 + e \cos \theta}$$

1 + e cos θ

EXCENTRICIDAD



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

ELIPSE

$$\frac{dA}{dt} = CTE = \frac{a \cdot b \cdot \pi}{T} = \frac{a^2 \pi \sqrt{1 - e^2}}{T} = \frac{h}{2} = \frac{\sqrt{\mu} \cdot a \cdot \sqrt{1 - e^2}}{2}$$

PERÍODO ORBITAL

$$h = \sqrt{\mu a (1 - e^2)}$$

$$\frac{a^2 \pi}{T} = \frac{\sqrt{\mu} \cdot a}{2} \Rightarrow \frac{a^4 \pi^2}{T^2} = \frac{\mu a}{4}$$

$$\frac{a^3}{T^2} = \frac{\mu}{(2\pi)^2} \Rightarrow \frac{G(M_0 + m)}{(2\pi)^2} = \frac{a^3}{T^2}$$

3ª LEY KEPLER

2ª LEY KEPLER

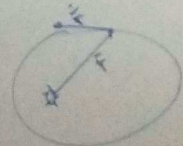
VEL. AREOLAR = $\frac{|h|}{2} = CTE$



RADIAL TRANSEVERAL

$$\vec{r} = (r, \theta)$$



$$\dot{\vec{r}} = (\dot{r}, r\dot{\theta})$$



MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

1ª LEY KEPLER

$$r = \frac{h^2}{\mu}$$

1 +  G_0 

EXCENTRICIDAD

Nota

$$\frac{G(M_0 + m)}{(2\pi)^2} = \frac{a^3}{T^2}$$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

1ª LEY KEPLER

$$r = \frac{h^2 / \mu}{1 + e \cos \theta}$$

a
 r
 1 + e cos θ
 EXCENTRICIDAD

"MOVIMIENTO MEDIO" = $\frac{2\pi}{T} = n = \sqrt{\mu/a^3}$

↑
 VEL. ANG. MEDIA ↑
 DISTURBIO



$$\frac{G(M_0 + m)}{(2\pi)^2} = \frac{a^3}{T^2} \Rightarrow \left(\frac{2\pi}{T}\right)^2 = \frac{\mu}{a^3}$$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

1ª Ley KEPLER

$$r = \frac{h^2}{\mu} \frac{1}{1 + e \cos \theta}$$

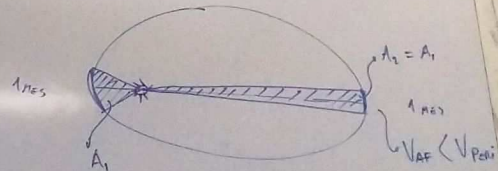
EXCENTRICIDAD

$$r = \frac{a(1 - e^2)}{1 + e \cos \theta}$$

"MOVIMIENTO MEDIO" = $\frac{2\pi}{T} = n = \sqrt{\mu/a^3}$

↑
VEL. ANG. MEDIA

↑
ROTACION



$$\frac{G(M_0 + m)}{(2\pi)^2} = \frac{a^3}{T^2} \Rightarrow \left(\frac{2\pi}{T}\right)^2 = \frac{\mu}{a^3}$$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

1ª Ley KEPLER

$$r = \frac{h^2}{\mu} \frac{1}{1 + e \cos \theta}$$

EXCENTRICIDAD

$$r(\theta) = \frac{a(1-e^2)}{1 + e \cos \theta}$$

Forma

si $e < 1$

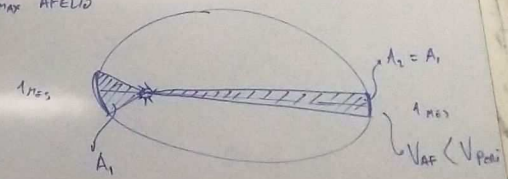
$$r_{max} = r(\theta = 180^\circ) \Rightarrow r = \frac{a(1-e^2)}{1-e} = a(1+e) = r_{max} \text{ "AFELIO"}$$

$$r_{min} = r(\theta = 0) \Rightarrow r = a(1-e) = r_{min} \text{ "PERIHELIO"}$$

"MOVIMIENTO MEDIO" = $\frac{2\pi}{T} = n = \sqrt{\mu/a^3}$

↑
VEL. ANG. MEDIA

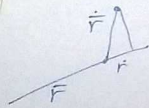
↑
ROTACION



$$\frac{G(M_0 + m)}{(2\pi)^2} = \frac{a^3}{T^2} \Rightarrow \left(\frac{2\pi}{T}\right)^2 = \frac{\mu}{a^3}$$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

1ª Ley KEPLER



$$r = \frac{h^2 / \mu}{1 + e \cos \theta}$$

$1 + e \cos \theta$

EXCENTRICIDAD

$$r(\theta) = \frac{a(1-e^2)}{1 + e \cos \theta}$$

Forma

$$\ddot{\vec{r}} = -\frac{\mu}{r^2} \hat{r}$$

$$\dot{\vec{r}} \cdot \ddot{\vec{r}} = -\frac{\mu}{r^2} \dot{\vec{r}} \cdot \hat{r} \Rightarrow \frac{d}{dt} \left(\frac{\dot{r}^2}{2} \right) = -\frac{\mu}{r^2} \dot{r}$$

$$\Rightarrow \dot{r} \cdot \ddot{\vec{r}} = -\frac{\mu}{r^2} \dot{r} \quad \text{INTEG:} \quad \frac{1}{2} \dot{v}^2 = \frac{\mu}{r} + \mathcal{E} \Rightarrow \mathcal{E} = \frac{v^2}{2} - \frac{\mu}{r}$$

"MOVIMIENTO MEDIO" = $\frac{2\pi}{T} = n = \sqrt{\mu/a^3}$

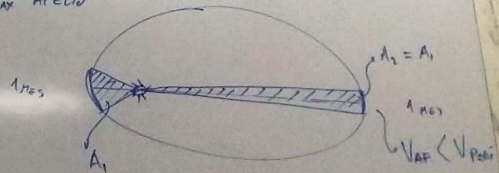
↑
VEL. ANG. MEDIA

↑
NOTACIÓN

si $e < 1$

$$r_{max} = r(\theta=180) \Rightarrow r = \frac{a(1-e^2)}{1-e} = a(1+e) = r_{max} \text{ "AFELIO"}$$

$$r_{min} = r(\theta=0) \Rightarrow r = \frac{a(1-e^2)}{1+e} = r_{min} \text{ "PERIHELIO"}$$

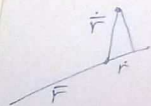


ENERGIA ORBITAL

$$\mathcal{E} = \frac{v^2}{2} - \frac{\mu}{r}$$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

1ª Ley KEPLER



$$r = \frac{h^2}{\mu} \frac{1}{1 + e \cos \theta}$$

Labels: h^2/μ (circled), $1 + e \cos \theta$ (circled), EXCENTRICIDAD (with arrow pointing to e)

$$r(\theta) = \frac{a(1-e^2)}{1 + e \cos \theta}$$

Label: r (with arrow pointing to the left side of the equation)

si $e < 1$

$$r_{max} = r(\theta=180^\circ) \Rightarrow r = \frac{a(1-e^2)}{1-e} = a(1+e) = r_{max} \text{ "AFELIO"}$$

$$r_{min} = r(\theta=0) \Rightarrow r = a(1-e) = r_{min} \text{ "PERIHELIO"}$$

"MOVIMIENTO MEDIO" = $\frac{2\pi}{T} = n = \sqrt{\mu/a^3}$

Labels: $2\pi/T$ (with arrow pointing to "VEL. ANG. MEDIA"), n (with arrow pointing to "ROTACION")

$$\ddot{r} = -\frac{\mu}{r^2} \hat{r}$$

$$\dot{r} \cdot \ddot{r} = -\frac{\mu}{r^2} \dot{r} \cdot \hat{r} \Rightarrow \frac{\dot{r} \cdot \ddot{r}}{r^3} = \frac{\dot{r} \cdot \ddot{r}}{r^3} = \frac{\dot{r}}{r^2} \Rightarrow \dot{r} \cdot \ddot{r} = -\frac{\mu}{r^2} \dot{r}$$

Label: INTEG:

$$\frac{1}{2} v^2 = \frac{\mu}{r} + \mathcal{E}$$

$$\mathcal{E} = \left(\frac{v^2}{2} \right) - \left(\frac{\mu}{r} \right)$$

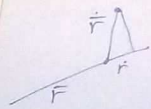
Labels: $v^2/2$ (with arrow pointing to "CIN"), μ/r (with arrow pointing to "POT")

si $\mathcal{E} < 0 \Rightarrow$ RACONADO \Rightarrow LIGADO \Rightarrow órbita

si $\mathcal{E} > 0 \Rightarrow$ FUERA RACONADO \Rightarrow NO LIGADO

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

1ª Ley KEPLER



$$r = \frac{h^2}{\mu} \frac{1}{1 + e \cos \theta}$$

EXCENTRICIDAD

$$V(\theta) = \frac{a(1-e^2)}{1 + e \cos \theta}$$

Forma

si $e < 1$

"MOVIMIENTO MEDIO" = $\frac{2\pi}{T} = n = \sqrt{\mu/a^3}$

↑
VEL. ANG. MEDIA ↑
ROTACION

$r_{max} = r(\theta=180^\circ) \Rightarrow r = \frac{a(1-e^2)}{1-e} = a(1+e) = r_{max}$ "AFELIO"
 $r_{min} = r(\theta=0) \Rightarrow r = \frac{a(1-e^2)}{1+e} = a(1-e) = r_{min}$ "PERIHELIO"

$$\ddot{\vec{r}} = -\mu \frac{\hat{r}}{r^2}$$

$$\dot{\vec{r}} \cdot \dot{\vec{r}} = -\mu \frac{\dot{\vec{r}} \cdot \hat{r}}{r^2} \Rightarrow \frac{\dot{r}^2}{r^2} = \frac{\dot{r}}{r} \Rightarrow \dot{r} \cdot \frac{\dot{r}}{r} = -\mu \frac{\dot{r}}{r^2} \Rightarrow \frac{N^2}{2} = \frac{\mu}{r} + \mathcal{E}$$

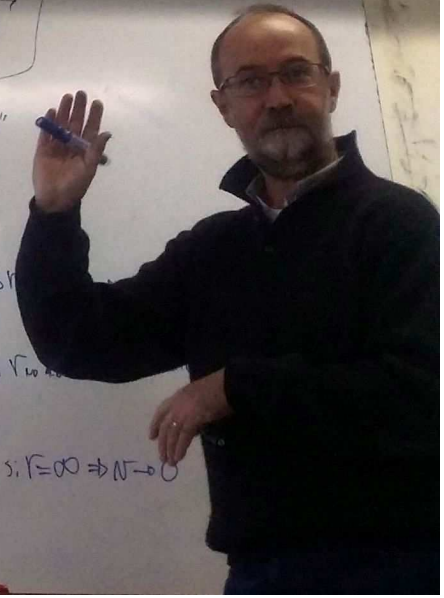
INTEG:

ENERGÍA ORBITAL

$$\mathcal{E} = \frac{N^2}{2} - \frac{\mu}{r}$$

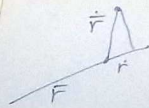
(N) (POT)

- si $\mathcal{E} < 0 \Rightarrow$ []
- si $\mathcal{E} > 0 \Rightarrow$ []
- si $\mathcal{E} = 0 \Rightarrow$ si $r = \infty \Rightarrow N \rightarrow 0$



MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

1ª Ley KEPLER

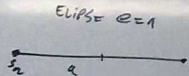
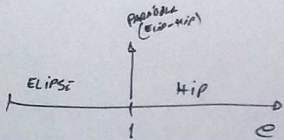


$$r = \frac{h^2}{\mu} \frac{1}{1 + e \cos \theta}$$

EXCENTRICIDAD

$$r(\theta) = \frac{a(1-e^2)}{1 + e \cos \theta}$$

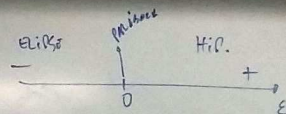
Fórmula



"MOVIMIENTO MEDIO" = $\frac{2\pi}{T} = n = \sqrt{\mu/a^3}$

VEL. ANG. MEDIA

NOTACIÓN



si $e < 1$

$r_{max} = r(\theta=180) \Rightarrow r = \frac{a(1-e^2)}{1-e} = a(1+e) = r_{max}$ "AFELIO"
 $r_{min} = r(\theta=0) \Rightarrow r = \frac{a(1-e^2)}{1+e} = a(1-e) = r_{min}$ "PERIHELIO"

ENERGÍA ORBITAL

$$\epsilon = \frac{N^2}{2} - \frac{\mu}{r}$$

(N) (POT)

- si $\epsilon < 0 \Rightarrow r$ ACOTADO \Rightarrow LIGADO \rightarrow Órbita cerrada (ELIPSE)
- si $\epsilon > 0 \Rightarrow r$ NO ACOTADO \Rightarrow NO LIGADO \rightarrow Órbita abierta (HIPÉRBOLA)
- si $\epsilon = 0 \Rightarrow$ si $r = \infty \Rightarrow N = 0$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

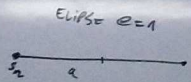
SEMIOSE: $a = \frac{\Delta_{TL}}{2}$

$$V(\theta) = \frac{a(1-e^2)}{1+e \cos \theta}$$

↑
Fuerza

$$T_{caída} = \frac{T}{2}$$

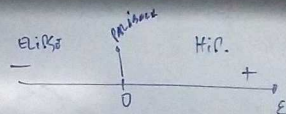
$$\frac{T^2}{a^3} = CTE = \frac{2\pi^2}{\Delta_{TL}^3}$$



"MOVIMIENTO MEDIO" = $\frac{2\pi}{T} = n = \sqrt{\mu/a^3}$

↑
VEL. ANG. MEDIA

↑
NOTACIÓN



si $e < 1$

- $r_{max} = r(\theta=180) \Rightarrow r = \frac{a(1-e^2)}{1-e} = a(1+e) = r_{max}$ "AFELIO"
- $r_{min} = r(\theta=0) \Rightarrow r = \frac{a(1-e^2)}{1+e} = a(1-e) = r_{min}$ "PERIHELIO"

ENERGÍA ORBITAL

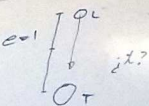
$$\Rightarrow \mathcal{E} = \frac{N^2}{2} - \frac{\mu}{r}$$

(N) (POT)

- si $\mathcal{E} < 0 \Rightarrow r$ ACOTADO \Rightarrow LIGADO \rightarrow ÓRBITA CERRADA (ELIPSE)
- si $\mathcal{E} > 0 \Rightarrow r$ NO ACOTADO \Rightarrow NO LIGADO \rightarrow ÓRBITA ABIERTA (HIPÉRBOLA)
- si $\mathcal{E} = 0 \Rightarrow r = \infty \Rightarrow N = 0$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

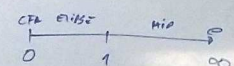
Semi-eje: $a = \frac{\Delta r_L}{2}$

$e=1$ 


$$r(\theta) = \frac{a(1-e^2)}{1+e \cos \theta}$$

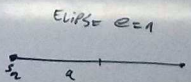
Forma

$T_{orbita} = \frac{T}{2}$



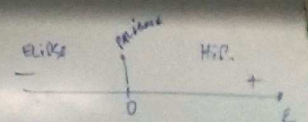
$$\frac{T^2}{a^3} = CTE = \frac{2\pi^2}{\Delta T_L^3} = \left(\frac{T}{2}\right)^2$$





"MOVIMIENTO MEDIO" = $\frac{2\pi}{T} = n = \sqrt{\mu/a^3}$

↑
VEL. ANG. MEDIA
↑
INERCIACIÓN



Si $e < 1$

- $r_{max} = r(\theta=180) \Rightarrow r = \frac{a(1-e^2)}{1-e} = a(1+e) = r_{max}$ "AFELIO"
- $r_{min} = r(\theta=0) \Rightarrow r = a(1-e) = r_{min}$ "PERIHELIO"

ENERGÍA ORBITAL

$$\Rightarrow \mathcal{E} = \frac{N^2}{2} - \frac{\mu}{r}$$

(CIN) (POT)

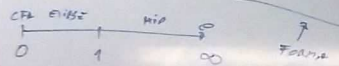
- Si $\mathcal{E} < 0 \Rightarrow r_{max} < \infty \Rightarrow$ LIGADO \rightarrow ÓRBITA CERRADA (ELIPSE)
- Si $\mathcal{E} > 0 \Rightarrow r_{max} = \infty \Rightarrow$ NO LIGADO \rightarrow ÓRBITA ABIERTA (HIPÉRBOLA)
- Si $\mathcal{E} = 0 \Rightarrow r_{max} = \infty \Rightarrow N \rightarrow 0$

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

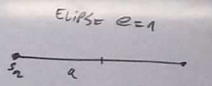
semieje: $a = \frac{\Delta_{TL}}{2}$

$$V(\theta) = \frac{a(1-e^2)}{1+e \cdot \cos \theta}$$

$$T_{caída} = \frac{T}{2}$$



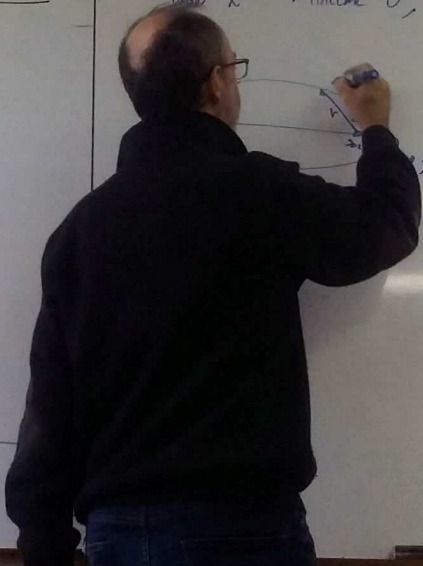
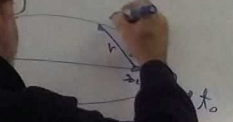
$$\frac{T^2}{a^3} = CTE = \frac{2\pi^2}{\Delta_{TL}^3} = \frac{(T/2)^2}{(\Delta_{TL}/2)^3}$$



DADO $t \rightarrow$ HALLAR θ, r

CASO ELIPSE

DEFINIMOS $M = m \cdot (t - t_0)$
"ANOMALIA MEDIA"

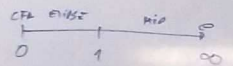


MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

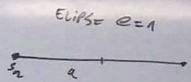
SMALL: $a = \frac{\Delta_{TL}}{2}$

$$V(\theta) = \frac{a(1-e^2)}{1+e \cos \theta}$$

$T_{caída} = \frac{T}{2}$

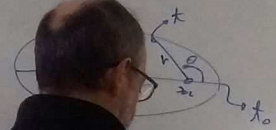


$$\frac{T^2}{a^3} = CTE = \frac{2\pi^2}{\Delta_{TL}^3} = \frac{(T/2)^2}{(\Delta_{TL}/2)^3}$$



DADO $t \rightarrow$ HALLAR θ, r

CASO ELIPSE



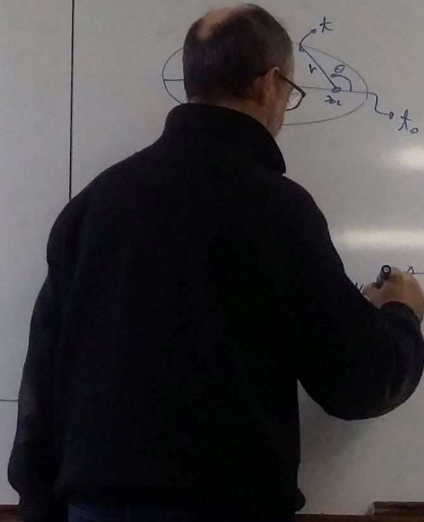
DEFINIMOS $M = m \cdot (t - t_0)$

"ANOMALIA MEDIA"

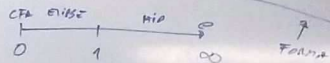
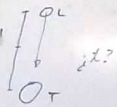
$$\theta = M + 2e \sin M + \frac{5}{4} e^2 \sin 2M + \dots$$

$(\theta(x))$

$$M = E - e \cos E$$



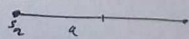
NTD Y CONFIGURACIONES PLANETARIAS



$$V(\theta) = \frac{a(1-e^2)}{1+e \cos \theta}$$

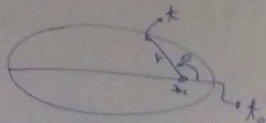
$$\frac{27^4}{\Delta_{TL}^3} = \frac{(T/2)^2}{(\Delta_{TL}/2)^3}$$

ELIPSE $e=1$



DADO $t \rightarrow$ HALLAR θ, r

CASO ELIPSE



DEFINICION $M = m \cdot (t - t_0)$

"ANOMALIA MEDIA"

$$\theta = M + 2e \sin M + \frac{5}{4} e^2 \sin 2M + \dots$$

($\theta(t)$)

$E \sim M$

$$M = E - e \cos E$$

$$V = a(1 - e \cos E)$$

$$E = M + e \cos E$$

DEF. ANOM. EXCENTRICAS

EC DE KEPLER

MOVIMIENTO Y CONFIGURACIONES PLANETARIAS

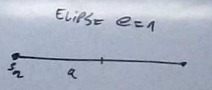
SE PRUEBA QUE

$$E = -\frac{\mu}{2a}$$

$a > 0$ ELIPSES
 $a = \infty$ PARABOLA
 $a < 0$ LA LO HIPERBOLAS

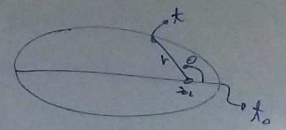
$$V(\theta) = \frac{a(1-e^2)}{1+e \cos \theta}$$

Forma



DADO $t \rightarrow$ HALLAR θ, r

CASO ELIPSE



$E \sim M$

DEFINIMOS $M = m \cdot (t - t_0)$

"ANOMALIA MEDIA"

$$\theta = M + 2e \sin M + \frac{5}{4} e^2 \sin 2M + \dots$$

EC. DE KEPLER

$$M = E - e \cos E$$

DEF "ANOM. EXCENTRICA"

$$r = a(1 - e \cos E)$$

$$E = M + e \cos E$$

ITERACION

\Rightarrow OBTENGO $E \rightarrow r$