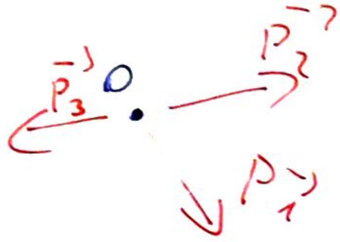
Fisica generale I 04/12/2020

Forze centrali



$\vec F_1$ direzione $\overline{O P_1}$

$\vec F_2$ direzione $\overrightarrow{O P_2}$

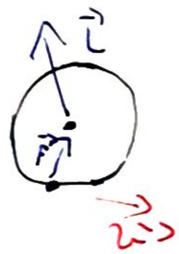
$\vec F_3$ direzione $\overrightarrow{O P_3}$

$$\vec F = \pm F(r)\, \hat u_R$$

F < 0 Attrattiva

F > 0 Repulsiva

Campo di forza



$$\vec L_0 = \vec b \times \vec P \qquad \vec L_0 = \overrightarrow{OP} \times \vec P$$

$$= \vec r \times \vec P$$

$$\vec \tau_0 = \frac{d\vec L_0}{dt}$$

$$\vec \tau_0 = \overrightarrow{OP} \times \vec F$$

$$\vec \tau_0 = \vec r \times \vec F$$

$$\vec r \parallel \vec F$$

$$\Downarrow$$

$$L = \text{cost} = \vec r \times m\vec v$$

$$\vec L = \vec r \times \vec P = \vec r \times m(\underbrace{\vec v_P}_{} + \underbrace{\vec v_N}_{=0})$$

$$L = \vec r \times m \vec v_\theta = r m v_\theta = r m \omega r = m \omega r^2$$

Velocità Areale

$$L = m r^2 \frac{d\theta}{dt}$$

$$A = \frac{1}{2}\frac{L}{m}$$

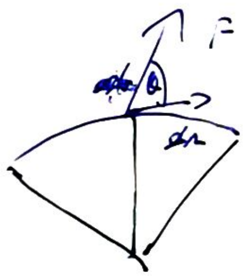
$$\frac{dA}{dt} = \frac{1}{2} r^2 \frac{d\theta}{dt}$$

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

$$rA = dA$$

$$d = dr = r\,d\theta$$

Forze centrali conservative



$$W = \int_\gamma \vec{F} \cdot d\vec{r}$$

$$= \int F(r)\, \hat{u}_r \cdot d\vec{r}$$

$$= \int_A^B F(r)\, dr \cos(\theta)$$

$$= \int_A^B F(r)\, dr = \int_A^B F(r) dr$$

$$= F(B) - F(A)$$

Keplero

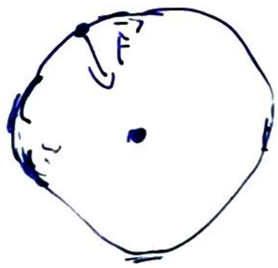
I. Orbita Ellittica

II. $A = cost$ $\frac{dA}{dt} = cost$

III. $T^2 = Ka^3$

Moto di rivoluzione

Approssimazione



$$\vec{F} = m \cdot \vec{a_c} \qquad a_{//} = 0$$

$$= m \cdot \frac{\omega^2}{r} r \hat{u_r} = m \frac{4\pi^2}{T^2} r$$

$$T = \frac{2\pi}{\omega}$$

$$\omega = 2\pi \cdot \frac{1}{T}$$

$$F = 4m \frac{\pi^2}{T^2} r$$

$$T^2 = K a^3 \qquad F^2 = K r^3 \qquad \sqrt{Kr^3} = 4m \frac{\pi^2}{T^2} r$$

$$a = r$$

$$F = \sqrt{Kr^3}$$

$$\vec{F}_{ST} = \frac{4\pi}{KT} \frac{m_T}{r^2} \hat{u_r}$$

$$\vec{F}_{TS} = \frac{4\pi}{K_S} \frac{m_T}{r^2} \hat{u_r}$$

$$F_{TS} = F_{ST}$$

$$\frac{m_T}{K_T} = \frac{m_S}{K_S}$$

$$\vec{F} = \gamma \frac{m_S m_T}{r^2} \hat{u}_r$$

$$m_T K_S = m_S K_T$$

$$\vec{F} = \gamma \frac{m_S m_T}{r^2} \hat{u}_r$$

$$\gamma = \frac{4\pi^2}{m_T K_S} = \frac{4\pi^2}{m_S K_T}$$

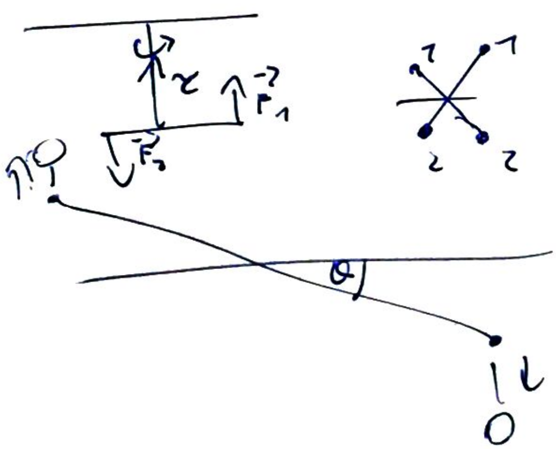
$$\vec{F} = \gamma \frac{m\, m_T}{r_T^2} \hat{u}_r = g\, m$$

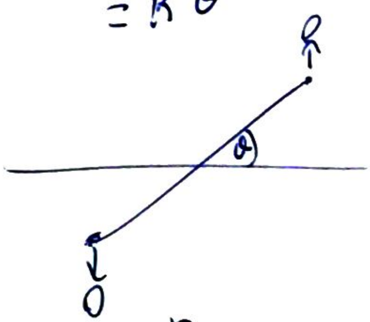
$$g = \gamma \frac{m_T}{r_T^2} = 9,81\ m/s^2$$

Bilancia di Torsione

Cavendish

$$\tau = Fb = K\theta$$





$$F = \gamma \frac{M m}{r^2}$$

$$F = \gamma \frac{m\, m_T}{r^2}$$

$m = 5 \cdot 10^{-2}\ Kg$

$M = 5 \cdot 10^{-1}\ Kg$

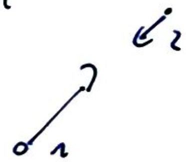
$l = 0{,}8\ m$

$r = 0{,}2\ m$

$K =$

Campi Gravitazionali

$$\vec F_{12} = \gamma \frac{m_1 m_2}{r^2} \hat u_{r12}$$



$$\vec G_1 = \frac{\vec F_{12}}{m_2}$$

$$= \frac{m_2 \gamma}{m_2} \frac{m_1}{r^2} u_r$$

$$= \hat u_r \gamma \frac{m_1}{r_2}$$

$$\vec G = \vec G_1 + \vec G_2 + \vec G_3$$

$$G = -\gamma \frac{m_1}{r_1^2} \hat u_{r_1} - \gamma \frac{m_2}{r_2^2} \hat u_r - \gamma \frac{m_3}{r_3^2} \hat u_{r_3}$$

$$G = \sum_{i=1}^{N} -\gamma \frac{m_i}{r_i^2} \hat u_{r_i}$$

$$\vec{W} = \int \vec{F}(r) dr$$

$$\int_r^B \frac{dr}{r_2} = -2+7\left[\frac{1}{r}\right]$$

$$= \int_{r_A}^{r_B} -\gamma \frac{m_1 m_2}{r^2} dr$$

$$W = -\gamma m_1 m_2 \int_{r_A}^{r_B} \frac{dr}{r^2}$$

$$= +\gamma m_1 m_2 \left[\frac{1}{r}\right]_{r_A}^{r_B}$$

$$\gamma m_1 m_2 \left[\frac{1}{r_B} - \frac{1}{r_A}\right]$$

$$= \gamma \frac{m_1 m_2}{r_B} - \gamma \frac{m_1 m_2}{r_A}$$

$$W = -\Delta W$$

$$W = -U_B - U_A$$

$$U_B = -\gamma \frac{m_1 m_2}{r_B}$$

$$U_A = -\gamma \frac{m_1 m_2}{r_A} +$$

$$U_\infty = 0$$

Velocità di Fuga

$$K_0 + U_0 = K_F + U_F$$

$$\frac{1}{2} m v_0^2 - \gamma \frac{m M_T}{r_T^2} = \frac{1}{2} m v_F^2$$

$$v_F^2 = 0 \Rightarrow v_0 = v_{Fuga}$$

$$= \gamma \frac{m M_T}{r_T^2}$$

$$v_F = \sqrt{2 \gamma \frac{m_T}{r_T^2}} \qquad v_F = \sqrt{\frac{2}{r_T}}$$

$$v_F = \sqrt{2 \cancel{g} \frac{r^{\cancel{2}}}{\cancel{m}} \frac{M_T}{r_T^{\cancel{2}}}} \qquad v_{FT} = 10^4 \frac{Km}{h}$$

$$v_F = \sqrt{\frac{2}{r_T}}$$

$$\vec{F} = m \vec{a}_\perp \qquad a_{\parallel} = 0$$

$$F = \gamma \frac{m M}{r^2} 4 r^2$$

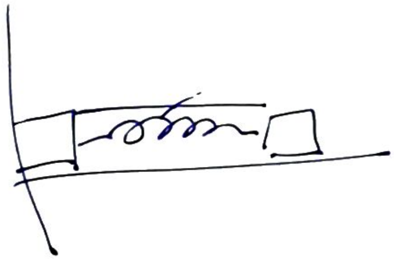
$$F = m \frac{v^2}{r} \qquad \frac{1}{2} m v_0^2 - \gamma \frac{m M}{r} = \text{costante}$$

$$a_c = \gamma \frac{M}{r^2} \qquad E = -\gamma \frac{m M}{2r}$$

$$v^2 = \rightarrow \gamma \frac{M}{r} \qquad \overline{E}^2 = -\gamma \frac{M m}{2r}$$

$$\frac{1}{2} m \gamma \frac{M}{r} - \gamma \frac{m M}{r} = E$$

$m = 6\,Kg$
$M = 18\,Kg$
$K = 7{,}2\,K\frac{N}{m}$
$x = 15 \cdot 10^{-2}\,m$



S 1
n° 5

$$U = \frac{1}{2}\Delta K$$

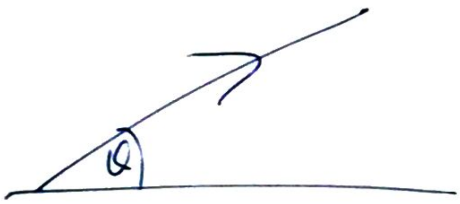
$$W_0 = U$$

$$W_0 = \frac{1}{2} K \; x^2$$

$$\frac{1}{2} K x^2 = \frac{1}{2} m_2 v_2^2$$

$$K_{cm} = \frac{1}{2}\frac{(m_1 + m_2)}{n} v_{cm}^2$$

$$v_{cm} = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}$$



$v_x : 30\,m/s$
$m = 0{,}20\,Kg$

$$M x_{cm} = m_1 x_1 + m_2 x_2$$ n° 3

$$x_2 = \frac{M x_{cm} - m_1 x_1}{m_2}$$

$$x_{cm} = x(t)$$