VER. 5-8

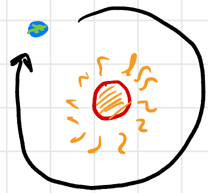
$R = 1,5 \cdot 10^{11}\, m$

$M_{sole} = 1,987 \cdot 10^{30}\, Kg$

$G = 6,674 \cdot 10^{-11}\, m^3/kg\, s^2$

$$T = \frac{2\pi R}{v} = \frac{6,28 \cdot 1,5 \cdot 10^{11}}{2,97 \cdot 10^4}$$

$$= 31,7 \cdot 10^6\, s \simeq 366\, g$$

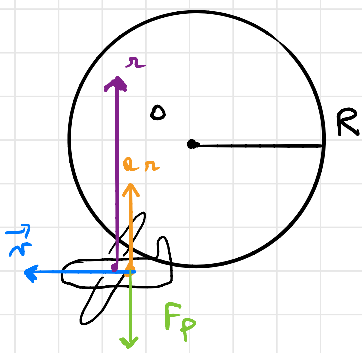


- L'unica forza che mantiene l'orbita è la $F_{gravità}$

- $$F = G \underbrace{\frac{M_s \cancel{M_T}}{R^{\cancel{2}}}}_{} = \cancel{M_T} \underbrace{\overbrace{\frac{v^2}{\cancel{R}}}^{a_n}}_{\text{EQUAZIONE}}$$

$$v = \sqrt{\frac{G \cdot M_s}{R}} \simeq 2,97 \cdot 10^4\, m/s$$

VERIFICA 5_8



DATI:

- $v = 78\, m/s$
- $a_n \leq 3g \rightarrow \frac{v^2}{r} \leq 3g$

$\rightarrow v^2 \leq 3rg \rightarrow R \geq \frac{v^2}{3g}$

$\rightarrow R \geq \frac{(78)^2}{3 \cdot (9,8)} \geq 210\, m$

- Peso apparente del pilota? Si considerano: forza peso e forza normale.

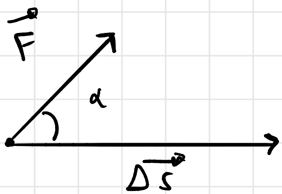
$\cdot\ \vec{F}_{TOT} = m \cdot \vec{a_r}$

$N - P = m \cdot \vec{a_r}$

$N = (m \cdot \vec{a_r}) + P = m \cdot g + 3gm = 4mg$

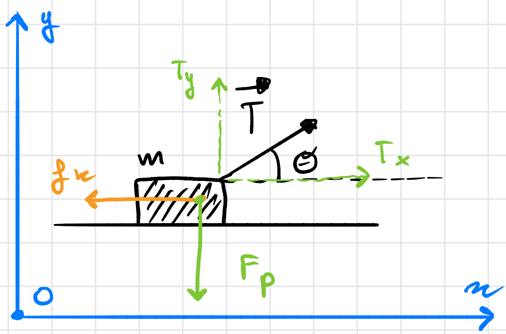
4 volte

$\boxed{\text{ricordare il lavoro}}$



$L = \vec{F} \cdot \vec{\Delta s} = F \cdot \Delta s \cdot \cos\alpha$

ES. 6_2



$\theta = 20{,}0°$ $\quad \Delta s = 170\,m$

$m = 26\,kg$

$\mu_k = 0{,}15$ $\quad ?\ L_{TRASC.},\ L_{fk}$

$\vec{v} = \text{COSTANTE}$ (!)

$F_p = 26 \cdot 9{,}8 = 254{,}8$

(*) velocità costante, 1° principio dinamica

$$\begin{cases} \sum f_x = 0 \\ \sum f_y = 0 \end{cases}$$

$$\vec{T}_y = \vec{T} \cdot \operatorname{sen}\theta$$

$$\vec{T}_x = \vec{T} \cdot \cos\theta > 0$$

→ FORZE ASSE x:

→ FORZE ASSE y:

$$\begin{cases} T_x - f_k = 0 \\ T_y + N - F_p \end{cases}$$

- $T_x - f_k = 0 \rightarrow T\cos\theta - \mu_k N = 0 \rightarrow T = \dfrac{\mu_k N}{\cos\theta}$

- $\dfrac{\mu_k N}{\cos\theta}\operatorname{sen}\theta + N = mg \rightarrow N(1 + tg\,\theta \cdot \mu_k) = mg$

- $N = \dfrac{mg}{1 + \mu_k\, tg\,\theta}$

$$T = \frac{\mu_k\, mg}{(1 + \mu_k\, tg\,\theta)\cos\theta}$$

$$= \frac{\mu_k mg}{\cos\theta + \mu_k \operatorname{sen}\theta} = 41\,N$$

FORZA

→ $L_T = T \cdot \Delta s \cdot \cos\theta = 4600\,J$

→ $L_{fk} = \Delta s \cdot f_k \cdot \overbrace{\cos\alpha}^{-1} = -4600\,J$

- $K = \frac{1}{2} m v^2$ (componente cinetica)
- U = en. pot. grav. $= mgh$
- $E_{mecc.} = K + U$

se non ci sono attriti la considero conservativa

$$E_{M_{iniz.}} = E_{M_{finale}}$$

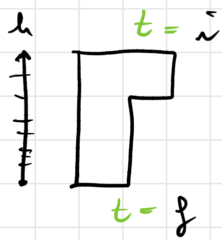
- se si considera l'attrito:

$$(W)\ L_{mecc} = \Delta E_{mecc} = E_{M_{ini.}} - E_{M_{fin.}}$$

$$= (K_f + U_f) - (K_i + U_i) = K_f - K_i + U_f - U_i$$

$$= \Delta K - \Delta U$$

ES. 6_5



DATI:

$m = 60\ kg$

$h = 12\ m$

$v_f = 2{,}0\ m/s$

$g = 9{,}78\ m/s^2$

inizio

$v_i = 0$ $\quad U_i = 0$

$K_i = 0$

fine

$v_f = 2{,}0\ m/s$ $\quad U_f = 0$

$K_f = \frac{1}{2} m v_f^2$

$\rightarrow L_{mecc} = K_f + \cancel{U_f} - (\cancel{K_i} + U_i)$

$= \frac{1}{2} m v_f^2 - (mgh) = -6920\,J$

Fine

$K_f = 0$ e $v_f = 0$ $\qquad U_f = mgh$

$\rightarrow L_{mecc} = K_f + U_f - (K_i + U_i) =$

$= mgh - \frac{1}{2} m v^2$

$\rightarrow$ CHIESTO RAPPORTO $\frac{L_{mecc}}{K} \rightarrow \frac{\cancel{m}gh - \frac{1}{2}\cancel{m}v^2}{\frac{1}{2}\cancel{m}v^2} = \frac{gh}{\frac{1}{2}v^2} - 1$

$\simeq 0,24$

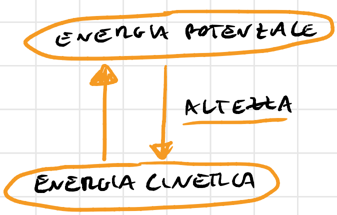
ES. 6_6

- CONSERVAZIONE ENERGIA $\rightarrow$ NESSUN attrito

$E_{mecc.in} = E_{mecc.fin}$

$h_1 = 35\,m \qquad h = 22\,m$

$v_1 = 4,0\,m/s \qquad v_2 = ?$



$\rightarrow E_{m_f} = \frac{1}{2} m v_2^2 + mgh_2$

$E_{m_i} = \frac{1}{2} m v_1^2 + mgh_1$

$\rightarrow \frac{1}{2}\cancel{m} v_2^2 + \cancel{m}g h_2 = \frac{1}{2}\cancel{m} v_1^2 + \cancel{m}g h_1$

$\rightarrow v_2^2 = 2\left(\frac{1}{2}v_1^2 + gh_1 - gh_2\right)$

$$\rightarrow \quad v_2^2 = v_1^2 + 2g(h_1 - h_2)$$

$$v_2 = \sqrt{v_1^2 + 2g(h_1 - h_2)} \simeq 17\ m/s$$

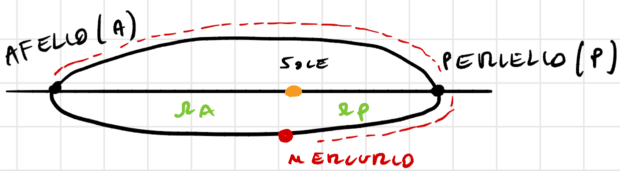
RICORDA ENERGIE POTENZIALI

- vicino alla sup. terrestre: $U = mgh$
- generalmente: $U = -G\dfrac{m_1 m_2}{r}$

ES. 6-7

- $r_P = 4,6 \cdot 10^7$ Km
- $r_A = 6,98 \cdot 10^7$ Km
- $v_P = 59$ Km/s

? v



$$E_{MECC\,P} = \frac{1}{2} M_{MERC.}\, v_P^2 - G\frac{M_S M_M}{r_P}$$

$$E_{MECC\,A} = \frac{1}{2} M_M\, v_A^2 - G\frac{M_S M_M}{r_A}$$

$$\frac{1}{2}\cancel{M_M}\, v_P^2 - G\frac{M_S \cancel{M_M}}{r_P} = \frac{1}{2}\cancel{M_M}\, v_A^2 - G\frac{M_S \cancel{M_M}}{r_A}$$

$$v_p^2 + 2GM_s\left(\frac{1}{r_A} - \frac{1}{r_p}\right) = v_A^2$$

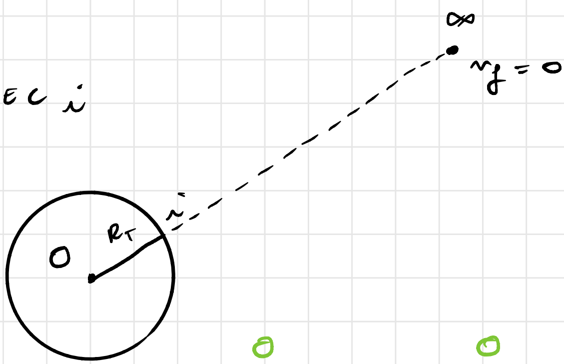
$$v_A = \sqrt{v_p^2 + 2GM_s\left(\frac{1}{r_A} - \frac{1}{r_p}\right)} = 39000\ m/s$$

ES. 6_8 VELOCITÀ DI FUGA DAL CAMPO GRAVITAZIONALE

Che velocità deve avere un proiettile per sfuggire al campo gravitazionale?

Conservazione:

$$E_{MEC\ f} = E_{MEC\ i}$$



$$\underbrace{\frac{1}{2} m v_i^2 - G\frac{m M_T}{R_T}}_{\text{velocità meccanica iniziale}} = \frac{1}{2} m v_f^2 - \lim_{R\to\infty} G\frac{m M_T}{R}$$

$$\rightarrow \frac{1}{2}\cancel{m} v_i^2 - G\frac{\cancel{m} M_T}{R_T} = 0$$

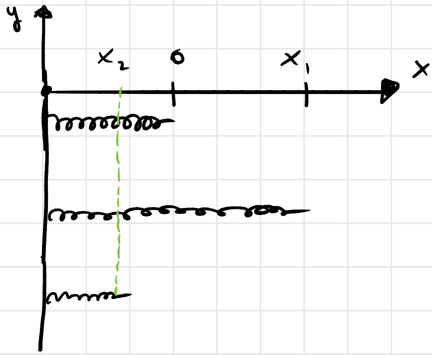
$$v_i = \sqrt{\frac{2GM_T}{R_T}} = 11{,}2\ Km/s$$

Es. 6_8

$R_2 = 7{,}00 \cdot 10^9\ m$

$v = \sqrt{\frac{2 M_S \cdot G}{R_1}} = 195\ km/s$

Es. 6_10



$k = 400{,}0\ N/m$

$U_{ELASTICA} = \frac{1}{2} k x^2$

$x_2 = -8\ cm$ (CARICATO DI 8 cm)

? v_f

L'energia potenziale gravitazionale non varia: stessa quota

$$E_{mec\ i} = U_{el\ i} + K_i = \frac{1}{2} k x_2^2 + 0$$

$$E_{mec\ f} = 0 + \frac{1}{2} m v_f^2$$

$$\frac{1}{2} k x_2^2 = \frac{1}{2} m v_f^2 \rightarrow v_f = \sqrt{\frac{k x_2^2}{m}}$$

$$v_f = x_2 \sqrt{\frac{k}{m}}$$