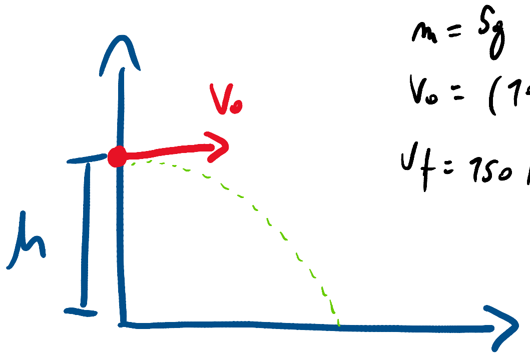
Appello 14/06/2021

venerdì 26 gennaio 2024 16:06

Es 1



$m = 5g$

$V_0 = (10, -5, 0)\ m/s$

$v_f = 150\ Km/h$

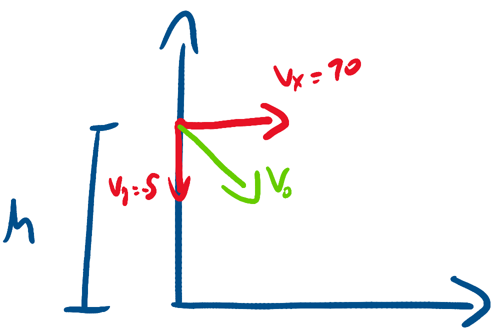
Determinare

a) Da che altezza ha iniziato il suo moto

b) In che posizione r_f raggiunge il suolo

c) Lavoro della Forza Peso

Sol



$$
\begin{array}{l} x \\ \\ y \end{array}
\begin{cases} S_f = S_0 + V_x \cdot t \\ S_f = S_0 + V_0 t + \frac{1}{2} a t^2 \\ V_f = V_0 + a t \end{cases}
\Rightarrow
\begin{cases} S_f = 0 + 10 \cdot t \\ 0 = h - 5t - \frac{1}{2} g t^2 \\ -150\ km/h = -5 - g t \end{cases}
$$

$\Rightarrow$

$\{ S_f = 10 \cdot t$ $\qquad\qquad$ $\{ S_f = 10 \cdot t$

$\quad \ldots\ at + \frac{1}{2} a t^2$

$\Rightarrow$

$$\begin{cases} S_f = 10 \cdot t \\ h = 5t + \frac{1}{2} g t^2 \\ g t = -5 + 41,7 \end{cases} \Rightarrow \begin{cases} S_f = 10 \cdot T \\ h = 5T + \frac{1}{2} g t^2 \\ T = \dfrac{36,7}{g} = 3,74 \, s \end{cases}$$

$$\Rightarrow \begin{cases} S_f = r_f = 10 \cdot 3,74 = 37,4 \, m \\ h = 5 \cdot 3,74 + \frac{1}{2} \cdot 9,81 \cdot (3,74)^2 = 87,37 \, m \end{cases}$$

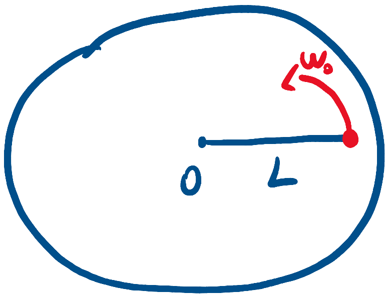
c) $L = F \cdot \Delta S = F_p \cdot h = m \cdot g \cdot h$

Es 2

$m = 1 \, Kg$

$w_0 = 1 \, rad/s$

$L = 1 \, m$

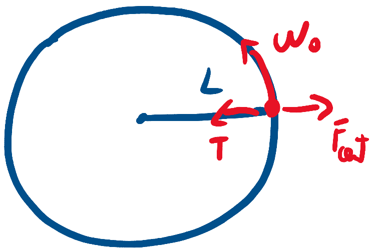


a) Quanto vale la Tensione del Filo?

b) Calcolare Δw se $\tilde{L} = \frac{L}{2}$

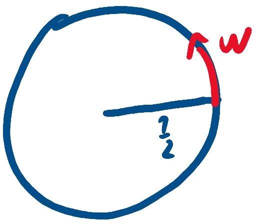
c) ΔE_c

Sol



$$T = F_{centrifuga} = m \cdot w^2 \cdot r = m \cdot w^2 \cdot L = 1 \cdot (1)^2 \cdot 1 = 1N$$

b)



$$\Delta L_{TOT} = 0 \Rightarrow L_f = L_i \Rightarrow m R_f^2 w_f = m R_i^2 w_i$$

Momento Angolare

$$\Rightarrow \left(\frac{L}{2}\right)^2 w = (L^2)\, w_0$$

$$\Rightarrow \frac{1}{4} w = w_0$$

$$\Rightarrow w = 4 w_0 = 4 \text{ rad/s}$$

c) $$\Delta E_c = \frac{1}{2} I w_f^2 - \frac{1}{2} I w_i^2 =$$

$$= \frac{1}{2} m \left(\frac{L}{2}\right)^2 w_f^2 - \frac{1}{2} m L^2 w_i^2 =$$

$$= \frac{1}{2} \cdot 1 \cdot \frac{1}{4} \cdot 16 - \frac{1}{2} \cdot 1 \cdot 1 \cdot 1 = 2 - \frac{1}{2}$$

$$= \frac{3}{2} J$$

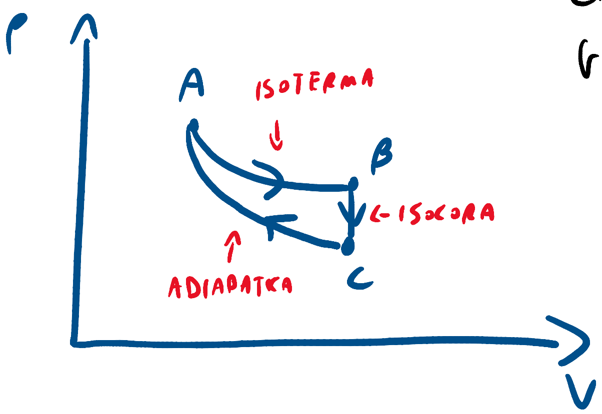
$$= \frac{3}{2} J$$

Es 3

Ciclo Reversibile

GAS BIATOMICO

$$\frac{V_B}{V_A} = 2$$



Calcolare il rendimento

SOL

$$\eta = \frac{L}{Q_{ASSORBITO}} \quad , \quad \eta = 1 + \frac{Q_{CEDUTO}}{Q_{ASSORBITO}} \quad , \quad \eta_{CARNOT} = 1 - \frac{T_{Fredda}}{T_{CALDA}}$$

(A->B, ISOTERMA):

$$\Delta U = 0$$

$$Q = L$$

$$L = nRT \ln\left(\frac{V_f}{V_i}\right)$$

(B->C, ISOCORA):

$$L = 0$$

$$\Delta U = Q$$

$$\Delta U = \frac{5}{2} n R \Delta T$$

(C->A, ADIABATICA): $Q = 0$

$$\Delta U = -L$$

$$\Delta U = \frac{5}{2} n R \Delta T$$

(A->B->C, CICLICA): $\Delta U = 0$

$$Q_{TOT} = L_{TOT}$$

$$L_{TOT} = n R T \ln\left(\frac{V_A}{V_B}\right) + 0 - \frac{5}{2} n R \Delta T = nR\left(T \ln\left(\frac{V_A}{V_B}\right) - \frac{5}{2}\Delta T\right)$$

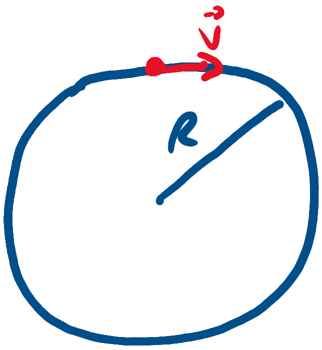
$$Q_{TOT} = n R T \ln\left(\frac{V_A}{V_B}\right) + \frac{5}{2} n R \Delta T + 0 = nR\left(T \ln\left(\frac{V_A}{V_B}\right) + \frac{5}{2}\Delta T\right)$$

$$\eta = \frac{L}{Q}$$

Appello 14/07/2021

venerdì 9 febbraio 2024 15:20

Es 1



$\mu_s = 0,5$

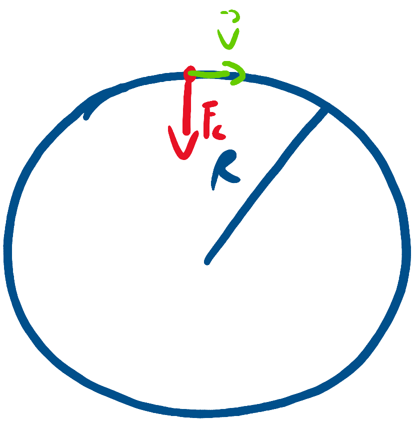
$V_{MAX} = 25\ m/s$

Calcolare

1) Il raggio R di curvatura della strada
2) Il vettore velocità in $(R,0)$
3) L'accelerazione in $(R,0)$

Sol

1) :



Essendo $V =$ costante $\Rightarrow F_{TOT} = 0$

$\Rightarrow$

$\vec{F}_{ATTR} + \vec{F}_{CENTR} = 0$

$\Rightarrow$

$$F_{ATTR} - F_{CENT} = 0$$

$$\Rightarrow F_{ATTR} = F_{CENTR}$$

$\Rightarrow$

$$\mu_s N = m \cdot a$$

$\Rightarrow$

$$\mu_s \cdot N = m \cdot w^2 R$$

$\Rightarrow$

$$\mu_s \cdot N = m \cdot \frac{V^2}{R^2} \cdot R$$

$\Rightarrow$

$$\mu_s \cdot N = m \frac{V^2}{R}$$

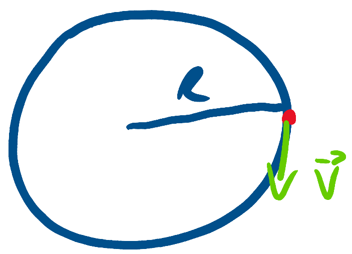
$\Rightarrow$

$$\mu_s \cdot mg = m \frac{V^2}{R}$$

$\Rightarrow$

$$\mu_s = \frac{V^2}{g \cdot R} \Rightarrow R = \frac{V^2}{g \cdot \mu_s} = \frac{V_{MAX}^2}{g \cdot \mu_s}$$

2) in $(R,0)$ la velocità è $V = V_{max} = 25$ m/s

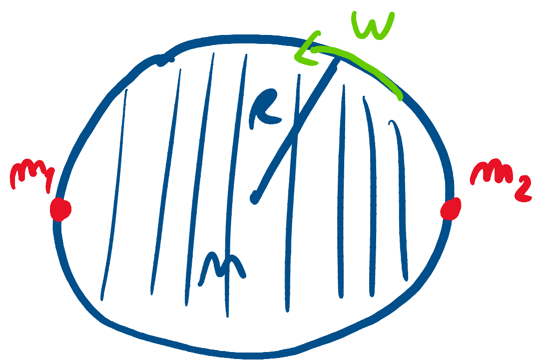


3) L'accelerazione è quella della forza centripeta:

$$a = w^2 \cdot R$$

$$\Rightarrow a = \frac{V^2}{R} = \frac{V_{max}^2}{R}$$

Es 2



calcolare

a) Il momento d'Inerzia dell'insieme giostra/bambini

b) Se i bambini si spostano posizionandosi al centro della giostra quanto cambia il momento d'Inerzia complessivo?

quanto cambia al momento d'inerzia complessivo !

c) Calcolare ω nella nuova configurazione

<u>SOL</u>

1)
$$I_{TOT} = I_{GIOSTRA} + I_{BIMBO} + I_{BIMBO} =$$

$$= \frac{1}{2} M R^2 + m R^2 + m R^2$$

2) $I_{TOT} = I_{GIOSTRA} + 0 + 0 = I_{GIOSTRA}$

3) $\Delta L_{TOT} = 0$

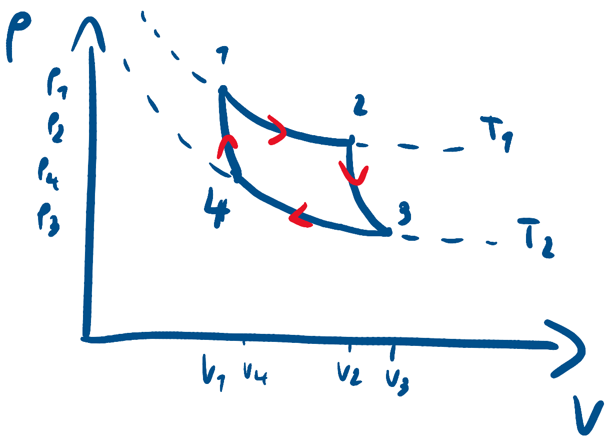
$\Rightarrow$
$$L_{TOT_f} - L_{TOT_i} = 0$$

$\Rightarrow$
$$I_{GIOSTRA} \cdot \omega_f + I_{BIMBO} \, \omega_f + I_{BIMBO} \, \omega_f - I_{GIOSTRA} \, \omega_i + I_{BIMBO} \, \omega_i + I_{BIMBO} \, \omega_i = 0$$

$\Rightarrow$
$$I_{GIOSTRA} \, \omega_f = \left(I_{GIOSTRA} + I_{BIMBO} + I_{BIMBO} \right) \omega_i$$

$\Rightarrow$
$$\omega_f = \frac{I_{GIOSTRA} + I_{BIMBO} + I_{BIMBO}}{I_{GIOSTRA}} \cdot \omega_i$$

Es 3



$T_1 = 600\,K$

$T_2 = 200\,K$

GAS BIATOMICO

$\frac{V_2}{V_1} = 2$

CICLO DI CARNOT

Calcolare

1) Calore scambiato dal gas con l'esterno
2) il rendimento
3) la variazione di entropia fra gli stati 1 e 3

SOL

$$Q_{CEDUTO} = \overset{\text{ISOTERMA}}{Q_{34}} + \overset{\text{ADIABATICA}}{Q_{41}} = Q_{34} = nRT \ln\left(\frac{V_4}{V_3}\right)$$

$$\begin{cases} P_2 V_2^\gamma = P_3 V_3^\gamma \\ P_4 V_4^\gamma = P_1 V_1^\gamma \end{cases} \Rightarrow \begin{cases} \frac{P_4 V_4^\gamma}{P_3 V_3^\gamma} = \frac{P_1 V_1^\gamma}{P_2 V_2^\gamma} \end{cases} \Rightarrow \begin{cases} \left(\frac{V_4}{V_3}\right)^\gamma \frac{P_4}{P_3} = \frac{P_1}{P_2}\left(\frac{1}{2}\right)^\gamma \end{cases}$$

$$\Rightarrow \left(\frac{V_4}{V_3}\right)^\gamma = \left(\frac{1}{2}\right)^\gamma \cdot \frac{P_1}{P_2} \cdot \frac{P_3}{P_4} = \left(\frac{1}{2}\right)^\gamma \cdot \frac{V_2}{V_1} \cdot \frac{V_4}{V_3}$$

$$\Rightarrow \left(\frac{V_4}{V_3}\right)^{\gamma-1} = \left(\frac{1}{2}\right)^{\gamma+1}$$

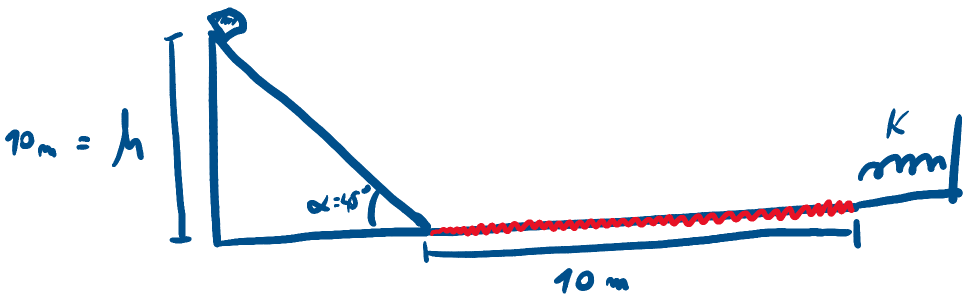
2)

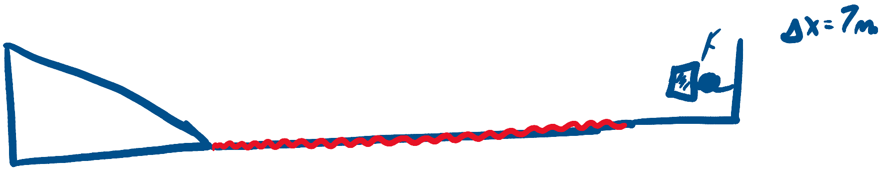
$$\eta = 1 - \frac{T_{FREDDA}}{T_{CALDA}} = 1 - \frac{200\,K}{600\,K} = 1 - \frac{1}{3}$$

$\blacksquare$

Appello 14/08/2021

venerdì 9 febbraio 2024 16:27



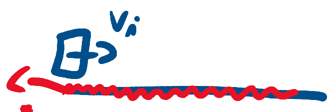


$$\Delta K + \Delta U = L_{n.c.}$$

$$\frac{1}{2} m V_f^2 - \frac{1}{2} m V_i^2 + m g h_f - m g h_i = 0$$

$$\Rightarrow \frac{1}{2} \cancel{m} V_f^2 = \cancel{m} g h$$

$$\Rightarrow V_f = \sqrt{2 g h}$$



$\overset{\shortparallel}{\mu_d} \cdot N = \mu_d \cdot m \cdot g$

$F = m \cdot a$

$\overset{\shortparallel}{\mu_d m g} \quad \Rightarrow a = \mu_d \cdot g$

$$\begin{cases} S_f = S_0 + V_0 t + \frac{1}{2} a t^2 \\ V_f = V_0 + a t \end{cases}$$

$$\Rightarrow \begin{cases} 10 = 0 + \sqrt{2gh} \cdot t + \frac{1}{2} \mu_d g t^2 \\ V_f = \sqrt{2gh} + \mu_d g \cdot t \end{cases}$$

$$\Rightarrow \begin{cases} \frac{1}{2} \mu_d \cdot g t^2 + \sqrt{2gh}\, t - 10 = 0 \end{cases} \Rightarrow t = \frac{-\sqrt{2gh} \pm \sqrt{2gh - 20 \mu_d g}}{\mu_d \cdot g}$$

$$\begin{cases} \\ V_f = \dots = \text{* Un Numero *} \end{cases}$$

h)

$$L_{TOT} = \vec{L}_{F_{ATT}} + \vec{L}_{F_{el}}$$

$$L_{TOT} = \Delta E_c$$

$\Rightarrow$

$$\frac{1}{2} m V_f^2 - \frac{1}{2} m V_i^2 = L_{F_{ATT}} - K \cdot \frac{\Delta x^2}{2}$$

$\Rightarrow$

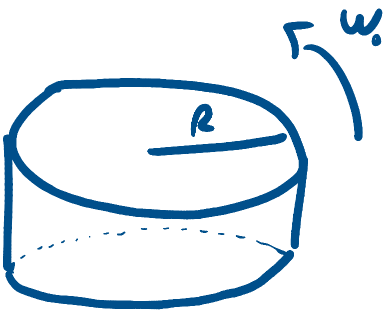
$$L_{F_{ATT}} = K \frac{\Delta x^2}{2} - \frac{1}{2} m \underbrace{V_i^2}_{\sqrt{2gh}}$$

$$\mu_d \cdot N \cdot 10m = K \frac{\Delta x^2}{2} - \frac{1}{2} m V_i^2$$

$\Rightarrow$

$$\mu_d = \frac{K \frac{\Delta x^2}{2} - \frac{1}{2} m V_i^2}{10 \cdot m \cdot g}$$

Es 2



$$\begin{cases} \theta = 0 + w_0 \cdot 10 + \frac{1}{2} \alpha \cdot 100 \\ 0 = w_0 + \alpha \cdot 10 \quad \Rightarrow \quad \alpha = -\frac{w_0}{10} \end{cases}$$

$$M_{TOT} = I \cdot \alpha$$

$$\|$$

$$r \cdot F_{TOT}$$

$$\Rightarrow F_{TOT} \cdot R = I \cdot \alpha = I \cdot \left(-\frac{w_0}{10}\right)$$

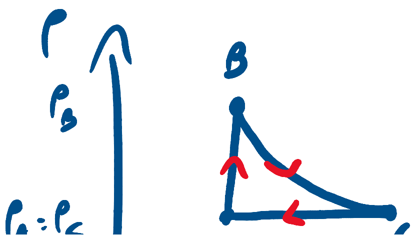
$$\Rightarrow F_{TOT} = \left(-I \frac{w_0}{10}\right) \cdot \frac{1}{R} = -\left(\frac{1}{2} m R^2 \cdot \frac{w_0}{10} \cdot \frac{1}{R}\right)$$

$$F_{BRACCIO_1} = F_{BRACCIO_2} = \frac{F_{TOT}}{2}$$

$$L_{TOT} = F_{TOT} \cdot \text{Spostamento}$$

$$\Rightarrow L_{TOT} = M_{TOT} \cdot \theta_f = I \cdot \alpha \cdot \left(w_0 \cdot 10 + \frac{1}{2} \alpha \, 100\right)$$

Es 3

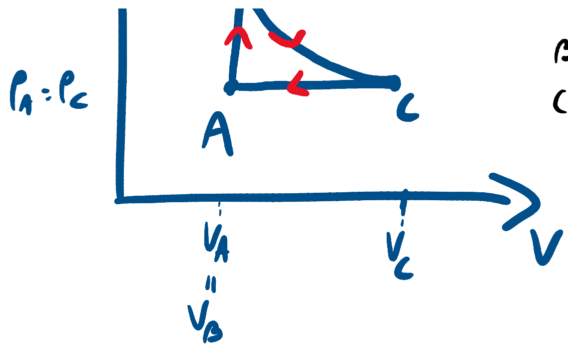


GAS BIATOMICO

AB = ISOCORA

BC = ISOTERMA

CA = ISOBARA



BC = ISOTERMA
CA = ISOBARA

$T_A = 0°C$

$V_C = 1,5\, V_A$

1)

AB = ISOCORA $\Rightarrow \dfrac{P_A}{T_A} = \dfrac{P_B}{T_B} \Rightarrow T_B = \dfrac{P_B}{P_A} \cdot T_A$

BC = ISOTERMA $\Rightarrow P_B \cdot V_B = P_C \cdot V_C \Rightarrow$

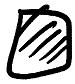
$$\Rightarrow P_B \cdot V_B = P_A \cdot V_C \Rightarrow \frac{P_B}{P_A} = \frac{V_C}{V_B} = \frac{V_C}{V_A} = \frac{1,5\, V_A}{V_A} = 1,5$$

$$\Rightarrow T_B = 1,5 \cdot T_A$$

b): $\eta = 1 - \dfrac{Q_{CEDUTO}}{Q_{ASS}}$

$$Q_{CED} = Q_{CA} + Q_{AB} = \frac{7}{2} nR \left(T_A - \overset{\overset{T_B}{\shortparallel}}{T_C}\right) + \frac{5}{2} nR \left(T_B - T_A\right)$$

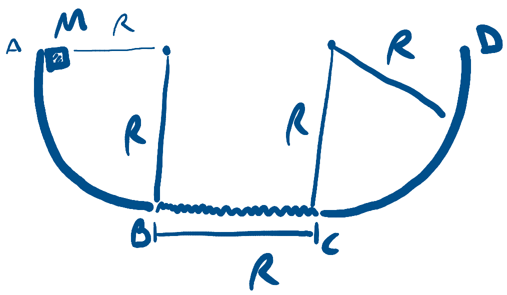
$$Q_{ASS} = Q_{BC} = nRT_B \ln\left(\frac{V_C}{V_B}\right)$$



Appello 14/09/2021

venerdì 16 febbraio 2024 11:40

Es 1



$\overline{AB}$: $\Delta K + \Delta U = L_{N.C.}$

$$\Rightarrow \frac{1}{2} m V_f^2 - \frac{1}{2} m V_i^2 + mg h_f - mg h_i = 0$$

$$\Rightarrow \frac{1}{2} m V_f^2 - mgR = 0$$

$$\Rightarrow \frac{1}{2} V_f^2 = gR \Rightarrow V_f = \sqrt{2gR}$$

$\overline{BC}$: $\Delta K + \Delta U = L_{N.C.}$

$$\Rightarrow \frac{1}{2} m V_f^2 - \frac{1}{2} m V_i^2 = F_{ATT} \cdot \Delta X$$

$$\Rightarrow \frac{1}{2} m V_f^2 - \frac{1}{2} m 2gR = \mu_D \cdot N \cdot R$$

$$\Rightarrow \frac{1}{2} m V_f^2 - mgR = \mu_d \cdot m g \cdot R$$

$$\Rightarrow \frac{1}{2} V_f^2 - gR = \mu_d g \cdot R$$

$$\Rightarrow \frac{1}{2} V_f^2 - gR = \mu_d g \cdot R$$

$$\Rightarrow \mu_d = \frac{\frac{1}{2} V_f^2 - gR}{gR}$$

b):

$\overline{CD}$: $\Delta K + \Delta U = L_{n.c.}$

$$\Rightarrow \frac{1}{2} m V_f^2 - \frac{1}{2} m V_i^2 + mg h_f - mg h_i = 0$$

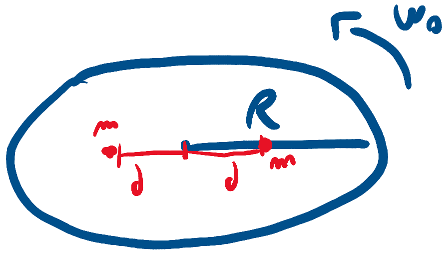
$$\Rightarrow -\frac{1}{2} m V_i^2 + mg h_f = 0$$

$$\Rightarrow mg h_f = \frac{1}{2} m V_i^2$$

$$\Rightarrow h_f = \frac{1}{2} V_i^2 \cdot \frac{1}{g} = \frac{V_i^2}{2g}$$

c) $L = F_{ATT} \cdot \Delta X = \mu_d \cdot m \cdot g \cdot R$

Es 2



$$\Delta L_{TOT} = 0$$

$$\Rightarrow L_{TOT_f} - L_{TOT_i} = 0$$

$$\Rightarrow L_{TOT_f} = L_{TOT_i}$$

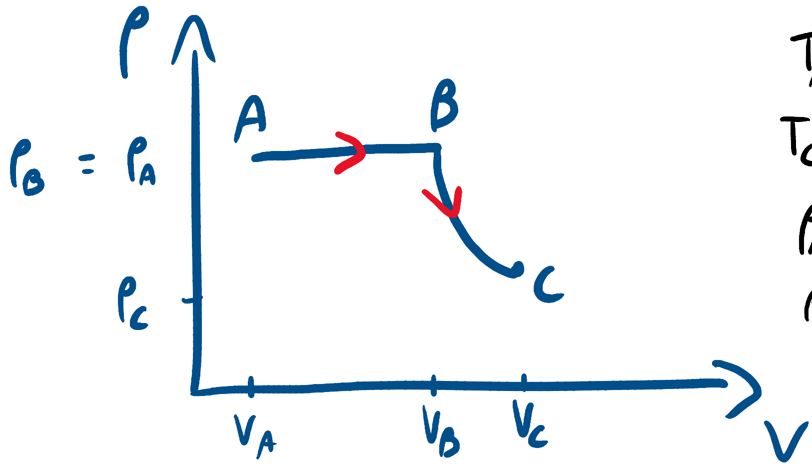
$$\Rightarrow I_{giostra} \cdot \omega_f + I_{corpo_1} \cdot \omega_f + I_{corpo_2}\, \omega_f = I_{giostra}\, \omega_i$$

$$\Rightarrow \omega_f = \frac{I_{giostra}\, \omega_i}{(I_{giostra} + 2 I_{corpo})} = \frac{\frac{1}{2} m R^2 \omega_i}{(\frac{1}{2} m R^2 + 2 m d^2)}$$

b) $\Delta E_c = E_{c_{f\,TOT}} - E_{c_{i\,TOT}} =$

$$= \frac{1}{2} I_{giostra}\, \omega_f^2 + 2 \cdot \frac{1}{2} I_{corpo}\, \omega_f^2 - \frac{1}{2} I_{giostra}\, \omega_0^2$$

Es 3



$T_A = 20°C$

$T_C = 20°C$

$P_A = 2 \cdot 10^5$

$P_B = 2 \cdot 10^5$

$V_B = 2 V_A$

$P_A = 2 \cdot 10^5$

$P_B = 2 \cdot 10^5$

$P_C =$

$V_A =$

$V_B = 2V_A =$

$V_C =$

$T_A = 20°$

$T_B = 40°$

$T_C = 20°$

$\overline{AB}$: ISOBARA : $\frac{V_A}{T_A} = \frac{V_B}{T_B}$

$\rightarrow V_A \quad 2V_A \quad \rightarrow T_B = \frac{2V_A}{} \cdot 20°C = 40°C$

$$\Rightarrow \frac{V_A}{20} = \frac{2V_A}{T_B} \quad \Rightarrow T_B = \frac{2V_A}{V_A} \cdot 20°C = 40°C$$

$\overline{BC}$: ADIABATICA : $p_B V_B^{\gamma} = p_C V_C^{\gamma}$

$$\Rightarrow 2 \cdot 10^5 \cdot V_B^{\gamma} = p_C V_C^{\gamma}$$

$$\begin{cases} \frac{V_A}{T_A} = \frac{V_B}{T_B} \\ p_B V_B^{\gamma} = p_C V_C^{\gamma} \end{cases} \Rightarrow \begin{cases} \frac{V_A}{T_A} = \frac{2V_A}{T_B} \\ p_B (2V_A)^{\gamma} = p_C V_C^{\gamma} \end{cases}$$

$\overline{AB}$: ISOBARA :

$$L_{AB} = p_A \cdot (V_B - V_A) = p_A (2V_A - V_A) = p_A \cdot V_A$$

$$Q = \frac{7}{2} n R (T_B - T_A) = \frac{7}{2} n R (2T_A - T_A) = \frac{7}{2} n R T_A$$

$$\Delta U = \frac{5}{2} n R (T_B - T_A) = \frac{5}{2} n R T_A$$

$$\Delta U = Q - L$$

$$\Rightarrow Q - L = \frac{5}{2} n R T_A$$

$\Rightarrow$

$$\frac{7}{2} n R T_A - P_A V_A = \frac{5}{2} n R T_A$$

$\Rightarrow$

$$\frac{7}{2} n R T_A - \frac{5}{2} n R T_A = P_A V_A$$

$$\Rightarrow V_A = \frac{\frac{7}{2} n R T_A - \frac{5}{2} n R T_A}{P_A}$$

$P_A = 2 \cdot 10^5$ $\qquad V_A = \dfrac{\frac{7}{2} n R T_A - \frac{5}{2} n R T_A}{P_A}$ $\qquad T_A = 20°$

$P_B = 2 \cdot 10^5$ $\qquad V_B = 2 V_A = 2 \dfrac{\frac{7}{2} n R T_A - \frac{5}{2} n R T_A}{P_A}$ $\qquad T_B = 40°$

$P_C = ?$ $\qquad V_C = ?$ $\qquad T_C = 20°$

$\overline{BC}$: ADIABATICA :

$$\Delta U = \frac{5}{2} n R (T_C - T_B)$$

$$P_C V_C = n R T_C = n R T_A$$

$$\Rightarrow P_C = \frac{n R T_A}{V_C}$$

$$\left\{ P_C = \frac{n R T_A}{V} \right.$$

$$\left\{ P_C = \frac{n R T_A}{V_C} \right.$$

$$\begin{cases} p_C = \dfrac{m R T_A}{V_C} \\ p_B (2V_A)^\gamma = p_C \, V_C^\gamma \end{cases} \Rightarrow \begin{cases} p_C = \dfrac{m R T_A}{V_C} \\ p_B (2V_A)^\gamma = \dfrac{m R T_A}{V_C} \cdot V_C^\gamma \end{cases}$$

$$\Rightarrow \begin{cases} p_C = \\ p_B (2V_A)^\gamma = m R T_A \cdot V_C^{\gamma-1} \end{cases} \Rightarrow \begin{cases} \\ V_C^{\gamma-1} = \dfrac{p_B (2V_A)^\gamma}{m R T_A} \end{cases}$$

$$\Rightarrow \quad V_C = \sqrt[\gamma-1]{\frac{p_B (2V_A)^\gamma}{m R T_A}}$$

$$p_C = \frac{m R T_C}{\sqrt[\gamma-1]{\dfrac{p_B (2V_A)^\gamma}{m R T_A}}}$$