AP#3- Trabalho e Energia - Resolução com Estudantes

Bartolomeu Joaquim Ubisse

Universidade Eduardo Mondlane

(Física - FENG - 2022)

22 de Abril de 2022

① $\vec{F} = \text{const.}$

$\vec{F}_R = 5\vec{i} + 7\vec{j} + \vec{k}$

$\vec{r} = -20\vec{i} - 15\vec{j}$

$W = \vec{F}_R \cdot \vec{r}$

$W_{AB} = -100 - 105 = -205\,J$

ii) $W_{AB} = \Delta E_c \Rightarrow \Delta E_c = -205\,J$

iii) $\measuredangle \widehat{\vec{F}_1 \vec{r}}$: $\vec{F}_1 \cdot \vec{r} = \boxed{F_1 r \cos\theta = F_{1x} x + F_{1y} y + F_{1z} z}$

$\theta = \arccos\left(\dfrac{F_{1x} x + F_{1y} y}{F_1 r}\right) \simeq 122{,}3^{\circ}$

② $E_{M_A} = E_{M_C} \Rightarrow E_{P_A} + \cancel{E_{C_A}} = E_{P_C} + E_{C_C}$

$\cancel{m}gR = \cancel{m}gh + \frac{1}{2}\cancel{m}v_c^2$

$gR = gh + \frac{1}{2}v_c^2$

$gR = gR(1-\sin\alpha) + \frac{1}{2}v_c^2$

$0 = -gR\sin\alpha + \frac{1}{2}v_c^2 \Rightarrow v_c = (2gR\sin\alpha)^{1/2}$

b) $v = R\omega \Rightarrow \omega = \left(\frac{2g\sin\alpha}{R}\right)^{1/2}$

③ $F_g \cos\theta = m a_c \Rightarrow \cancel{m} g \cos\theta = \cancel{m} \frac{v^2}{R}$

$$\boxed{v^2 = Rg\cos\theta}$$

$$\cancel{m} g h = \cancel{m} g R(1+\cos\theta) + \frac{1}{2}\cancel{m} v^2$$

$$h = R(1+\cos\theta) + \frac{1}{2} R\cos\theta$$

$$h = R\left(1+\frac{3}{2}\cos\theta\right)$$

$$\cos\theta = \frac{2}{3}\left(\frac{h}{R}-1\right) \Rightarrow$$

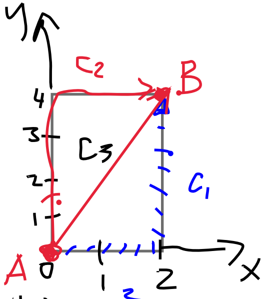
$$\frac{2}{3}\left(\frac{h}{R}-1\right) = 1 \hookrightarrow h = \frac{5}{3}R$$

4) $\vec{F} = (y^2 - x^2)\vec{i} + 3xy\vec{j}$ (N)

i) $C_1: (0,0) \to (2,0) \to (2,4)$

$W = \int_C \vec{F}\,d\vec{r}$

$W_C = \int_{x_0}^{x_f} F_x(x, y(x), z(x))\,dx + \int_{y_0}^{y} F_y(x(y), y, z(y))\,dy + \int_{z_0}^{z} F_z(x(z), y(z), z$



$W_{AB(C_1)} = \int_0^2 (0^2 - x^2)\,dx + \int_0^4 3 \cdot 2 \cdot y\,dy$

$= -\frac{1}{3}x^3 \Big|_0^2 + 3y^2 \Big|_0^4 = -\frac{8}{3} + 48 = 45{,}3\,J$

ii) $C_2: (0,0) \to (0,4) \to (2,4)$

$$W_{C_2} = \int_0^4 3 \cdot 0 \cdot y \, dy + \int_0^2 (4^2 - x^2)\, dx$$

$$W_{C_2} = \left(16x - \frac{1}{3}x^3\right)\Big|_0^2$$

$$W_{C_2} = 32 - \frac{8}{3} = 29.3\,J$$

$A \longrightarrow B \qquad (0,0) \longrightarrow (2,4)$

$$\frac{x - x_0}{x_f - x_0} = \frac{y - y_0}{y_f - y_0} \Rightarrow \frac{x-0}{2-0} = \frac{y-0}{4-0}$$

$y = 2x$ $\qquad$ $\boxed{x = \frac{1}{2}y}$

$$W = \int_0^2 \left((2x)^2 - x^2\right) dx + \int_0^4 \frac{3}{2} y^2 \, dy$$

$$W_{C_3} = \int_0^2 3x^2 \, dx + \frac{3}{2} \int_0^4 y^2 \, dy$$

$$W_{C_3} = x^3 \Big|_0^2 + \frac{1}{2} y^3 \Big|_0^4$$

$$W_{C_3} = 8 + 32 = 40 \text{ J}$$