③

$E_{mi} = E_{mf}$

$K_{roti} + K_{trai} + U_{gi} = K_{rotf} + K_{traf} + U_{gf}$

$\frac{1}{2} I \omega_i^2 + \frac{1}{2} m v_i^2 = \frac{1}{2} I \omega_f^2 + \frac{1}{2} m v_f^2 + mgy_f$

$\frac{1}{2}\left(\frac{2}{5} mR^2\right)\frac{v_i^2}{R^2} + \frac{1}{2} m v_i^2 = \frac{1}{2}\left(\frac{2}{5} mR^2\right)\frac{v_f^2}{R^2} + \frac{1}{2} m v_f^2 + mgy_f$

$\frac{1}{5} v_i^2 + \frac{1}{2} v_i^2 = \frac{1}{5} v_f^2 + \frac{1}{2} v_f^2 + gy_f$

$\frac{7}{10} v_i^2 = \frac{7}{10} v_f^2 + gy_f$

$v_f = \sqrt{v_i^2 - \frac{10}{7} g y_f} = \sqrt{(25\,m/s)^2 - \frac{10}{7}(9{,}8\,m/s^2)(28\,m)}$

$v_f = 15{,}26\,m/s$ (2 pts)

Luego, por cinemática:

$y = y_0 + v_{0y} t + \frac{1}{2} a_y t^2$

$t = \sqrt{\frac{-2y_0}{a_y}} = \sqrt{\frac{-2(28\,m)}{-9{,}8\,m/s^2}} = 2{,}4\,s$ (1 pto)

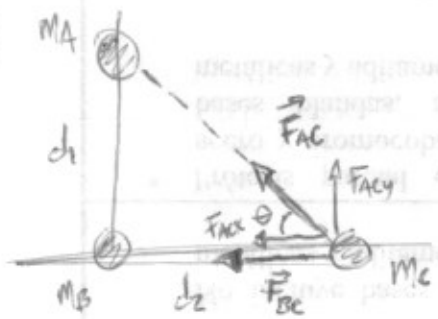
$X = v_{0x} t = v_f t = (15{,}26\,m/s)(2{,}4\,s) = 36{,}5\,m$ (1 pto)

$v_y = v_{0y} + a_y t = (-9{,}8\,m/s^2)(2{,}4\,s)$

$v_y = -23{,}52\,m/s$

$v' = \sqrt{(15{,}26\,m/s)^2 + (23{,}52\,m/s)^2} = 28{,}03\,m/s$ (1 pto)

④



$\vec{F}_{AC} = -F_{ACx}\hat{i} + F_{ACy}\hat{j} = -|\vec{F}_{AC}|\cos\theta\,\hat{i} + |\vec{F}_{AC}|\sin\theta\,\hat{j}$

$tg\theta = \frac{d_1}{d_2} \Rightarrow \theta = tg^{-1}\left(\frac{0{,}3\,m}{0{,}4\,m}\right) = 36°$

$d_{AC} = \sqrt{d_1^2 + d_2^2} = \sqrt{(0{,}3\,m)^2 + (0{,}4\,m)^2} = 0{,}5\,m$

$|\vec{F}_{AC}| = G\frac{M_A M_C}{d_{AC}^2} = \left(6{,}67\times10^{-9}\frac{N\cdot m^2}{kg^2}\right)\frac{(5\,kg)(5\,kg)}{(0{,}5\,m)^2} = 6{,}67\times10^{-9}\,N$

$\vec{F}_{AC} = -5{,}39\times10^{-9}\,N\,\hat{i} + 3{,}92\times10^{-9}\,N\,\hat{j}$ (2 ptos)

$\vec{F}_{BC} = -F_{BCx}\hat{i} + 0\hat{j}$

$= -|\vec{F}_{BC}|\hat{i} + 0\hat{j}$

$|\vec{F}_{BC}| = G\frac{M_B M_C}{d_2^2} = \left(6{,}67\times10^{-9}\frac{N\cdot m^2}{kg^2}\right)\frac{(5\,kg)(5\,kg)}{(0{,}4\,m)^2} = 10\times10^{-9}\,N$

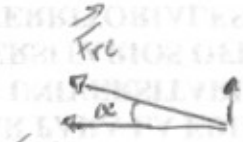
$\vec{F}_{BC} = -10\times10^{-9}\,N\,\hat{i} + 0\hat{j}$ (1 pto)

Sumamos las fuerzas:

$\vec{F}_{AC} = -5{,}39\times10^{-9}\,N\,\hat{i} + 3{,}92\times10^{-9}\,N\,\hat{j}$

$\vec{F}_{BC} = -10\times10^{-9}\,N\,\hat{i} + 0\,\hat{j}$

$\vec{F}_{rc} = -15{,}39\times10^{-9}\,N\,\hat{i} + 3{,}92\times10^{-9}\,N\,\hat{j}$



$\cos\alpha = \frac{15{,}39\times10^{-9}\,N}{15{,}88\times10^{-9}\,N}$ (1 pto)

$\alpha = 14{,}27°$ respecto al eje -x

ó 165,73 respecto al eje +x

$|\vec{F}_{rc}| = \sqrt{(-15{,}39\times10^{-9}\,N)^2 + (3{,}92\times10^{-9}\,N)^2} = 15{,}88\times10^{-9}\,N$ (1 pto)