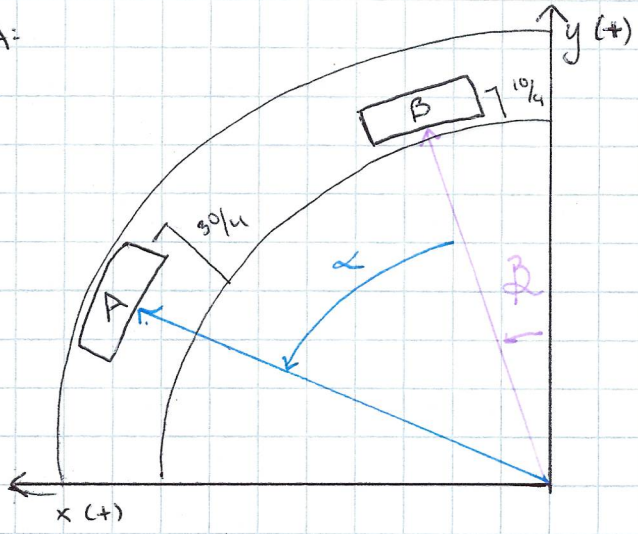
20-P-1KM-AF-030

Relative Motion: Advanced

Q: Race tracks ovals, however the curves can be described as a section of a circle with the equation $x^2 + y^2 = C$. Car A and B are speeding around the curve with A m/s and B m/s respectively. Car B accelerates at D m/s² in the same direction of the velocity, Car A accelerates in the opposite direction with F m/s².

A:



$\alpha = G°$, $\beta = H°$, $r = C$

$r_A = \sqrt{C} + 30/4$

$r_B = \sqrt{C} + 10/4$

$\theta_A = H + G$

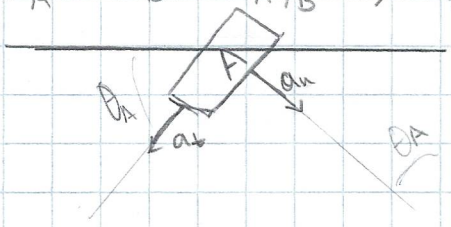
$\theta_B = H$

$V_A = V_B + V_{A/B}$

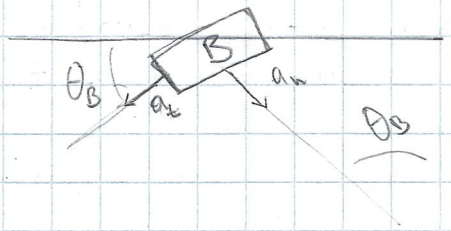
$\Rightarrow [+A\cos(\theta_A)i - A\sin(\theta_A)j] = [B\cos(\theta_B) - B\sin(\theta_B)] + V_{A/B}$

$V_{A/B} = [A\cos(\theta_A) - B\cos(\theta_B)]i + [-A\sin(\theta_A) + B\sin(\theta_B)]$

$a_A = a_B + a_{A/B}$, $a_{tA} = -F$, $a_{tB} = D$, $a_{NA} = {V_A^2}/{r_A}$, $a_{NB} = {V_B^2}/{r_B}$



$a_A = [a_t\cos(\theta_A) - a_n\cos(90-\theta_A)]i + [-a_t\sin(\theta_A) - a_n\sin(90-\theta_A)]j$



$a_B = [a_t\cos(\theta_B) - a_n\cos(90-\theta_B)]i + [-a_t\sin(\theta_B) - a_n\sin(90-\theta_B)]j$

$a_{A/B} = a_A - a_B$