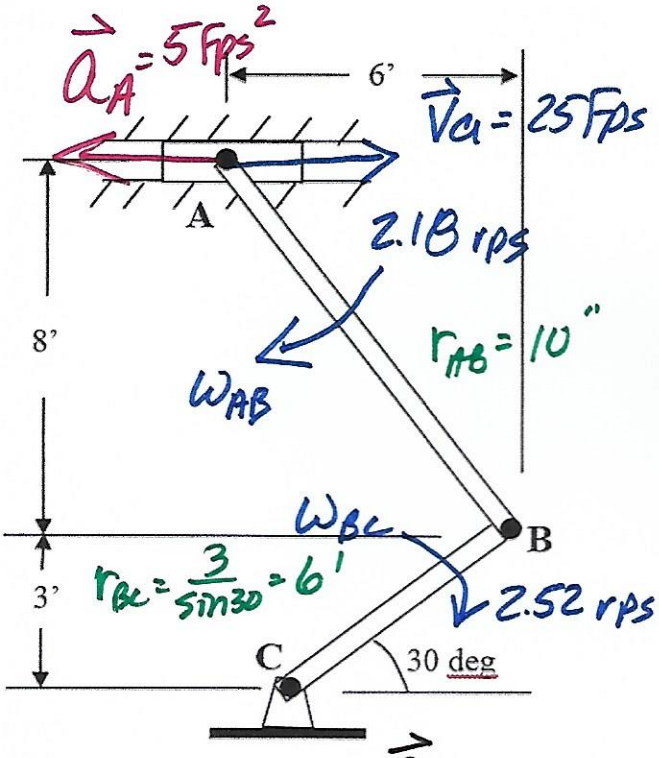
Rigid Body Kinematics III – Problem 2

At the instant shown, the piston, A, is moving to the right in the slot at a velocity of 25 fps and is decelerating at a rate of 5 fps^2. The angular velocity of rods AB and BC are ω_{AB} = 2.18 rps CW and ω_{BC} = 2.52 rps CW. Determine the angular acceleration, α_{AB} and α_{BC}, for each of the rods.



CLASSIFY MOTION

PISTON A — TRANS

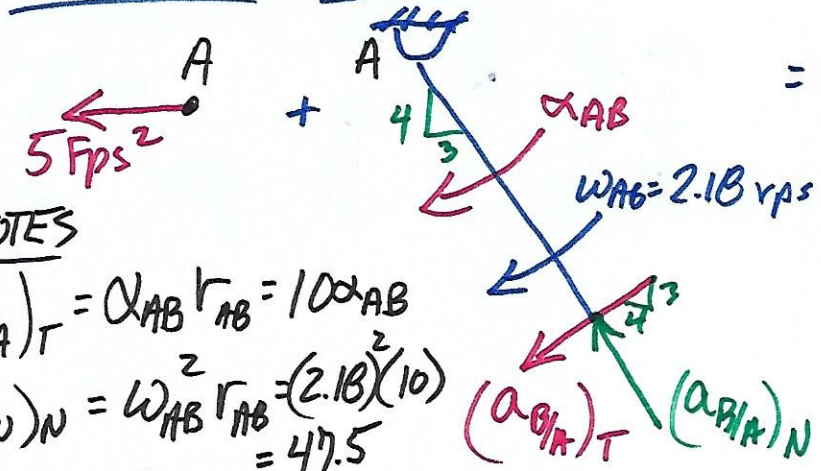
BAR AB — GPM

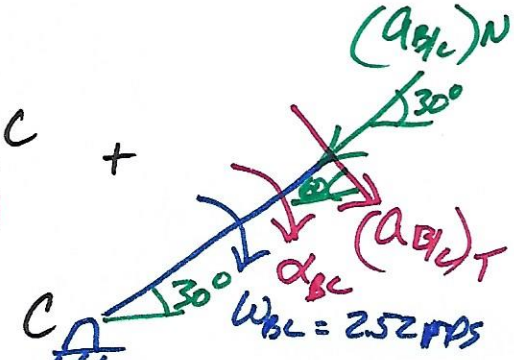
BAR BC — RAFA

RELATIVE ACCELERATION EQNS

$$\vec{a}_B = \vec{a}_A + \vec{a}_{B/A} = \vec{a}_C + \vec{a}_{B/C}$$

KINEMATIC DIAGRAMS





NOTES

$(a_{B/A})_T = \alpha_{AB} r_{AB} = 10\alpha_{AB}$

$(a_{B/A})_N = \omega_{AB}^2 r_{AB} = (2.18)^2(10) = 47.5$

NOTES

$(a_{B/C})_T = \alpha_{BC} r_{BC} = 6\alpha_{BC}$

$(a_{B/C})_N = \omega_{BC}^2 r_{BC} = (2.52)^2(6) = 38.1$

SCALAR EQNS

$$\rightarrow \quad -5 - \tfrac{4}{5}(10\alpha_{AB}) - \tfrac{3}{5}(47.5) = 0 + 6\alpha_{BC}\cos 60 - \cos 30(38.1)$$

$$\uparrow \quad 0 - \tfrac{3}{5}(10\alpha_{AB}) + \tfrac{4}{5}(47.5) = 0 - 6\alpha_{BC}\sin 60 - \sin 30(38.1)$$

SIMPLIFY

$$8\alpha_{AB} + 3\alpha_{BC} = -0.504$$
$$6\alpha_{AB} - 5.196\alpha_{BC} = 57.05$$

SOLVE (SIMUL OR MATRIX)

$\alpha_{AB} = 2.83$ rps^2 ↻

$\alpha_{BC} = -7.71 = 7.71$ rps^2 ↺