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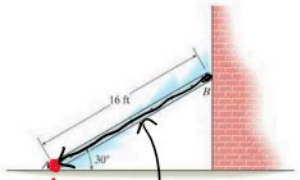
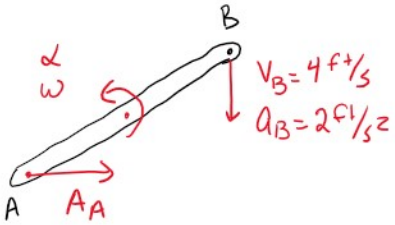
$\alpha = ?$

Example 3: The top of the ladder has an acceleration $a_B = 2$ ft/s^2 and a velocity of $v_B = 4$ ft/s , both acting downward. Determine the acceleration of the bottom A of the ladder and the ladders angular acceleration at this instant



$r_{A/B} = -16\cos 30\,\hat{i} - 16\sin 30\,\hat{j}$



$$\bar{a}_A = \bar{a}_B + \bar{\alpha} \times \bar{r}_{A/B} - \omega^2 \bar{r}_{A/B}$$

$$a_A\hat{i} = -2\hat{j} + \alpha\hat{k} \times (-16\cos 30\,\hat{i} - 16\sin 30\,\hat{j}) - \omega^2(-16\cos 30\,\hat{i} - 16\sin 30\,\hat{j})$$

$-13.85\alpha\hat{j} + 8\alpha\hat{i}$ $\qquad +13.85\omega^2\hat{i} + 8\omega^2\hat{j}$

$+13.85(0.083)\hat{i} + 8(0.083)\hat{j}$

$$a_A\hat{i} = -2\hat{j} - 13.85\alpha\hat{j} + 8\alpha\hat{i} + 1.15\hat{i} + 0.664\hat{j}$$

$\hat{i}$: $a_A = 8\alpha + 1.15$

$a_A = 8(-0.096) + 1.15 = 0.378$ ft/s^2

$\hat{j}$: $0 = -2 - 13.85\alpha + 0.664$

$\alpha = -0.096$ rad/s^2

$$V_A = V_B + \omega \times r_{A/B}$$

$$V_A\hat{i} = -4\hat{j} + \omega\hat{k} \times (-16\cos 30\,\hat{i} - 16\sin 30\,\hat{j})$$

$$V_A\hat{i} = -4\hat{j} - 13.85\omega\hat{j} + 8\omega\hat{i}$$

$\hat{j}$: $0 = -4 - 13.85\omega$

$\omega = -.289$ rad/s^2

$\omega^2 = .083$

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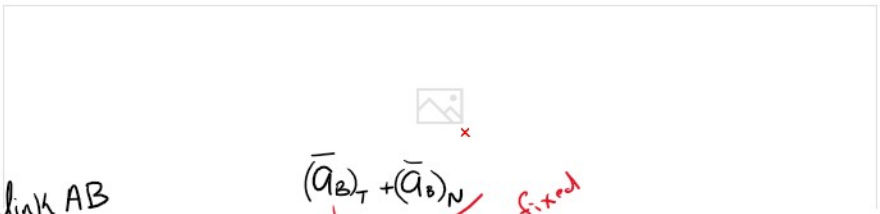


link AB

$(\bar{a}_B)_T + (\bar{a}_B)_N$

$\bar{a}_B = \bar{a}_A + \bar{\alpha}_{AB} \times \bar{r}_{B/A} - \omega^2 \bar{r}_{B/A}$ ($\bar{a}_A = 0$, fixed)

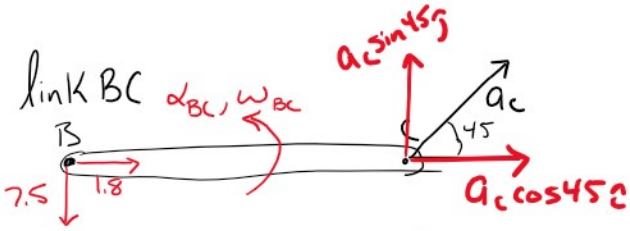
$= -6\hat{k} \times (0.3\hat{j}) - (-5)^2 (0.3)\hat{j}$

$a_B = 1.8\hat{i} - 7.5\hat{j}$

$\omega = -5\hat{k}$ rad/s

$\alpha = -6\hat{k}$ rad/s^2

link BC α_{BC}, ω_{BC}



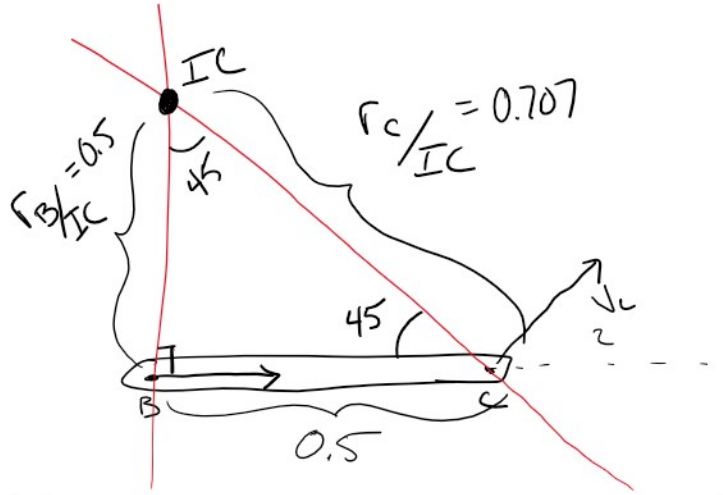
$\bar{a}_C = \bar{a}_B + \bar{\alpha}_{BC} \times \bar{r}_{C/B} - \omega_{BC}^2 \bar{r}_{C/B}$

$a_c \cos 45\hat{i} + a_c \sin 45\hat{j} = 1.8\hat{i} - 7.5\hat{j} + \alpha_{BC}\hat{k} \times (0.5\hat{i}) - \omega_{BC}^2 (0.5\hat{i})$

$0.5\alpha_{BC}\hat{j} \quad - \omega_{BC}^2 (0.5\hat{i})$

$\hat{i}$: $a_c \cos 45 = 1.8 - 0.5\omega_{BC}^2$

$\hat{j}$: $a_c \sin 45 = -7.5 + 0.5\alpha_{BC}$



$\hat{i}$

$a_c \cos 45 = 1.8 - 0.5(3)^2$

$a_c = -3.82$ m/s^2

$\hat{j}$

$-3.82 \sin 45 = -7.5 + 0.5\alpha_{BC}$

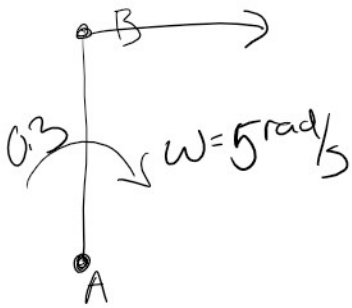
$\alpha_{BC} = 9.6$ rad/s^2 ↺

$V_x = \omega r_{x/IC}$

$V_B = \omega(0.5)$

$1.5 = \omega(0.5)$

$\omega = 3$ rad/s



$V_B = \omega r$

$= (5)(.3)$

$= 1.5$ m/s

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