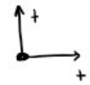
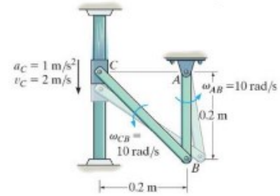
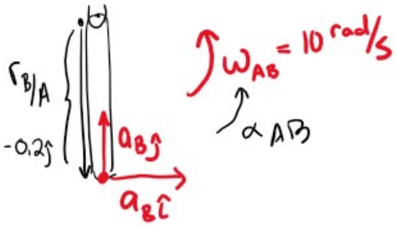


Example 1: The collar moves downward with an acceleration of 1 m/s². At the instant shown, it has a speed of 2 m/s which gives links CB and AB an angular velocity $\omega_{AB} = \omega_{CB} = 10$ rad/s. Determine the angular accelerations of CB and AB at this instant



link AB



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

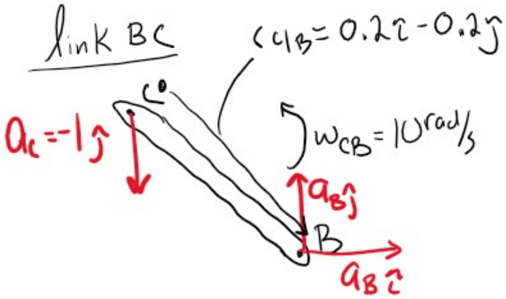
$$a_B\hat{i} + a_B\hat{j} = 0 + \alpha_{AB}\hat{k} \times (-0.2\hat{j}) - \boxed{10}^2(-0.2\hat{j})$$

$$\underbrace{a_B\hat{i} + a_B\hat{j}}_{\bar{A}_B} = 0.2\alpha_{AB}\hat{i} + 20\hat{j}$$

$a_B\hat{i} \rightarrow$ tangential

$a_B\hat{j} \rightarrow$ Normal

link BC



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

$$0.2\alpha_{AB}\hat{i} + 20\hat{j} = -1\hat{j} + \underbrace{\alpha_{CB}\hat{k} \times (0.2\hat{i} - 0.2\hat{j})}_{0.2\alpha_{CB}\hat{j} + 0.2\alpha_{CB}\hat{i}} \overbrace{- 10^2(0.2\hat{i} - 0.2\hat{j})}^{-20\hat{i} + 20\hat{j}}$$

$\hat{i}$:

$$0.2\alpha_{AB} = 0.2\alpha_{CB} - 20$$

$$0.2\alpha_{AB} = 0.2(5) - 20$$

$$\alpha_{AB} = -95 \text{ rad/s}^2$$

$$= 95 \text{ rad/s}^2$$

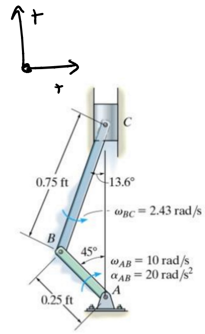
$\hat{j}$:

$$2\cancel{0} = -1 + 0.2\alpha_{CB} + 2\cancel{0}$$

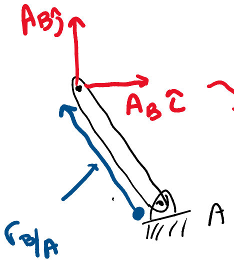
$$1 = 0.2\alpha_{CB}$$

$$\alpha_{CB} = 5 \text{ rad/s}^2$$

Example 2: The crankshaft AB turns with a clockwise angular acceleration of 20 rad/s². Determine the acceleration of the piston at the instant AB is in the position shown. At this instant $\omega_{AB} = 10$ rad/s and $\omega_{BC} = 2.43$ rad/s.



$.25 \sin 45 = .18$



$\omega_{AB} = -10$ rad/s

$\alpha_{AB} = -20$ rad/s²

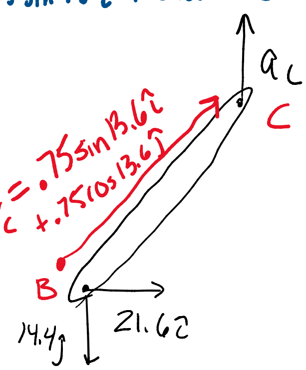
$r_{B/A}$: $-0.25 \sin 45\,\hat{i} + 0.25 \cos 45\,\hat{j}$

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

$$a_B = 0 + (-20K) \times (-0.25 \sin 45\hat{i} + 0.25 \cos 45\hat{j}) - (-10)^2(-0.25 \sin 45\hat{i} + 0.25 \cos 45\hat{j})$$

$$\bar{a}_B = 3.6\hat{j} + 3.6\hat{i} + 18\hat{i} - 18\hat{j}$$

$$= 21.6\hat{i} - 14.4\hat{j}$$



$r_{B/C} = .75 \sin 13.6\,\hat{i} + .75 \cos 13.6\,\hat{j}$

$r_{B/C} = .18\hat{i} + .73\hat{j}$

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

$$a_C\hat{j} = 21.6\hat{i} - 14.4\hat{j} + \underbrace{\alpha_{CB}\hat{k} \times (0.18\hat{i} + 0.73\hat{j})}_{+0.18\alpha_{CB}\hat{j} - 0.73\alpha_{CB}\hat{i}} - \overbrace{(2.43)^2(0.18\hat{i} + 0.73\hat{j})}^{-1.1\hat{i} - 4.3\hat{j}}$$

$\hat{i}$

$$0 = 21.6 - 0.73\alpha_{CB} - 1.1$$

$$\alpha_{CB} = 28.1 \text{ rad/s}^2$$

$\hat{j} =$

$$a_C = -14.4 - 4.3 + 0.18\alpha_{CB}$$

$$= -14.4 - 4.3 + 0.18(28.1) = -13.65 \text{ ft/s}^2$$

$$= 13.65 \text{ ft/s}^2 \downarrow$$

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