Quiz 10: Chapter 16   Due: Friday 01 Mar 2024

Examine the solved problem below. There are six errors in the solution below. Your task is to locate and identify those errors, then correct them and calculate the proper result. If the same error occurs more than once, only count it as a single error, even if you have to correct it in more than one instance.

Each correctly identified error is worth 3 points, and the re-calculated results are worth 7 points. You must save your work in pdf format and submit via the Quiz 10 Assignment in the Chapter 16 folder of the in the Quizzes folder in the Online Classroom in Blackboard. Please do not use any other file format than pdf.

The slider block moves with velocity $v_B = 4\frac{m}{s}$ and acceleration $a_B = 2\frac{m}{s^2}$ as shown. Determine the angular velocity ω_{AB} and angular acceleration α_{AB} of the rod AB and ω_C and α_C of the wheel at this instant.

A)   Sketch the absolute and relative velocity vectors $\overrightarrow{v_A}$, $\overrightarrow{v_B}$, and $\overrightarrow{v_{A/B}}$:
    See diagram on the right

B)   Write the vector equations for the velocities:
$$\overrightarrow{v_A} = (\omega_C r_{CA})(-\hat{\jmath}) = -(0.150m)(\omega_C)\hat{\jmath}$$
$$\overrightarrow{v_B} = \left(4\frac{m}{s}\right)\hat{\imath}$$
$$\overrightarrow{v_{A/B}} = \overrightarrow{\omega_{AB}} \times \overrightarrow{r_{BA}} = (\omega_{AB})(\hat{k}) \times [-0.8\hat{\imath} + 0.6\hat{\jmath}](0.500m)$$
$$\overrightarrow{v_{A/B}} = (\omega_{AB})[-0.300\hat{\imath} - 0.400\hat{\jmath}]\frac{m}{s}$$

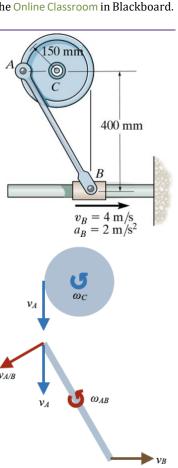C)   Write the relative velocity equation and solve the system:
$$\overrightarrow{v_A} = \overrightarrow{v_B} + \overrightarrow{v_{A/B}}$$
$$-(0.150m)(\omega_C)\hat{\jmath} = \left(4\frac{m}{s}\right)\hat{\imath} + (\omega_{AB})[-0.300\hat{\imath} - 0.400\hat{\jmath}]$$
x–direction: $4\frac{m}{s} - 0.300(\omega_{AB}) = 0$
y–direction: $-(0.150m)(\omega_C) = -0.400(\omega_{AB})$
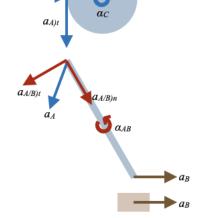$$\omega_{AB} = 1.20\frac{rad}{s}$$
$$\omega_C = 3.20\frac{rad}{s}$$

D)   Sketch the absolute and relative acceleration vectors $\overrightarrow{a_A}$, $\overrightarrow{a_B}$, and $\overrightarrow{a_{A/B}}$:
    See diagram below

E)   Write the vector equations for the accelerations:
$$\overrightarrow{a_A} = (\omega_C^2 r_{CA})\hat{\imath} - (\alpha_C r_{CA})\hat{\jmath}$$
$$\overrightarrow{a_A} = \left(3.20\frac{rad}{s}\right)^2 (0.500m)\hat{\imath} - (0.500m)(\alpha_C)\hat{\jmath} = \left(0.512\frac{m}{s^2}\right)\hat{\imath} - (0.500m)(\alpha_C)\hat{\jmath}$$
$$\overrightarrow{a_B} = \left(2\frac{m}{s^2}\right)\hat{\imath}$$
$$\overrightarrow{a_{A/B}} = \overrightarrow{\alpha_{AB}} \times \overrightarrow{r_{BA}} - \omega_{AB}^2 \overrightarrow{r_{BA}}$$
$$\overrightarrow{a_{A/B}} = (\alpha_{AB})(\hat{k}) \times [-0.400\hat{\imath} + 0.300\hat{\jmath}]m + (\omega_{AB})[-0.400\hat{\imath} + 0.300\hat{\jmath}]$$
$$\overrightarrow{a_{A/B}} = (\alpha_{AB})[-0.300\hat{\imath} - 0.400\hat{\jmath}]m + \left(1.20\frac{rad}{s}\right)[-0.400\hat{\imath} + 0.300\hat{\jmath}]$$
$$\overrightarrow{a_{A/B}} = [-0.300\alpha_{AB} - 0.480]\hat{\imath} + [-0.400\alpha_{AB} + 0.360]\hat{\jmath}$$

F)   Write the relative acceleration equation and solve the system:
$$\overrightarrow{a_A} = \overrightarrow{a_B} + \overrightarrow{a_{A/B}}$$
$$(0.512)\hat{\imath} - (0.500\alpha_C)\hat{\jmath} = (2)\hat{\imath} + [-0.300\alpha_{AB} - 0.480]\hat{\imath} + [-0.400\alpha_{AB} + 0.360]\hat{\jmath}$$
x–direction: $0.512\frac{m}{s^2} = 2\frac{m}{s^2} - 0.300\alpha_{AB} - 0.480\frac{m}{s^2}$
y–direction: $-0.500\alpha_C = -0.400\alpha_{AB} + 0.360\frac{m}{s^2}$
$$\alpha_{AB} = 3.36\frac{rad}{s^2}$$
$$\alpha_C = 1.97\frac{rad}{s^2}$$