

Rigid Body Kinematics II – Problem 2

At the instant shown the angular velocity of BC is 2 rad/second clockwise. Wheel A is a rolling no-slip wheel. Classify the motion of each rigid body in the figure, and determine the angular velocity of Wheel A. The radius of Wheel A is 1".

CLASSIFY MOTION

BC - RPPA
AB - GPM
WHEEL A - GPM

VELOCITY EQNS (CHOOSE PT "B")

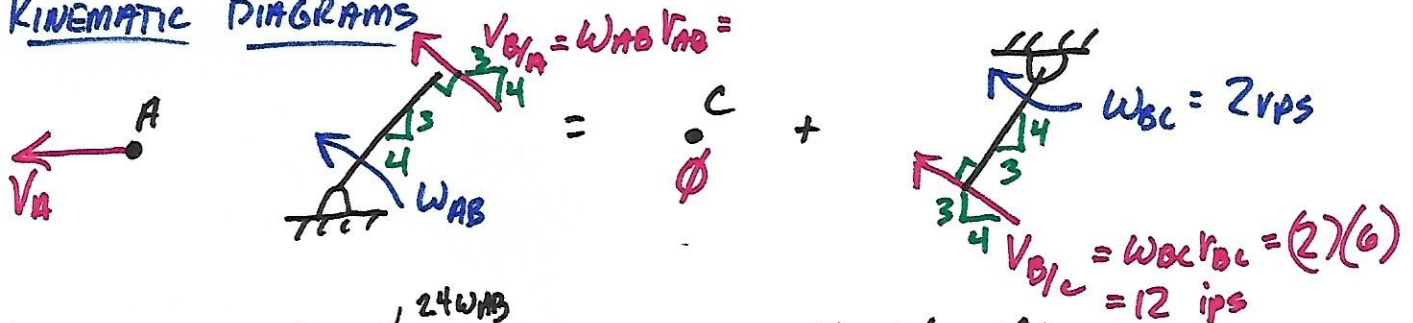
$$\vec{V}_B = \vec{V}_A + \vec{V}_{B/A}$$

$$\vec{V}_B = \vec{V}_C + \vec{V}_{B/C}$$

COMBINING

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

KINEMATIC DIAGRAM



$$\begin{aligned} \leftarrow \sum x \quad V_A + \frac{3}{5} V_{B/A} &= 0 + \frac{4}{5} V_{B/C} \\ \uparrow \sum y \quad 0 + \frac{4}{5} V_{B/A} &= 0 + \frac{3}{5} V_{B/C} \end{aligned}$$

$$\frac{4}{5} V_{B/A} = \frac{3}{5} (12) \Rightarrow V_{B/A} = 9 \text{ ips}$$

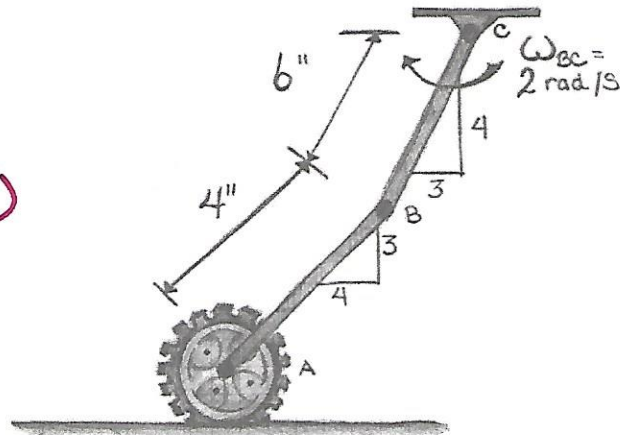
NO SLIP WHEEL

$$V_A = \omega_{WH} r_{WH} \Rightarrow$$

$$V_A + \frac{3}{5} (9) = \frac{4}{5} (12)$$

$$\underline{\underline{V_A = 4.2 \text{ ips}}}$$

$$4.2 = \omega_{WH} (1") \Rightarrow \underline{\underline{\omega_{WH} = 4.2 \text{ rad/s}}}$$



Rigid Body Kinematics II – Problem 2 **ALTERNATE SOLUTION**

At the instant shown the angular velocity of BC is 2 rad/second clockwise. Wheel A is a rolling no-slip wheel. Classify the motion of each rigid body in the figure, and determine the angular velocity of Wheel A. The radius of Wheel A is 1".

CLASSIFY MOTION

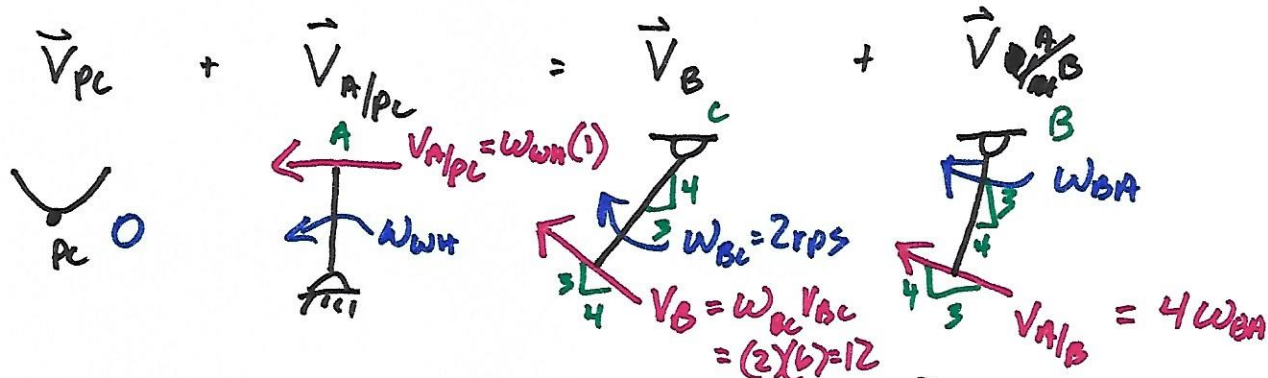
BC – RAFA
AB – GPM
WHEEL A – GPM

VELOCITY EQNS **CHOOSE PT "A"**

$$\vec{V}_A = \vec{V}_{PC} + \vec{V}_{A/PC}$$

$$\vec{V}_A = \vec{V}_B + \vec{V}_{A/B}$$

COMBINING



$$\leftarrow \sum X \quad 0 + V_{A/PC} = \frac{4}{5} V_B + \frac{3}{5} V_{A/B}$$

$$W_{WH}(1) = \frac{4}{5}(12) + \frac{3}{5}(4W_{BA})$$

$$\uparrow \sum Y \quad 0 + 0 = \frac{3}{5}(12) + \frac{4}{5}(4W_{BA})$$

$$W_{BA} = -2.25 = 2.25 \text{ rps} \uparrow$$

$$W_{WH} = 4.2 \text{ rps} \uparrow$$

$$V_A = W_{WH}(1) = 4.2(1) = 4.2 \text{ in/s} \leftarrow$$

