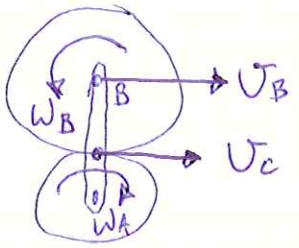
PROB. 15-51

$$\omega_{AB} = \left(42 \frac{REV}{SEC}\right)\left(\frac{MIN}{60\ s}\right)\left(\frac{2\pi}{REV}\right) = 4.398 \frac{RAD}{SEC}\ C.W.$$

a) FIND ω_A WHEN $\omega_B = (20\ RPM)\left(\frac{2\pi}{60}\right) = 2.094 \frac{RAD}{SEC}$ CCW



$$v_B = r_{AB} \cdot \omega_{AB}, \quad v_C = r_A \omega_A$$

$$\vec{v}_C = \vec{v}_B + \vec{v}_{C/B} = \vec{v}_B + (\omega_B)\hat{k} \times \vec{r}_{C/B}$$

$$\vec{r}_{C/B} = (-r_B)\hat{j}$$

$$(r_A \omega_A)\hat{i} = (r_{AB} \omega_{AB})\hat{i} + (\omega_B)\hat{k} \times (-r_B)\hat{j}$$

$$(\omega_B)\hat{k} \times (-r_B)\hat{j} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & \omega_B \\ 0 & -r_B & 0 \end{vmatrix}$$

$$= [0 - (\omega_B)(-r_B)]\hat{i} = (r_B \omega_B)\hat{i}$$

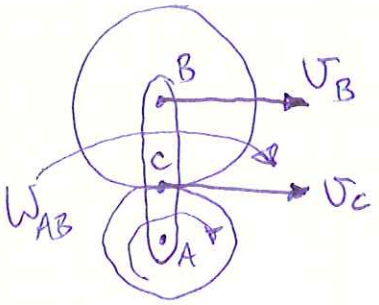
$$r_A \omega_A = r_{AB} \omega_{AB} + r_B \omega_B$$

$$\omega_A = \frac{(r_{AB} \omega_{AB} + r_B \omega_B)}{r_A} = \frac{(150^{mm})\left(4.398 \frac{RAD}{SEC}\right) + (90)(2.094)}{(60^{mm})}$$

$$\omega_A = \left(14.14 \frac{RAD}{SEC}\right)\left(\frac{60}{2\pi}\right) = \boxed{135\ RPM\ \circlearrowleft}$$

b) CURVILINEAR TRANSLATION: ALL POINTS ON THE BODY HAVE THE SAME VELOCITY.

PROB. 15-51 CONT.



$\omega_{AB} = 42 \text{ RPM} = 4.398 \frac{\text{RAD}}{\text{SEC}}$ CW

FOR CURVILINEAR TRANSLATION,

$v_B = v_C$

$v_B = r_{AB}\omega_{AB}$

$v_C = r_A \omega_A$

$r_A \omega_A = r_{AB}\omega_{AB}$

$$\omega_A = \left(\frac{r_{AB}}{r_A}\right)\omega_{AB} = \left(\frac{150}{60}\right)\left(4.398 \frac{\text{RAD}}{\text{SEC}}\right) = \left(10.99 \frac{\text{RAD}}{\text{SEC}}\right)\left(\frac{60}{2\pi}\right)$$

$\boxed{\omega_A = 105.0 \text{ RPM} \quad \checkmark}$