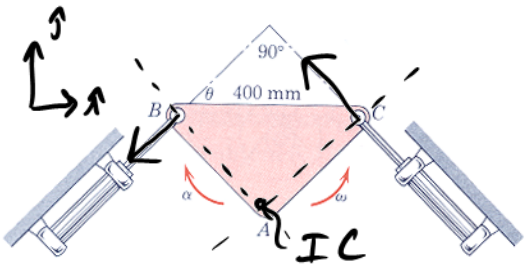
# Example Problem - Le 20

**5.136** At the instant shown, θ=45 deg and the plate ABC has a counterclockwise angular velocity of 20 rad/s and a clockwise angular acceleration of 100 rad/s$^2$.
Determine:

a) the magnitude of the velocity of the piston attached to C,
b) the magnitude of the acceleration of the piston attached to C

(*taken from Dynamics, 3rd Edition by Merriam & Kraige*)



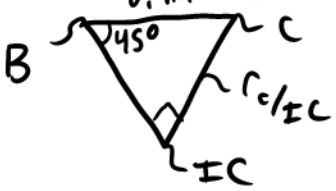

a) Kinematics of ABC

$v_C = \omega r_{C/IC}$

$= \left(20 \frac{rad}{s}\right)(r_{C/IC})$

$\boxed{v_C = 5.657 \text{ m/s}}$

Geometry / Trig




$r_{C/IC} = 0.28\text{m}$

If velocity was requested

$\vec{v}_C = \vec{\omega} \times \vec{r}_{C/IC}$

$\vec{v}_C = -4\hat{\imath} + 4\hat{\jmath}$ m/s

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

$\vec{\alpha} = \left(-100 \frac{rad}{s^2} \hat{k}\right)$

$\vec{r}_{C/B} = 0.4\text{m}\,\hat{\imath}$

$\vec{a}_C = \vec{a}_B - 40 \text{ m/s}^2 \hat{\jmath} - 160 \text{ m/s}^2 \hat{\imath}$

$\hat{\imath}$) $a_{Cx} = a_{Bx} - 160 \text{ m/s}^2$ ①

$\hat{\jmath}$) $a_{Cy} = a_{By} - 40 \text{ m/s}^2$ ②

$C = B - 160$

$-C = B - 40$

$B = 100$

$C = -60$

$\vec{a}_B = (a_B)(\cos 45^\circ \hat{i} + \sin 45^\circ \hat{j})$

$\vec{a}_C = (a_C)(\cos 45^\circ \hat{i} - \sin 45^\circ \hat{j})$

$a_{Bx} = a_B \cos 45^\circ$ ③

$a_{By} = a_B \sin 45^\circ$ ④

$a_{Cx} = a_C \cos 45^\circ$ ⑤

$a_{Cy} = -a_C \sin 45^\circ$ ⑥

$a_C = -84.85\ m/s^2$

$|\vec{a}_C| = 84.85\ m/s^2$