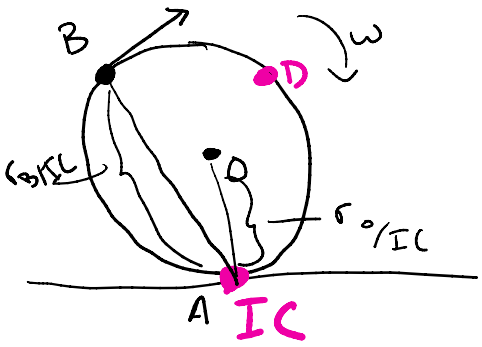
# Instantaneous Center of Zero Velocity

Thursday, October 6, 2022 3:32 PM




- The velocity of any point can be found by a base point (IC) which has 0 velocity
- Body will appear to rotate about IC in a circular path
- $V_B = \omega r_{B/IC}$

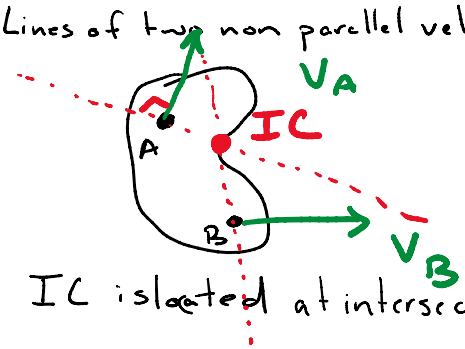
$V_O = \omega r_{O/IC}$

$V_B = \omega r_{B/IC}$

$V_D = \omega r_{D/IC}$

## Location of IC

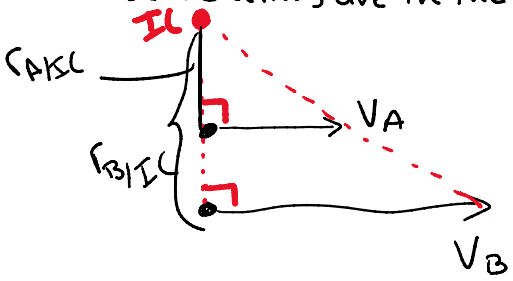
Lines of two non parallel velocities. Velocities are Known




IC is located at intersection of ⊥ lines

Lines of two parallel velocities

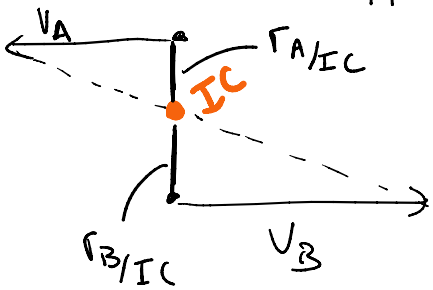
Case Velocities are in the same direction

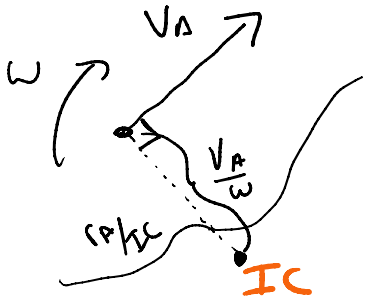



$r_{A/IC} = \frac{V_A}{\omega}$

$r_{B/IC} = \frac{V_B}{\omega}$

Case Velocities are in opposite directions

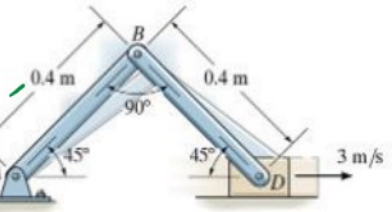


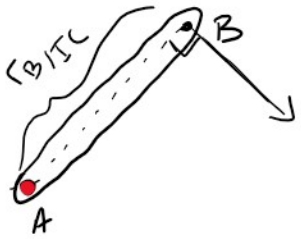



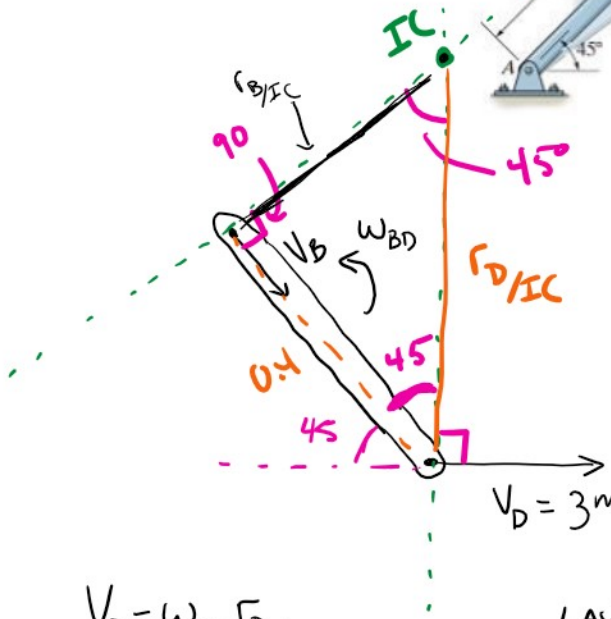

2) Velocity of Point A and ω are known.
IC is located at a point along a ⊥ line with a distance of $\frac{V_A}{\omega}$

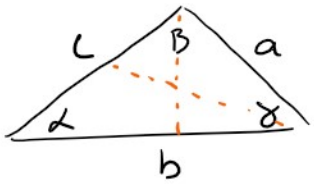
Tuesday, October 4, 2022 3:12 PM

**Example 2:** Block D moves with a speed of 3m/s. Determine the angular velocities of links BD and AB at the instant shown




$V_B = \omega r_{B/IC}$

$V_B = \omega_{AB}(0.4)$

$2.12 = \omega_{AB}(0.4)$

$\omega_{AB} = 5.3^{rad}/_s$

$V_D = \omega_{BD} r_{D/IC}$

$3 = \omega_{BD}(0.5657)$

$\omega_{BD} = 5.3^{rad}/_s$

$V_B = (5.3)(0.4)$

$= 2.12^m/_s$

LAW OF SINES

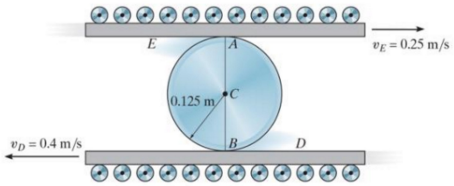
$\frac{\sin(\alpha)}{a} = \frac{\sin(B)}{b} = \frac{\sin\gamma}{c}$

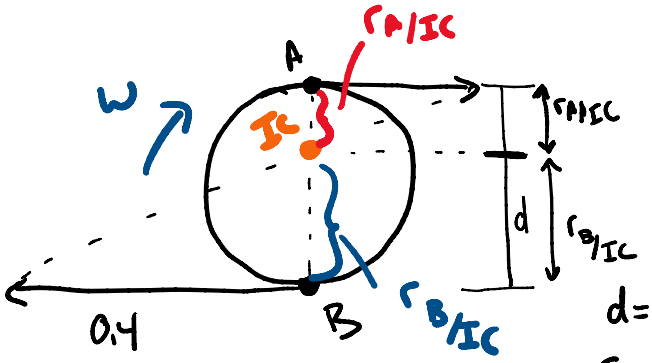
$\frac{\sin 45}{0.4} = \frac{\sin 90}{r_{D/IC}}$

$\frac{0.4(1)}{\sin 45} = r_{D/IC} = .5657$

$\frac{\sin(45)}{0.4} = \frac{\sin(45)}{r_{B/IC}}$

**Example 1:** The cylinder shown rolls without slipping between two moving plates E and D. Determine the angular velocity of the cylinder and the velocity of its center C




$d = 0.25$

$r_{A/IC} = 0.25 - r_{B/IC}$

$V_B = \omega r_{B/IC}$

$.4 = \omega r_{B/IC}$

$r_{B/IC} = \frac{.4}{\omega}$

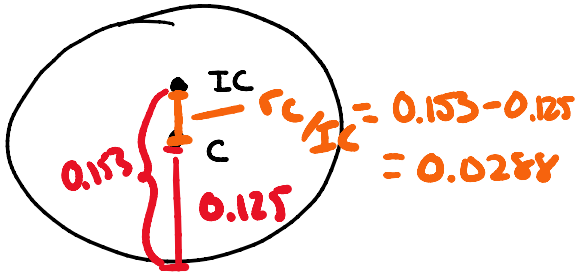
$r_{B/IC} = \frac{.4}{2.6} = 0.153$

$V_A = \omega r_{A/IC}$

$.25 = \omega(0.25 - r_{B/IC})$

$.25 = \omega(0.25 - \frac{.4}{\omega})$

$\omega = 2.6$ rad/s

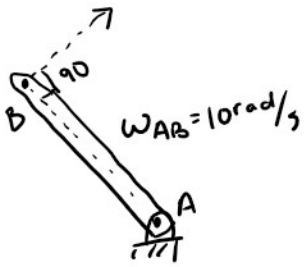


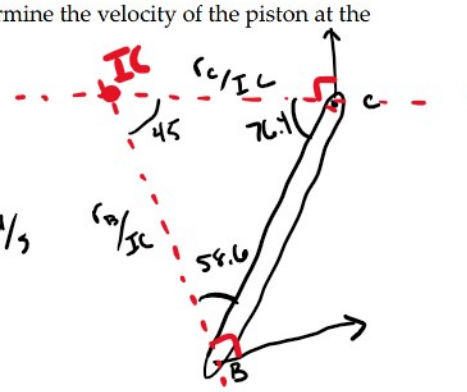

$V_C = \omega r_{C/IC}$ ←

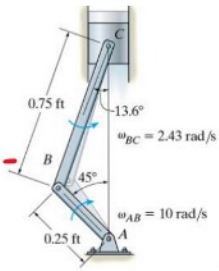
$V_C = (2.6)(0.0288) = 0.0749$ m/s

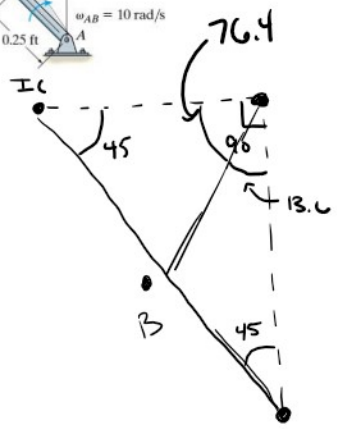
Thursday, October 6, 2022 2:17 PM

**Example 2:** The crankshaft AB turns with a clockwise angular velocity of 10 rad/s. Determine the velocity of the piston at the instant shown




$V = \omega_{AB}(r_B)$
$= (10)(0.25)$
$= 2.5\ ft/s$

$\frac{.75}{\sin 45} = \frac{r_{C/IC}}{\sin 58.6}$

$r_{C/IC} = 0.905$

$\frac{.75}{\sin 45} = \frac{r_{B/IC}}{\sin 76.4}$

$r_{B/IC} = 1.031$

$V_C = \omega r_{C/IC}$
$= (2.42)(0.905)$
$= -2.19\ ft/s$

$V_B = \omega r_{B/IC}$
$2.5 = \omega(1.031)$
$\omega = 2.42\ rad/s$

Example: The double gear shown rolls on the stationary lower rack; the velocity of its center A is 1.2 m/s directed to the right. Determine the a) angular velocity of the gear, b) the velocities of the upper rack R and point D of the gear.