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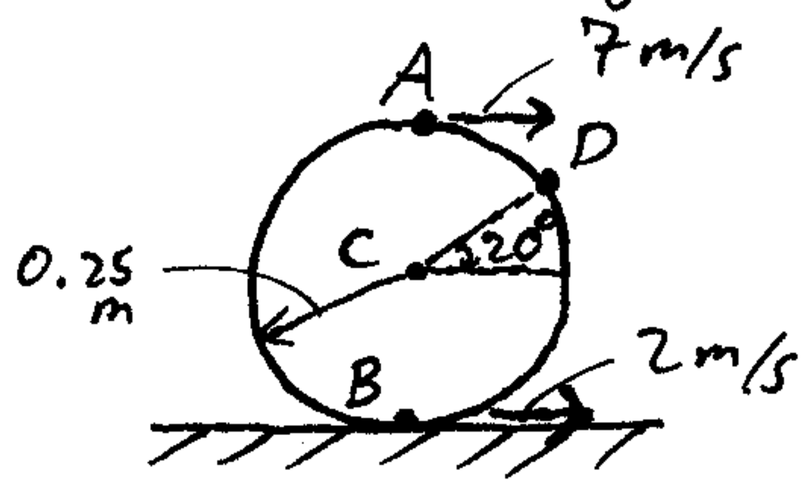
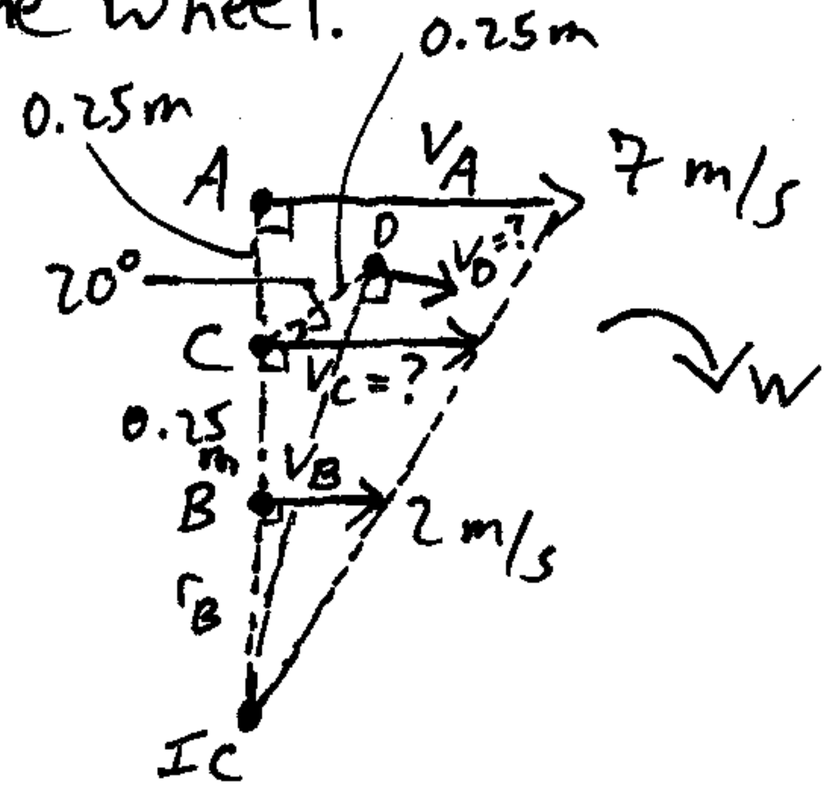
March 29, 2020

This is a problem involving instant center (engineering mechanics).



A wheel rolls with slipping on a surface, and as a result, the top and bottom of the wheel have a velocity of 7 m/s and 2 m/s, respectively. Determine the velocity of the center C and point D on the wheel.

Solution:



By similar triangles, $\frac{V_A - V_C}{0.25\,m} = \frac{V_A - V_B}{0.5\,m} = \frac{V_B}{r_B}$

Substitute known values and solve for V_C: $\frac{7\,m/s - V_C}{0.25\,m} = \frac{7\,m/s - 2\,m/s}{0.5\,m}$

$V_C = 4.5\,m/s$ (ans.)

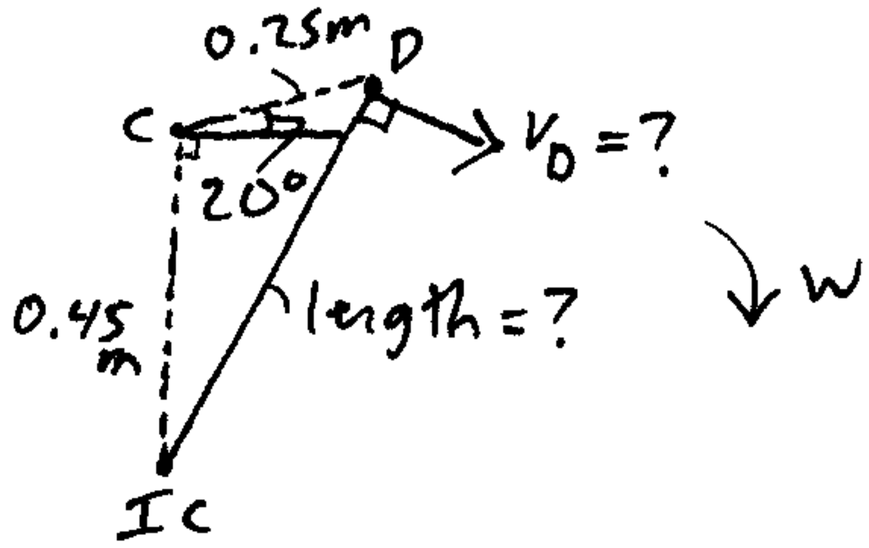
and $r_B = \frac{(0.5\,)V_B}{V_A - V_B}$

$r_B = 0.2\,m$

Now,

$$w = \frac{v_B}{r_B} = \frac{2\ m/s}{0.2\ m} = 10\ rad/s$$

Next find the length between IC and point D.



By the law of cosines:

$$(length)^2 = 0.45^2 + 0.25^2 - 2(0.45)(0.25)\cos(90° + 20°)$$

$$length = 0.585\ m$$

Therefore, $V_D = (0.585)w = (0.585)(10) = 5.85\ m/s$ (ans.)