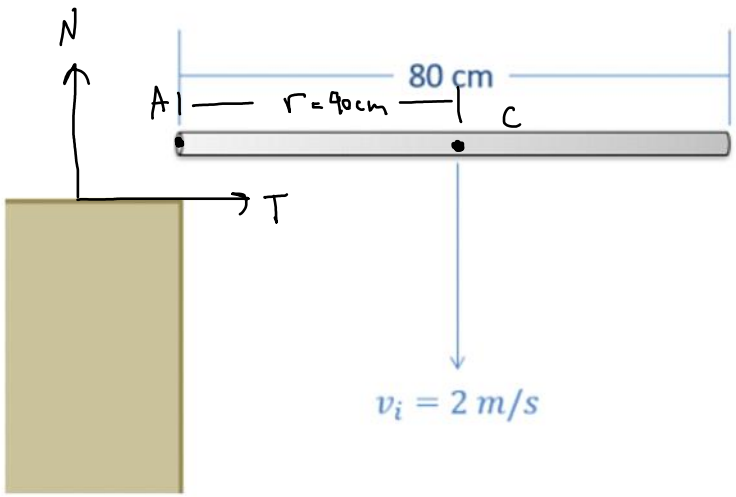
Problem 1

An 80 centimeter long 1 kilogram metal bar falling at 2 meters per second strikes the edge of a table as shown below. Assuming a coefficient of restitution of .9, what is the expected velocity and angular velocity of the bar after impact?



$V_{Ni} = -2\ m/s$

$V_{Ti} = 0$

$\omega_i = 0$

$$V_{TF} = V_{Ti} = 0$$

$$V_{ANF} = -e\,V_{ANi} \quad (V_{ANi} = V_{CNi} = -2\ m/s)$$

(e = .9)

$$V_{ANF} = 1.8\ m/s = V_{CNF} - r\,\omega_F$$

(r = .4 m)

$$V_{CNF} = 1.8 + .4\,\omega_F$$

$$KE_i = e^2 KE_f$$

$$\frac{1}{2} m V_{ci}^2 = (.9)^2 \left(\frac{1}{2} m V_{NCF}^2 + \frac{1}{2} I \omega_f^2 \right)$$

$$\frac{1}{2}(1)(-2)^2 = .9^2 \left(\frac{1}{2}(1)(V_{NCF})^2 + \frac{1}{2}\left(\frac{1}{12}(1)(.8)^2\right)\omega_f^2 \right)$$

$$2 = .81 \left(\frac{1}{2} V_{NCF}^2 + .2667\, \omega_f^2 \right)$$

Use equation Solver

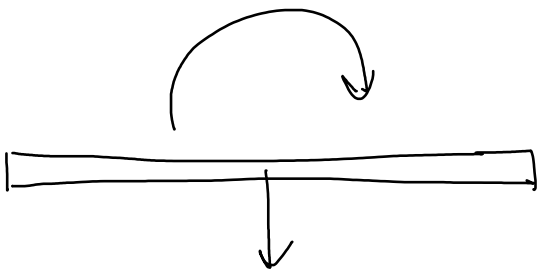
two solutions from equation solver

✓ $V_{CNF} = -1.31$ m/s & $\omega_f = -7.77$ rad/s

✗ $V_{CNF} = 2.21$ m & $\omega_f = 1.02$ rad/s ← would involve bar bouncing up faster than it hit the surface

After Impact

$\omega_f = 7.77$ rad/s



$V_f = 1.31$ m/s