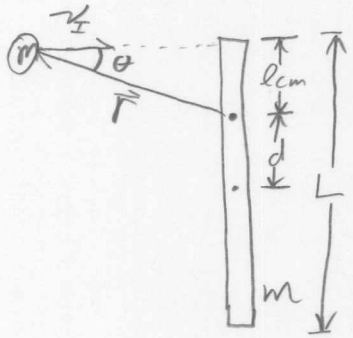
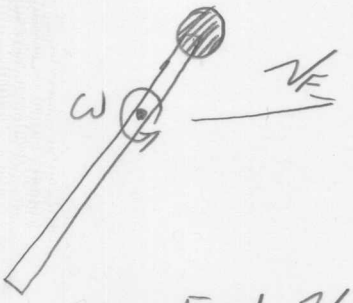
Throw a wad of clay at a stick on the ice





Find v_F and ω

Rod and stick have same mass m

Conserve linear momentum

$$P_I = P_F$$

$$m v_I = 2m v_F$$

$$\boxed{v_F = \tfrac{1}{2} v_I}$$

Conserve angular momentum

$$L_I = L_F$$

$$m(\vec{r} \times \vec{v}_I) = I_T \omega$$

$$m r v_I \sin\theta = I_T \omega$$

$$\boxed{① \; m v_I l_{cm} = I_T \omega}$$

We need to calculate I_T and l_{cm}

$$② \; l_{cm} = \frac{m(0) + m(\frac{L}{2})}{m + m} = \frac{\frac{1}{2}mL}{2m} = \frac{1}{4}L$$

continued ↓

$I_T = I_{ROD} + I_{clay}$

$I_{ROD} = I_{cmROD} + md^2$, $\quad d = L/2 - l_{cm}$

$= L/2 - L/4 = L/4$

$I_{cmROD} = \frac{1}{12} mL^2$

$I_{ROD} = \frac{1}{12} mL^2 + \frac{1}{16} mL^2 = \frac{7}{48} mL^2$

$I_{clay} = m l_{cm}^2 = \frac{1}{16} mL^2$

(3) $I_T = \frac{7}{48} mL^2 + \frac{1}{16} mL^2 = \frac{5}{24} mL^2$

Put ①, ②, and ③ together

$mV_I \frac{1}{4} L = \frac{5}{24} mL^2 \omega$

$$\boxed{\omega = \frac{6}{5} \frac{V_I}{L}}$$