A disk of mass $m_{\text{puck}}$ traveling with initial velocity $v_{\text{puck},i} = 3.0$ m/s in the x-direction strikes a stick of mass $m_{\text{stick}}$ and moment of inertia $I$, 2 meters from its center, that is lying flat on nearly frictionless ice. Assume the collision is elastic.
For this situation, have groups set up and indicate the unknowns:

**A: Momentum principle**

\[
\Delta \vec{p} = \vec{F}_{\text{net}} \Delta t
\]

\[
\Delta \left( m_{\text{puck}} v_{\text{puck}} + m_{\text{stick}} v_{\text{stick}} \right) = 0
\]

\[
\left( m_{\text{puck}} v_{\text{puck}} + m_{\text{stick}} v_{\text{stick}} \right)_{\text{final}} - \left( m_{\text{puck}} v_{\text{puck}} \right)_{\text{initial}} = 0
\]

\[
(2 \times 2.3 + 1 \times 1.3)_{\text{final}} - (2 \times 3.0)_{\text{initial}} = 0
\]

\[
(4.6 + 1.3)_{\text{final}} - (6.0)_{\text{initial}} = 0
\]

**B: Angular momentum principle**

\[
\Delta \vec{L} = \vec{r}_{\text{net}} \Delta t
\]

\[
\Delta \left( L_{\text{puck}} + L_{\text{stick}} \right) = 0
\]

\[
\left( -2 \times 2.3 \times 2 + (-2.7) \right)_{\text{final}} - (-2 \times 3 \times 2)_{\text{initial}} = 0
\]

\[
(-9.2 - 2.7)_{\text{final}} - (-12)_{\text{initial}} = 0
\]

**C: Energy principle**

\[
\Delta E = \vec{F}_{\text{net}} \cdot \Delta \vec{r}
\]

\[
\Delta \left( K_{\text{puck}} + K_{\text{stick}} \right) = 0
\]

\[
\left( \frac{1}{2} 2 \times 2.3^2 + \frac{1}{2} 1 \times 1.3^2 + \frac{1}{2} 1.337 \times 2^2 \right)_{\text{final}} - \left( \frac{1}{2} 2 \times 3.0^2 \right)_{\text{initial}} = 0
\]

\[
(5.3 + 0.9 + 2.7)_{\text{final}} - (9)_{\text{initial}} = 0
\]

Have one of each group present and show that you have a system of three equations and three unknowns, \( v_{df}, \ v_s, \) and \( \omega \). They should verify the table results.