p 14.57

Use | Cons momentum ✓ | Find a) V_0
Cons ✗ momentum | b) l
Cons energy | c) ω_0

Known
$\vec{V}_A = 2.6\ m/s\ \hat{j}$
$\vec{V}_C = 4.5\ m/s\ \hat{i}$
$a = 0.26\ m$
$d = 0.15\ m$

From cons of momentum

$M\vec{V}_0 = \sum m_i \vec{V}_i$

$3m V_0 \hat{i} = m\vec{V}_A + m\vec{V}_B + m\vec{V}_C$

$3m V_0 \hat{i} = m\,2.6\hat{j} + m V_B \hat{j} + m\,4.5\hat{i}$

$\hat{i}$: $3m V_0 = 4.5m$

$\boxed{V_0 = 1.5\ m/s}$

$\hat{j}$: $0 = 2.6m + V_B m$

$V_B = -2.6m$

From cons of energy

$T_i = T_f$

$\frac{1}{2}(3m)V_0^2 + 3\left(\frac{1}{2} m V'^2\right) = \frac{1}{2} m V_A^2 + \frac{1}{2} m V_B^2 + \frac{1}{2} m V_C^2$

$3 \cdot 1.5^2 + 3V'^2 = 2.6^2 + 2.6^2 + 4.5^2$

$V' = \sqrt{\frac{2.6^2+2.6^2+4.5^2}{3} - 1.5^2} = 3\ m/s$

Cons angular momentum

$(M_O)_1 = (M_O)_2$ X is location of a in x direction

$3lmv' = xmV_A + (x-a)mV_B + dmV_C$

since $V_B = -V_A$

$3l3 = aV_A + dV_C$

$l = \frac{1}{9}(2.6 \cdot 0.26 + 0.15 \cdot 4.5)$

$l = 0.15\ m$

Thus $\omega = \frac{v'}{l} = \frac{3}{0.15} = 20\ rad/s$