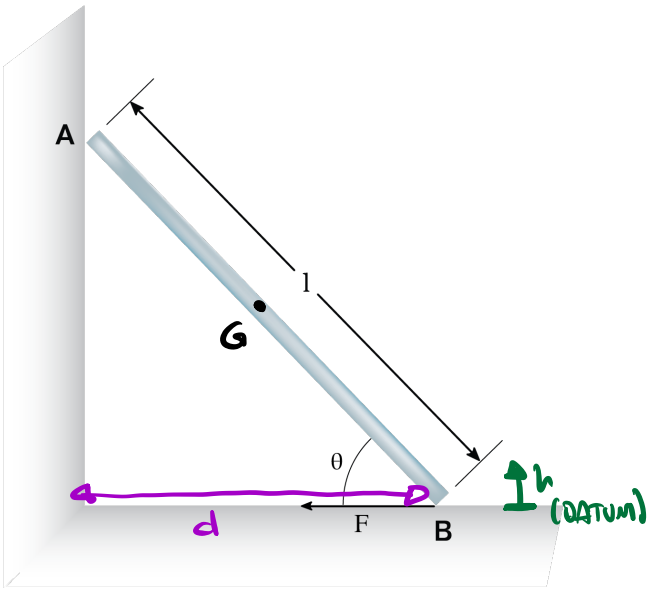
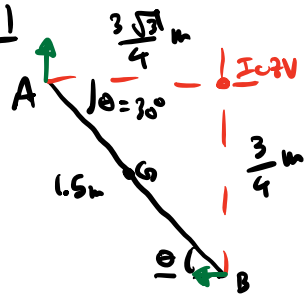
A $30Kg$ sheet of ice with length $l = 1.5\ m$ at an angle $\theta = 30\ degrees$ has a force $F = 650\ N$ applied at B. Determine the magnitude of the angular velocity of the plank when it reaches a vertical position. Assume the sheet acts like a thin plate and that contact between the sheet and all surfaces is frictionless.



State 1

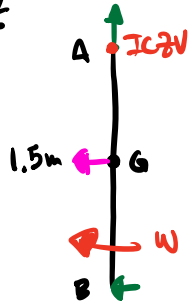


$T_1 = 0\ J$

$V_1 = mgh_1 = (30kg)(9.81 m/s^2)\left(\frac{3}{4}\sin 30°\right)$

$V_1 = 110.7\ J$

State 2



$T_2 = \frac{1}{2} m v_G^2 + \frac{1}{2} I_G \omega^2$

$= \frac{1}{2} m \left(\omega \frac{3}{4}\right)^2 + \frac{1}{2}\left[\frac{1}{12} m l^2\right]\omega^2$

$= \frac{1}{2}(30kg)\left(\omega \frac{3}{4} m\right)^2 + \frac{1}{2}\left(\frac{1}{12}(30kg)(1.5m)^2\right)\omega^2$

$$T_2 = 11.25\,w^2$$

$$V_2 = mgh_2 = (30\text{kg})(9.81\text{m/s}^2)(3\text{m}) = 220.73\text{ J}$$

Work due to force

$$U_{1\text{-}02} = U_F = Fd = (650\text{N})\left(\frac{3\sqrt{3}}{4}\text{m}\right)$$

$$T_1 + V_1 + U_{1\text{-}02} = T_2 + V_2$$

$$0 + 110.4\text{J} + (650\text{N})\left(\frac{3\sqrt{3}}{4}\text{m}\right) = 11.25\,w^2 + 220.7\text{J}$$

$$\boxed{w = 8.1\ \text{rad/s}}$$