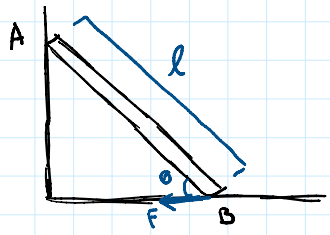
20-R-WE-DK-11

July 30, 2020 10:53 AM

20-R-WE-DK-11 Intermediate Principle of Work and Energy

Inspiration: F18-3 Hibbeler



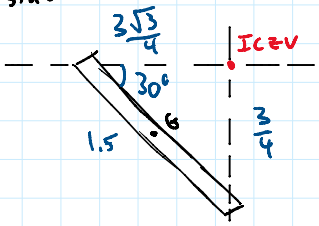
A ***30 kg*** sheet of ice with length ***l = 1.5 m*** at an angle ***theta = 30 degrees*** has a force ***F = 650 N*** applied at B. Determine the magnitude of the angular velocity of the plank when it reaches a vertical position. Assume the sheet acts like a thin plate and that contact between the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

$$I_G = \frac{1}{12} m l^2 = \frac{1}{12}(30)(1.5)^2 = 5.625$$

$T_1 = 0 \qquad V_1 = (30)(9.81)\left(\frac{3}{4} \times \frac{1}{2}\right)$ Datum is set at height of B (ground)

$= 110.3625$

State 1



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

$= \frac{1}{2}(30)\left(\frac{3}{4}\omega\right)^2 + \frac{1}{2}(5.625)\omega^2$

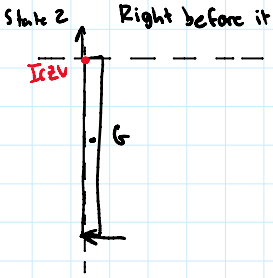
$= 11.25\omega^2$

At state 2, the ICEV is at A $\Rightarrow$ A acts as a pin

$\therefore v_G = \omega r_{G/IC}$

$V_2 = (30)(9.81)\left(\frac{3}{4}\right) = 220.725$

State 2 Right before it is vertical



$$\Sigma U_{1\to 2} = U_F = F \cdot d = 650\left(\frac{3\sqrt{3}}{4}\right)$$

$$T_1 + V_1 + \Sigma U_{1\to 2} = T_2 + V_2$$

$$0 + 110.3625 + 650\left(\frac{3\sqrt{3}}{4}\right) = 11.25\omega^2 + 220.725$$

$$\boxed{\omega = 8.07747 \text{ rad/s}}$$