

Elementary Dynamics Example #22: (Conservation of Energy)

Given: $W_C = 600 \text{ (lb)}$, $W_B = 200 \text{ (lb)}$

$\theta = 20 \text{ (deg)}$

system is released from **rest**

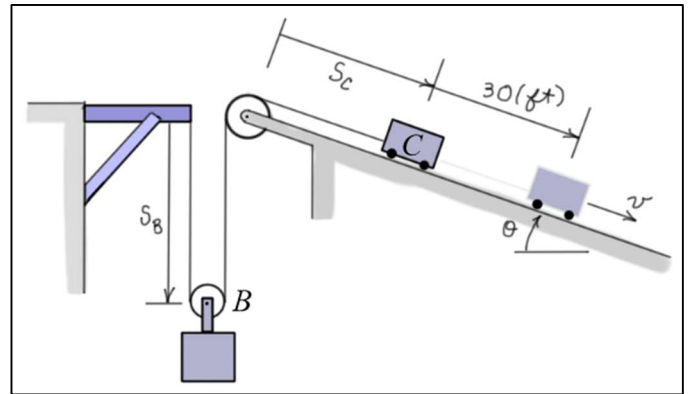
cart travels **down** the incline

Find: v_C when the cart is 30 (ft) down the incline

Solution: Conservation of energy for the system

Kinematics:

$$2s_B + s_C = \text{constant} \Rightarrow v_C = 2v_B$$



Conservation of Energy: (choosing the datum for each mass at the starting positions)

$$\underbrace{K_1}_{\text{zero (at rest)}} + \underbrace{V_1}_{\text{zero (each mass at its datum)}} = K_2 + V_2$$

$$K_2 = \frac{1}{2} \left(\frac{W_C}{g} \right) v_C^2 + \frac{1}{2} \left(\frac{W_B}{g} \right) \left(\frac{1}{2} v_C \right)^2 = \frac{1}{2g} \left(W_C + \frac{1}{4} W_B \right) v_C^2 = \frac{325}{g} v_C^2$$

$$V_2 = W_B (15) - W_C (30 \sin(20)) = -3156.36 \approx -3156 \text{ (ft-lb)}$$

Substituting into the conservation of energy equation:

$$\left(\frac{325}{g} \right) v_C^2 = 3156.36 \Rightarrow v_C = \sqrt{\frac{3156.36g}{325}} = 17.684 \approx 17.7 \text{ (ft/s)}$$

Note: Tension “ T ” does **negative** work on C , and tension “ $2T$ ” does **positive** work on B . But because B moves just **half** the distance that C moves, the net work of the tension T on the system is **zero**.