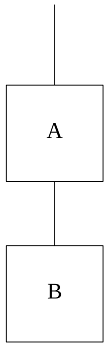
Problem 2: (30 pts.) You are trying to lower two boxes connected by a rope as shown in the figure. The top box (A) has a mass of 170 kg, and the bottom box (B) has a mass of 130 kg. Unfortunately, the rope between the two boxes is old and frayed, and can only support 70% of box B's weight.

a. (10 pts.) What is the acceleration of box B?



b. (10 pts.) What is tension in the top rope (T_1)?

c. (10 pts.) Under these conditions, if you have to lower the bottom box a total vertical distance of 10 m, how fast will it be going when it hits the ground?

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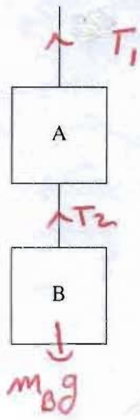

$\Sigma F_B = m_B a_B$

$T_2 - m_B g = m_B a_B$

$(0.70)(m_B g) - m_B g = m_B a_B$

$-0.3g = a_B$

$\boxed{-2.94\ m/s^2 = a_B}$

b. (10 pts.) What is tension in the top rope (T_1)?

$\Sigma F_A = m_A a_A$ assume $a_A = a_B$

$T_1 - T_2 - m_A g = m_A a_A$

$T_1 - (0.70 m_B g) - m_A g = m_A a_B$, Use $a_B = -0.3g$

$T_1 = m_A(g - 0.3g) + 0.70 m_B g$

$T_1 = (m_A + m_B)(0.70g) = \boxed{2058 N}$

c. (10 pts.) Under these conditions, if you have to lower the bottom box a total vertical distance of 10 m, how fast will it be going when it hits the ground?

$v_B^2 = v_{B0}^2 + 2a_B(\Delta y)$

$v_B^2 = 0 + 2(-0.3g)(-10) =$

$\boxed{v_B = 7.67\ m/s}$