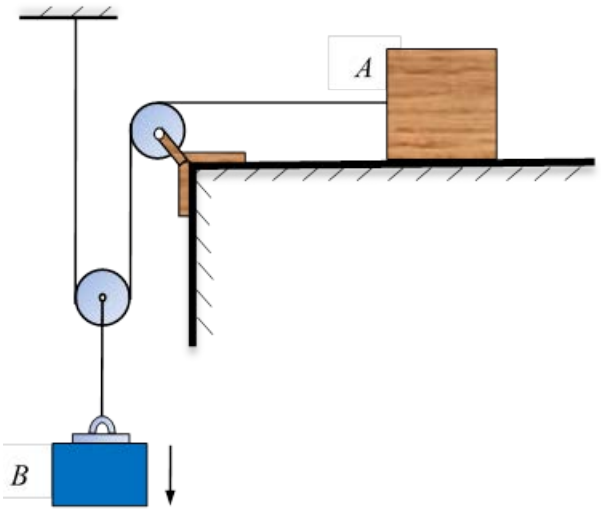
2-22. The 20 kg block B has an initial downward velocity $(v_B)_1 \sim N(1, 0.1^2)$ m/s. If block A is 100 kg and the mass of the pulleys and cords is negligible, determine the velocity of A when $t = 2$ s. Assume that the horizontal plane is smooth.



Solution:

$$s_A + 2s_B = l$$

$$v_A = -2v_B$$

Block A $+\rightarrow$

$$m_A(v_A)_1 - Tt = m_A(v_A)_2$$

Block B $(+\downarrow)$

$$m_B(v_B)_1 + m_B gt - 2Tt = m_B(v_B)_2$$

Since $(v_A)_1 = -2(v_B)_1$ and $(v_B)_2 = -0.5(v_A)_2$, thus

$$-2m_A(v_B)_1 - Tt = m_A(v_A)_2$$

$$m_B(v_B)_1 + m_B gt - 2Tt = -0.5m_B(v_A)_2$$

Solving above equations, we have

$$(v_A)_2 = \frac{(4m_A + m_B)(v_B)_1 + m_B gt}{-0.5m_B - 2m_A}$$

$$\mu_{(v_A)_2} = \frac{(4m_A + m_B)\mu_{(v_B)_1} + m_B gt}{-0.5m_B - 2m_A} = -3.87 \text{ m/s} = 3.87 \text{ m/s} \leftarrow$$

$$\sigma_{(v_A)_2} = \sqrt{\left(\frac{(4m_A + m_B)\sigma_{(v_B)_1}}{-0.5m_B - 2m_A}\right)^2} = 0.2 \text{ m/s}$$

Therefore, $(v_A)_2 \sim N(3.87, 0.2^2)$ m/s $\leftarrow$. **Ans.**