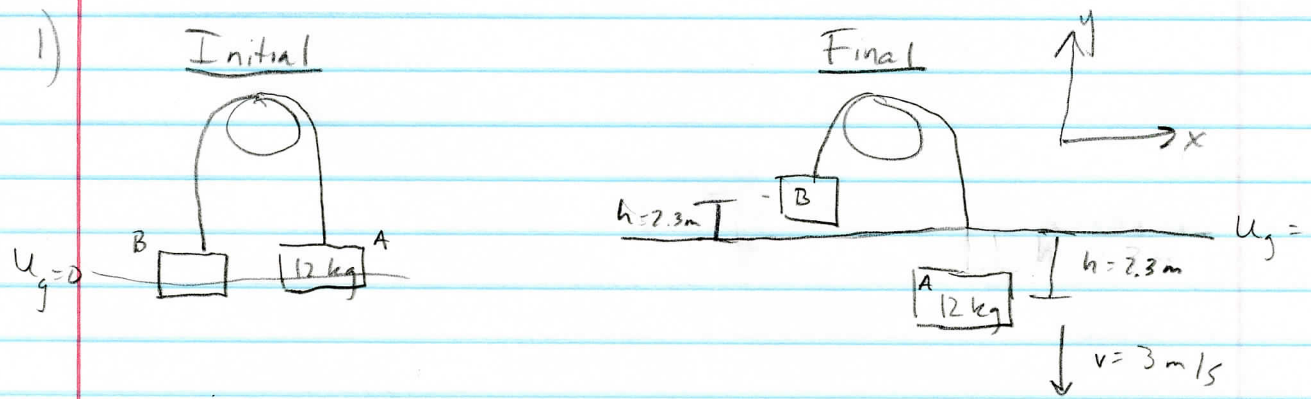
Solutions

1)



Setting $U_g = 0$ at the level the two blocks start at, and analyzing the system, both blocks have gained kinetic energy, but one has lost potential while the other gained

a)

$$\cancel{W_{OTHER}}^{\,0} = \Delta K + \Delta U_g + \cancel{\Delta U_{ela}}^{\,0}$$

$$0 = \tfrac{1}{2}(m_A + m_B)v^2 - 0 + (m_B - m_A)gh - 0$$

$$0 = \tfrac{1}{2}m_A v^2 + \tfrac{1}{2}m_B v^2 + m_B gh - m_A gh$$

$$m_A gh - \tfrac{1}{2}m_A v^2 = \tfrac{1}{2}m_B v^2 + m_B gh$$

$$m_B = \frac{m_A gh - \tfrac{1}{2}m_A v^2}{\tfrac{1}{2}v^2 + gh}$$

$$\boxed{m_B = 8\text{ kg}}$$

b) Force Analysis of the final position of the blocks

$$\Sigma F_y^A = T - m_A g = -m_A a_y$$

$$\Sigma F_y^B = T - m_B g = m_B a_y$$

Subtract the equations from each other

$$-m_B g + m_A g = m_B a_y + m_A a_y$$

$$a_y = \frac{(m_A - m_B)}{(m_A + m_B)} g = 1.96\text{ m/s}^2$$

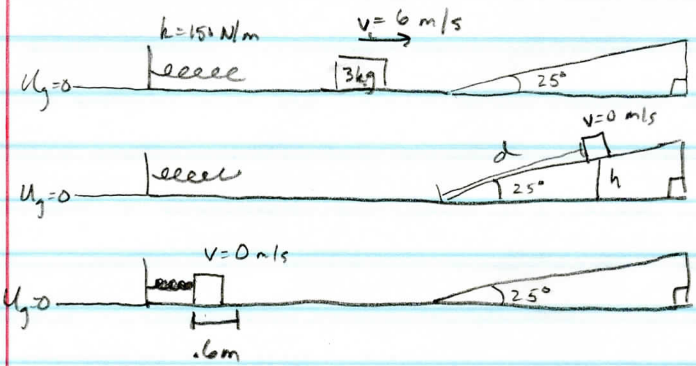
$$v_{fa}^2 = v_{ia}^2 + 2a_y(y_f - y_i)$$

$$9\text{ m}^2/\text{s}^2 = 9\text{ m}^2/\text{s}^2$$

Verified

Solutions

2)



Friction will do all of its work on the incline, since the level surface is frictionless, so I'll choose Position 1 as initial and Position 3 as final.

a)

$$W_{OTHER} = \Delta K + \cancel{\Delta U_g} + \Delta U_{ela}$$

$$W_{OTHER} = \cancel{0} - \tfrac{1}{2}mv_i^2 + \tfrac{1}{2}kx^2 - \cancel{0}$$

$$\boxed{W_{OTHER} = -27\text{ J}}$$

At position 2, friction will only have done half of that work, since it does work on the block as it travels both up and down the incline, so choosing Position 1 as initial and Position 2 as final

b)

$$W_{OTHER} = \Delta K + \Delta U_g + \cancel{\Delta U_{ela}}$$

$$-13.5\text{ J} = \cancel{0} - \tfrac{1}{2}mv_i^2 + mgh - \cancel{0}$$

$$h = 1.38\text{ m}$$

$$\sin 25° = \frac{h}{d}$$

$$d = 3.26\text{ m}$$

This is only the distance that the block has travelled up the incline, the total distance is twice that, since it travels up and down

$$\boxed{\text{total distance} = 6.51\text{ m}}$$

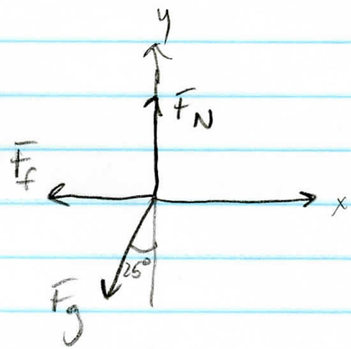
Solutions

Now we know the total work done by friction and the distance over which it did that work. Now all we need is the normal force to find μ_k

c)

$$W_{OTHER} = \vec{F} \cdot \vec{d}$$

$$-27J = -\mu_k F_N \cdot (\text{total distance})$$



$$\Sigma F_y = F_N - F_g \cos 25° = 0$$

$$F_N = mg \cos 25°$$

$$27\,J = \mu_k mg \cos 25° \ (\text{total distance})$$

$$\boxed{\mu_k = 0.155}$$