$$U_{1-2} = T_2 - T_1$$

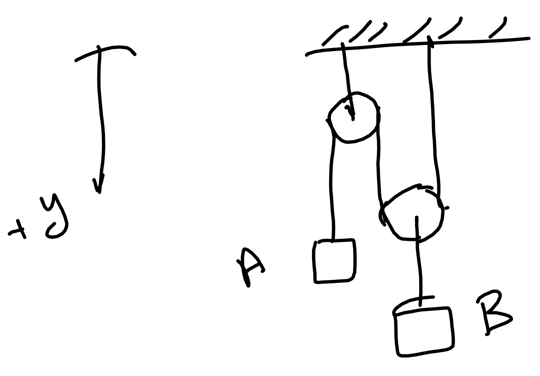
Conservative → work done depends on initial & final positions only

non-conservative → work done depends on path

Internal → work done by forces acting between bodies.

1) Work done by Tensile forces in pulley system is 0.

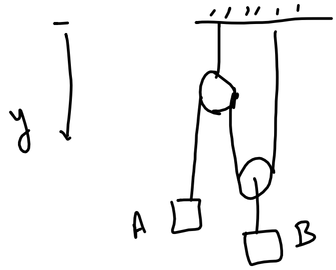
- Rope is inextensible
- Rope is massles
- No friction



$W_{T,A} = ?$

$W_{T,B} = ?$

Assuming tension = T



$W_{T,A}$

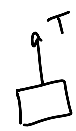
$$W_F = \int_{1-2} \bar{F} \cdot d\bar{r}$$

$$y_A + 2y_B + \text{constants} = L$$

$$V_A + 2V_B = 0$$

$$\Delta y_A + 2\Delta y_B = 0 \quad //$$

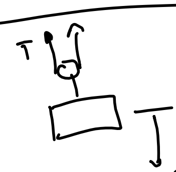
$W_{T,A}$



Δy_A

$$W_{T_A} = -T\Delta y_A$$

$W_{T,B}$

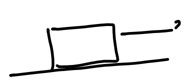


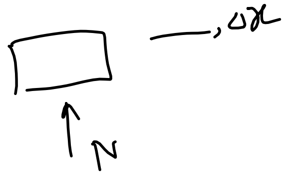
Δy_B

$$W_{T_B} = -(2T)\Delta y_B$$

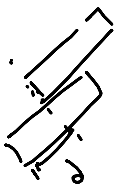
$$W_T = W_{TA} + W_{TB}$$
$$= -T\Delta y_A - 2T\Delta y_B$$
$$= -T(\Delta y_A + 2\Delta y_B)$$

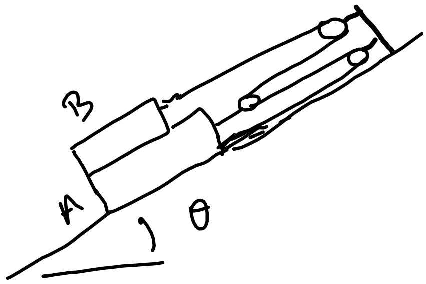
$$\boxed{W_T = 0}$$





$$\boxed{W_N = 0}$$



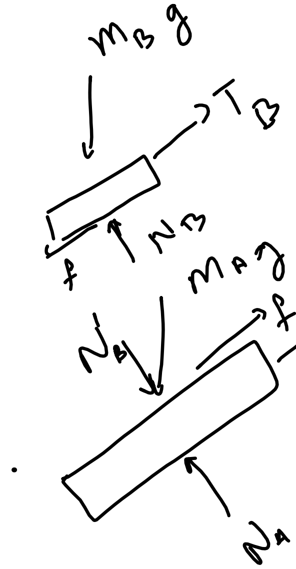


m_A , $m_A > m_B$

m_B

$\mu_s \simeq 0$, $\mu_k = .1$

$V_A, V_B = 0$.

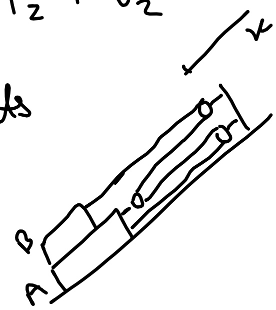


relo displacement is d, $x_A - x_B = d$

compute $W_F = ?$, $W_T = 0$, $W_N = 0$

$$U_{1-2,F} + T_1 + V_1 = T_2 + V_2$$

computing displacents



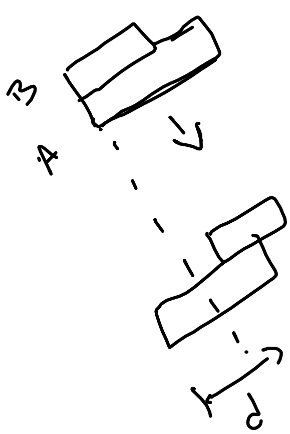
$$3x_A + x_B + C = L$$

$3V_A + V_B = 0$ ←

$$3\Delta x_A + \Delta x_B = 0$$

$$\Delta x_A - \Delta x_B = d$$

$$\Delta x_A = \frac{d}{4}, \quad \Delta x_B = -\frac{3d}{4}$$

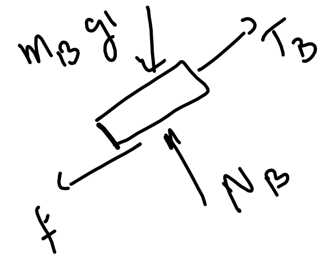


$$3x_{A_1} + x_{B_1} + C = L$$

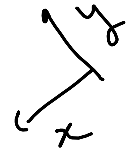
$$-\quad 3x_{A_2} + x_{B_2} + C = L$$

$$3(x_{A_1} - x_{A_2}) + (x_{B_1} - x_{B_2}) = 0$$

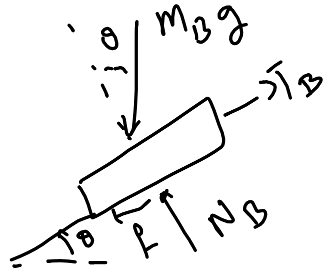
$$3\Delta x_A + \Delta x_B = 0$$



$$\sum F_y = m_B a_y = 0$$



$$N_B - m_B g \cos\theta = 0$$



$$\rightarrow \quad N_B = m_B g \cos\theta$$

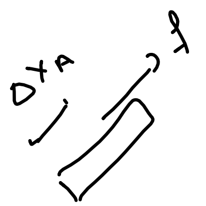
$$f_B = \mu_k N_B = \mu_k m_B g \cos\theta$$

$$W_{F,B} = \int \vec{F} \cdot d\vec{r}$$

$$= |\vec{F}||\Delta\vec{r}| \cos(\phi) \quad \phi \to 180^\circ$$

$$= -1 \times \mu_k m_B g \cos\theta \times \frac{3}{4} d$$

$$= -\frac{3\mu_k m_B g d}{4} \cos\theta$$



$$W_{F,A} = \int \vec{F} \cdot d\vec{r}$$

$$= |F||\Delta r| \cos(\phi)$$

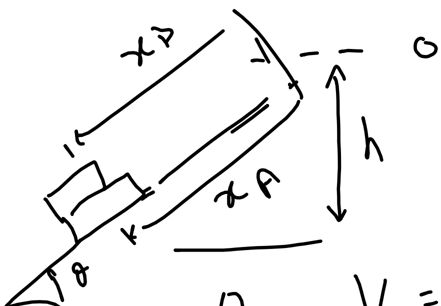
$$= (-1)\left(\mu_k m_B g \cos\theta\right)\left(\frac{d}{4}\right)$$

$$= -\frac{\mu_k m_B g d}{4} \cos\theta$$

$$W_F = W_{F,A} + W_{F,B}$$

$$W_F = -\mu_k m_B g d \cos\theta$$

$$T_1 = 0 \quad , \quad V_1 = m_A g h_A + m_B g h_B$$



$$h_A = - x_A \sin\theta$$

$$h_B = - x_B \sin\theta$$

$$T_1 = 0 , \quad V_1 = - m_A g x_A \sin\theta - m_B g x_B \sin\theta$$

$$T_2 = \frac{1}{2} m_A V_A^2 + \frac{1}{2} m_B V_B^2$$

$$V_2 = - m_A g (x_A + \Delta x_A) \sin\theta - m_B g (x_B + \Delta x_B) \sin\theta$$

$3V_A + V_B = 0,$

$$W_F = - \mu_K m g d \cos\theta$$

$$(U_{1-2})_F + T_1 + V_1 = T_2 + V_2$$

$$-\mu m_B g d\cos\theta + 0 - m_A g \cancel{x_A} \sin\theta$$
$$- m_B g \cancel{x_B} \sin\theta$$
$$= \frac{1}{2} m_A V_A^2 + \frac{1}{2} m_B V_B^2 - m_A g (\cancel{x_A} + \Delta x_A) \sin\theta$$
$$- m_B g (\cancel{x_B} + \Delta x_B) \sin\theta$$

$$\Rightarrow -\mu m g d\cos\theta = \frac{1}{2} m_A V_A^2 + \frac{1}{2} m_B V_B^2$$
$$- m_A g \Delta x_A \sin\theta$$
$$- m_B g \Delta x_B \sin\theta$$

$$\Delta x_A = d/4 \quad , \quad \Delta x_B = -3d/4$$

$$3 V_A + V_B = 0$$

$$\Rightarrow -\mu m_B g d\cos\theta = \frac{1}{2} m_A V_A^2 + \frac{1}{2} m_B V_B^2$$
$$- \frac{m_A g d}{4} \sin\theta + \frac{3d}{4} m_B g \sin\theta$$

$$-\mu m_B g d \cos\theta = \frac{1}{2} m_A V_A^2 + \frac{1}{2} m_B V_B^2 - \frac{m_A g d \sin\theta}{4} + \frac{3 m_B g d \sin\theta}{4}$$

$3V_A + V_B = 0$

$V_B = -3V_A$

$$\frac{1}{2} m_A V_A^2 + \frac{1}{2} m_B V_B^2 = \frac{(m_A - 3m_B)}{4} g d \sin\theta - \mu m_B g d \cos\theta$$

$$\frac{1}{2}(m_A + 9m_B) V_A^2 = \left(\frac{m_A - 3m_B}{4}\right) g d \sin\theta - \mu m_B g d \cos\theta$$

$$V_A = \sqrt{\frac{(m_A - 3m_B) g d \sin\theta - 4\mu m_B g d \cos\theta}{2(m_A + 9m_B)}}$$