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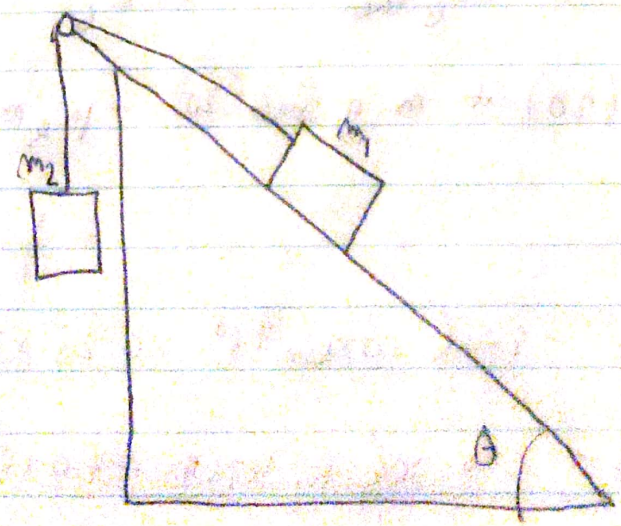
03/23/2021

LAB QUIZ #6

The diagram below represents a system consisting of two masses: $m_1 = 20$ kg and $m_2 = 40$ kg, one of them on an incline and the other one hanging. The pulley is massless and frictionless and the cords joining the masses are ideal. The angle of the incline is $\theta = 39°$. The coefficient of kinematic friction is $\mu_k = 0.25$ and we know the system starts to move from rest.

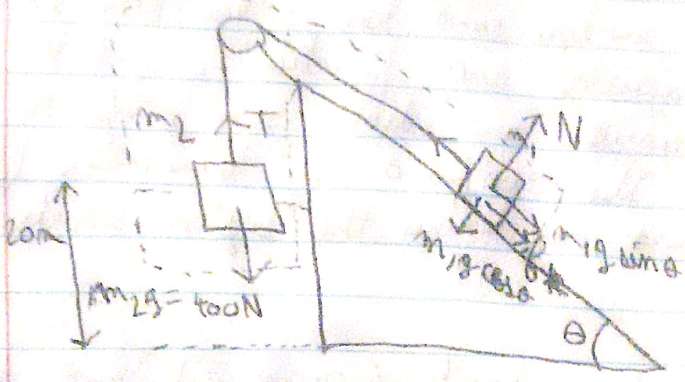
(a) Find the system's velocity (magnitude and direction) after moving 20 m along the incline. Solve the problem using the Energy approach.

(b) After moving those 20 m along the incline, m_1 reaches the top of the ramp. If, at that instant the string and pulley are somehow removed, m_1 will start a projectile motion. If the height of the ramp is 50 m, determine the range of m_1 in the projectile motion.



Ans:- Given:- $m_1 = 20\,kg$, $m_2 = 40\,kg$, $\theta = 35°$, $\mu_k = 0.25$

Initial speed = 0 m/s



$N = m_1 g \cos\theta$

$f_k = \mu_k m_1 g \cos\theta$

$g = 10\,m/s^2$

Direction of velocity for m_2 is downwards & for m_1 is up the incline.

(a) Displacement along incline = 20m

Using work energy theorem, we get:-

$W_{all} = \Delta K$

$W_{gravity} + W_{friction} = K.E_f - K.E_i$

$\Rightarrow m_2 g(20) + m_1 g \sin\theta(20) - \mu_k m_1 g \cos\theta(20) = \frac{1}{2}(m_1 + m_2)v^2$

$\Rightarrow 400 \times 20 - 200(20 \times \sin 35° + 0.25 \times 20 \times \cos 35°) = 30v^2$

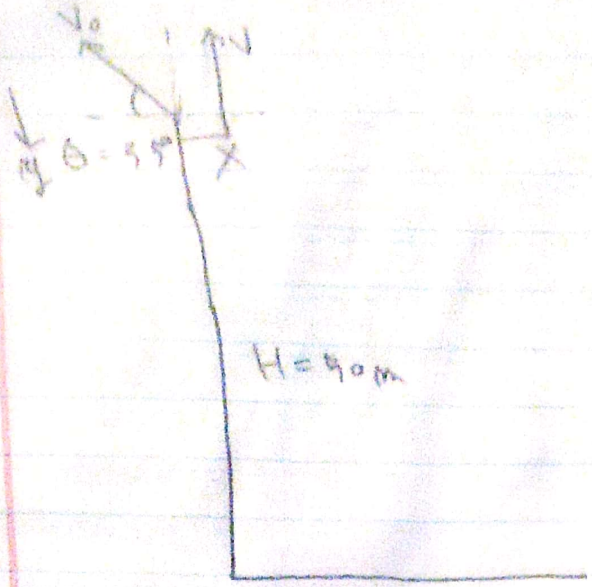
$\Rightarrow 8000 - 200 \times (11.4715 + 4.0957) = 30v^2$

$v_0 = 12.76\,m/s$

(2)

P.T.O.

(b)



Along Y axis,

-90 = displacement

Initial speed = $V_0 \sin 35°$

acceleration = $-10\ m/s^2$

Let time taken be t.

$$\therefore \quad S_y = u_y t + \frac{1}{2} a_y t^2$$

$$\Rightarrow \quad -90 = 7.318t - 5t^2$$

$$\Rightarrow \quad 5t^2 - 7.318t - 90 = 0$$

$$\therefore \quad t = 3.98s$$

Range = $u_0 \times t$

$= V_0 \cos 35° \times 3.98$

$= 41.60\ m$