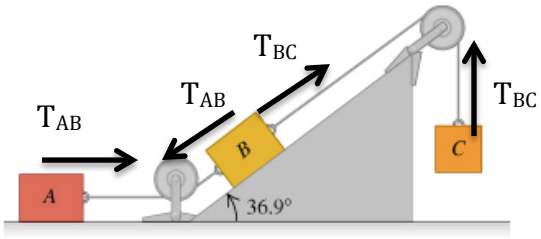
PHYS 1211, QUIZ 6, November 6, 2017

Below **Box A**, $M_A = 2$ kg, is on a floor with **kinetic friction coefficient**, $\mu_k = 0.15$, and **static coefficient of friction**, $\mu_s = 0.25$. **Box A** is connect to a frictionless pulley system to **Box B**, $M_B = 3$ kg, resting on a 36.9°, with **no friction**. **Box B**, is connected by a frictionless pulley system, to **Box C**, $M_C = 10$ kg, as shown.



A) If Box C **moves down** a distance of 0.5 m. Calculate the **total work done** by Gravity on Box A, B, and C.

$W_g = -mg\Delta y$, where Δy is the change in height. **Box A**, $\Delta y_A = 0, W_{g,A} = 0$. (**1 point**)

Box B, $\Delta y_B = 0.5m \times \sin 36.9^\circ = 0.3m$,

$W_{g,B} = -M_B g \Delta y_B = -8.82J$. (**1 point**)

Box C, $\Delta y_C = -0.5m$, $W_{g,C} = -M_C g \Delta y_C = 49J$. (**1 point**)

Total, $W_g = W_{g,A} + W_{g,B} + W_{g,C} = 40.18J$. (**1 point**)

B) Calculate the **total work done** by **friction** after **Box C moves down** 0.5m.

Only **Box A** is affected by friction, $f_k = M_A g \mu_k = 2.94N$, $W_f = -f_k(0.5m) = -1.47J$.

(**2 points**)

C) Calculate the **work done** by the **rope** connecting **Box B** and **C** on the **system**, after **Box C moves down** 0.5m.

In diagram, **Box C** moves **down** 0.5m in **opposite direction** of **tension**, T_{BC}, so work done is $-(0.5\text{m})T_{BC}$, which **Box B** moves **up incline** in **same direction** of **tension**, T_{BC}, so work done is $+(0.5\text{m})T_{BC}$, so total work is $-(0.5\text{m})T_{BC} + (0.5\text{m})T_{BC} = 0$. (**1 point**)

D) Calculate the **work done** by the rope connecting **Box A** and **B** on the **system**, after **Box C moves down** 0.5m.

In diagram, **Box A** moves **right** 0.5m in **opposite direction** of **tension**, T_{AB}, so work done is $+(0.5\text{m})T_{AB}$, which **Box B** moves **up incline** in **same opposite** of **tension**, T_{AB}, so work done is $-(0.5\text{m})T_{BC}$, so total work is $(0.5\text{m})T_{AB} - (0.5\text{m})T_{AB} = 0$. (**1 point**)

E) Assume **Box A** is initially **moving right** at 2 m/s. Use the **work-energy theorem** to calculate the **speed** of **Box A**, after **Box C** has **fallen** 0.5 m.

Work Final Kinetic energy Initial Kinetic Energy, $v_i = 2$ m/s

$$W_g + W_f = \Delta K = \left(\frac{1}{2}M_A v_f^2 + \frac{1}{2}M_B v_f^2 + \frac{1}{2}M_C v_f^2\right) - \left(\frac{1}{2}M_A v_i^2 + \frac{1}{2}M_B v_i^2 + \frac{1}{2}M_C v_i^2\right)$$

$$38.71J = \frac{1}{2}\left(M_A + M_B + M_C\right)v_f^2 - 30J,\ M_A + M_B + M_C = 15kg,\ v_f = 3m/s.$$ (**4 points**)

Students can get **12** out of **10**.