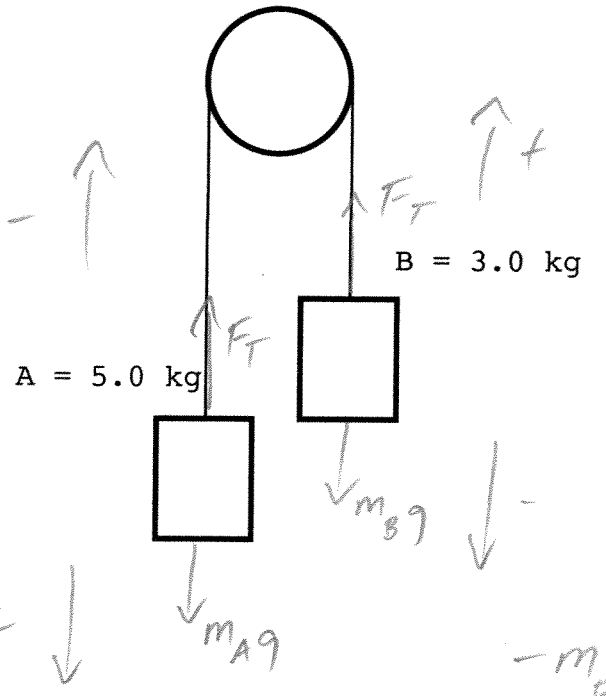
Physics 10154 - Exam #2d

Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct units and significant figures.

1. (30 pts) The system shown below is released from rest. What is (a) the tension in the rope connecting the two masses and (b) the magnitude and direction of the acceleration of mass A?



$\Sigma F_y(m_A) = m_A g - F_T = m_A a$

$\Sigma F_y(m_B) = -m_B g + F_T = m_B a$

$F_T = m_A g - m_A a$

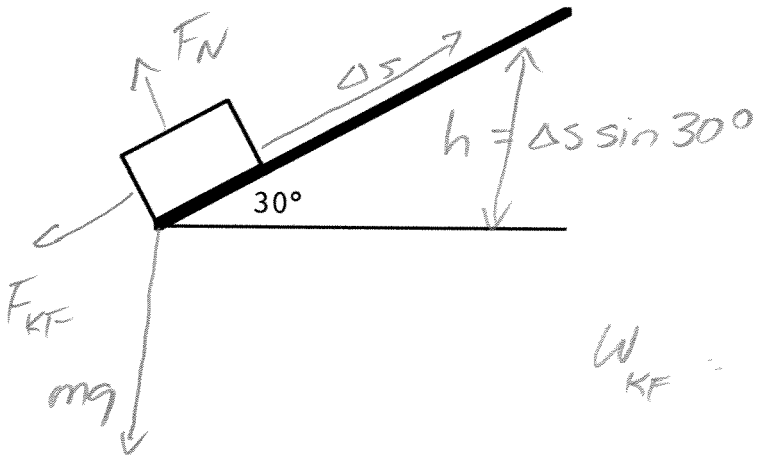
$-m_B g + (m_A g - m_A a) = m_B a$

$m_A g - m_B g = (m_A + m_B) a$

$a = \frac{49.0 - 29.4}{8} = \boxed{2.5\ m/s^2,\ \text{down}}$

$F_T = (5)(9.8) - (5)(2.45) = \boxed{37\ N}$

2. (30 pts) A block of unknown mass has an initial velocity of 7.0 m/s up a ramp inclined 30° above the horizontal. The coefficient of kinetic friction between the block and the ramp is 0.15. How far (in meters) along the ramp does the block move before coming to a stop?



$W_N = 0$

$W_{grav} = -mgh$

$= -mg\Delta s \sin 30°$

$W_{KF} = \mu_K F_N \Delta s \cos 180°$

$= -\mu_K (mg \cos 30°)\Delta s$

$\Sigma W_F = 0 - mg\Delta s \sin 30° - \mu_K mg \cos 30° \Delta s = 0 - \frac{1}{2}mv_0^2$

$-(9.8)\Delta s \sin 30° - (0.15)(9.8)\cos 30° \Delta s = -\frac{1}{2}(7)^2$

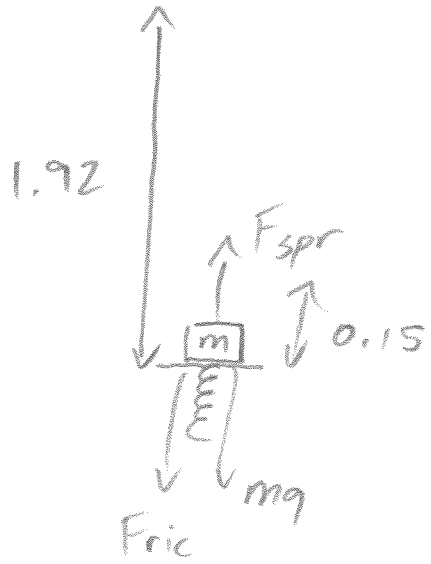
$-4.90\Delta s - 1.27\Delta s = -24.5$

$-6.17\Delta s = -24.5$

$\boxed{\Delta s = 4.0\ m}$

3. (40 pts) A 5.00 kg mass is on a vertical spring compressed by 15.0 cm (by some outside force that releases the system from rest initially) with spring constant k = 9250 N/m. After the system is released, the mass is launched and reaches a maximum height of 1.92 m above its initial position on the spring (so the height includes the 15.0 cm displacement on the spring).

How much work does the frictional force do during this motion?



$W_{spr} = \frac{1}{2}kx^2$

$W_{grav} = -mgh$

$W_{Fric} = ?$

$v = 0$

$v_0 = 0$

so $\Delta K = 0$

$\Sigma W_F = \frac{1}{2}kx^2 - mgh + W_{Fric} = \Delta K$

$\frac{1}{2}(9250)(0.15)^2 - (5)(9.8)(1.92) + W_{Fric} = 0$

$104.06 - 94.08 + W_{Fric} = 0$

$$\boxed{W_{Fric} = -9.98\ J}$$