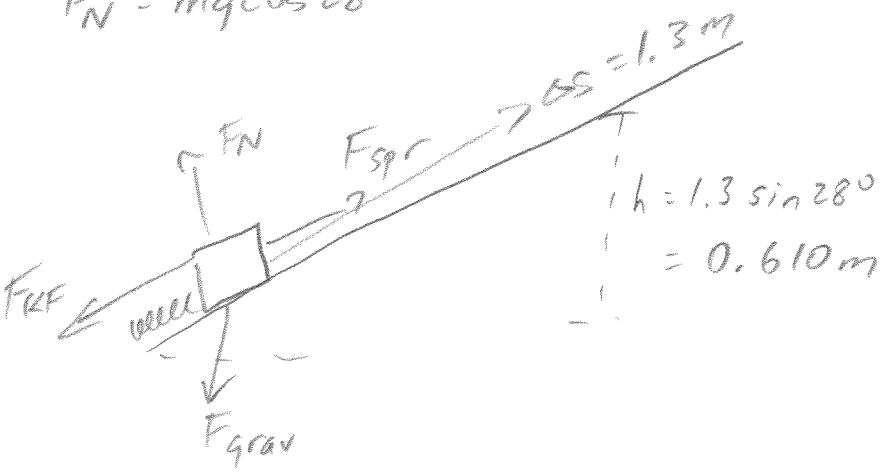
Physics 10154 - Exam #2c

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.

(30 pts) A 7.5 kg mass is initially at rest at the bottom of a rough surface inclined 28° above the horizontal. The mass is compressing a spring (k = 940 N/m) that is oriented parallel to the inclined surface. The mass compresses the spring by 41 cm initially and is released from rest. The mass slides 1.3 meters up the ramp before coming to a stop.

What is the coefficient of kinetic friction between the mass and the ramp?

$F_N = mg\cos 28°$



$\Sigma W_F = W_N = 0$

$+ W_g = -mgh$

$+ W_{KF} = -\mu_K (mg\cos 28°)\Delta s$

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

$K_f \quad K_i$

$\downarrow \quad \downarrow$

$-mgh - \mu_K (mg\cos 28°)\Delta s + \frac{1}{2}kx^2 = 0 - 0$

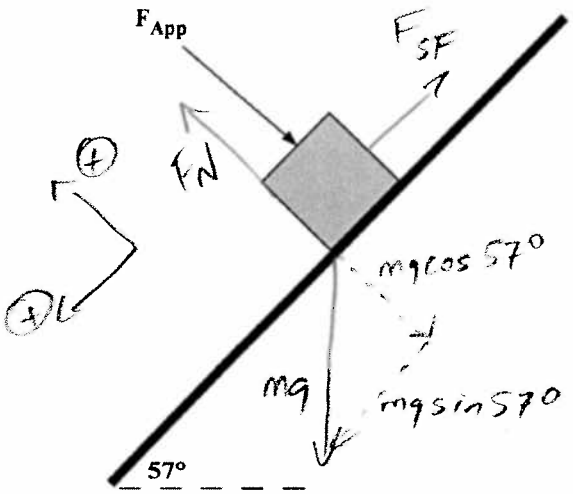
$-44.835 - 84.37\mu_K + 79.01 = 0$

$-84.37\mu_K = -34.172$

$\mu_K = 0.41$

B

2. (30 pts) A 27-kg mass is at rest on a 57° inclined plane. The coefficient of static friction between the mass and the plane is 0.52. A force is applied perpendicular to the ramp as shown below. What minimum force is necessary in order to prevent the book from sliding down the ramp?



Since m is on verge of moving, we can say

$F_{SF} = F_{SF,MAX} = \mu_S F_N$

$\Sigma F_{\parallel} = mg\sin 57° - \mu_S F_N = 0$

$\Sigma F_{\perp} = F_N - F_{App} - mg\cos 57° = 0$

$(27)(9.8)\sin 57° - 0.52 F_N = 0$

$221.9 - 0.52 F_N = 0$

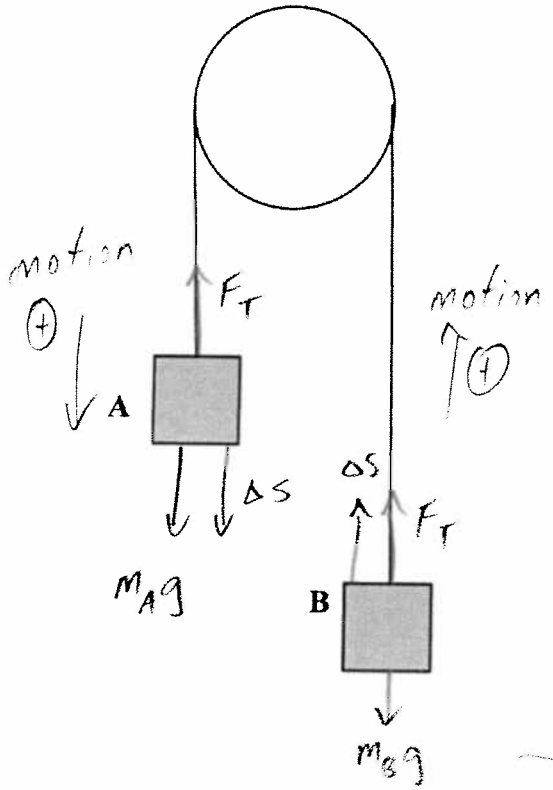
$F_N = 426.75\ N$

$426.75 - F_{App} - (27)(9.8)\cos 57° = 0$

$F_{App} = 426.75 - 144.11$

$= 280\ N$

3. (35 pts) For the vertical pulley system shown below, mass A (3.20 kg) is 85.0 cm above the floor. Mass B is 2.50 kg. Both masses are initially at rest. How many seconds elapse before mass A hits the floor?



Ch 4 method

m_A: $\Sigma F_y = m_A g - F_T = m_A a$

m_B: $\Sigma F_y = F_T - m_B g = m_B a$

$F_T = m_B a + m_B g$

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

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

$(3.2)(9.8) - (2.5)(9.8) = 5.7a$

$a = 1.20\ m/s^2$

$\Delta s = 0.85\ m$

$v_0 = 0$

$\Delta s = v_0 t + \frac{1}{2} a t^2$

$0.85 = 0 + \frac{1}{2}(1.20) t^2$

$t = 1.20\ s$

Ch 5 method

$\Sigma W_F = W(m_A g) = m_A g \Delta s$

$+W(F_T \text{ on } m_A) = -F_T \Delta s$

$+W(F_T \text{ on } m_B) = +F_T \Delta s$

$+W(m_B g) = -m_B g \Delta s$

$m_A g \Delta s - m_B g \Delta s = \frac{1}{2}(m_A + m_B) v^2 - 0$

$(3.2)(9.8)(.85) - (2.5)(9.8)(.85) = \frac{1}{2}(5.7) v^2$

$5.831 = 2.85 v^2$

$v = 1.43\ m/s$

$v_0 = 0$

$\Delta s = 0.85$

$\Delta s = \frac{1}{2}(v + v_0) t$

$0.85 = \frac{1}{2}(1.43) t \Rightarrow t = 1.20\ s$