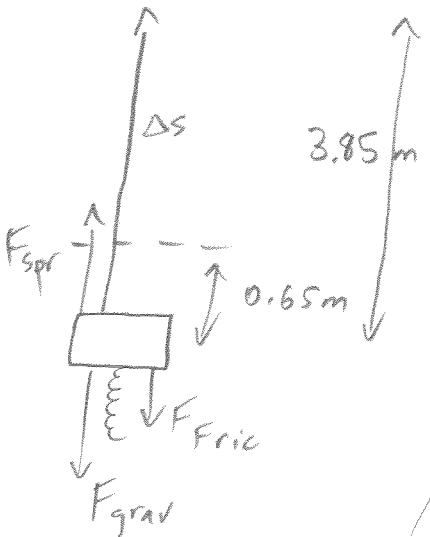
Physics 10154 - Exam #2b

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. (35 pts) A 3.50-kg mass is placed on a vertical spring (k = 765 N/m) the is compressed by 65.0 cm. The system is released from rest, and the spring launched the mass upward to a maximum height of 3.85 meters above the initial position of the mass. How much work was done by frictional forces during this motion?



$$\Sigma W_F = W_{grav} = -mg\Delta s$$

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

$$+W_{Fric} = ?$$

$$-mg\Delta s + \frac{1}{2}kx^2 + W_{Fric} = \Delta K$$

$\Delta K = 0$ since $v = v_0 = 0$

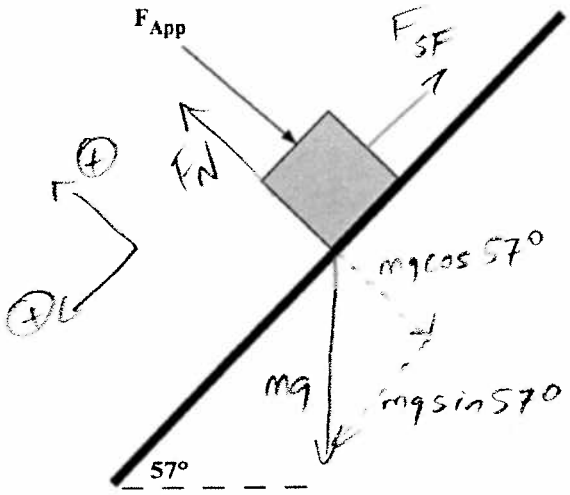
$$-(3.50)(9.8)(3.85) + \frac{1}{2}(765)(.65)^2 + W_{Fric} = 0$$

$$-132.1 + 161.6 + W_{Fric} = 0$$

$$\boxed{W_{Fric} = -29.6\ J}$$

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

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

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

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

$(27)(9.8)\sin 57° - 0.52 F_N = 0$

$221.9 - 0.52 F_N = 0$

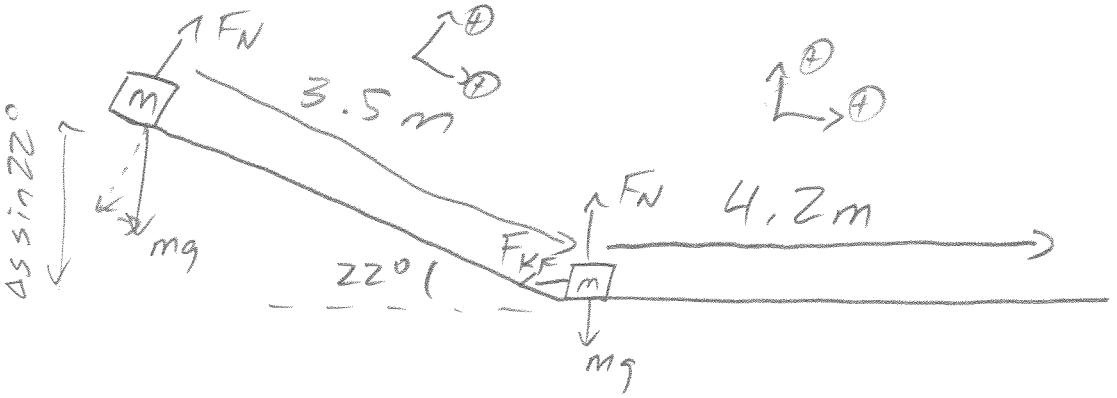
$F_N = 426.75\ N$

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

$F_{App} = 426.75 - 144.11$

$= 280\ N$

3. (35 pts) A puck of unknown mass slides down a frictionless 3.5-meter long ramp inclined 22° above the horizontal. Upon reaching the bottom of the ramp, the puck slides across a rough horizontal surface for 4.2 meters before coming to a stop. What is the coefficient of kinetic friction between the puck and the rough horizontal surface?



Forces:

Part 1 $\Sigma F_{\parallel} = mg\sin 22° = ma_1 \Rightarrow a_1 = 3.67\ m/s^2$

$v^2 = v_0^2 + 2a\Delta s$

$v^2 = 0 + 2(3.67)(3.5) \Rightarrow v = 5.07\ m/s$

Part 2: $\Sigma F_x = -\mu_K m g = m a_2$

$\mu_K = -\frac{a_2}{g}$

$\Delta s_2 = 4.2$ $\quad v^2 = v_0^2 + 2a_2\Delta s_2$

$v_0 = 5.07$

$v = 0$

$0 = (5.07)^2 + 2a_2(4.2) \Rightarrow a_2 = -3.06$

$\mu_K = -\frac{-3.06}{9.8} = 0.31$

Work-Energy:

$\Sigma W_F = W(F_{grav}\ part\ 1) = +mg\Delta s \sin 22°$

$+ W(F_N\ part\ 1) = 0$

$+ W(F_{grav}\ part\ 2) = 0$

$+ W(F_N\ part\ 2) = 0$

$+ W(F_{KF}\ part\ 2) = -\mu_K mg\Delta s$

$\Delta s_1 \sin 22° - \mu_K \Delta s_2 = 0$

$\mu_K = \frac{3.5\sin 22°}{4.2}$

$= 0.31$

$m g \Delta s_1 \sin 22° - \mu_K m g \Delta s_2 = 0$