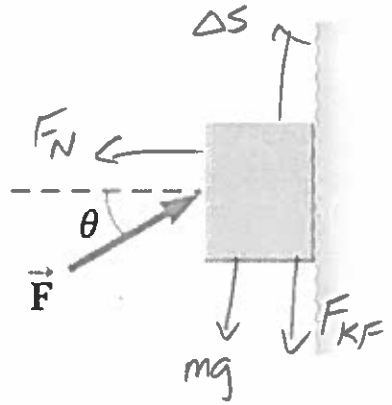
Physics 10154 - Exam #2D

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 7.87 kg block is sliding up or down a vertical wall. The coefficient of kinetic friction is 0.250. In both cases, an applied force pushes on the block, making an angle of 33° above the horizontal as shown below.

a) For case 1, the block slides up the wall with a constant velocity of 3.50 m/s. What is the magnitude of the applied force?

b) For case 2, the block slides DOWN the wall with a constant velocity of 3.50 m/s. What is the magnitude of the applied force?



$$\Sigma F_x = F_{App}\cos 33^\circ - F_N = 0$$

$$\Sigma F_y = F_{App}\sin 33^\circ - mg - \mu_k F_N = 0$$

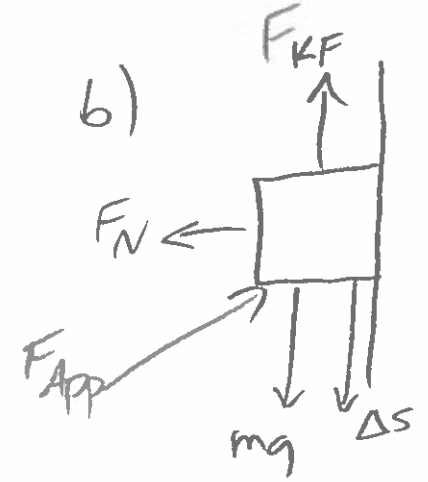
$$F_{App}\sin 33^\circ = mg + \mu_k F_{App}\cos 33^\circ$$

$$F_{App}(\sin 33^\circ - \mu_k \cos 33^\circ) = mg$$

$$F_{App}(0.335) = (7.87)(9.8)$$

$$\boxed{F_{App} = 230\ N}$$

b)



ΣF_x same

$$\Sigma F_y = F_{App}\sin 33^\circ - mg + \mu_k F_{App}\cos 33^\circ = 0$$

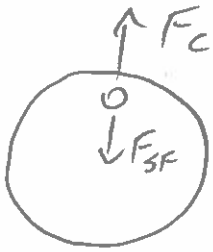
$$F_{App}(\sin 33^\circ + \mu_k \cos 33^\circ) = mg$$

$$F_{App}(0.755) = (7.87)(9.8)$$

$$\boxed{F_{App} = 102\ N}$$

2. (30 pts) A penny is placed at the outer edge of a disk of radius 12.4 cm. The disk rotates about an axis perpendicular to the planet of the disk at its center. The period of motion is 1.15 seconds. What is the minimum coefficient of static friction necessary in order for the penny to rotate along with the disk without slipping?

$$V = \frac{2\pi r}{T} = \frac{2\pi(.124)}{1.15} = 0.6775\ m/s$$



$$\Sigma F_{rad} = \frac{mv^2}{r} - F_{SF} = 0$$

threshold problem $\Rightarrow F_{SF} = \mu_s F_N$

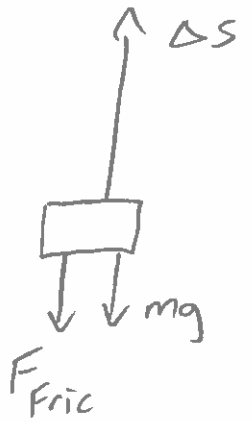
$$\frac{mv^2}{r} - \mu_s mg = 0$$

$$\frac{v^2}{r} = \mu_s g$$

$$\mu_s = \frac{v^2}{rg} = \boxed{0.378}$$

3. (35 pts) A 1.50-kg object is launched vertically upward with an initial speed of 28.4 m/s. Due to air resistance, the object doesn't rise to quite the same maximum height as it would if we were dealing with an ideal problem. Instead, the object rises to a maximum height of 38.9 meters. (a) How much work is done by the resistive force during this motion? (b) What is the magnitude of the average resistive force on the object?

a)



$$\Sigma W_F = W_{grav} + W_{Fric} = \Delta K$$

$$W_{grav} = -mg\Delta s = -571.83$$

$$W_{Fric} = ?$$

$$\Delta K = 0 - \tfrac{1}{2}mv_0^2 = -604.92$$

$$-571.83 + W_{Fric} = -604.92$$

$$\boxed{W_{Fric} = -33.1\ J}$$

b) $W_{Fric} = |F_{Fric}| \cdot \Delta s \cdot (\cos 180^\circ)$

$$-33.1 = -F_{Fric}(38.9)$$

$$\boxed{F_{Fric} = 0.851\ N}$$