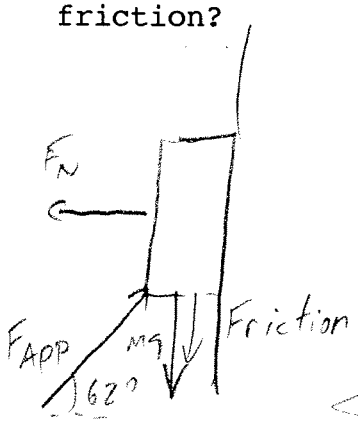
Physics 10154 - Exam #2d

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. (40 pts) A 12-kg block is held at rest against a vertical wall by an applied force of 240 Newtons directed 62° above the horizontal. The coefficient of static friction between the book and the wall is 0.75. The coefficient of kinetic friction is 0.55.

Does the book move?
If yes, what is the magnitude and direction of the acceleration?
If no, what is the magnitude and direction of the force of static friction?



$\Sigma F_\perp = F_N - F_{App}\cos 62° = 0$

$F_N = 240\cos 62° = 112.7\,N$

$F_{SF,MAX} = \mu_S F_N = 84.5\,N$

Set $a = 0$, find F_{SF}

Since $F_{App}\sin 62 > mg$, friction points down, opposing net force.

$\Sigma F_{||} = F_{App}\sin 62° - mg - F_{SF} = 0$

$F_{SF} = -mg + F_{App}\sin 62°$

$= -(12)(9.8) + (240)\sin 62° = 94.3$

Since $F_{SF} > F_{SF,MAX}$, block moves, so find a

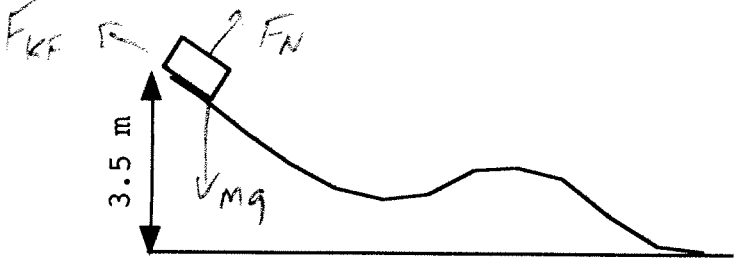
$\Sigma F_{||} = F_{App}\sin 62 - mg - \mu_K F_N = ma$

$240\sin 62 - (12)(9.8) - (.55)(112.7) = 12a$

$32.32 = 12a$

$a = 2.7\ m/s^2$, up

2. (30 pts) Starting from rest, a 55-kg block slides down a curved track as shown below. When it reaches the bottom, it has a speed of 6.5 m/s. How much work is done by friction during the block's motion?



$W_N = 0$

$W_{grav} = mgh = 1886.5$

$W_{KF} = ?$

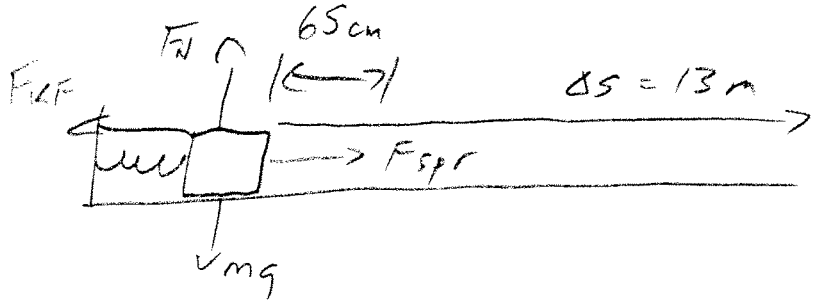
$$0 + 1886.5 + W_{KF} = \frac{1}{2}mv^2 - 0$$

$$1886.5 + W_{KF} = \frac{1}{2}(55)(6.5)^2$$

$$1886.5 + W_{KF} = 1161.9$$

$$\boxed{W_{KF} = -720\ J}$$

3. (30 pts) A 2.5-kg mass is at rest on a rough, horizontal surface, compressing a horizontal spring (k = 220 N/m) by 65 cm. After the mass is released, it slides 13 meters (this distance includes the 65 cm while touching the spring) before coming to rest. What is the coefficient of kinetic friction between the mass and the surface?



$W_N = 0$

$W_{grav} = 0$

$W_{spr} = \frac{1}{2}kx^2 = \frac{1}{2}(220)(.65)^2 = 46.475$

$W_{kf} = -\mu_k F_N \Delta s = -\mu_k mg\, \Delta s$

$= -\mu_k (25)(9.8)(13)$

$= -318.5\,\mu_k$

$0 + 0 + 46.475 - 318.5\,\mu_k = \frac{1}{2}mv^2 - \frac{1}{2}mv_0^2$

$46.475 = 318.5\,\mu_k$

$\mu_k = 0.146$ or $\boxed{0.15}$