# Physics 10154 - Exam #2d

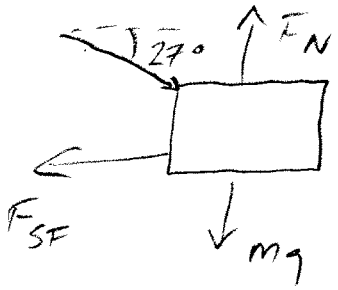
Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct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

1. (40 pts) A 22-kg crate is at rest on a rough surface. An applied force of 320 Newtons pushes on the crate at an angle of 27° below the horizontal. The coefficient of kinetic friction between the crate and the surface is 0.40. The coefficient of static friction is 0.60.

Does the box move?

If yes, what is its acceleration?

If no, what is the force of static friction acting on the box?




$F_{App} = 320$

$\Sigma F_\perp = F_N - mg - F_{App} \sin 27$

$F_N = mg + 320 \sin 27°$

$= 361\ N$

$F_{SF,MAX} = \mu_s F_N = 216.5\ N$

$\Sigma F_{||} = F_{App} \cos 27° - F_{SF} = 0$

$F_{SF} = 320 \cos 27° = 285$, so it moves

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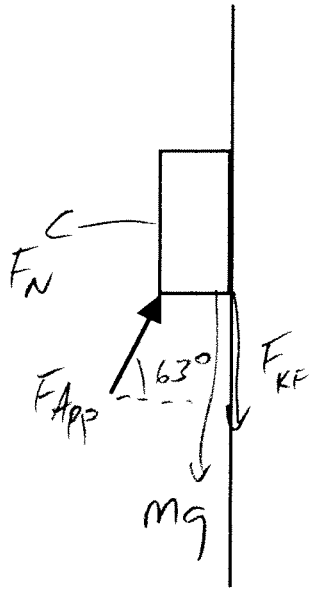
$\Sigma F_{||} = F_{App} \cos 27 - \mu_k (361) = ma$

$285 - 144.4 = 22a$

$a = 6.4\ m/s^2$

2. (30 pts) A 5.0 kg block is sliding up a vertical wall as shown below, being pushed by an applied force of 130 Newtons directed 63° above the horizontal. The coefficient of kinetic friction between the block and the wall is 0.22. If the block begins at rest, how fast is it moving after it has moved 1.7 meters up the wall?




$$\Sigma F_\perp = F_N - F_{App}\cos 63^\circ = 0$$

$$F_N = 130\cos 63^\circ = 59\ N$$

$$\Sigma F_\parallel = F_{App}\sin 63 - mg - \mu_k F_N = ma$$

$$115.8 - 49 - 13 = 5a$$

$$a = 10.8\ m/s^2$$

$$v^2 = 0^2 + 2(10.8)(1.7)$$

$$v = 6.0\ m/s$$

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or $\Sigma W_F = W_N + W_{App} + W_{grav} + W_{KF} = \frac{1}{2}mv^2 - 0$

$W_N = 0$

$W_{App} = F_{App}\,\Delta s\cos 27^\circ = 197$

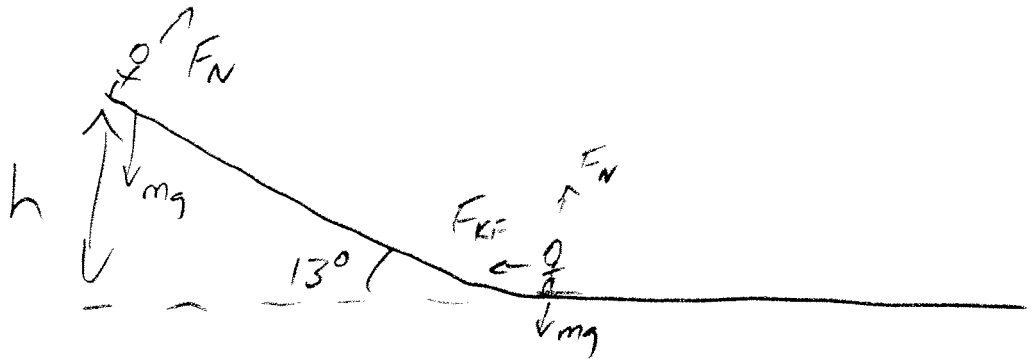
$W_{grav} = -mgh = -83.3$

$W_{KF} = -\mu_k(59)\,\Delta s = -22$

$$197 - 83.3 - 22 = 2.5v^2$$

$$\boxed{v = 6.0\ m/s}$$

3. (30 pts) A skier starts from rest at the top of a hill that is inclined 13° with respect to the horizontal. The hillside is 86 meters long and frictionless. At the bottom of the hill, the snow is level and the coefficient of kinetic friction between the snow and the skis is 0.077. How far does the skier glide along the horizontal portion of the snow before coming to rest?




$$h = 86 \sin 13 = 19.3$$

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

$$W_{grav} = mgh = 189.6m$$

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

$$= -0.7546 m \Delta s$$

$$\Delta K = 0 - 0$$

$$189.6 - .7546 \Delta s = 0 \quad (m\text{'s cancel})$$

$$\boxed{\Delta s = 250 m}$$