# Physics 10154 - Exam #2a

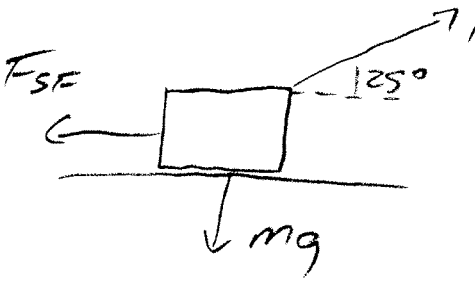
Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct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

1. (40 pts) A 55-kg crate is at rest on a rough surface. An applied force of 220 Newtons pulls on the crate at an angle of 25° above 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?




$$F_N = mg - F_{App}\sin 25°$$
$$= 539 - 93 = \underline{446\ N}$$

$$F_{SF,MAX} = \mu_S F_N = 268\ N$$

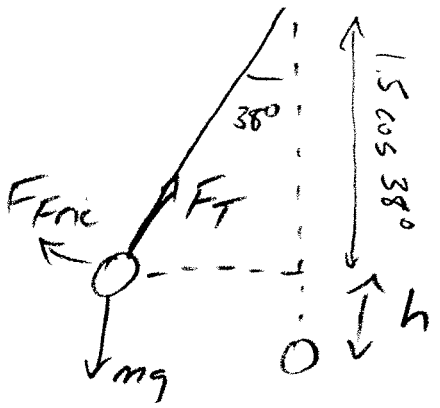
$$\Sigma F_{\parallel} = F_{App}\cos 25° - F_{SF} = 0$$

$$F_{SF} = 220\cos 25° = 199\ N$$

Since $F_{SF} < F_{SF,MAX}$
$199 < 268$

Crate does not move and $F_{SF} = 199\ N$ or $\underline{200\ N}$

2. (30 pts) A 7.5 kg pendulum bob is initially held at rest at an angle of 38° with respect to the vertical. The pendulum string is 1.5 meters long. If 2.4 Joules of energy is lost due to frictional forces as the pendulum bob makes its initial descent, what is the speed of the pendulum bob as it passes through its minimum?




$$h = 1.5 - 1.5 \cos 38^\circ$$

$$= 0.318 \text{ m}$$

$$\Sigma W_F = W_{grav} + W_T + W_{Fric} = \tfrac{1}{2}mv^2 - 0$$

$$mgh + 0 - 2.4 = \tfrac{1}{2}mv^2$$

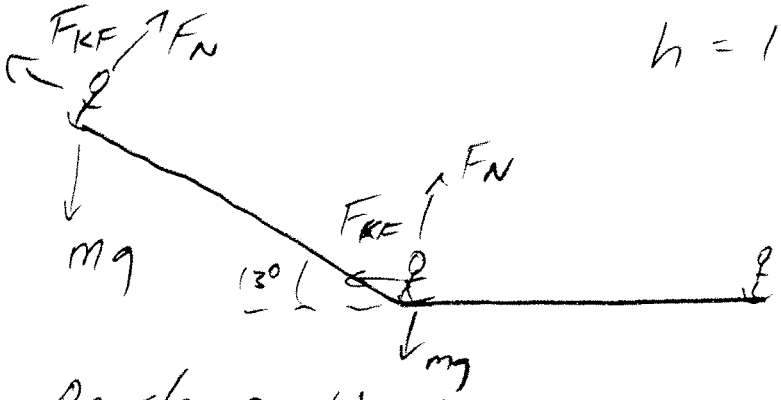
$$(7.5)(9.8)(0.318) - 2.4 = 3.75v^2$$

$$23.4 - 2.4 = 3.75v^2$$

$$v^2 = 5.59$$

$$\boxed{v = 2.4 \text{ m/s}}$$

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 150 meters long, and the coefficient of kinetic friction between the skies and the snow is 0.085. At the bottom of the hill, the snow is level and the coefficient of kinetic friction is still the same. How far does the skier glide along the horizontal portion of the snow before coming to rest?




$h = 150 \sin 13 = 33.7$

At base of slope

$\Sigma W_F = 208_m = \frac{1}{2} m v^2$

$v = 20.4\ m/s$

On slope, $W_N = 0$

$W(grav) = mgh$ or $mg\Delta s \cos 77°$

$= m(9.8)(33.7)$ or $m(9.8)(150)\cos 77°$

$= 330m$

$W(KF) = \mu_k F_N \Delta s \cos 180°$

$= -\mu_k mg \cos 13\, \Delta s = -122m$

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On level ground,

$W(grav) = W(N) = 0$

$W(KF) = \mu_k F_N \Delta s \cos 180$

$= -\mu_k mg \Delta s = -0.833m\Delta s$

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$\Sigma W_F = 330m - 122m - 0.833m\Delta s = 0 - 0$

$= 208 - .833\Delta s = 0$

$\Delta s = \frac{208}{.833} = \boxed{250\ m}$