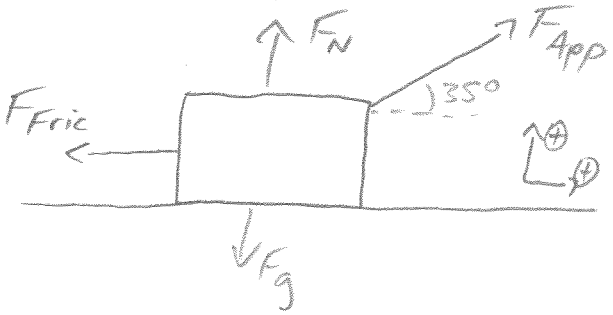
# Physics 10154 - Exam #2a

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. (35 pts) A 45 kg crate is initially at rest on a rough surface. A person tries to pull the crate with an applied force of 270 Newtons directed 35° above the horizontal. The coefficient of static friction between the crate and surface is 0.62. Coefficient of kinetic friction is 0.42.

Does the crate move? If no, what is the force of static friction acting on the crate? If yes, what is the acceleration of the crate?




$\Sigma F_y = F_N + F_{App}\sin 35° - F_g = 0$

$F_N = F_g - F_{App}\sin 35°$

$= (45)(9.8) - (270)\sin 35°$

$F_N = 286.1\ N$

$F_{SF,MAX} = \mu_S F_N = (0.62)(286.1) = 177.4\ N$

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

$\Sigma F_{\parallel} = F_{App}\cos 35° - F_{SF} = 0$

$F_{SF} = 270\cos 35° = 221.2\ N$

Since $F_{SF}(221.2) > F_{SF,MAX}(177.4)$, object moves.

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Assume $a = ?$, kinetic friction...

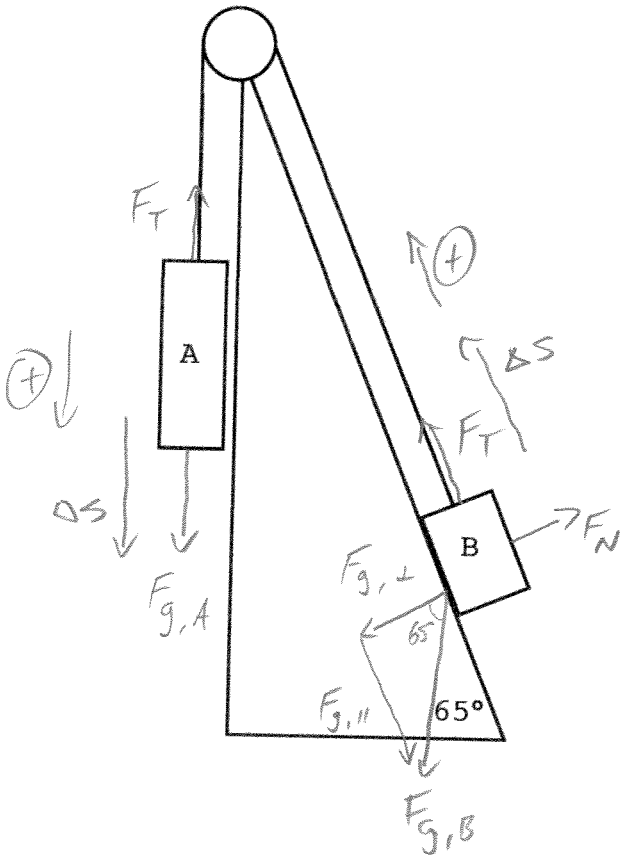
$\Sigma F_{\parallel} = F_{App}\cos 35° - F_{KF} = ma$

$(270)\cos 35° - (.42)(286.1) = 45a$

$221.2 - 120.2 = 45a$

$a = 2.2\ m/s^2$

2. (35 pts) Block A has a mass of 7.5 kg. Block B has a mass of 5.5 kg. The two blocks are connected by a pulley while block B is initially at rest on a 65° frictionless incline. After block B moves a distance of 1.5 meters up the incline, what is its speed?




## Ch 4 Method:

$A: \Sigma F_y: \quad F_{g,A} - F_T = m_A a$

$m_A g - F_T = m_A a \qquad I.$

$B: \Sigma F_\parallel: \quad F_T - F_{g,\parallel} = m_B a$

$F_T - m_B g \sin 65° = m_B a \qquad II.$

$I. \quad F_T = m_A g - m_A a$

$II. \quad m_A g - m_A a - m_B g \sin 65° = m_B a$

$m_A g - m_B g \sin 65° = (m_A + m_B) a$

$73.5 - 48.8 = 13 a$

$a = 1.896 \ m/s^2$

## Ch 5 method

$W_{grav,A} = m_A g \Delta s = 110.25$

$W_{T,A} = -F_T \Delta s$

$W_{T,B} = +F_T \Delta s$

$W_{N,B} = 0$

$W_{grav,B} = -mgh = -mg\Delta s \sin 65 = -73.3$

$\Sigma W_F = 110.25 - F_T \Delta s + F_T \Delta s - 73.3 = 36.98$

$36.98 = \frac{1}{2} m v^2 - 0$

$36.98 = \frac{1}{2}(7.5 + 5.5) v^2$

$5.688 = v^2$

$v = 2.4 \ m/s$

$\Delta s = 1.5$

$v_0 = 0$

$v = ?$

$a = 1.896$

$t = ?$

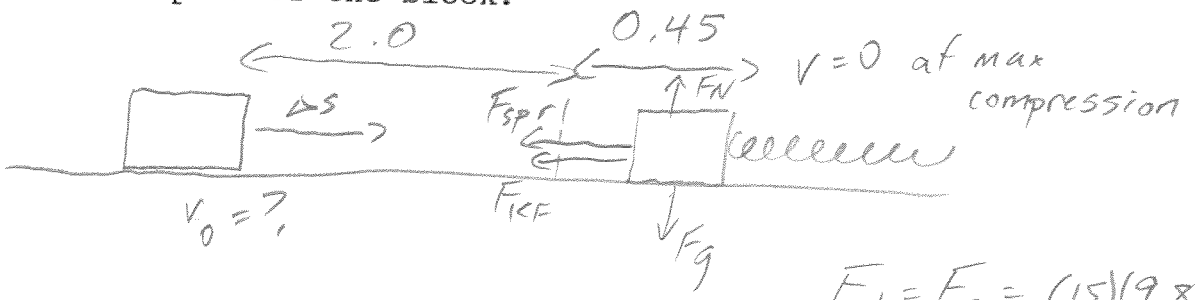
$v^2 = v_0^2 + 2a\Delta s$

$v^2 = 0 + 2(1.896)(1.5)$

$v^2 = 5.688$

$v = 2.4 \ m/s$

3. (30 pts) A 15 kg block has some unknown initial speed. The block slides 2.0 meters across a rough horizontal surface, then encounters a horizontally oriented spring. The block compresses the spring, travelling an additional 45 cm across the rough surface (for a grand total of 2.45 meters) before the spring reaches its maximum compression. The spring constant is 280 N/m, and the coefficient of kinetic friction between the block and the surface is 0.33. What was the initial speed of the block?




$F_N = F_g = (15)(9.8)$
$= 147\ N$

$W_N = 0$

$W_g = 0$

$W_{spr} = -\frac{1}{2}kx^2 = -\frac{1}{2}(280)(.45)^2 = -28.35\ J$

$W_{KF} = \mu_k F_N \Delta s \cos 180°$

$= -(.33)(147)(2.45) = -118.85\ J$

$W_N + W_g + W_{spr} + W_{KF} = 0 - \frac{1}{2}mv_0^2$

$-147.2 = -\frac{1}{2}(15)v_0^2$

$19.63 = v_0^2$

$v_0 = 4.4\ m/s$