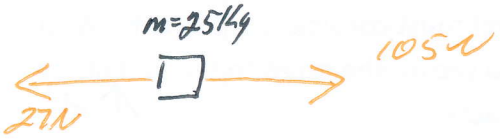
DYNAMICS

AT DYNAMICS (14)

Directions: Solve the following problems. Write all work. Be sure to include units with all values (even within the problem!!!). Circle your answer. Each problem is worth 3 points. You have 10 minutes to complete this quiz.

1. A 25kg mass is pulled to the right with a force of 105N. If the force of kinetic friction opposing this movement is 27N, what is the acceleration of the mass?



$\Sigma F_x = 105N - 27N = ma$

$\frac{105N - 27N}{25kg} = 3.12 m/s^2$

2. A pickup truck (1980kg) is driving down a side road at 25 mph (11.2 m/s). A wooden crate filled with construction parts with a mass of 158kg is strapped down to the wooden flatbed ($\mu_{s_{max}}$ = 0.48 and μ_k = 0.36). After driving a few blocks down the side road, the car in front of the truck abruptly stops for a hard to see stop sign. Given only moments to react, the driver of the pickup truck quickly slams on the brakes. The truck travels 50 meters and slows down considerably to only 8 mph (3.58 m/s) before hitting the car in front of it. Once the truck hits the car, the trunk of the car crumples 0.5 meters inward while at the same time, the hood of the truck crumples 0.5 meters backwards, essentially adding a meter to the stopping distance of the truck. When securing cargo to trucks, the truck driver must consider such events. With what tension must the cargo strap be pulling downward to secure the cargo to the bed of the truck to prevent it from sliding on the bed during this impact?

$a_1 = ?$

$v_0 = 11.2\ m/s$

$v = 3.58\ m/s$

$x = 50m$

$v^2 = v_0^2 + 2ax$

$\frac{v^2 - v_0^2}{2x} = a$

$\frac{(11.2\ m/s)^2 - (3.58\ m/s)^2}{(2)\,50m} = 1.13\ m/s^2$

$a_2 = ?$ (Same)

$x = 1m$

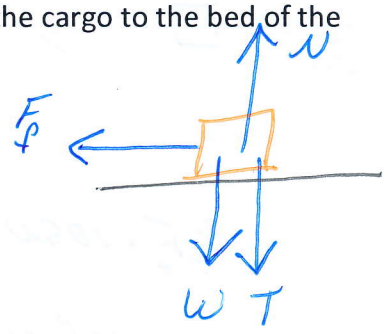
$v_0 = 3.58\ m/s$

$v = 0$

$\frac{v_0^2}{2x} = a = \frac{(3.58\ m/s)^2}{(2)(1m)}$

$a = 6.4\ m/s^2$

Use this accel. more likely to slide



$\Sigma F_x = F_f = ma$

$\Sigma F_y = N - w - T = 0$

$N = w + T$

$\Sigma F_x = uN = ma$

$u(w+T) = ma$

$w + T = \frac{ma}{u}$

$T = \frac{ma}{u} - w$

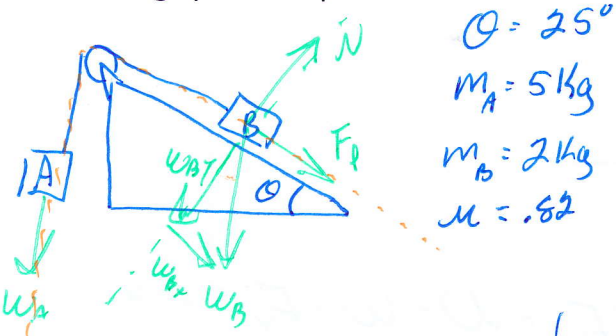
$T = \frac{ma}{u} - mg$

$T = m\left(\frac{a}{u_s} - g\right)$

$T = (158kg)\left(\frac{6.4\ m/s^2}{.48} - 9.8\ m/s^2\right)$

$T = 561N$

3. A 5.0 kg pumpkin is suspended from a string that goes over a small pulley and is then connected to a 2.0 kg box of pumpkin pies. The 2.0 kg box of pumpkin pies is on an incline with an angle of 25° from the horizontal. The coefficient of kinetic friction between the box and incline is $\mu_k = 0.82$. You can ignore the mass of the pulley and the string and assume the box of pies is moving up the ramp. What is the acceleration of the 5.0 kg pumpkin?

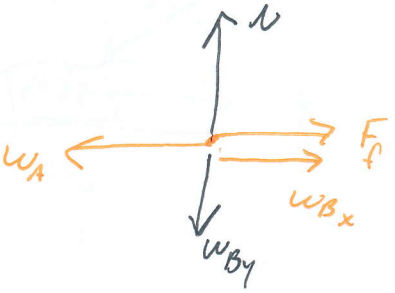


$\theta = 25°$

$m_A = 5\,kg$

$m_B = 2\,kg$

$\mu = .82$



$\Sigma F_x = F_f - W_A + W_{BX} = ma$

$\Sigma F_y = N - W_{BY} = 0$

$N = W_B \cos\theta$

$N = m_B g \cos\theta$

$\mu N - m_A g + m_B \sin\theta\, g = m_{A+B}\, a$

$\mu m_B g \cos\theta - m_A g + m_B g \sin\theta = (m_A + m_B) a$

$g\left[\dfrac{\mu m_B \cos\theta - m_A + m_B \sin\theta}{(m_A + m_B)}\right] = a$

$= a$

$g\left[\dfrac{(.82)(2kg)(\cos 25) - 5kg + (2kg)(\sin 25°)}{7kg}\right] = a$

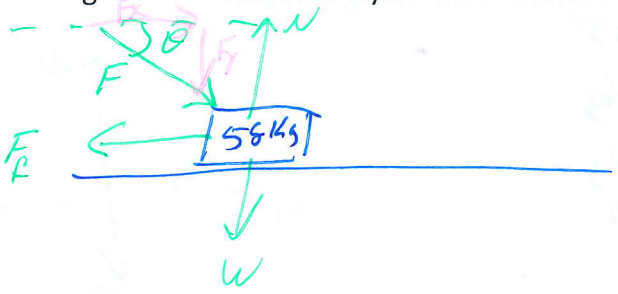
$-.38\ m/s^2 = a$

$-3.7\ m/s^2 = a$

up the ramp

$-3.7\ m/s^2$

4. A factory worker pushes a box of machine parts down a hallway. The box has a mass of 58 kg. Being that the box is shorter than the worker, he has to push it at an angle of 28 degrees below the horizon. Assuming the cart is already in motion and the coefficient of kinetic friction between the floor and box is 0.21, what force must the worker apply at this angle to keep the box moving at a constant velocity?



$\Sigma F_x = F_x - F_f = ma$

$F_x - F_f = 0$

$F\cos\theta = F_f$

$F = \frac{\mu N}{\cos\theta}$

$F = \frac{\mu(w + F\sin\theta)}{\cos\theta}$

$F = \frac{\mu(mg + F\sin\theta)}{\cos\theta}$

$F = \frac{mg\mu + F\mu\sin\theta}{\cos\theta}$

$F\cos\theta = mg\mu + F\mu\sin\theta$

$F\cos\theta - F\mu\sin\theta = mg\mu$

$\Sigma F_y = N - w - F_y = ma$

$N = w + F\sin\theta$

$F(\cos\theta - \mu\sin\theta) = mg\mu$

$F = \frac{mg\mu}{(\cos\theta - \mu\sin\theta)} = \frac{(58kg)(.21)(9.8 m/s^2)}{(\cos 28^\circ - (.21)(\sin 28^\circ))}$

$F = 152N$

5. You and a group of your friends decide to take a trip down to the coast in Maryland for the weekend. In your caravan with your friends, there are a total of three cars, you driving a 2008 Chevy Malibu (m=1556kg), one friend driving a 2002 Ford F150 (m=1980kg), and another friend driving a 2000 Honda Civic (m=1423kg). On the way, the two other cars purchase bad gasoline and the engines will not run any more. To save the cost of towing, you decide you will tow the two disabled cars using your own. You tie the two disabled cars to your Malibu in a row, the Ford F150 tied to your Malibu, and the Civic tied to the Ford F150. The cars are connected together using two identical tow straps. The tow straps you purchased before the trip were on special. They cost $13.99 each and have a towing capacity of 7000lb (31,137.5N). When you accelerate to merge onto the highway, you grow concerned that one or both of the straps may snap from too much tension. While merging, your car accelerates at 4 m/s^2. What will the tension in both straps be during acceleration, and will either of the towing straps break?

Malibu 1556kg
F150 1980kg
Civic 1423kg

$F = ma$

$F = [(1980kg) + (1423kg)][4\ m/s^2]$

$F = 13612N$ First Strap

$F = (1423kg)(4\ m/s^2)$

$F = 5692N$

6. How much would an 1800kg car weigh on earth **in pounds** (1 pound = 4.4 newton)?

$W = mg$

$W = (1800kg)(9.8 m/s^2)\left(\frac{1\ lb}{4.4\ N}\right) =$

$W = 4000\ lb$

7. Two objects, a mass with m_1 = 10kg and a mass with m_2 = 20kg are suspended from the ceiling by two lengths of string, with m_2 hanging below m_1. All the pieces of string are of the same length and are cut from the same roll. You can ignore the mass of the strings for this problem. Find the force of tension in both strings.