«First_Name» «Last_Name» Pd «Period»

DYNAMICS

AT DYNAMICS (12)

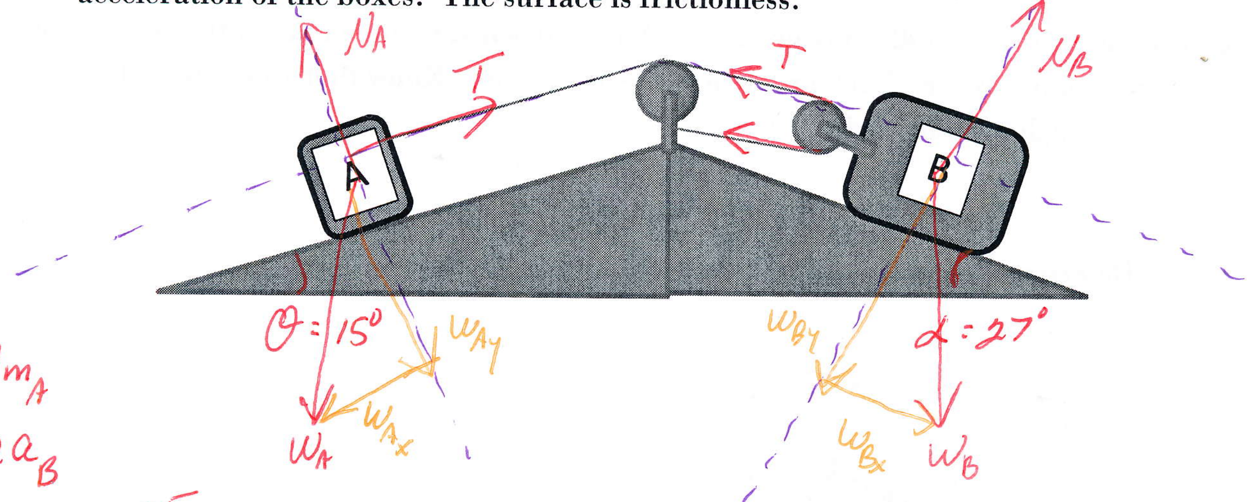
Directions: Solve the following problems. Show all work, include units with every value, and circle your answer. Each problem is worth 5 points. Know that 1 pound= 4.4N (...close enough for our work)

1) Determine the mass of a 10 kg object.

10kg

«First_Name» «Last_Name» Pd «Period»

2) From the diagram, the mass of "B" is 4 times the mass of "A." Mass "B" is on an incline that makes an angle of 27 degrees above the horizontal, while Mass "A" sits on a incline that makes an angle of 15 degrees above the horizontal. Determine the acceleration of the boxes. The surface is frictionless.



$m_B = 4m_A$

$a_A = 2a_B$

$$\Sigma F_{yA} = N_A - W_{Ay} = ma$$

$$N_A = W_A \cos\theta$$

$$\Sigma F_{xA} : T - W_{Ax} = m_A a_A$$

$$T - W_A \sin\theta = m_A a_A$$

$$T - m_A g \sin\theta = m_A a_A$$

$$T - m_A g \sin\theta = m_A 2a_B$$

$$T = m_A 2a_B + m_A g \sin\theta$$

$$\Sigma F_{xB} = W_{Bx} - 2T = m_B a_B$$

$$W_B \sin\alpha - 2T = m_B a_B$$

$$m_B g \sin\alpha - 2T = m_B a_B$$

$$4m_A g \sin\alpha - 2T = 4m_A a_B$$

$$4m_A g \sin\alpha - 2(m_A 2a_B + m_A g \sin\theta) = 4m_A a_B$$

$$4\cancel{m_A} g \sin\alpha - 2\cancel{m_A} 2a_B - 2\cancel{m_A} g \sin\theta = 4\cancel{m_A} a_B$$

$$2g \sin\alpha - 2a_B - g \sin\theta = 2a_B$$

$$2g \sin\alpha - g \sin\theta = 2a_B + 2a_B$$

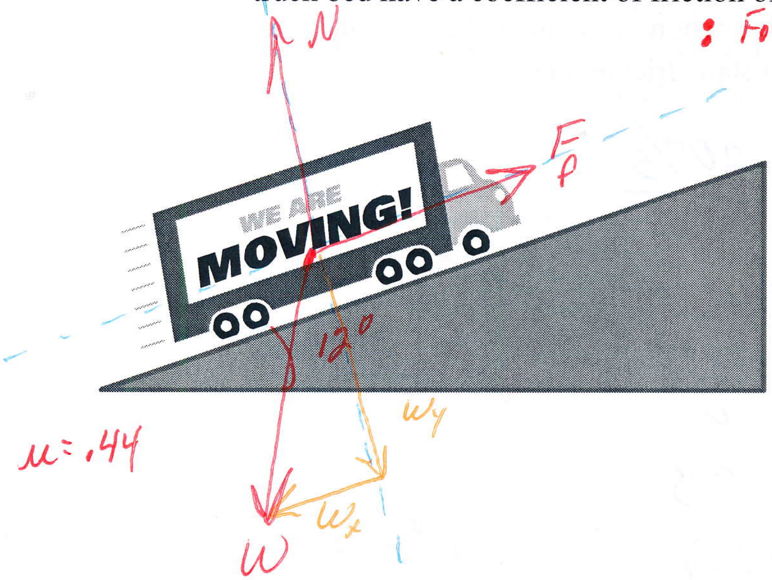
$$\frac{g(2\sin\alpha - \sin\theta)}{4} = a_B$$

$$\frac{(9.8\,m/s^2)(2\sin(27°) - \sin(15°))}{4} = a_B$$

$$1.6\frac{m}{s^2} = a_B$$

9) The moving truck shown below is accelerating up a steep hill. If a cardboard box is sitting on the floor of the truck, not strapped down (A really bad idea!!!), determine the maximum acceleration the truck can have without the box sliding. The box and truck bed have a coefficient of friction of 0.44, and the angle of the hill is 12 degrees.

: Forces Drawn Are Those Acting On the Box Inside the Truck



$\mu = .44$

$\Sigma F_y = N - W_y = ma$

$N - W\cos\theta = 0$

$N = mg\cos\theta$

$\Sigma F_x = F_f - W_x = ma$

$\mu N - W\sin\theta = ma$

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

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

$\mu g\cos\theta - g\sin\theta = a$

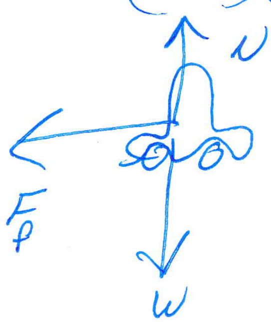
$g(\mu\cos\theta - \sin\theta) = a$

$9.8\frac{m}{s^2}(.44\cos 12° - \sin 12°) = a = 2.18\ m/s^2$

Level I Key Pd 1

10) The driver of a car traveling down a level road at 45 mi/hr spies a deer in the middle of the road. The deer appears as though it is not going to move, so the driver quickly removes their right foot from the gas pedal and places it firmly on the brake pedal, causing the car tires to (being controlled by the anti-lock mechanism in the car) to quickly attain their maximum static friction. Determine the stopping distance of the car if the tires have a coefficient of static friction of 0.86.

$$\left(45\,\frac{mi}{hr}\right)\left(\frac{1600\,m}{1\,mi}\right)\left(\frac{1\,hr}{3600\,s}\right) = 20\,m/s$$



$$\Sigma F_y = N - W = ma$$
$$N - W = 0$$
$$N = W$$
$$N = mg$$

$$\Sigma F_x = -F_f = m(-a)$$

$$v^2 = v_0^2 + 2ax$$
$$0 = v_0^2 + 2ax$$
$$-v_0^2 = 2ax$$
$$v_0^2 = 2(-a)x$$
$$\frac{v_0^2}{2x} = -a$$

$$-F_f = \frac{mv_0^2}{2x}$$

$$x = \frac{mv_0^2}{2\,{}^{-}F_f}$$

$$x = \frac{-mv_0^2}{2(\mu mg)}$$

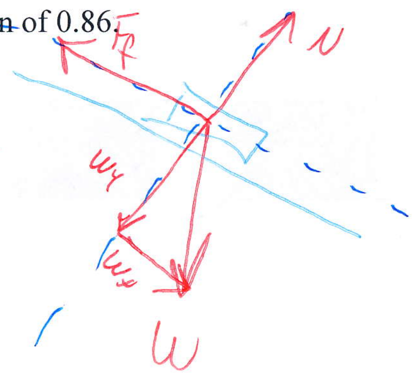
$$x = -\frac{v_0^2}{2\mu g}$$

* The negative Indicates the Force Is Opposite of the Direction Moved

$$x = \frac{-(20\,m/s)^2}{2(.86)(9.8\,m/s^2)}$$

$$x = 23\,m$$

11) The driver of a car traveling on a downhill (slope of 12 degrees) section of road at 45 mi/hr spies a deer in the middle of the road. The deer appears as though it is not going to move, so the driver quickly removes their right foot from the gas pedal and places it firmly on the brake pedal, causes the car tires to (being controlled by the anti-lock mechanism in the car) to quickly attain their maximum static friction. Determine the stopping distance of the car if the tires have a coefficient of static friction of 0.86.



$$\Sigma F_y = N - W_y = ma$$
$$N - W\cos\theta = ma$$
$$N - mg\cos\theta = 0$$
$$N = mg\cos\theta$$

$$\Sigma F_x = W_x - F_f = ma$$
$$W\sin\theta - \mu N = ma$$
$$mg\sin\theta - \mu mg\cos\theta = ma$$
$$g\sin\theta - \mu g\cos\theta = a$$

From Prior: $a = \dfrac{v_0^2}{2x}$

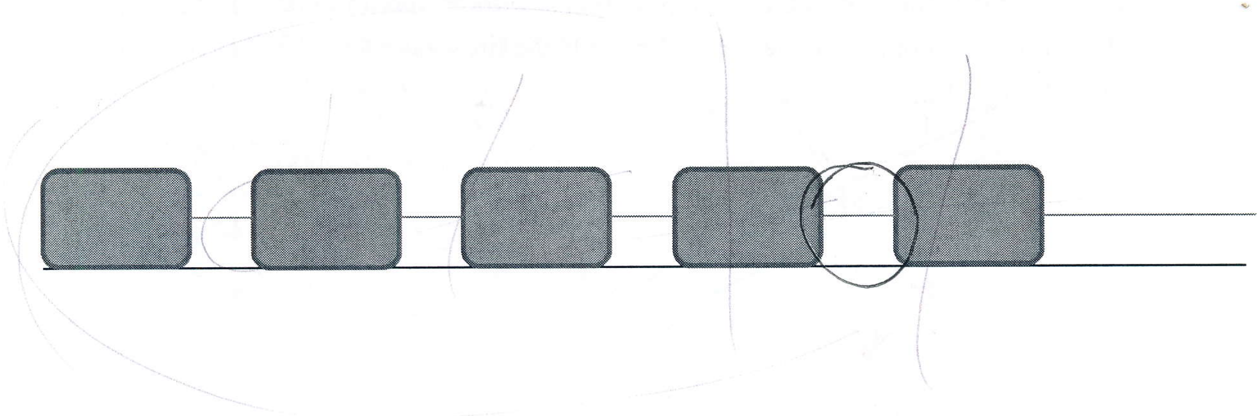
$v_0 = 20\,m/s$

$$g\sin\theta - \mu g\cos\theta = \frac{v_0^2}{2x}$$

$$x = \frac{v_0^2}{2(g\sin\theta - \mu g\cos\theta)} = \frac{v_0^2}{2g(\sin\theta - \mu\cos\theta)} = \frac{(20\,m/s)^2}{(2)(9.8\,m/s^2)(\sin 12 - (.86)\cos 12^\circ)}$$

$$x = 32\,m$$

12) The line of boxes shown below are all attached with separate ropes. Each box has a mass of 100 kg and a coefficient of kinetic friction of 0.34 with the level floor. The boxes are being pulled by the rope to the far right, with a force of 350 N. Determine the tension in the last rope.



zero

Reasoning:

Total mass = 500kg

Total Friction: $F_f = \mu N = \mu mg = 1666 N$

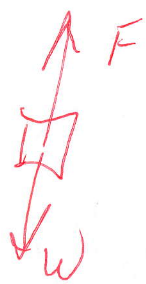
(they Don't Move)

Total Friction of First 4

$F_f = \mu mg = (.34)(400kg)(9.8 m/s^2) = 1333 N$

Level I Key Pd 1

13) Level I is in the weight room, on the weight bench doing (what else…) bench presses. Determine the upward force being exerted on the bar if the bar and plates has a total weight of 110 pounds and the bar is being accelerated upward at 3 m/s^2.



$$(110\ lb)\left(\frac{4.4\ N}{1\ lb}\right) \rightarrow \underline{484\ N}$$

$$\Sigma F_y = F - W = ma$$

$$W = mg$$

$$\frac{W}{g} = m$$

$$F = ma + W$$

$$F = \frac{Wa}{g} + W$$

$$F = W\left(\frac{a}{g} + 1\right)$$

$$F = 484\ N\left(\frac{3\ m/s^2}{9.8\ m/s^2} + 1\right)$$

$$F = 632\ N = 144\ lbs$$

14) Determine the weight of a 12 kg object

$W = mg$

117.6 N