Answer Key Pd 1

Dynamics part 1

AT Dynamics (17)

Directions: Solve the following problem. Show all work. Be neat. Your solution should mathematically read like an essay. Each problem is worth 5 points.

1) Determine the weight of a 25 kg object.

$W = mg$

$W = (25\,kg)(9.8\,m/s^2)$

$W = 245\,N$

Just Diagrams + ΣF equations

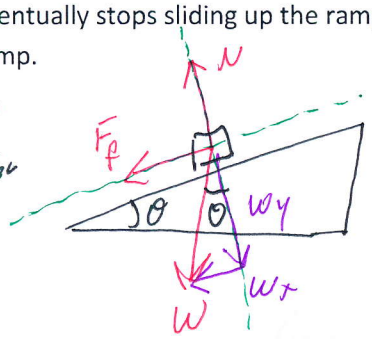
Pd 1 gets exception on this one

$a = 3.1\ m/s^2$

2) A 10kg box is sliding along on a frictionless and level surface at 3 m/s. The box then encounters a non-frictionless incline (the incline, unlike the level surface, has friction) that angles upward at 15 degrees above the horizontal. The box accelerates at $-0.31 m/s^2$ as it slides up the ramp. The box eventually stops sliding up the ramp. Determine the acceleration of the box after it stops sliding up the ramp.

Sliding UP

Solve For μ



$\theta = 15°$

$\Sigma F_y = N - w_y = 0$

$N = w_y$

$N = w\cos\theta$

$N = mg\cos\theta$

$\Sigma F_x = -F_f - w_x = ma$

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

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

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

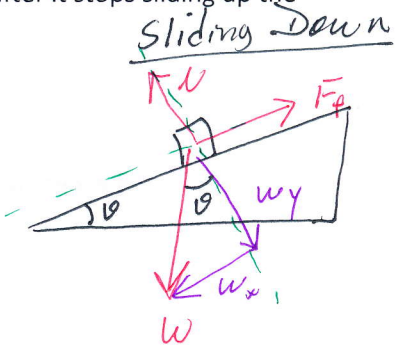
$-\mu g\cos\theta = a + g\sin\theta$

$$\mu = \frac{a + g\sin\theta}{-g\cos\theta}$$

$$\mu = \frac{-3.1\ m/s^2 + (9.8\ m/s^2)\sin(15^\circ)}{(-9.8\ m/s^2)(\cos 15^\circ)}$$

$\mu = .059$

Sliding Down



$\Sigma F_y = N - w_y = 0$

$N = mg\cos\theta$

$\Sigma F_x = F_f - w_x = ma$

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

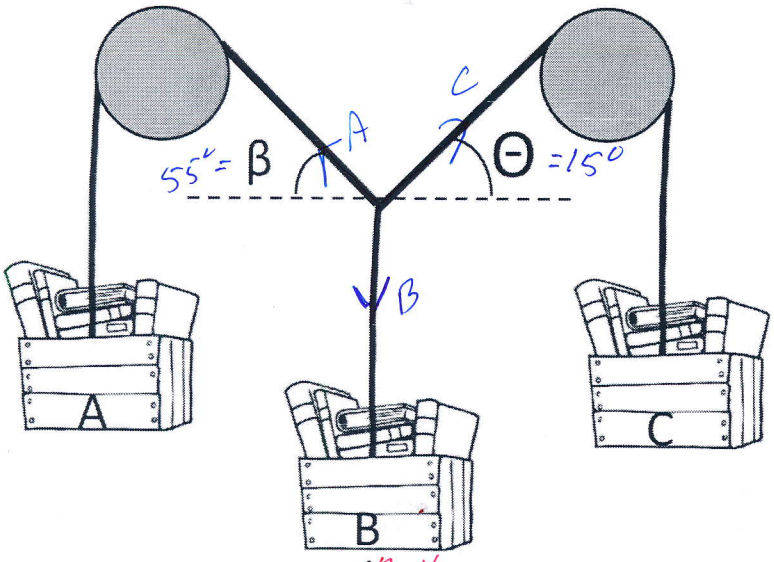
$\mu mg\cos\theta - mg\sin\theta = ma$

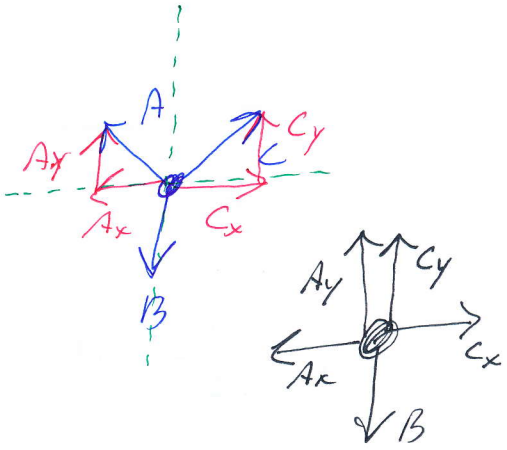
$\mu g\cos\theta - g\sin\theta = a$

$(.059)(9.8\ m/s^2)(\cos 15) - (9.8\ m/s^2)\sin(15)$

$-1.98\ m/s^2 = a$

3) Three masses are hanging has shown below. Box "B" has a weight of 12 pounds. Determine the weight, in pounds, of box "A" and box "C" when the angle beta is 55 degrees and the angle theta is 15 degrees. This diagram is not to scale. It is not proportionally accurate.





$\Sigma F_x = C_x - A_x = 0$

$C\cos\theta - A\cos\beta = 0$

$C\cos\theta = A\cos\beta$

$C = \dfrac{A\cos\beta}{\cos\theta}$

$C = \dfrac{(12.3\text{ lb})\cos(55)}{\cos(15)}$

$C = 7.3\text{ lb}$

$\Sigma F_y = A_y + C_y - B = 0$

$A\sin\beta + C\sin\theta - B = 0$

$A\sin\beta + \dfrac{A\cos\beta(\sin\theta)}{\cos\theta} - (B) = 0$

$A\sin\beta + A\cos\beta\tan\theta = B$

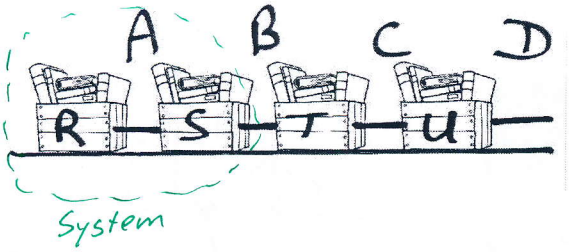
$A(\sin\beta + \cos\beta\tan\theta) = B$

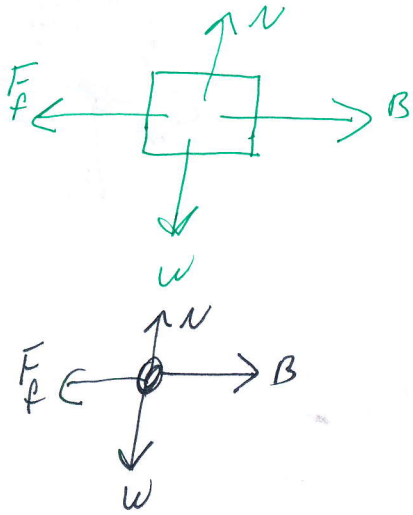
$A = \dfrac{B}{(\sin\beta + \cos\beta\tan\theta)}$

$A = \dfrac{(12\text{ lb})}{(\sin(55) + \cos(55)\tan(15))}$

$A = 12.3\text{ lb}$

4) Boxes **R**, **S**, **T**, **U** are pulled to the right, accelerating to the right at $3m/s^2$, by strings **A**, **B**, **C**, **D**, as indicated in the diagram. Each box has a mass of 5kg and a coefficient friction of 0.4. Determine the tension in string **B**.





$\Sigma F_y = N - w = 0$

$N = w$

$\Sigma F_x = B - F_f = ma$

$B - \mu N = ma$

$B = ma + \mu N$

$B = ma + \mu mg$

$B = m(a + \mu g)$

$B = (10kg)\left(3m/s^2 + (.4)(9.8m/s^2)\right)$

$B = 69.2N$

5) A 25kg mass is supported by a string. Determine the tension in the string when the mass is moving upward at a constant 3.5 m/s.

$a = 2 m/s^2$

$\Sigma F_y = T - w = ma$

$T - w = 0$

$T = w$

$T = mg$

$T = (25kg)(9.8 m/s^2)$

$T = 245 N$

Answer Key Pd 1

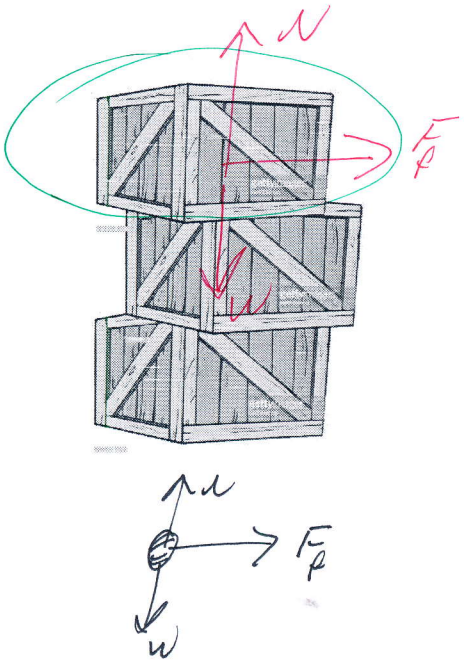
Dynamics part 2

AT Dynamics (17)

Directions: Solve the following problem. Show all work. Be neat. Your solution should mathematically read like an essay. Each problem is worth 5 points.

1) Determine the mass of a 25kg object.

2) Each of the 3 boxes has a mass of 15 kg. Each box has a coefficient of friction of 0.7 with the adjoining box. The stack of boxes are able to be accelerated as a whole. The bottom box is box A, the middle is box B, and the top is box C. What would be the maximum acceleration the box stack could have without any of the boxes sliding? (Note, in a real case, the boxes could tumble or roll. In this case, they will not...they can only slide)



The Top Box will Be The First To Slide Because the normal Force Is Less; Therefore Less Friction. Also, the Bottom + Middle Boxes will Have Friction From the Boxes Above them So... the Top Box Is The System

W/ Friction; Pick A Direction, the Only Force that Can Accelerate the Boxes Is Friction

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

$$N = mg$$

$$\Sigma F_x = F_f = ma$$

$$\mu N = ma$$

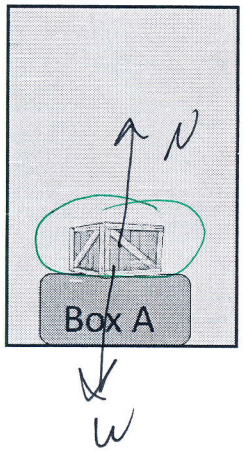
$$\mu mg = ma$$

$$\mu g = a$$

$$(.7)(9.8\ m/s^2) = a$$

$$6.86\ \frac{m}{s^2} = a$$

3) The two boxes are in an elevator (the shaded area). Box A has a mass of 65 kg. The wooden crate has a mass of 85 kg. Determine the force exerted on the wooden crate by Box A when the elevator accelerates upward at 1.5m/s^2.



the normal Is Supplied by Box "A"

$\Sigma F_y = N - W = ma$

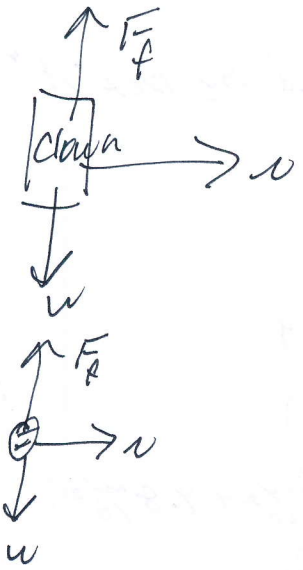
$N = ma + mg$

$N = m(a+g)$

$N = (85kg)(1.5\,m/s^2 + 9.8\,m/s^2)$

$N = 960.5\,N$

4) In a comedy stunt, a clown jumps in front of a slow moving, accelerating flat-front bus. The clown "sticks" to the front of the bus while the bus is accelerating forward without the clown holding onto anything. Determine the needed acceleration of the bus for the clown to stay. The coefficient of static friction between the clown suit and the front of the bus is 0.85.



$$\Sigma F_x = N = ma$$

$$\Sigma F_y = F_f - w = 0$$

$$\mu N - w = 0$$

$$\mu ma = w$$

$$\mu ma = mg$$

$$\mu a = g$$

$$a = \frac{g}{\mu} = \frac{9.8\ m/s^2}{.85} = 11.5\ m/s^2$$

5) A 25kg mass is supported by a string. Determine the tension in the string when the mass is accelerated upward at 3.5 m/s^2

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

$$T - mg = ma$$

$$T = ma + mg$$

$$T = m(a + g)$$

$$T = 25kg\left(3.5\,m/s^2 + 9.8\,m/s^2\right)$$

$$T = 332.5N$$