key Level I Physics Pd2 with shoe

Dynamics test

AT Dynamics (09)

Directions: Solve the following problems, showing all work and circling your answer. Each is worth 5 points. Also, check the data below and make any needed changes.

1) A crane is being used to lift a 2000 kg box. The maximum tension the crane cable can support is 22,000 N.
   a. Determine the weight of the box.

$w = mg = (2000\,kg)(9.8\,m/s^2) = 19600\,w$

30 20 25 20 5 /30

   b. Determine the greatest acceleration the crane can impart onto the box.

$\Sigma F_y = T - w = ma$

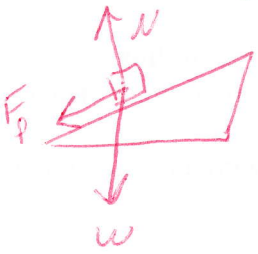
$\frac{T-w}{m} = a$

$\frac{T-mg}{m} = a = \frac{(22{,}000w) - (2{,}000)(9.8\,m/s^2)}{(2{,}000kg)}$

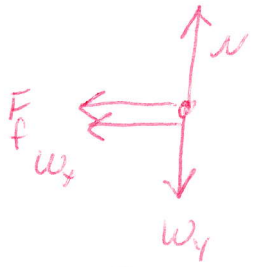
$1.2\,m/s^2$

2) You are driving your pick-up truck at 22 m/s. In the bed of the pick-up, you have a large cardboard box. Determine your shortest possible stopping distance without the box sliding if you are going uphill at a 12 degree angle. The truck has a mass of 2,000 kg and the box has a mass of 150kg. You are listening to Led Zeppelin at the time you are trying to stop.

a. Draw a body diagram of this situation.



b. Draw a free body diagram of this situation



c. Solve the problem as stated above.

Bonus - Read Level?

$\Sigma F_x = F_f - w_x = ma$

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

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

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

$g[\mu\cos\theta + \sin\theta] = a$

$\Sigma F_y = N - w_y = 0$

$N - w\cos\theta = 0$

$N = mg\cos\theta$

$v_0 = 22\ m/s$

$a = g[\mu\cos\theta + \sin\theta]$

$v = zero$

$x = ?$

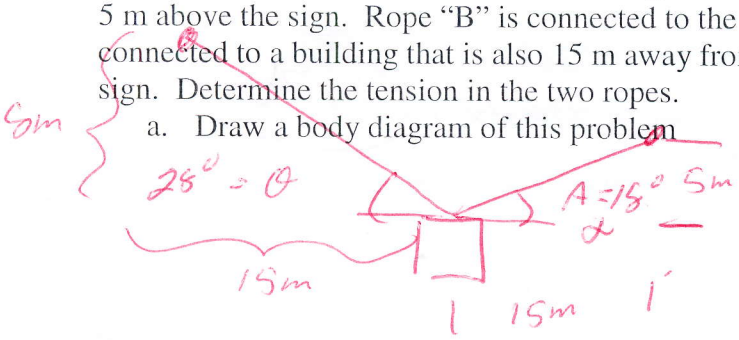
$v^2 = v_0^2 + 2ax$

$\frac{v_0^2}{2g(\mu\cos\theta + \sin\theta)} = x = \frac{(22\ m/s)^2}{(2)(9.8\ m/s^2)[.4\cos(12) + \sin(12)]}$

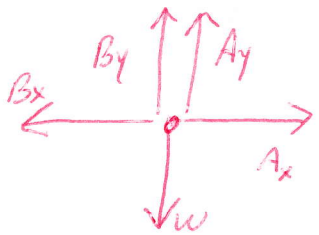
$x = 41m$

3) A 12kg sign is supported over a road by two ropes. Rope "A" is connected to the sign, and then is connected to a tall building that is 15 m away from the sign, and 5 m above the sign. Rope "B" is connected to the other side of the sign and is connected to a building that is also 15 m away from the sign, and 8 m above the sign. Determine the tension in the two ropes.

a. Draw a body diagram of this problem



b. Draw a free body diagram of this problem.



c. Solve for the tension is rope "A"

$\Sigma F_x = A_x - B_x = 0$

$A_x = B_x$

$A\cos\alpha = B\cos\theta$

$\frac{A\cos\alpha}{\cos\theta} = B$

$\Sigma F_y = A_y + B_y - w = 0$

$A\sin\alpha + B\sin\theta = w$

$A\sin\alpha + \frac{A\cos\alpha\sin\theta}{\cos\theta} = mg$

$A\left[\sin\alpha + \frac{\cos\alpha\sin\theta}{\cos\theta}\right] = mg$

$A = \frac{mg}{\left[\sin\alpha + \frac{\cos\alpha\sin\theta}{\cos\theta}\right]} = \frac{(12kg)(9.8m/s^2)}{\left[\sin 18 + \frac{(\cos 18)(\sin 28)}{(\cos 28)}\right]} = 144N = A$

d. Solve for the tension in rope "B"

$B\cos\theta = A\cos\alpha$

$B = \frac{A\cos\alpha}{\cos\theta} = \frac{(144N)\cos(18)}{\cos(28^\circ)} = 155N = B$

4) Determine the weight of a 15 kg object.

$W = mg = (15\,kg)(9.8\,m/s^2) = 147\,N$