Level I Key Pd 1

Dynamics

AT Dynamics (13)

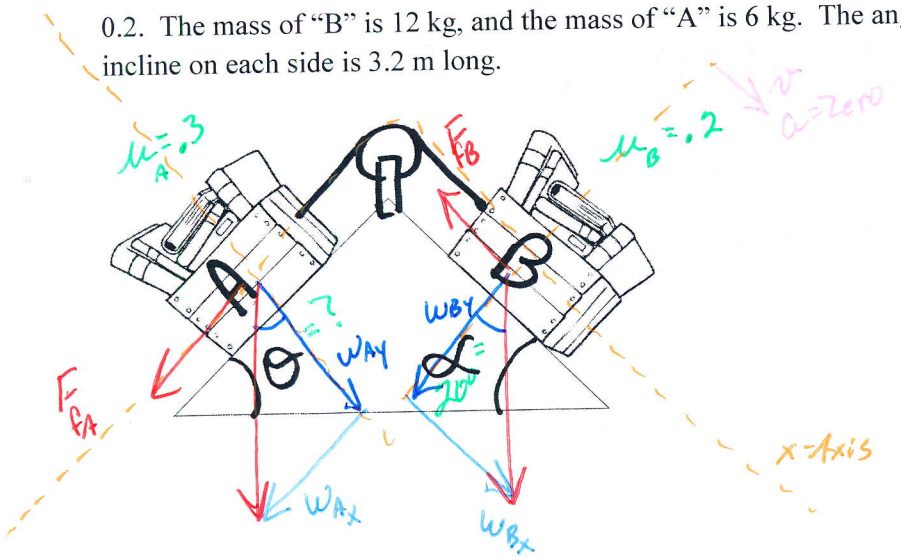
Directions: Solve the following problems. Show all work including units. Please circle your answer. Each is worth 5 points.

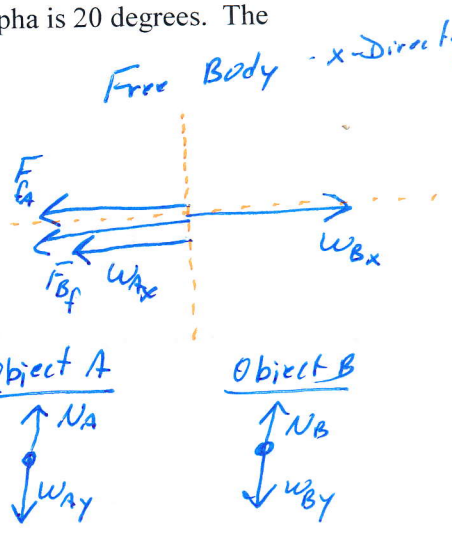
1) Determine the mass of a 12 kg object

12kg

14.6kg/slug

2) Determine the angle theta where "B" will slide down the incline at a constant speed. The coefficient of friction between "A" and the incline is 0.3, and the coefficient of friction between "B" and the incline is 0.2. The mass of "B" is 12 kg, and the mass of "A" is 6 kg. The angle of alpha is 20 degrees. The incline on each side is 3.2 m long.





$\Sigma F_{AY} = N_A - W_{AY} = ma$

$N_A - W_A \cos\theta = 0$

$N_A = m_A g \cos\theta$

$\Sigma F_{BY} = N_B - W_{BY} = ma$

$N_B - W_B \cos\alpha = 0$

$N_B = m_B \cos\alpha$

$\Sigma F_x = W_{Bx} - F_{fA} - F_{fB} - W_{Ax} = ma$

$W_B \sin\alpha - \mu_A N_A - \mu_B N_B - W_A \sin\theta = 0$

accel @ Zero Indicates Frictional Forces are maximized...

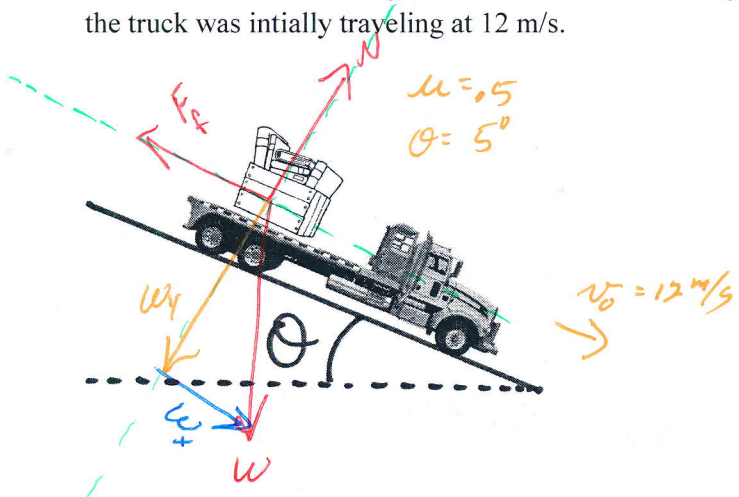
$m_B g \sin\alpha = \mu_A m_A g \cos\theta + \mu_B m_B \cos\alpha + m_A g \sin\theta$

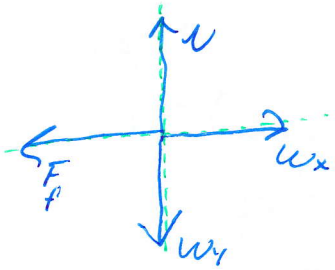
$m_B g \sin\alpha - \mu_B m_B \cos\alpha = \mu_A m_A g \cos\theta + m_A g \sin\theta$

$m_B g \sin\alpha - \mu_B m_B \cos\alpha = m_A g(\mu_A \cos\theta + \sin\theta)$

$$\frac{(m_B g \sin\alpha - \mu_B m_B \cos\alpha)}{m_A g} = \mu_A \cos\theta + \sin\theta$$

3) The coefficient between the box and the truck bed is 0.5. The angle of the hill is 5 degrees. Determine the shortest possible stopping distance of the truck without the box sliding on the bed of the truck if the truck has a mass of 580 kg, the box has a mass of 85 kg (yeah..values are WAY less than realistic…) and the truck was intially traveling at 12 m/s.





$\Sigma F_x = w_x - F_f = ma$

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

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

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

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

$\Sigma F_y = N - w_y = ma$

$N - mg\cos\theta = 0$

$N = mg\cos\theta$

$v_0 = 12\ m/s$

$v = zero$

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

$x = ?$

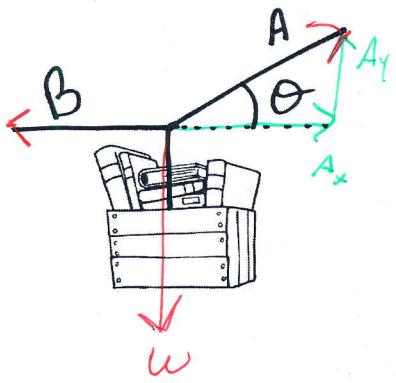
$v^2 = v_0^2 + 2ax$

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

$\frac{-(12\ m/s)^2}{-2(g(\sin 5^0 - (.5)(\cos 5^0))} = x$

$17.8m = x$

4) String "B" is 4 m long, and string "A" is 5 m long. The angle theta is 28 degrees, and the mass of the box is 22 kg. Determine the tension in both string "A" and string "B."



$\Sigma F_y = A_y - w = ma$

$A \sin\theta - mg = 0$

$A = \frac{mg}{\sin\theta}$

$A = \frac{(22kg)(9.8 m/s^2)}{\sin(28°)}$

$A = 459 N$

$\Sigma F_x = B - A\cos\theta = ma$

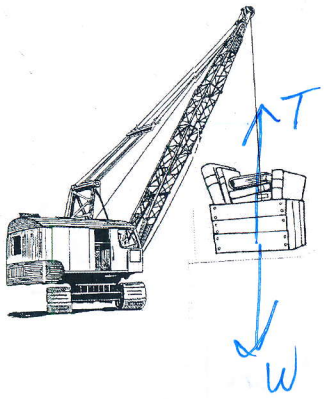
$B - A\cos\theta = 0$

$B = A\cos\theta$

$B = (459N)\cos(28°)$

$B = 405N$

5) The crane pictured below is lifting the 45 kg box, accelerating from rest to 2 m/s in a time of 1.2 seconds. Determine the tension in the cable.



$v_0 = 2 m/s$

$v = 2 m/s$

$t = 1.2 s$

$a = ?$

$v = v_0 + at$

$\frac{v - v_0}{t} = a$

$\frac{v}{t} = a$

$\Sigma F_y = T - w = ma$

$T = ma + w$

$T = ma + mg$

$T = m(a + g)$

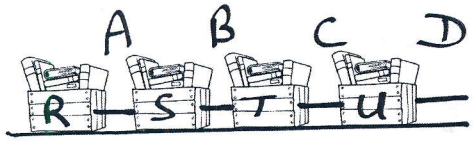
$T = m(\frac{v}{t} + g)$

$T = (45kg)(\frac{2 m/s}{1.2 s} + 9.8 m/s^2)$

$T = 516 N$

6) Determine the tension is each string (A,B,C,D) if the boxes are pulled across a frictionless surface and the masses of the box are R=5kg, S=12 kg, T=15kg, U=0.5 kg. The boxes are being accelerated at $3m/s^2$

$3\ m/s^2 \rightarrow$



A

$\Sigma F_x = A = m_R a$

$A = (5kg)(3\ m/s^2)$

$A = 15\ N$

B

$\Sigma F_x = B = m_{RS} a$

$B = (m_R + m_S) a$

$B = (5kg + 12kg)\ 3\ m/s^2$

$B = 51\ N$

C

$\Sigma F_x = C = m_{RST} a$

$C = (m_R + m_S + m_T) a$

$C = (5kg + 12kg + 15kg)\ 3\ m/s^2$

$C = 96\ N$

D

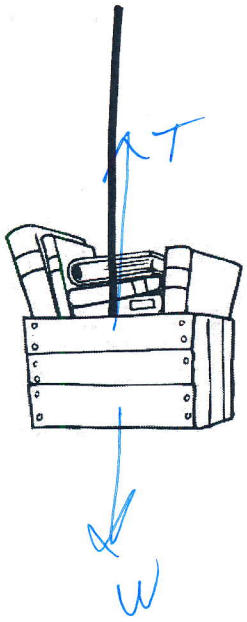
$\Sigma F_x = D = (m_{RSTU}) a$

$D = (m_R + m_S + m_T + m_U) a$

$D = (5kg + 12kg + 15kg + .5kg)\ 3\ m/s^2$

$D = 97.5\ N$

7) The 12 kg box below is being raised at a constant speed of 3m/s. Determine the tension in the string



$\Sigma F_y = T - w = ma$

$T - w = 0$ (Const. Speed)

$T = mg = (12\,kg)(9.8\,m/s^2)$

$T = 117.6\,N$