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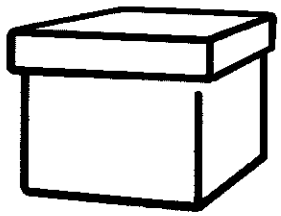
DYNAMICS TEST

AT Dynamics (20)

Directions: Solve the problems below. Each problem is worth 5 points; the test is worth 50 points. Consider each problem to be prompt for an essay. The essay you will write will be with the language of math!!! I need to be able to follow your work.

1) What is the mass of a 15 kg object?



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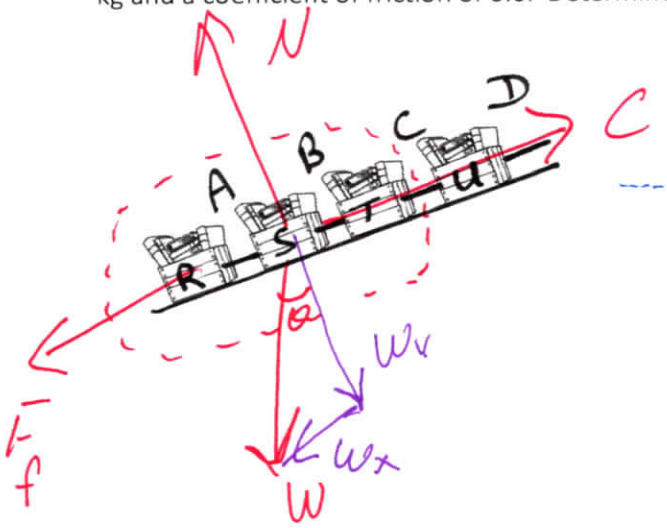
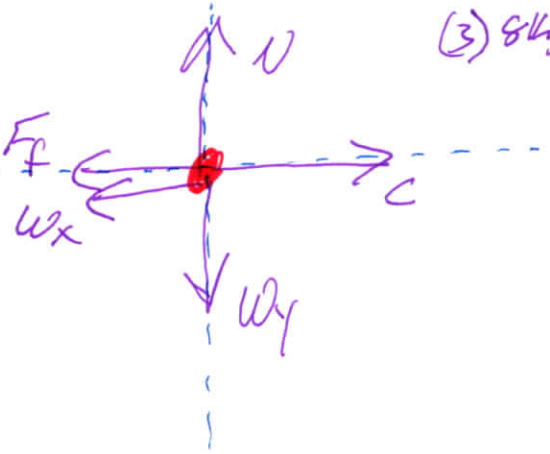
2) The 4 boxes shown are being accelerated up the 20 degree hill at 1.2 m/s^2. Each box has a mass of 8 kg and a coefficient of friction of 0.6. Determine the tension in string "C".

3 Boxes
(3) 8kg => 24kg





$\Sigma F_y = N - W_y = ma$

$N - W\cos\theta = ma$

$N - mg\cos\theta = ma$

$N - mg\cos\theta = 0$

$N = mg\cos\theta$

$\Sigma F_x = C - F_f - W_x = ma$

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

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

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

$C = m(\mu g\cos\theta + g\sin\theta + a)$

$C = (24kg)[(.6)(9.8 m/s^2)\cos 20 + (9.8 m/s^2)(\sin 20) + (1.2 m/s^2)]$

$C = 10.1N$

$C = 242N$

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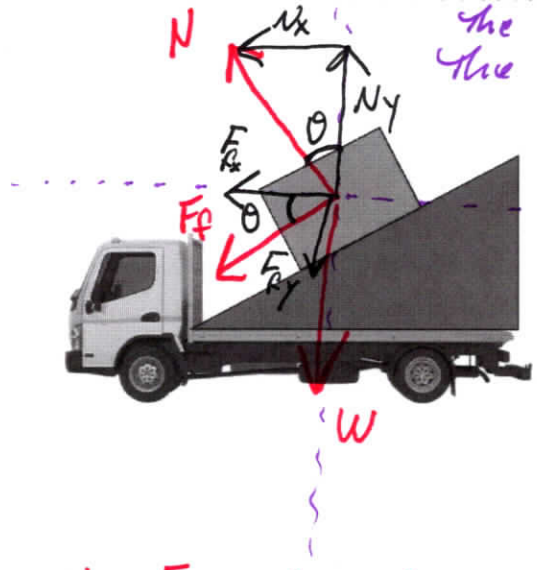
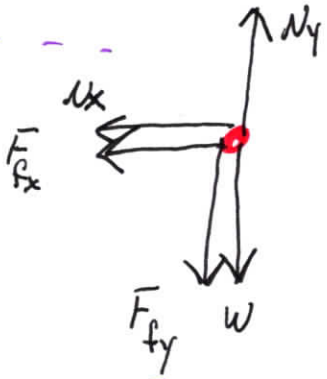
3) Imagine if you would, a box on an incline, that is riding on a flatbed truck. The incline is rigidly attached to the truck and makes an angle of 30 degrees. The box is sitting on the incline. There is a coefficient of friction between the box and the incline of 0.7. Determine the minimum forward acceleration of the truck that will cause the box to slide off the back of the truck.



The x-Direction Is Arranged In This Manner So The acceleration Is In the x-Direction.



$\Sigma F_y = N_y - F_{fy} - W = ma$

$N\cos\theta - F_f \sin\theta - mg = 0$

$N\cos\theta - \mu N\sin\theta - mg = 0$

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

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

$N = \dfrac{mg}{(\cos\theta - \mu\sin\theta)}$

$\Sigma F_x = -N_x - F_{fx} = -ma$

$N_x + F_{fx} = ma$

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

$N(\sin\theta + \mu\cos\theta) = ma$

$\dfrac{mg(\sin\theta + \mu\cos\theta)}{(\cos\theta - \mu\sin\theta)} = ma$

$\dfrac{g(\sin\theta + \mu\cos\theta)}{(\cos\theta - \mu\sin\theta)} = a$

$\dfrac{(9.8\,m/s^2)(\sin 30^\circ + .7\cos 30)}{(\cos 30^\circ - .7\sin 30^\circ)} = a = \dfrac{10.8\,m/s^2}{.516} = 21\,m/s^2$

... It's Not Going To Slide...

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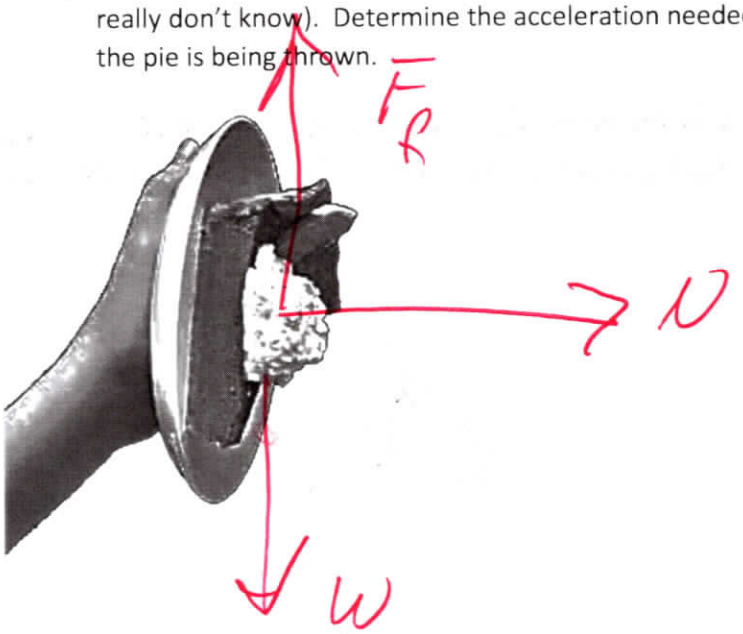
4) The coefficient of friction between the pie crust and the plate is 0.85 (This is a made-up value...I really don't know). Determine the acceleration needed for pie to stay on the plate. Think like the pie is being thrown.



$\Sigma F_x = N = ma$

$\Sigma F_y = F_f - w = ma$

$\mu N - w = 0$

$\mu ma - mg = 0$

$\mu ma = mg$

$\mu a = g$

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

$a = 11.5\ m/s^2$

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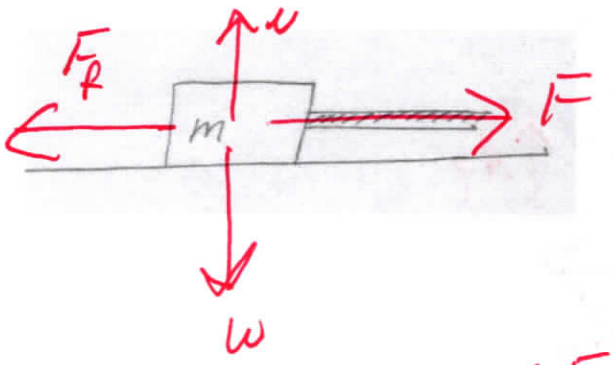
5) A 18kg box is being pulled, accelerating at $2m/s^2$ to the right with a force of 65N. Determine the coefficient of friction.



$\Sigma F_y = N - w = ma$

$N = w$

$N = mg$

$\Sigma F_x = F - F_f = ma$

$F - \mu N = ma$

$\frac{F - ma}{mg} = \mu$

$\frac{65N - (18kg)(2m/s^2)}{(18kg)(9.8m/s^2)} = .16$

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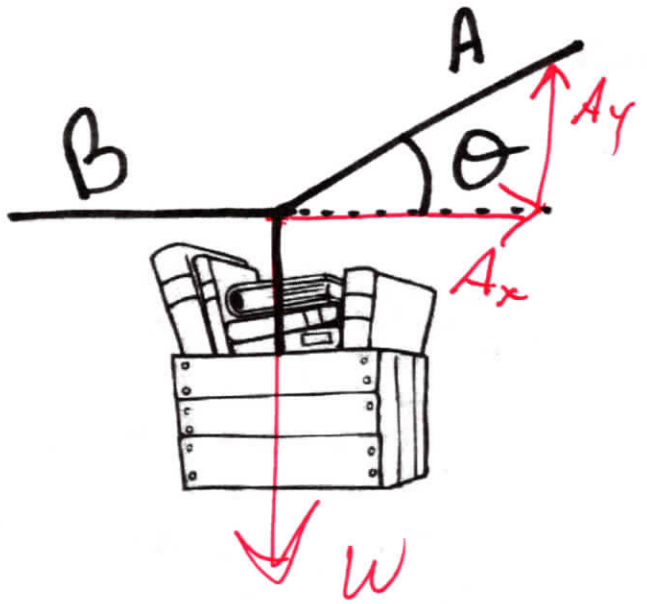
6) The box in the diagram below has a mass of 12 kg. The angle indicated is 75 degrees. Assume string "B" is in the negative x-direction, and the dotted line is in the positive X-direction. Find the tension in both string "A" and string "B".



$\Sigma F_y = A_y - W = ma$

$A_y = W$

$A \sin\theta = mg$

$A = \frac{mg}{\sin\theta} = \frac{(12kg)(9.8 m/s^2)}{\sin(75)}$

$A = 121.7N$

$\Sigma F_x = A_x - B = ma$

$A_x = B$

$(121.7N)\cos 75 = B$

$31.5N = B$

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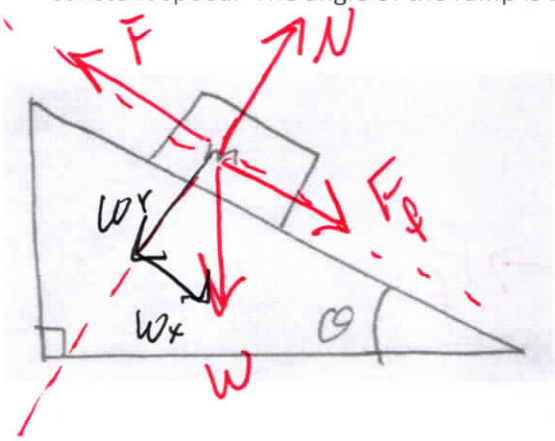
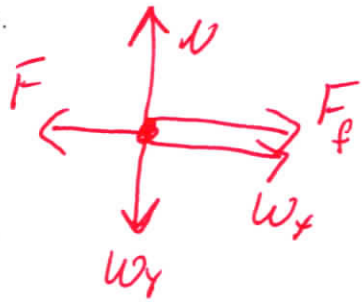
7) The box shown in the diagram has a mass of 12 kg. There is a coefficient of friction between the box and the incline of 0.34. Determine the force required to push the box up the ramp at a constant speed. The angle of the ramp is 15 degrees.





$\Sigma F_y = N - W_y = ma$

$N = W_y$

$N = W\cos\theta$

$N = mg\cos\theta$

$\Sigma F_x = F_f + W_x - F = ma$ a = zero

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

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

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

$(12\text{kg})(9.8\frac{m}{s^2})(.34\cos 15^\circ + \sin 15^\circ) = F$

$69N = F$

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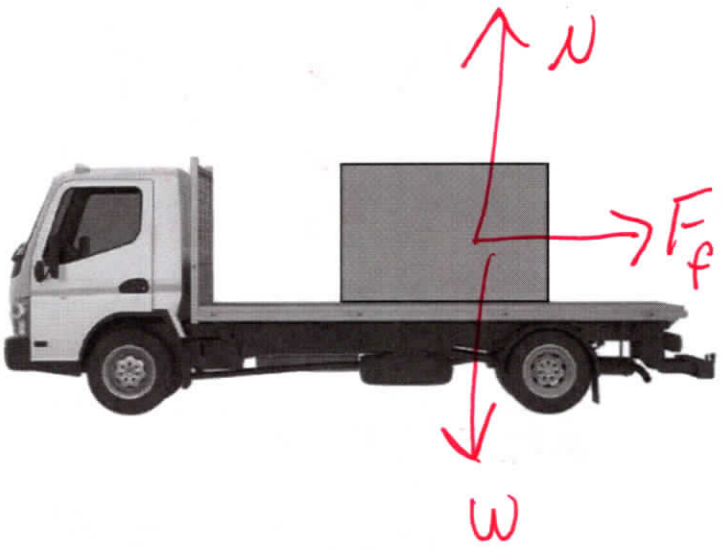
8) The box below has a mass of 250kg and is sitting on the flatbed of the truck as shown. The coefficient of friction between the box and the bed of the truck is 0.75. Determine the greatest acceleration the truck can have without the box sliding on the bed.



$\Sigma F_y = N - W = ma$

$N = W$

$N = mg$

$\Sigma F_x = F_f = ma$

$\mu N = ma$

$\mu mg = ma$

$\mu g = a$

$(0.75)(9.8\ m/s^2) = a$

$7.35\ m/s^2 = a$