key Level I Physics Pd 1

Dynamics

AT Dynamics (21 S2)

Directions: Solve the following problems. Your work will be graded, not just the answer. This test is worth 50 points.

1) Determine the mass of an object that weighs 63 N.

$W = mg$

$\frac{W}{g} = m = \frac{63N}{9.8\frac{m}{s^2}} = 6.43kg$

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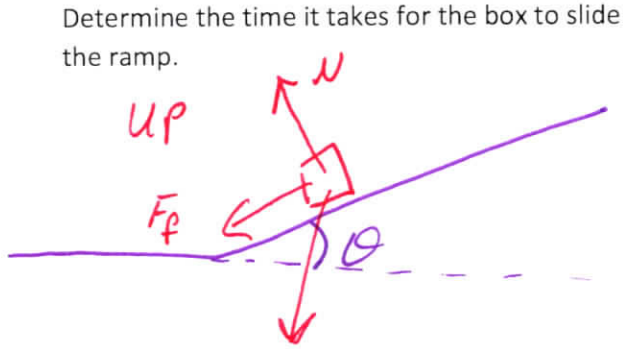
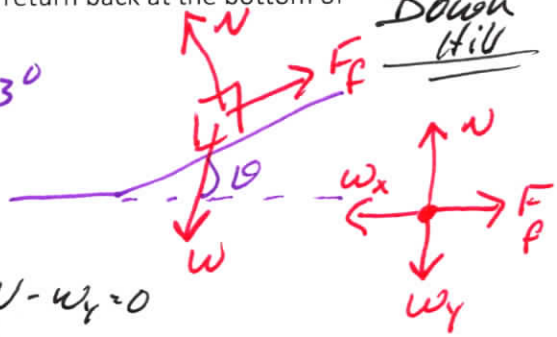
2) A box is pushed on a level and frictionless surface such that it is traveling at 8 m/s. The box then encounters an uphill that has an angle of 23 degrees. There is coefficient of friction of 0.38. Assume the coefficient of static friction and the coefficient of kinetic friction are equal. Determine the time it takes for the box to slide up the ramp and return back at the bottom of the ramp.



$\theta = 23^\circ$



Up the Hill

$\Sigma F_y = N - w_y = 0$

$N = w_y$

$N = mg\cos\theta$

$\Sigma F_x = F_f - w_x = ma$

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

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

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

$\left(9.8\frac{m}{s^2}\right)\left[(.38)\cos(23^\circ) - \sin(23^\circ)\right] = a$

$-.4\,m/s^2 = a$

To the Left..

$\Sigma F_y = N - w_y = 0$

$N = w\cos\theta$

$N = mg\cos\theta$

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

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

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

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

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

$\left(9.8\frac{m}{s^2}\right)(.38\cos(23^\circ) + \sin 23^\circ) = a$

$7.26\frac{m}{s^2} = a$

To the Left; Defined As Such In Line #1

Time To Highest Point Up

$v_0 = 8\,m/s$

$a = -7.26\,m/s^2$

$v = \text{zero}$

$t = ?$

$v = v_0 + at$

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

$\frac{0 - 8\,m/s}{-7.26\,m/s^2} = 1.1s$

Time Down.... need Dist. Up

$v_0 = 8\,m/s$

$v = \text{zero}$

$a = -7.26\,m/s^2$

$x = ?$

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

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

$\frac{-64\,m^2/s^2}{(2)(7.26\,m/s^2)} = 4.4m$

$x = 4.4m$

$t = ?$

$v_0 = \text{zero}$

$a = .4\,m/s^2$

$x = v_0 t + \frac{1}{2}at^2$

$\sqrt{\frac{2x}{a}} = t$

$\sqrt{\frac{(2)(4.4m)}{.4}} = 4.7s$

Total Time

5.8s

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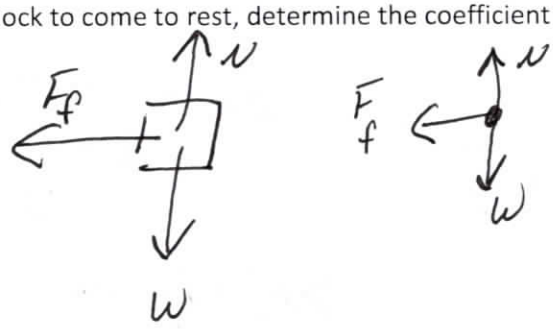
3) A block of ice (Maybe carved into the shape of a sphinx) is pushed on a smooth floor, much like in the café. Figure the block of ice was initially moving at a walking speed of 2 m/s. If it takes 20m for the block to come to rest, determine the coefficient of friction between the ice and the floor.



$\Sigma F_y = N - W = 0$

$N = W$

$N = mg$

$\Sigma F_y = -F_f = ma$

$-\mu N = ma$

$-\mu mg = ma$

$-\mu g = a$

$v_0 = 2\ m/s$

$a = -\mu g$

$v = \text{zero}$

$x = 20m$

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

$0 = v_0^2 + 2(-\mu g)x$

$-v_0^2 = -2\mu g x$

$\frac{v_0^2}{2gx} = \mu = \frac{(2\ m/s)^2}{(2)(9.8\ m/s^2)(20m)} = .01$

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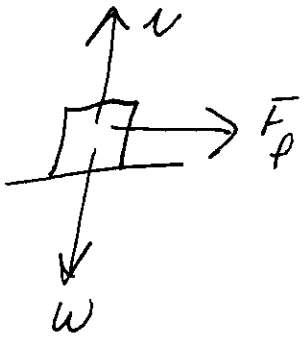
4) A box is riding along in the cargo area of your vehicle. Determine the minimum coefficient of friction between the box and the "floor" of the cargo area so the box doesn't slide when the vehicle accelerates at rates as high as $4 m/s^2$.



$\Sigma F_y = N - w = 0$

$N = w$

$N = mg$

$\Sigma F_x = F_f = ma$

$\mu N = ma$

$\mu mg = ma$

$\mu g = a$

$\mu = \frac{a}{g} = \frac{4\ m/s^2}{9.8\ m/s^2} = .4$

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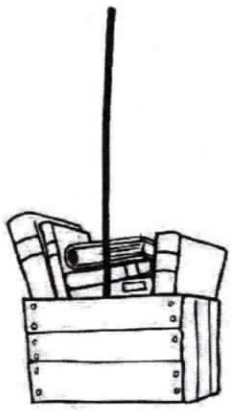
5) A 2 kg box is hanging by a string. Determine the tension in the string when the box accelerates upward at 3 m/s^2.



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

$$T = ma + mg$$

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

$$T = (2kg)(3\,m/s^2 + 9.8\,m/s^2)$$

$$T = 25.6\,N$$

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You are finished with the test....