key Level II Physics Pd 2

KEY KEY KEY

DYNAMICS

FT DYNAMICS (21)

Directions: Solve the following problems. Each is worth 5 points, except if noted at the start of the problem/question. Your work will be graded, not just the answer. Required with each question (with the exceptions of #1, #9, and #10) is a body diagram, free-body diagram, and sum of force equation(s). This test is challenging, not because I want to see you do poorly, but because I feel you are able step up to the challenge. I have been genuinely impressed with your work ethic and your willingness to learn!

1) What is the mass of a 25 kg object?

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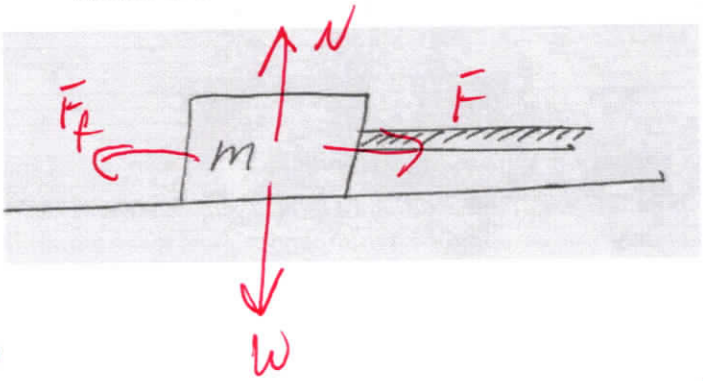
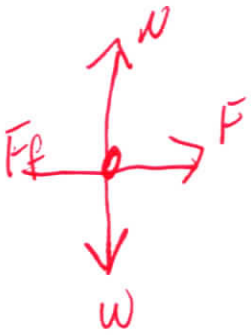
2) The box shown below has a mass of 10kg. The box and the floor have a coefficient of friction of 0.4. Determine the force needed to pull the box at a constant speed.





$\Sigma F_y = N - w = ma$

$N - w = 0$

$N = w$

$N = mg$

$\Sigma F_x = F - F_f = ma$

$F - F_f = 0$

$F = F_f$

$F = \mu N$

$F = \mu mg$

$F = (.4)(10kg)(9.8 m/s^2)$

$F = 39.2 N$

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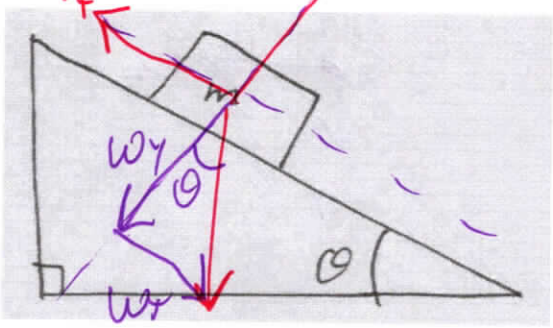
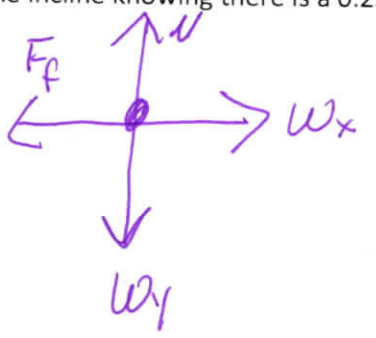
3) The box shown below has a mass of 10kg. The angle of the incline is 30 degrees, determine the acceleration of the box down the incline knowing there is a 0.25 coefficient of friction between the box and the incline.





$\Sigma F_y = N - W_y = ma$

$N - W\cos\theta = 0$

$N = mg\cos\theta$

$\Sigma F_x = W_x - F_f = ma$

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

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

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

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

$(9.8\,m/s^2)(\sin(30) - (.25)(\cos 30)) = a$

$2.78\,\frac{m}{s^2} = a$

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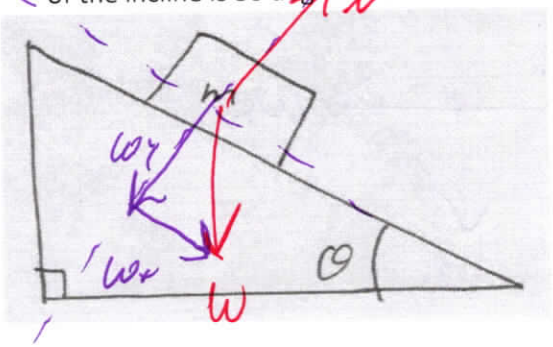
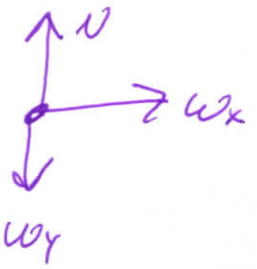
4) The 10 kg box below is on a frictionless incline. Determine the acceleration when the angle of the incline is 30 degrees.





$\Sigma F_x = w_x = ma$

$w \sin\theta = ma$

$mg \sin\theta = ma$

$g \sin\theta = a$

$9.8\ m/s^2 \sin 30^\circ = a$

$4.9\ m/s^2 = a$

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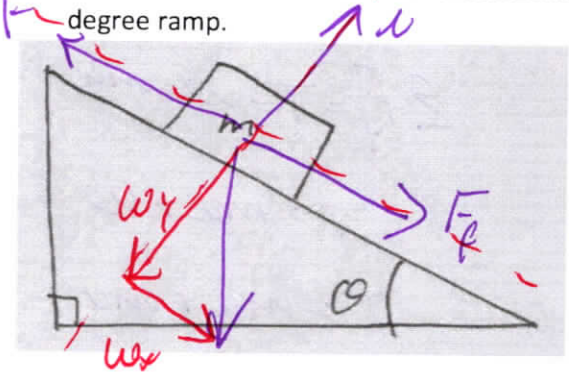
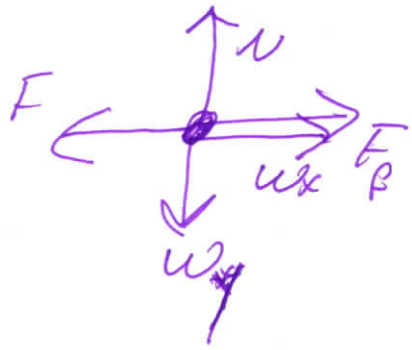
5) The box shown below has a mass of 10kg. The box and the incline have a coefficient of friction of 0.4. Determine the force needed to pull the box at a constant speed up the 30 degree ramp.





$\Sigma F_y = N - W_y = ma$

$N - W\cos\theta = 0$

$N = W\cos\theta$

$N = mg\cos\theta$

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

$F_f + W_x - F = 0$

$F_f + W_x = F$

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

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

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

$(10kg)\left(9.8\frac{m}{s^2}\right)[(.4)(\cos(30)) + \sin(30)] = F$

$83N = F$

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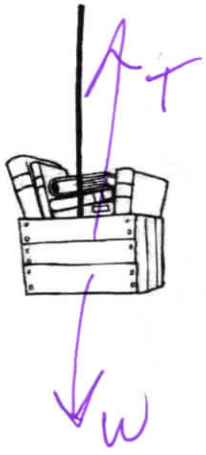
6) Determine the tension in the string when the 10 kg box is accelerated upward at $2 m/s^2$.



$\Sigma F_y = T - w = ma$

$T = ma + w$

$T = ma + mg$

$T = m(a+g)$

$T = (10kg)(2 m/s^2 + 9.8 m/s^2)$

$T = (10kg)(11.8 m/s^2)$

$T = 118 N$

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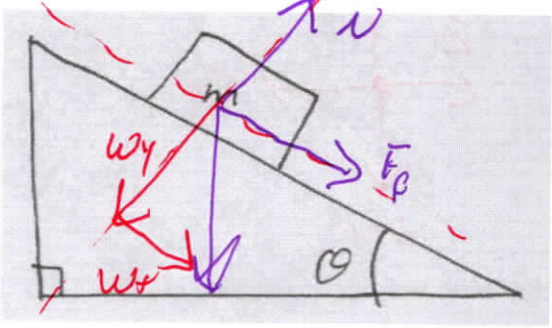
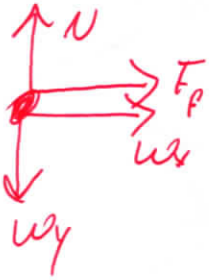
7) The box shown below has a mass of 10kg. The angle of the incline is 30 degrees, and there is a 0.65 coefficient of friction between the box and the incline. Knowing the box is initially moving up the incline at 5 m/s, determine the stopping distance of the box.





$\Sigma F_y: N - w_y = ma$

$N - w_y = 0$

$N = w_y$

$N = w\cos\theta$

$N = mg\cos\theta$

$\Sigma F_x = F_f + w_x = ma$

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

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

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

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

$(9.8\,m/s^2)[(.65)\cos(30) + \sin 30] = a$

$10.4\,m/s^2 = a$

$v_0 = 5\,m/s$

$a = 10.4\,m/s^2$

$v = zero$

$x = ?$

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

$\frac{v^2 - v_0^2}{2a} = x = \frac{0 - v_0^2}{2a} = \frac{0 - (5\,m/s)^2}{2(10.4\,m/s^2)} = -1.2\,m$

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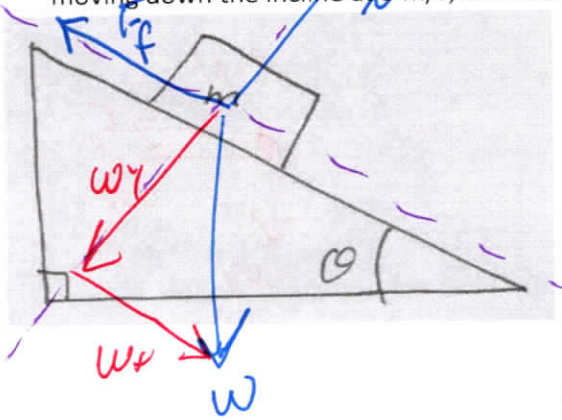
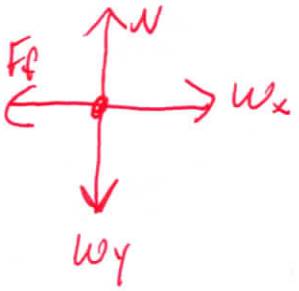
8) The box shown below has a mass of 10kg. The angle of the incline is 30 degrees, and there is a 0.65 coefficient of friction between the box and the incline. Knowing the box is initially moving down the incline at 5 m/s, determine the stopping distance of the box.





$\Sigma F_x = W_x - F_f = ma$

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

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

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

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

$(9.8\,m/s^2)[\sin(30) - (.65)(\cos 30)] = a$

$-.617\,\frac{m}{s^2} = a$

To the Left

$\Sigma F_y = N - W_y = ma$

$N - W_y = 0$

$N = W_y$

$N = W\cos\theta$

$N = mg\cos\theta$

$v_0 = 5\,m/s$

$v = \text{Zero}$

$a = -.617\,m/s^2$

$x = ?$

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

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

$\frac{0 - (5\,m/s)^2}{(2)(-.617\,m/s^2)} = 20.3\,m$

Up the Ramp

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9) (bonus 3 points) if the values in #7 & #8 are different, explain why. If they are not different, explain why going uphill or downhill doesn't matter. Be concise, feel free to use diagrams with words; whatever helps you get the thoughts across.

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10) What is the weight of a 10kg object?

$W = mg$

$W = (10kg)(9.8\ m/s^2)$

$W = 98N$