PHYS-1130(4) (Kaldon-40519)
WMU - Fall 2006
Exam 000 - 000,000 points

Name ____

Book Title ___This is for Topic 1, not your textbook!___
Section: **3a** A to G **3b** H to M **3c** N to S **3d** T to Z Rev.

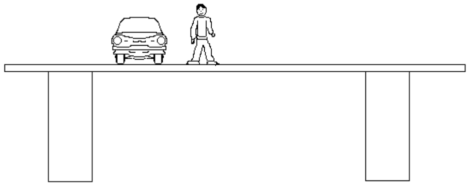
Sample Exam
11/16/06

State Any Assumptions You Need To Make -- Circle Any Final Answers
Use Your Time Wisely - Work on What You Can - Be Sure to Write Down Equations
Show All Work - Feel Free to Ask Any Questions

A Mission to Mars (50,000 points)

1.) (a) Man has dreamed of going to Mars (mass = 6.42×10^{23} kg ; radius = 3.37×10^{6} m) for a long time – and someday we probably will. It is a smaller planet than our Earth and its gravity is weaker. Here on Earth, a man has a weight of 1320 N. What would this 1320 N man weigh on Mars? $G = 6.67 \times 10^{-11}\ N{\cdot}m^2/kg^2$

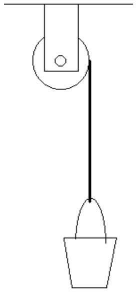
To travel to Mars, our intrepid astronaut first has to get to work in his car. The parking deck has a mass of 11,400 kg and is 20.0 m wide. Support Piers 1 and 2 are located 3.00 m from the ends. The 1950 kg car is 6.00 m from the left and our 1320 N astronaut is 3.00 meters from the center-of-mass of the car. Find the support forces (b) F_1 and (c) F_2. *To get full credit, you must include the F.B.D. and the F.R.D.*



(d) Our astronaut's car ($m_1 = 1950\ kg$, $v_1 = 29.1\ m/s$) accidentally runs into an SUV ($m_2 = 2480\ kg$). The wreck moves at $V = +11.3\ m/s$. What was the speed and direction of the SUV before the crash?

(e) This collision is a Totally Inelastic Collision. Show that K.E. is not conserved in this collision, that is, that the total K.E. before is not equal to the total K.E. after. *If you can't get an answer to (d), see Dr. Phil.*

Spinning and Falling and Crashing and Spilling… (50,000 points + A Bonus Round)



2.) (a) A bucket (m = 5.00 kg) is hanging at rest from a 1.00 m length of cable ($Y = 10 \times 10^{10}$ N/m² , square cross-section $A = 4.00 \times 10^{-6}$ m²). How much does the cable stretch?

(b) The cable is wrapped around a solid cylinder (m = 12.5 kg , R = 0.200 m). Draw the Free Body Diagram of the bucket and the Free Rotation Diagram of the cylinder.

(c) Find the acceleration of the bucket if the brake on the cylinder is released. *We are neglecting the mass of the cable in this problem.*

(d) The bucket starts off at rest 12.5 meters above the ground. If the brake on the cylinder is released and the unwinding cable does not slip on the cylinder, find the speed of the bucket just before it hits the ground.

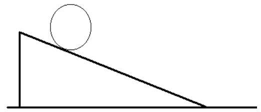
(e) What is the angular speed of the cylinder just before the bucket hits the ground?

(f) Tony pours some Coca-Cola™ into the glass ($\rho_{Coke} = 1060\ kg/m^3$) and adds a one cubic inch ice cube ($0.0250\ m \times 0.0250\ m \times 0.0250\ m$ *dimensions*, $\rho_{ice} = 917\ kg/m^3$). The ice cube floats level in the glass. How much of the *0.0250 m* height is submerged?

(g) To wash his pans after his Mac & Cheese dinner, Tony turns on the faucet and water comes out 8.72 m/s. If the water pressure in the pipe came just from a water tower, how high would the water be compared to Tony's kitchen sink faucet?

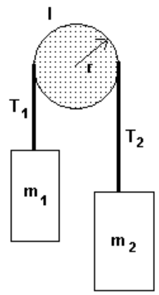
(h) The planet Venus is sometimes described as Earth's mean twin, because while it is about the same size as Earth, its atmosphere is poisonous and it is far too hot. If the mass of Venus is $4.88 \times 10^{24}\ kg$ and its radius is $6.06 \times 10^{6}\ m$, find the acceleration due to gravity, g_{Venus} . $G = 6.67 \times 10^{-11}\ N{\cdot}m^2/kg^2$

Ends and Odds (60,000 points)



3.) A hollow ball of mass 0.838 kg and radius 0.135 m starts out on at rest an inclined plane 0.400 m above the ground. (a) Find the speed of the ball at the bottom of the ramp if there is no friction and the ball slides without rotating.

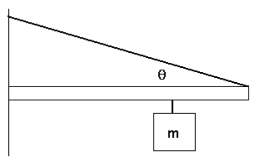
(b) Find the speed of the ball at the bottom of the ramp if there is friction and the ball rotates without sliding.



(c) A real pulley, made of a 1.50 kg solid disk 0.150 m in *diameter*, is attached to two masses, m_1 = 10.0 kg and m_2 = 15.0 kg, which are initially at rest. Find the acceleration of the two masses, a_1 and a_2, and the angular acceleration of the pulley, α.

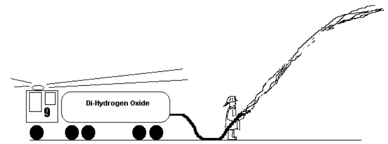
(d) Find θ and ω of the pulley after 2.00 seconds. *If you did not get an answer to (c), use $\alpha = 1.23$ rad/s².*

(e) A metal pole 4.00 meters long and a weight 98.1 N is kept from falling by a taut steel cable at an angle $\theta = 24°$. A mass of 12.0 kg is suspended 1.33 meters from the end. Draw the Free Body Diagram and the Free Rotation Diagram of the metal pole. There is an unknown force F_1 from the wall on the base of the metal pole at left – set your axis of rotation there. Find the tension T_1 in the steel cable.



(f) The steel cable ($Y_{steel} = 20.0 \times 10^{10}$ N/m²) is stretched by 0.0100 mm. If the cable has a square cross-section of sides d, find d. *If you did not get an answer to (d), use T_1 = 135 N.*

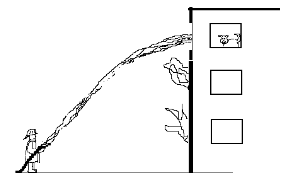
"Engine Company 7, Time Out, 15:48." "Roger." (35,000 points)



4.) (a) At what angle should the fireman hold the nozzle to get the maximum range of her water stream?
This requires no calculation – just short answer!

(b) The water tank in the fire truck is pressurized to gauge pressure of 147 psi (10 atmospheres = 1,013,000 Pa). The pressure outside is the normal atmospheric pressure of 1 atmosphere = 101,300 Pa = 14.7 psi. What is the speed of the water coming out of the fireman's hose? *Assume no height difference between the nozzle and the tank.*

ρ_{water} = *1000 kg/m³*



(c) What height for a open column of water in a water tower would give the same gauge pressure of 147 psi (10 atmospheres = 1,013,000 Pa)?

(d) There isn't enough 3 inch hose to get the water close enough to the fire, so they have to splice in a section of 1 inch hose in between two pieces of 3 inch hose. What is the speed of the water in the 1 inch section of hose?
1 inch = 0.0254 m. If you didn't get an answer to part (b), use v_1 = 25.0 m/s.

(e) In the fuel tank of the fire truck, a small *float* goes up and down to let you know how full (or empty) your fuel tank is, sort of like the float in the tank of the toilet in your bathroom. Suppose that a fuel tank float has dimensions 1.00 cm × 1.00 cm × 0.300 cm (0.0100 m × 0.0100 m × 0.00300 m). Find the mass of this fuel tank float, if it is exactly half-submerged in the diesel fuel? ρ_{diesel} = *820. kg/m³*