

PHYS-1130(4) (Kaldon-40519)

Name \_\_\_\_\_

WMU - Fall 2006

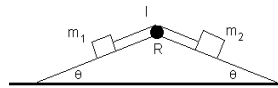
Exam 000 - 000,000 points

Book Title     This is for Topic 1, not your textbook!    Sample Exam  
11/09/06Section:      **3a**    **3b**    **3c**    **3d**  
                  A to G    H to M    N to S    T to Z    Rev.

**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**

**The (Inclined) Plane Truth (50,000 points)**

1.) Two masses,  $m_1$  and  $m_2$ , are connected over a real pulley with moment of inertia,  $I$ , and radius  $R$ , and where  $m_1 < m_2$ . Setup *But Do Not Solve* the equations from the Free Body Diagrams for (a)  $m_1$ , (b)  $m_2$  and from the Free Rotation Diagram for (c) the pulley. *You must indicate which way the masses and the pulley intend to move, and have the equations properly linked with each other.*

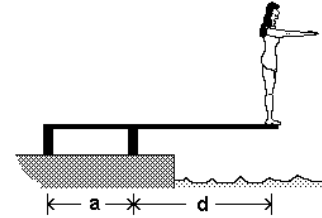


(d) A 5.00 kg ball of radius 0.150 m is rolling along without slipping at 5.00 m/s. Find the total kinetic energy of this ball – both linear and rotational terms.

(e) If this ball rolls into a spring and comes to a stop in 0.280 m, find the spring constant  $k$  of the spring.

**Dive! Dive! Dive! (50,000 points)**

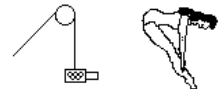
2.) (a) Wei Lin Shi of the People's Republic of China,  $m = 45.0$  kg, is standing at the end of 3.00 m long diving springboard (mass = 20.0 kg), contemplating her next jump. The board is supported at the left end by two struts, 1.20 m apart. Draw the Free Body Diagram and Free Rotation Diagram of the diving board. *Call the support force on the left  $F_1$  and the support toward the middle  $F_2$ . Assume that the diving board is completely uniform.*



What are the vector support forces, (b)  $F_1$  and (c)  $F_2$  ?



(d) One of the cooler technologies at the 1996 Olympics was NBC's "dive cam", where a camera (5.00 kg) was moved on a cable to follow the diver. If the cable is a composite fiber ( $Y = 10.1 \times 10^6$  N/m<sup>2</sup>, with a radius of 0.00700 m), what is the strain on the cable while the camera is at rest? *Ignore the pulley.*



(e) If the length of cable above the camera is 1.125 meters, then how far is the cable stretched?

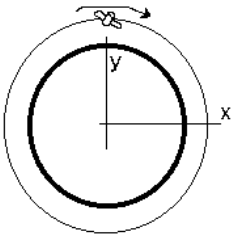
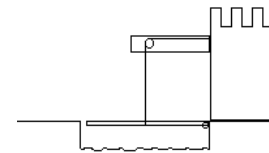
**Mars (50,000 points)**

3.) The planet Mars has a radius of 3398 km and a mass of  $6.57 \times 10^{23}$  kg. (a) An astronaut in a spacesuit has a weight of 981 N on the surface of the Earth. What would their weight be on the surface of Mars?

(b) The Mars Observer satellite ( $m = 227$  kg) is in a circular orbit 111 km above the surface of Mars. Calculate the acceleration due to gravity at this altitude.

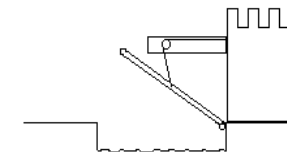
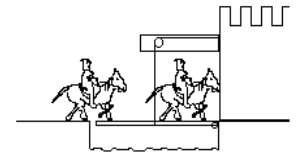
What is the orbital speed of the satellite in (c) m/s and (d) the angular speed in rad/s? *If you didn't get an answer to (b), use  $a_c = g/4 = 2.45$  m/s<sup>2</sup>.*

(e) The general solution to the Simple Harmonic Oscillator problem is  $x(t) = A \sin(\omega t) + B \cos(\omega t)$ . Consider our satellite going around Mars in the  $x$ - $y$  plane. Find the value of the constants  $A$  and  $B$  which describe  $x(t)$ , for when the satellite is at  $x = 0$  and  $t = 0$  as shown.

**From the Days of Chivalry and Knights Errant (50,000 points)**

4.) A drawbridge, 8.00 m long and with a weight of 2350 N, is lowered over a moat. It is held up by a hinge at the right and a cable that attaches to the middle of the drawbridge. There is no support on the left. Find (a) the tension in the cable,  $T_1$ , and (b) the force,  $F_1$ , supplied by the hinge.

(c) A bunch of knights in armor and their horses come clomping across the bridge. Explain (briefly!!!) what happens to  $T_1$  and  $F_1$  as the loading on the bridge continues.



(d) Set up *but do not solve* the equations for where the drawbridge is raised at a  $40^\circ$  angle, where the cable is  $10^\circ$  off from vertical.

(e) The 4.00 meter long cable ( $Y_m = 13.5 \times 10^{10}$  N/m<sup>2</sup>) is stretched by  $4.00 \times 10^{-3}$  m by the tension force found in part (a). What is the diameter of the cable? *If you didn't get the answer in (a), use  $T_1 = \text{weight of the drawbridge}$ .*