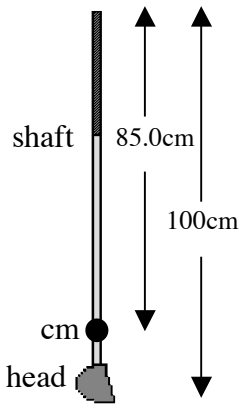
Name:_____

Solve the following problems in the space provided. Use the back of the page if needed. Each problem is worth 10 points. You must show your work in a logical fashion starting with the correctly applied physical principles. The equations you need are on the equation sheet. Your score will be maximized if your work is easy to follow because partial credit will be awarded.

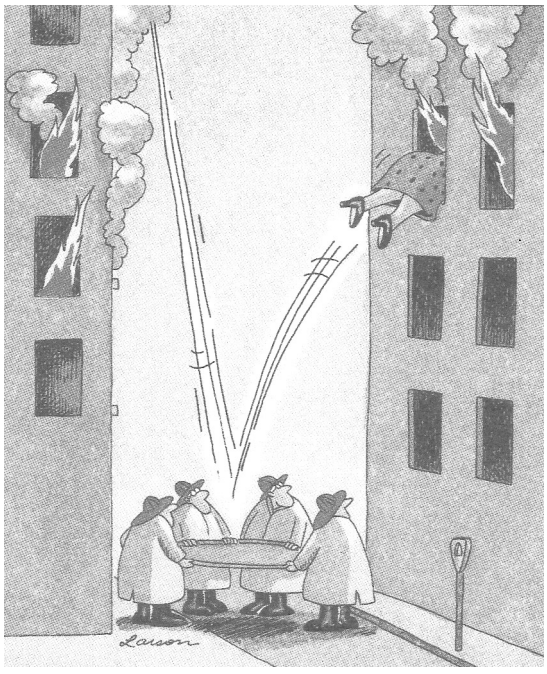
1. A soccer ball is kick with a speed of 18.0m/s at a 30.0° angle above the horizontal. Find (a)the time it is in the air and (b)the distance it travels before it hits the ground.

2. A gardener pushes a 7.00kg lawn mower at the constant speed of 0.800m/s across level ground by exerting a force of 60.0N directed along the handle, which makes a 50.0° angle with the horizontal. Find the size of (a)the normal force and (b)the frictional force on the mower.

3. The golf club shown at the right is 1.00m long. The head has a mass of 700g and the shaft has a mass of 200g. The center of mass is 85.0cm below the top of the shaft. At the bottom of the swing, the club head is moving at 9.00m/s in circular motion about the top of the shaft. Find the vertical component of the force that the shaft exerts on the head at this instant.



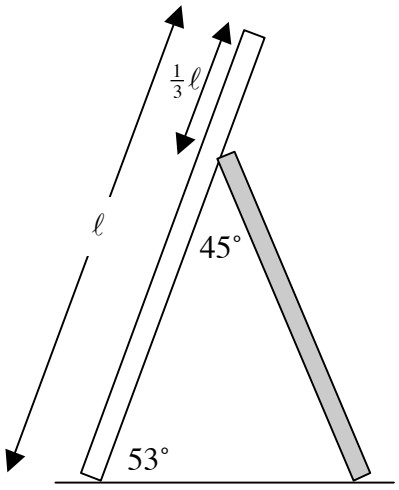
4. The 52.0kg woman pictured at the right falls into the safety net and stretches it 0.500m. The net springs back and he flies through the third story window 9.00m above the net at a speed of 13.0m/s. Estimate the height of the window she fell from.



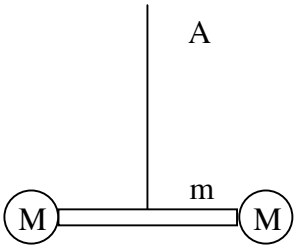
5. Three equally massive and equally strong astronauts are outside their ship in outer space. Two of them get the bright idea to play a game of catch by throwing the third one back and forth. Suppose the game begins with the first astronaut throwing the third astronaut toward the second astronaut at a speed v_o. Describe the rest of the game. This means that you must find the velocity of each astronaut after each catch and after each throw. Sketches of the game at each stage might be the best way to explain your answer. Be sure to state the principle or principles you use.

6. A circular saw blade has a mass of 200g and a radius of 9.20cm. It starts from rest and 2.00s later is had a rotation rate of 210rad/s. Find (a)the torque exerted by the motor and (b)the energy the motor supplied to the blade.

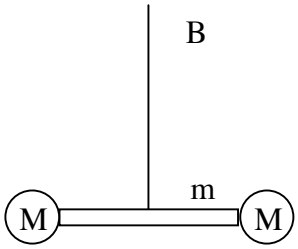
7. A 500g picture frame is propped up at a 53.0° degree angle by a stick (shown in gray) that contacts the frame one-third of the way down. The stick makes a 45.0° angle with the frame. Assuming that the stick only exerts force perpendicular to the frame, find the size of the force it exerts.



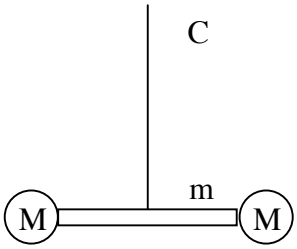
8. Shown below is a stick of mass, m, hung by a thread from its center. At the end of each stick are two equal masses, M. The threads are identical. The arrangement is set into oscillatory motion about the axis defined by the thread. In other words, the stick and masses move in a horizontal plane. Rank from greatest to least based on the period of oscillation. That is, rank the system with the longest period first and the shortest period last. Be sure to explain your reasoning.



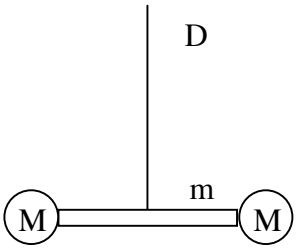
m = 30g
M = 30g



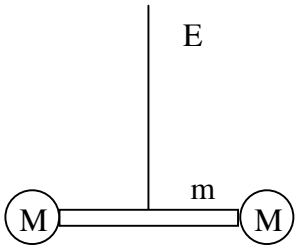
m = 30g
M = 20g



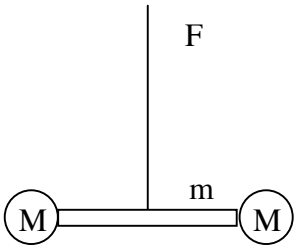
m = 30g
M = 10g



m = 60g
M = 30g



m = 60g
M = 20g



m = 60g
M = 10g

9. Complete the physics problem alluded to in the newspaper article at the right. Assume Xena's moon completes one orbit of radius R in a time T. Find the mass of Xena.

Scientists Discover 10th Planet's Moon
By Alicia Chang
Associated Press 01 October 2005

LOS ANGELES (AP) -- The astronomers who claim to have discovered the 10th planet in the solar system have another intriguing announcement: It has a moon.

While observing the new, so-called planet from Hawaii last month, a team of astronomers led by Michael Brown of the California Institute of Technology spotted a faint object trailing next to it. Because it was moving, astronomers ruled it was a moon and not a background star, which is stationary.

The moon discovery is important because it can help scientists determine the new planet's mass. In July, Brown announced the discovery of an icy, rocky object larger than Pluto in the Kuiper Belt, a disc of icy bodies beyond Neptune. Brown labeled the object a planet and nicknamed it Xena after the lead character in the former TV series ``Xena: Warrior Princess.'' The moon was nicknamed Gabrielle, after Xena's faithful traveling sidekick.

By determining the moon's distance and orbit around Xena, scientists can calculate how heavy Xena is. For example, the faster a moon goes around a planet, the more massive a planet is....

10. Treasure divers investigating a shipwreck find a gold bar that is 5.00cm by 10.0cm by 30.0cm. The density of gold is $19.3 \times 10^3 kg/m^3$. Find the force they must exert to lift it off the ocean floor.