

Physics 131-2 Test 2

I pledge that I have neither given nor received unauthorized assistance during the completion of this work.

Signature _____

Questions (10 pts. apiece) Answer in complete, well-written sentences WITHIN the spaces provided.

1. Can a string support a lateral force? Explain.
2. Given an object with a mass equal to the standard kilogram, how would you determine if a force applied to it has a magnitude equal to one newton? Ignore friction.
3. Two masses are hung by strings draped over pulleys and connected by a spring scale as shown in the figure. The spring scale in the figure reads twice the mass m . Is this correct? Explain?
4. What is Kepler's First Law? What is your evidence that it is correct or incorrect?
5. A coin lies on a turntable whose speed is gradually raised from zero. What happens to the magnitude of the friction force on the coin as the speed is increased to a large value?

Problems. Clearly show all reasoning for full credit. Use a separate sheet to show your work.

1. 15 pts. How far from Earth must a space probe be along a line toward the Sun so that the Sun's gravitational pull on the probe balances the Earth's pull?

2. 15 pts. A 2.0-kg block is pushed along a horizontal floor by a force $|\vec{F}| = 10\text{ N}$ at an angle $\theta = 45^\circ$ with the horizontal as shown in the figure. The coefficient of kinetic friction between the block and the floor is $\mu = 0.2$.
 1. What does the free-body diagram look like for this block?
 2. What is the frictional force exerted on the block?

3. 20 pts. You are asked to design bumpers for the walls of a parking garage. The specifications are that a 1200-kg car moving at 0.50 m/s can compress the bumper no more than 0.05 m before bringing the car to a halt. The bumpers obey Hooke's Law.
 1. Sketch the force exerted by the bumper as its is compressed a distance x_1 . Label the endpoints of your curve with their $x - y$ values in terms of x_1 and k the spring constant.
 2. What is the work done by the bumper when it is compressed? Explain your answer using the figure you made above.
 3. What is the required spring constant of the bumper?

Some constants.

Acceleration of gravity (g)	9.8 m/s^2	Gravitational constant	$6.67 \times 10^{-11}\text{ N} \cdot \text{m}^2/\text{kg}^2$
Earth-Sun distance	$1.5 \times 10^{11}\text{ m}$	Earth mass	$6 \times 10^{24}\text{ kg}$
Sun mass	$2 \times 10^{30}\text{ kg}$		