

Physics 101

Test 2

Oct 26 2015

Name: \_\_\_\_\_

This test is administered under the rules and regulations  
of the Honor Code of William & Mary.

Signature: \_\_\_\_\_

**Problem Session** (circle one):

Wed. 9:00 am (Prof. Cooke)

Wed. 3:00 pm (Prof. Aubin)

Thurs. 1:00 pm (Prof. Sher)

Thurs. 3:30 pm (Prof Krakauer)

Tues. 1:00 pm (Prof. Mikhailov)

Thurs. 2:00 pm (Prof. Vahala)

1. \_\_\_\_\_ (25 points)

2. \_\_\_\_\_ (25 points)

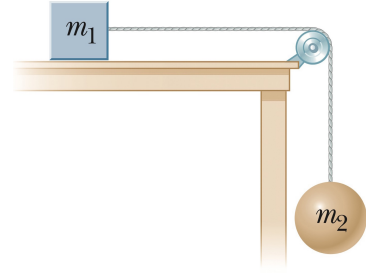
3. \_\_\_\_\_ (25 points)

4. \_\_\_\_\_ (25 points)

Total \_\_\_\_\_

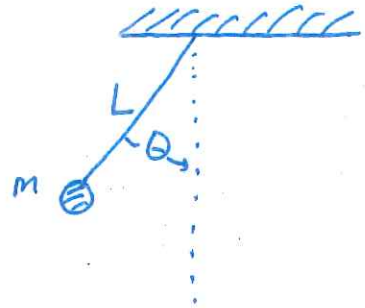
## Problem 1.

Two masses,  $m_1 = 3.0$  kg and  $m_2 = 5.0$  kg are connected via a light rope, as shown in the figure. The system starts at rest. The coefficient of kinetic friction between  $m_1$  and the surface is  $\mu_k = 0.400$ . Use energy considerations to determine the speed of mass  $m_2$  when it has fallen a distance of  $h = 1.50$  m.



## Problem 2.

A pendulum consists of a bob of mass  $m$  attached to a massless string of length  $L$ . The bob is pulled aside so that the string makes an angle of  $\theta$  with the vertical, as shown, and is released from rest. Find:



- The speed  $v$  of the bob when it is at the lowest point on its swing.
- The tension  $T$  in the string at that moment.

### Problem 3.

An innocent duck is flying horizontally to the left at 3.0 m/s. Unfortunately for him, he is struck by a hunter's bullet, traveling at 100 m/s horizontally to the right. The bullet sticks inside the duck. The mass of the duck is 1.5 kg, and that of the bullet is 50 grams. Neglect any effects due to gravity or air resistance<sup>1</sup>.

- a) What is the velocity (magnitude *and* direction) of the duck after the collision?
- b) How much mechanical energy was converted into other forms (heat, sound, chemical...) in the collision?
- c) Which is larger: the force the bullet exerted on the duck, or the force the duck exerted on the bullet?

<sup>1</sup> No actual ducks were harmed in the crafting of this question.

### Problem 4.

A constant force  $\vec{\mathbf{F}} = (3.0\text{N})\hat{\mathbf{i}} - (2.0\text{N})\hat{\mathbf{j}} + (4.0\text{N})\hat{\mathbf{k}}$  is exerted on an object which moves from  $r_1 = (1.0\text{m})\hat{\mathbf{i}} - (3.0\text{m})\hat{\mathbf{j}}$  to  $r_2 = (4.0\text{m})\hat{\mathbf{i}} - (5.0\text{m})\hat{\mathbf{j}}$ .

- a) How much work is done by this force on the object?
- b) What is the angle between the force  $\vec{\mathbf{F}}$  and the displacement vector?