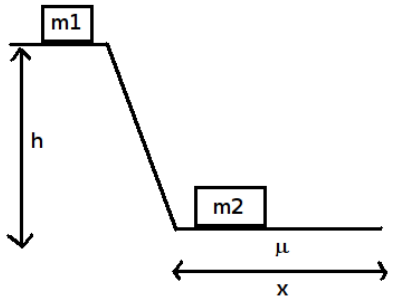
Instructions: You have a total of 55 minutes to complete this test.
Answer each of the following questions completely. You must supply all details that led to your answer and provide correct SI units where required. Constants: $g = 9.8 \frac{m}{s^2}$

Time Start_____ Time finish_____ Pledged_____

Do not discuss any aspect of this test with anyone until I return the test.



1. A mass m1 falls through the height h (here the surface is frictionless) starting with zero velocity. It strikes and sticks to mass m2 and moves along the lower surface. Along this lower surface, the coefficient of friction is μ. In order to complete this problem successfully, you must **use energy considerations**.
a. How fast is mass m1 moving at the bottom, right before it strikes m2. Your answer must involve **m1, g and h** only.

b. Immediately after mass m1 strikes and sticks to mass m2, how fast is the system moving? Your answer must involve **m1, g, h and m2** only.

c. How far (indicated by x above) does the system move along the lower surface until it stops? Your answer must involve m1, g, h, m2 and μ only.

2. A mass m is resting against a spring of spring constant k. The spring is allowed to expand through a distance Δx. In answering this problem, **you must use energy considerations**.
(a). How fast is the mass m moving immediately after the spring uncompresses? Your answer here should involve k, Δx, and m only.

(b) How high (h) will the mass m travel until it comes to a complete stop? Your answer here must involve k, Δx, m, and g only.

(c) If k=10.0 N/m, m=1.0 kg, and Δx=0.5 m, provide numerical results together with correct SI units for (a) and (b).

v=_____

h=_____

3. A wheel of radius R is subject to an angular acceleration $\alpha = bt$, where b is a constant with SI units of "rad"/s^3. **After a time t**, answer the following questions: (**aside from numerical constants, your answers must involve only α, R, b, and t for each part**)

(a) what is the angular velocity of a point on the wheel?

(b) Through what angle has the wheel turned?

(c) what is the tangential acceleration of a point on the wheel?

(d) What is the centripetal acceleration of a point on the wheel?

(e) what is the magnitude of the total acceleration of a point on the wheel?

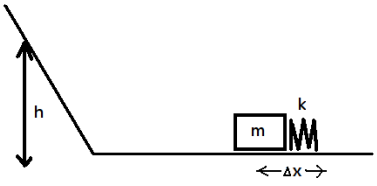
(f) Suppose a rock that was earlier stuck to the wheel flies off at time t. With what velocity does the rock move?

(g) Suppose that this rock has a mass m_1 and elastically collides with a much smaller mass m_2. Approximately how fast will mass m_2 move after the collision?

4. A mass m is resting against a spring of spring constant k. The spring is allowed to expand through a distance Δx. In answering this problem, **you must use energy considerations**.

(a). How fast is the mass m moving immediately after the spring uncompresses? Your answer here should involve k, Δx, and m only.

(b) How high (h) will the mass m travel until it comes to a complete stop? Your answer here must involve k, Δx, m, and g only.



(c) If k=10.0 N/m, m=1.0 kg, and Δx=0.5 m, provide numerical results together with correct SI units for (a) and (b).

V=_____ h=_____