October 9, 2019	Physics 240: UnTest #2: page 1	Name _____

Time Start_____ Time finish_____ Pledged_____

Instructions:

You have a total of 50 minutes to complete this test. Answer each of the following questions completely. Supply all details that led to your answer and correct SI units where required.Do not discuss any aspect of this test with anyone until I return the test.

Constants: $g=9.8\ m/s^2$

[1] A point mass M is attached to a massless hoop of radius R=1m and the hoop has an axis in the center and massless spokes are attached to the hoop so it can spin like a bicycle wheel. The hoop (starting from rest and from zero angle) undergoes undergoes an angular acceleration given by $\alpha=bt$ where b is a positive constant with SI units of "rad"/s^3. You may assume that the mass is initially at rest and is initially at θ=0. After a time of t=2 s, answer the following for the case **(with correct SI units)** in which $b=3 rad/s^3$.

(a) What is the angular velocity of the mass?

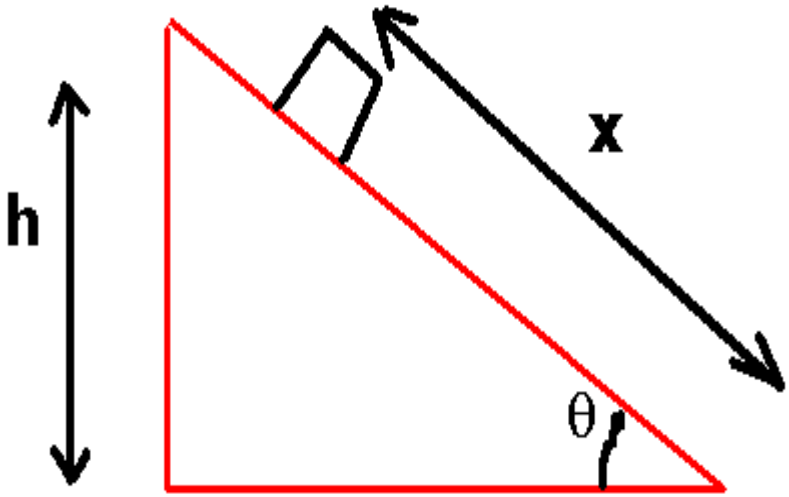
(b) What is the angle that the mass has gone through?

(c) What is the tangential velocity of the mass?

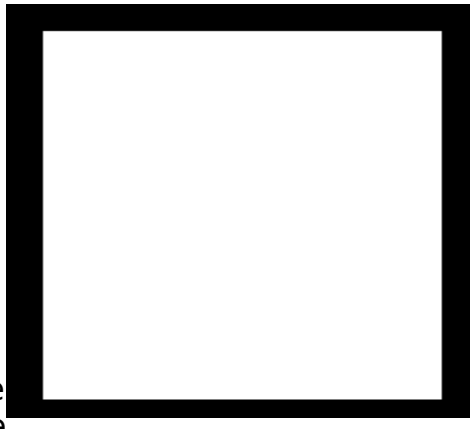
(d) What is the centripetal acceleration (a_c) of the mass?

(e) What is the tangential acceleration (a_t) of the mass?

(f) What is the magnitude of the translational acceleration?



[2] A mass m is resting on a frictionless inclined plane (inclined at an angle θ) at a height h above the floor. After the mass reaches the bottom of the plane, the coefficient of friction between the plane and the flat surface after the base is μ.



(a) Draw a correct and complete free body diagram for the mass as it slides along the flat surface after the plane. Be sure to indicate the direction of acceleration and velocity here.

(b) If the mass is allowed to slide down the plane, how fast is it moving at the bottom of the plane in terms of g and h?

(c) How far will the mass slide until it stops in terms of v, μ and g ?

(d) if m=4 kg, h=1 m, and μ=0.5, provide a numerical answer for [a] and [b] together with correct SI units.

(d:a) v=_____ **(d:b)** x=_____

[3] Suppose a force varies in time as $\vec{F}=(bt^2)\hat{x}$ where b is a constant which has SI units of N/s^2 . This force is applied to a point mass m which is initially at rest for a time t. Note that the impulse is given by $\vec{J}=\int \vec{F}\,dt$.

(a) What is the change in the **vector** momentum of the mass in terms of the symbols b and t?

(b) What is the **vector** velocity of the mass after a time t in term of the symbols b, m and t?

(c) After the time t, the mass strikes and compresses a spring of spring constant k (at which time the force is completely removed). When the mass stops, how much is the spring compressed in terms of the symbols b, m,k and t?

(d) Provide numerical answers to (b) and (c) above with correct SI units for the case m=2Kg, t=2 s, b=3 N/s^2 and k=50 N/m.

(d:a) v=_____ **(d:b)** x=_____

[4] A mass m_1 is moving along the x-axis at a velocity v_b. In this problem, assume m_1=2 kg, m_2=6 kg, and $\vec{v}_b = +30\,\text{m/s}\,\hat{x}$. Your answers here must show details and **include correct SI units.**

(a) If m_1 strikes and sticks to mass m_2 which initially at rest, how fast is the system traveling after the collision?

(b) After m_1 strikes mass m_2 , the mass combination slides up a frictionless plane. How far (h) above the ground level will the combined mass slide until it stops?

(c) Suppose that mass m_1 struck mass m_2 and went through a completely elastic collision. What is the **vector** velocity of each mass after the collision?

$\vec{v}_{1a}$ =_____ $\vec{v}_{2a}$ =_____