October 5, 2016	Physics 240: UnTest #2: page 1	Name ____________________

Time Start________________ Time finish________________ Pledged______________________

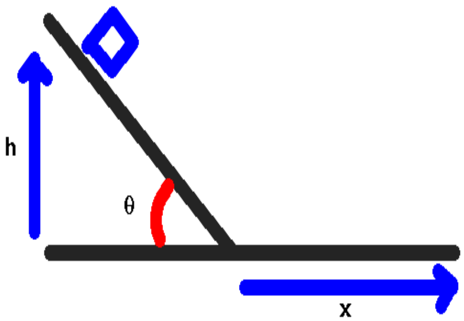
Instructions: You have a total of 55 minutes to complete this test.
Answer each of the following questions completely.
Supply all details that led to your answer and correct SI units where required.
Do not discuss any aspect of this test with anyone until I return the test.

[1] A point mass is attached to the end of a massless bar of length R=4m. The other end of the bar is attached to a hinge at the origin. Suppose a mechanism is devised so that the mass has an angular position given by $\theta = bt^3$ where b is a positive constant with SI units of "rad"/s^3. Note that the mass is initially at rest and is initially at θ=0. After a time of t=3 s, answer the following for the case (with correct SI units) in which b=2 rad/s^3.

(a) What is the angle the mass has gone through (θ)?
(b) What is the angular velocity (ω)?
(c) What is the angular acceleration of the mass (α)?

Suppose that at t=5 s, ω=1.50 rad/s and α=2.50 rad/s^2.
Use these values for the rest of the problem.
(d) What is the tangential velocity (v_t) of the mass.

(e) What is the centripetal acceleration (a_c) of the mass?
(f) What is the tangential acceleration (a_t) of the mass?
(g) What is the magnitude of the acceleration?



[2] A mass m is resting on an inclined plane (inclined at an angle θ) at a height h above the floor. The plane is frictionless. When the mass strikes the bottom of the plane, it slides along a flat surface through a distance x. There is a coefficient of friction μ between the mass and the level surface.

[a] Draw a correct and complete free body diagram for this system when the mass is on the level surface.

[b] When the mass slides along the level surface until it stops, calculate ΔK_{NC} . Your answer here must involve the symbols g, m, x and μ.

[c] Calculate ΔK_c in terms of m and v (velocity) starting at the beginning and ending where the mass has stopped.

[d] Calculate ΔU in terms of m, g and h.

[e] Solve, using your energy equation, to find out how far the mass slides until it stops.

[f] if h=2 m, and μ=0.25, provide a numerical answer for [e] together with correct SI units.

[3] Suppose a force varies in time as $\vec{F}=(F_0+bt)\hat{x}$ where b is a constant which has SI units of $\frac{N}{s}$. This force is applied to a mass m which is initially at rest for a time t_1.

(a) What is the change in the **vector** momentum of the mass in terms of the symbols F_0, b and t?

(b) After a time t, the force is removed and the mass is allowed to slide up a frictionless plane until it stops. When it stops, how high is it above the ground level? Your answer involves m, F_0 ,b, t, and g.

(c) Provide numerical answers to (b) and (c) above with correct SI units for the case F_0=2N, m=1Kg, t=2 s and b=3 N/s.

h=______________

[4] A mass m_1 is moving along the x-axis at a velocity v_b. In this problem, assume m_1=3 kg, m_2=1 kg, and $\vec{v}_b = +20\frac{m}{s}\hat{x}$. **Your answers here must show details and include correct SI units.**

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

(b) After the collision, the mass combination encounters a spring of spring constant k=10 N/m. How much will the mass combination compress the spring until it stops?

(c) Suppose that the mass struck a mass m_2 and instead of sticking together, went through a completely elastic collision. After the collision, what is the **vector** velocity of each mass?

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