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.

$g=9.8\ m/s^2$

[1] A point mass is attached to the end of a massless bar of length R=2m. The other end of the bar is attached to a hinge at the origin. Suppose a mechanism is devised so that the mass undergoes an angular acceleration given by $\alpha=\alpha_0$. You may assume that the mass is initially at rest and is initially at $\theta=0$. After a time of t=2 s, answer the following for the case **(with correct SI units)** in which $\alpha_0=5\,rad/s^2$.

[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?

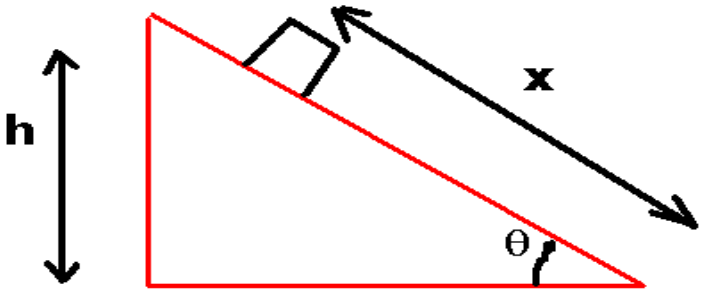
[d] What is the centripetal acceleration (a_c) of the mass?

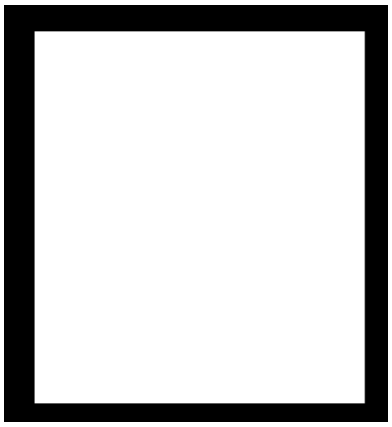
[e] What is the tangential acceleration (a_t) of the mass?

[f] What is the magnitude of the total acceleration?

[2] A mass m is resting on an inclined plane (inclined at an angle θ) at a height h above the floor. The coefficient of kinetic friction between the mass and the plane is μ. Note that x and h are related by $h = x\sin(\theta)$.

[a] draw a correct free body diagram for this system.





Suppose the mass is given a tiny theoretical velocity down the plane (which you may approximate to be zero).

[b] When the mass slides down the plane (through the distance x), calculate ΔK_{NC} . Your answer here must involve h, μ, g, and m.

[c] Calculate ΔK_C in terms of m and v.

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

[e] How fast is the mass traveling at the bottom of the plane?

[f] if h=2.0 m, μ=0.10 and $\Theta = 60^0$, provide a numerical answer for [e] **together with correct SI units.**

[3] Suppose a force varies in time as $\vec{F}=F_0\hat{x}$ where F_0 is a constant . This force is applied to a mass m which is initially at rest for a time t.

[a] What is the change in the **vector** momentum of the mass in terms of the symbols F_0, and t?

[b] What is the **vector** velocity of the mass after a time t in term of the symbols F_0, 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 F_0 , m,k and t?

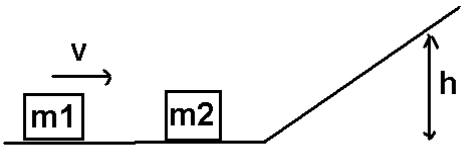
[d] Provide numerical answers to (a), (b) and (c) above **with correct SI units** for the case F_0=2N, m=1.0Kg, t=2 s, and k=5 N/m.

[d:a] $\Delta\vec{P}$ =_____ **[d:b]** $\vec{v}$ =_____ **[d:c]** 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=3 kg, and $\vec{v}_b = 15\,\hat{x}\,\text{m/s}$. 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] How far (h) will the combination slide up a frictionless inclined plane 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?

v_{1a} =_____ v_{2a} =_____