

October 5, 2026	Physics 210: UnTest #2: page 1	Name _____
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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 mass $m_1 = 1.0$ kg moving on a frictionless horizontal table with speed $v_0 = 12.0$ m/s collides perpendicularly with a mass $m_2 = 3.0$ kg and sticks to it. Mass m_2 is connected to a pivot point by a massless rigid rod of length $R = 2.0$ m and is initially at rest. After the collision, the combined mass moves in a circle on the horizontal table.

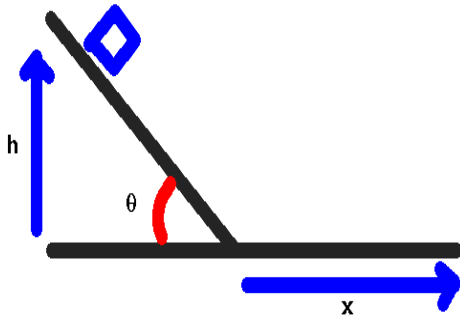
[1:a] Find the speed of the combined mass (in m/s) immediately after the collision.

[1:b] The angular velocity ω (in "rad"/s) of the system after the collision is given by:

[1:c] The centripetal acceleration (in m/s^2) of the combined mass as it rotates is given by:

[1:d] The force (in N) exerted by the rod on the combined mass is given by:

[1:e] The mechanical energy lost (in J) during the inelastic collision is given by:



[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 $\mu=0.25$, provide a numerical answer for [e] together with correct SI units.

[3] Suppose a constant force is given by $\vec{F} = (F_0)\hat{x}$ where F_0 is a constant which has SI units of N. 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) 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 , t , and g .

(c) Provide numerical answers to (a) and (b) above with correct SI units for the case $F_0 = 2\text{N}$, $m = 1\text{Kg}$, and $t = 2\text{ s}$.

$\Delta \vec{p} =$ _____ $h =$ _____

[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 $\vec{v}_b = +20 \frac{\text{m}}{\text{s}} \hat{x}$. **Your answers here must show details and include correct SI units.**

(a) If it strikes and sticks to a mass m_2 which is 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?

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