Problem Set 1

Physics 311
Classical Mechanics I

Due on Friday, September 4th, 2026

Class date: Monday, August 31st, 2026.
Reading: pp. 48–65, a review of Newton's laws and familiar forces.

Problem 1

Starting from the observation,

$$\theta = \sin^{-1}(\sin(\theta))\,, \tag{1}$$

take the derivative of both sides and use the chain rule to find an expression for

$$\frac{d\sin^{-1}(x)}{dx} = \boxed{?}. \tag{2}$$

Problem 2

Evaluate the indefinite integral

$$\int \frac{dx}{\sqrt{1-x^2}} = \boxed{?}. \tag{3}$$

Hint: Use a substitution like $x = \sin\theta$ to take advantage of the form of the numerator, or do Problem 1.

Problem 3

Solve $m\ddot{x}(t) = -m\omega^2 x(t) - 2mb\dot{x}(t)$ with $x(0) = 0$ and $\dot{x}(0) = v_0$ in the underdamped setting.

Problem 4

Using the gravitational force between two masses, with magnitude $F = GMm/x^2$, find the initial acceleration for a mass m_1 that starts from rest a distance d to the left of a mass m_2. What is the initial acceleration of mass m_2? Suppose we have found a chunk of negative mass, so that $m_2 = -m_1$ – what is the position of each mass as a function of time (take the starting position of m_1 to be 0, and m_2 to be d)? Is energy conserved here?