Physical Applications:

Physics Formulas	Associated Calculus Problems
Mass: Mass = Density * Volume *(for 3-D objects)* Mass = Density * Area *(for 2-D objects)* Mass = Density * Length *(for 1-D objects)*	**Mass of a one-dimensional object with variable linear density:** $$Mass = \int_a^b (linear\ density)\ \underbrace{dx}_{distance} = \int_a^b \rho(x)dx$$
Work: Work = Force * Distance Work = Mass * Gravity * Distance Work = Volume * Density * Gravity * Distance	**Work to stretch or compress a spring (force varies):** $$Work = \int_a^b (force)dx = \int_a^b F(x)dx = \int_a^b \underbrace{kx}_{\substack{Hooke's\ Law \\ for\ springs}}\ dx$$ **Work to lift liquid:** $$Work = \int_c^d (gravity)(density)(distance)\underbrace{(area\ of\ a\ slice)}_{volume}dy$$ $$W = \int_c^d 9.8 * \rho * A(y) * (a-y)dy \quad (in\ metric)$$
Force/Pressure: Force = Pressure * Area Pressure = Density * Gravity * Depth	**Force of water pressure on a vertical surface:** $$Force = \int_c^d (gravity)(density)(depth)\underbrace{(width)}_{area}dy$$ $$F = \int_c^d 9.8 * \rho * (a-y) * w(y)dy \quad (in\ metric)$$