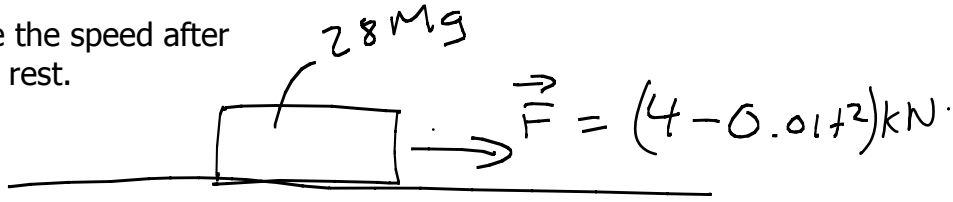
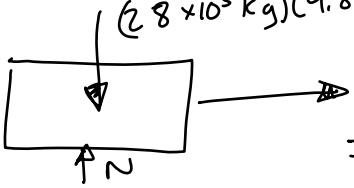
Kinetics of a Particle: Principle of Linear Impulse and Momentum

Problem Statement: Determine the speed after 4 seconds if the object starts from rest.



1.) Draw the Free-Body Diagram if needed.

$(28 \times 10^3 \text{ kg})(9.81 \text{ m/s}^2) = 274{,}680$ Newtons



$(4 - 0.01t^2)$ kN

$= (4 - 0.01t^2) \times 10^3$ Newtons

2.) Determine the impulses and momentum.

$\overset{+}{\rightarrow} \quad mv_1 = (28 \times 10^3 \text{ kg})(0) = 0$

$\overset{+}{\rightarrow} \quad \sum \int F dt = \int_0^4 (4 - 0.01t^2)\, dt \times 10^3 = \left[4t - \frac{0.01}{3} t^3\right]\Big|_0^4$

$= 15{,}787 \text{ kg} \cdot \text{m/s}$

$\overset{+}{\rightarrow} \quad mv_2 = (28 \times 10^3 \text{ kg})\, v_2$

3.) Apply the Principle of Linear Impulse and Momentum.

$0 + 15{,}787 = 28 \times 10^3 v_2$

$$\boxed{v_2 = 0.564 \text{ m/s}}$$

4.) Apply kinematics if needed and solve for the unknowns.

Already done