

Name: _____

1) (20 pts) A mass M is at rest on a frictionless surface when a force equal to $Ma e^{-t/\tau}$ is applied. How large does its velocity become?

2) (20 pts) A mass M is at rest at $x = 0$ when a force is turned on at $t = 0$. After this it moves so that $x(t) = \frac{1}{2}at^2e^{-t/\tau}$. What is the force that was applied?

3) (25 pts) A slightly damped harmonic oscillator satisfies $\ddot{x} + 2\beta\dot{x} + \omega_0^2 x = 0$. Before time $t = 0$ there is no friction ($\beta = 0$) and $x(t) = A \sin(\omega_0 t)$. At $t = 0$ friction is introduced. Find $x(t)$ after $t = 0$ and verify that it satisfies the equation of motion and the initial conditions.

4) (35 pts) A particle of mass $M = 1 \text{ kg}$ is dropped from a height h . Assume that $g = 10 \text{ m/s}^2$ and that air resistance is proportional to speed. The particle's terminal velocity is 10 m/s . It falls for 10 s and hits the ground. What is the height h ?