Physics 3344 **Professor Scalise**
Fall 2006 **Assignment #5**

Due: 21 September 2006

1. Consider a point mass in free fall with no air resistance ($\vec{\boldsymbol{a}} = -g\hat{\jmath}$) with the following initial conditions: $\vec{\boldsymbol{v}}(0\ sec) = 50\ m/s\ \hat{\imath}$ and $\vec{\boldsymbol{x}}(1\ sec) = 20\ m\ \hat{\imath} + 100\ m\ \hat{\jmath}$. Find the displacement at 4 seconds, $\vec{\boldsymbol{x}}(4\ sec)$.

2. If a ballistic projectile moves such that its distance from the point of projection is always increasing, find the maximum angle above the horizontal at which the particle could have been launched. Assume no air resistance.

3. A railroad boxcar of mass m on a level frictionless track has initial speed v_0 at the origin. There is an aerodynamic drag force $-cv\vec{v}$ acting horizontally. Find

   (a) $v(t)$

   (b) $x(t)$

   (c) $v(x)$

4. A rocket has an initial mass of 7×10^4 kg and on firing burns its fuel at a rate of 250 kg/s. The exhaust velocity is 2500 m/s. If the rocket has a vertical ascent from resting on the Earth, how long after the rocket engines fire will the rocket lift off? What is wrong with the design of this rocket?

5. A particle is given an initial velocity $v_0 = 1.5v_{\text{terminal}}$ downward in a long vertical tank of viscous fluid on the Earth's surface. What is the initial acceleration vector's magnitude and direction? What is the acceleration vector after a long time?