NYU General Physics 1—Problem set 2

Problem 1: What is the mean acceleration a of a dragster (that is, a drag-racing automobile) that can travel 0.25 mi in 5.5 s, starting from a dead stop? Assume that the dragster accelerates with constant acceleration throughout the 5.5 s (not a terrible assumption, but not a good one either). Give your answer in terms of the gravitational acceleration g. Does your answer seem reasonable? What do you predict, under the constant-acceleration assumption, for the final speed v_f of the dragster as it crosses the finish line? Convert your answer to $\mathrm{mi\,h^{-1}}$. Search the web for the current world-record quarter-mile drag-race time and final speed.

Problem 2: For the time interval $0 < t < 1$ s, draw graphs of the vertical position y (height) as a function of time, the vertical velocity v_y as a function of time, and the vertical acceleration a_y as a function of time of a rock that is thrown precisely upwards at 3 $\mathrm{m\,s^{-1}}$ at time $t = 0$. For definiteness, set $|\vec{g}| = 10$ $\mathrm{m\,s^{-2}}$ and make the "upwards" direction the positive-y direction. Where does the rock "end up" at the end of the 1 s period; that is, what is $y(1\,\mathrm{s})$? Assume that the rock is large and dense enough that we can ignore air resistance.

Problem 3: Below is a graph of velocity v_x in the x direction as a function of time. Draw the corresponding graph of position x and acceleration a_x. Be very careful with the transitions and the vertical scales.