For a constant acceleration a, you can derive useful equations that relate two specific points in time, called the initial time t_i, and final time t_f, as well as the initial position $x_i = x(t_i)$, the final position $x_f = x(t_f)$, the initial velocity $v_i = v_x(t_i)$, and the final velocity $v_f = v_x(t_f)$. For example, in one dimension defined by an x-axis,

$$v_f = v_i + a\Delta t \tag{1}$$

$$x_f = x_i + v_i\Delta t + \frac{1}{2}a(\Delta t)^2 \tag{2}$$

$$v_f^2 = v_i^2 + 2a\Delta x \tag{3}$$

where $\Delta t = t_f - t_i$, and $\Delta x = x_f - x_i$.

1. You release a ball from rest and it falls without friction or air resistance. What is its velocity after it has fallen a height h? Leave in terms of the acceleration due to gravity, g.

2. You throw a ball upward with an initial velocity, v_o. What is the maximum height it reaches? Leave in terms of the acceleration due to gravity, g.

3. You throw a ball upward with an initial velocity of 19 m/s when your hand is 1.5 m above the ground. How long is the ball in the air before it hits the ground. (You move out of the way.)

4. An object is sliding across the floor. It starts with a speed of 3.2 m/s but is slowing down at a rate of 0.6 m/s^2. how long does it take to stop?

5. A bad driver is driving at 20 m/s when they see a light turn yellow 50 m ahead. They accelerate at 5 m/s^2 to try to beat the light. How fast are they moving when they get to the intersection? How long does it take for the car to get there?

6. A car going 30 m/s slams on their brakes, decelerating at a rate of 20 m/s^2, but still hits a parked car 1.3 seconds later. how far apart were the cars when the person slammed on their brakes? What was the speed of the first car when they collided?