Displacement and acceleration

When an object moves with acceleration $\vec{a}$ while having a non-zero initial velocity $\vec{v}_0$:

$$\begin{cases} \vec{v}_f = \vec{v}_0 + \vec{a} \cdot t \\ \vec{v}_{average} = \dfrac{\vec{v}_0 + \vec{v}_f}{2} \end{cases} \longrightarrow \boxed{\vec{v}_{average} = \vec{v}_0 + \frac{1}{2} \cdot \vec{a} \cdot t}$$

$$\vec{d} = \vec{v}_{average} \cdot t \longrightarrow \boxed{\vec{d} = \vec{v}_0 \cdot t + \frac{1}{2} \cdot \vec{a} \cdot t^2}$$

Homework 5

Problem 1.

Several weeks ago, we calculated the acceleration of the Tesla Model S Plaid to be $11.6\,\frac{m}{s^2}$ based on it reaching a speed of 60 mph from zero initial speed in 2.3 seconds. We have also found that it would take 6.7 seconds to brake from 60 mph with acceleration $4\,\frac{m}{s^2}$.

a) How far does the car travel during the 2.3 seconds with acceleration $11.6\ \frac{m}{s^2}$?

b) What is the braking distance (how far does the car travel during breaking before it stops) when the car brakes from 60 mph with acceleration $4\,\frac{m}{s^2}$?

Problem 2.

You have a bet with your friend that you could throw a ball higher than the roof of your school. Your school is 6 m high. You throw the ball vertically up with an initial speed of $15\ \frac{m}{s}$.

a) At what time will it reach the highest point? (hint: at the highest point, the ball has to stop - if it has not stopped yet, it would go even higher)

b) What height will the ball reach? Did you win the bet?

c) What time will it take the ball to return to the ground after you threw it?