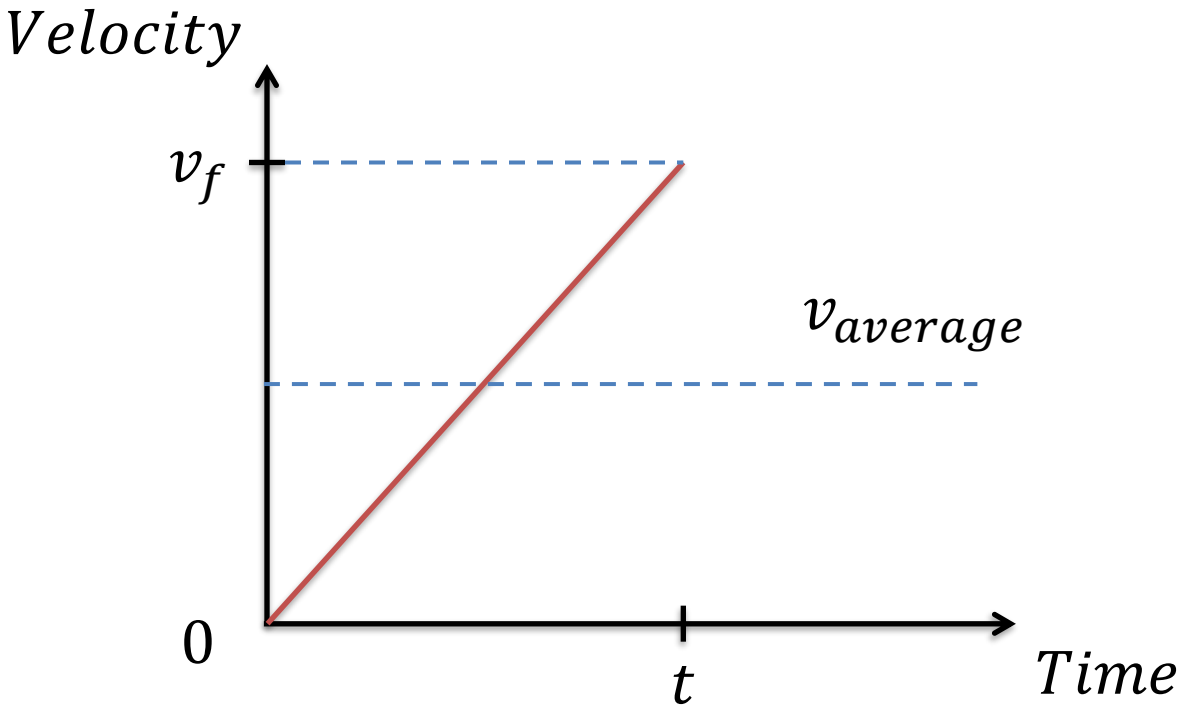
Average velocity for $\vec{a} = const$

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

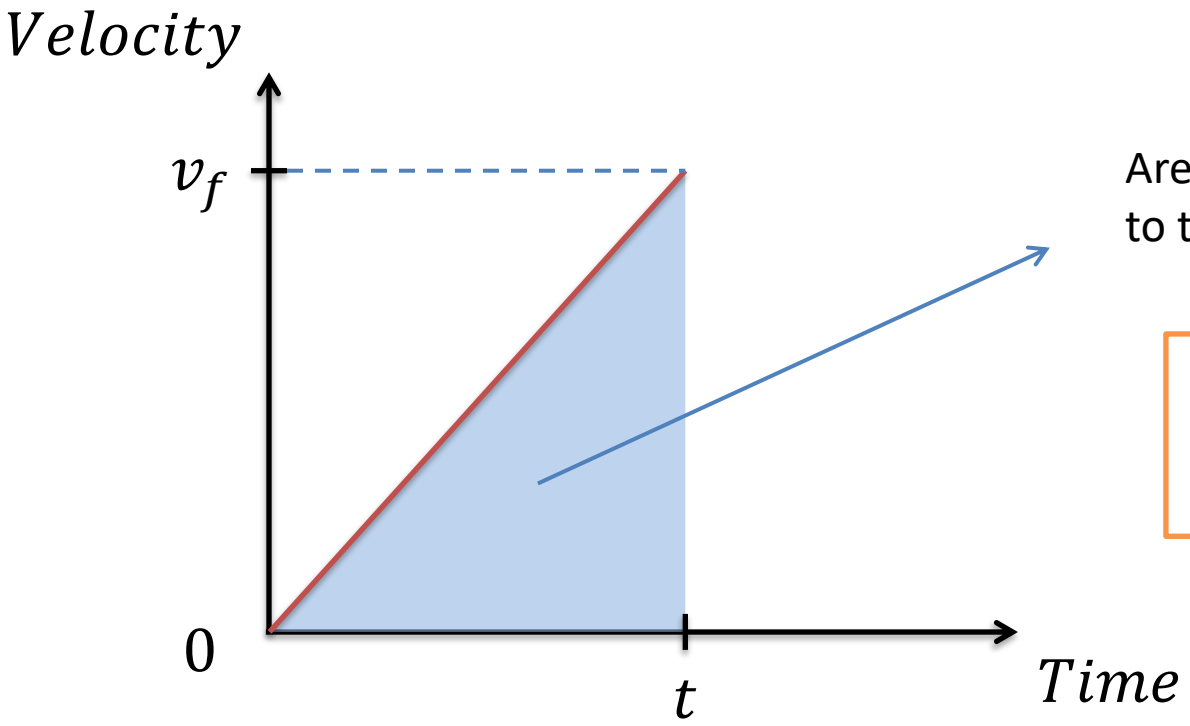
$$\vec{v}_{average} = \vec{v}_0 + \frac{1}{2} \cdot \vec{a} \cdot t$$



Displacement and acceleration

$$d = t \cdot v_{average}$$

$$d = \frac{1}{2} \cdot a \cdot t^2$$



Area under the graph is equal to the traveled distance:

$$d = \frac{1}{2} \cdot v_f \cdot t$$

Homework 4

Problem 1.
During the class we have seen a video of an experiment where the time it takes an object to fall from a certain height was measured using an acoustic stopwatch. From the table below with the experimentally measured values, find the free fall acceleration for each of the 3 heights, and then find the average.

d, meters	0.66	1.01	1.43
t, seconds	0.381	0.487	0.547

Problem 2.
Let us find how long the runway in an airport should be so that an airplane has enough space to gain speed. An airplane initially at rest accelerates with constant acceleration $a = 2\ m/s^2$ until it gets to the takeoff speed of $v = 80\ m/s$.

a) What time does it take the airplane to reach the takeoff speed?
b) How far does the airplane move before taking off? (normally you would want a runway to be about twice as long - to allow some space for braking in case of emergency).
c) What is average velocity of the airplane during acceleration?