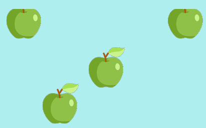
Gravity and Uniform Acceleration

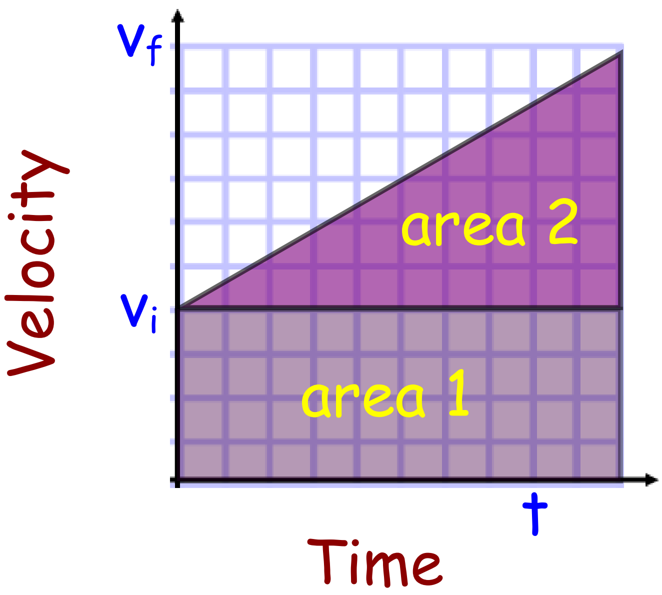


On average, the acceleration due to gravity on the Earth's surface is 9.8 m/s^2 [downward]. This means that in the absence of air resistance, an object falling freely toward Earth accelerates at 9.8 m/s^2 [downward]

Solving Uniform Acceleration Problems

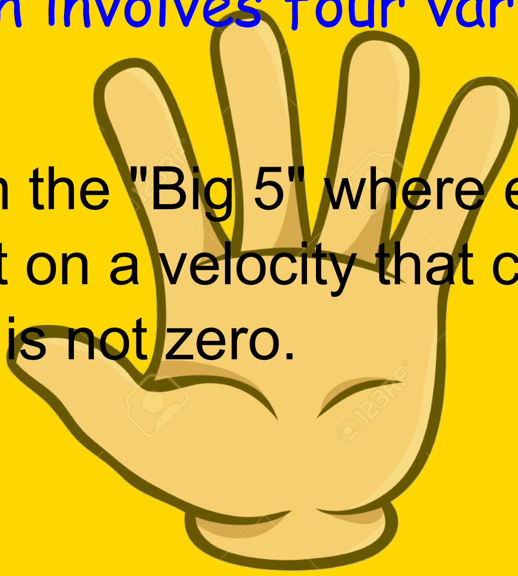
Remember: $\vec{a}_{av} = \dfrac{\vec{v}_f - \vec{v}_i}{\Delta t}$

Also, looking at a velocity-time graph of uniform acceleration we can use the area under the line to derive an equation for displacement.



Δd = area 1 + area 2

We can combine these two equations to form three other uniform acceleration equations, each of which involves four variables.



We call them the "Big 5" where each equation is dependent on a velocity that changes. ie - acceleration is not zero.

Then, substitute this equation into our displacement equation.

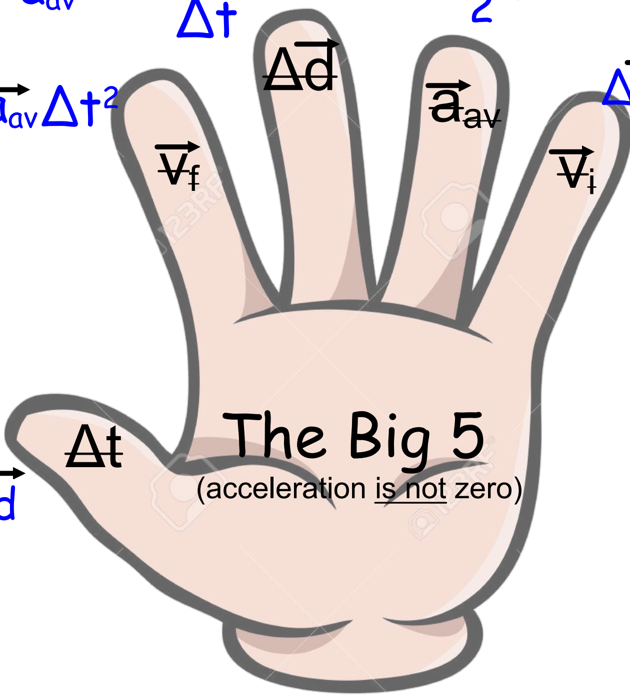
$$\Delta d = 1/2(v_i + v_f)\Delta t$$

$$\vec{a}_{av} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$$

$$\Delta\vec{d} = \frac{1}{2}(\vec{v}_i + \vec{v}_f)\Delta t$$

$$\Delta\vec{d} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}_{av}\Delta t^2$$

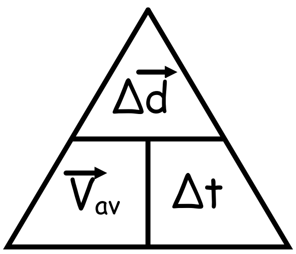
$$\Delta\vec{d} = \vec{v}_f\Delta t - \frac{1}{2}\vec{a}_{av}\Delta t^2$$



$$\vec{v}_f^{\,2} = \vec{v}_i^{\,2} + 2\vec{a}_{av}\Delta\vec{d}$$

Note: When acceleration is zero, then we have constant speed and can use the average velocity equation from earlier.

$$\vec{v}_{av} = \frac{\Delta\vec{d}}{\Delta t}$$



Example 1:

Starting from rest at t = 0.0 s, a car accelerates uniformly at 4.1 m/s^2 [S]. What is the cars displacement from its initial position at 5.0 s?

Example 2

It was once recorded that a Jaguar left skid marks that were 2.90×10^2 m in length. Assuming that the Jaguar skidded to a stop with a constant acceleration of $3.90\ m/s^2$ (backward), determine the speed of the Jaguar before it began to skid.

Example 3

An "olympic diver" falls from rest from a high platform. Assume that the fall is the same as the official height of the platform above water, 10.0 m. At what velocity does the diver strike the water?