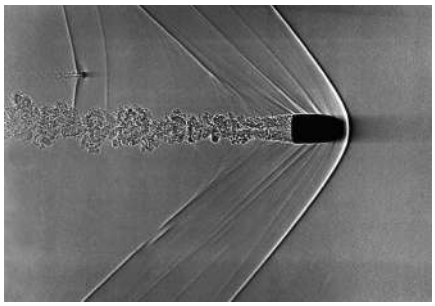
One-Dimensional Motion – Constant Acceleration Equations

As we already know, acceleration is defined as the change of velocity per unit of time and can be found using:

$a = \frac{\Delta v}{t}$

Since: $\Delta v = v_f - v_i$, our formula then becomes:



If we apply some algebra and solve for "v_f" then we arrive at:

$$\mathbf{v_f = v_i + at}$$

Several derivations using the above information lead to useful equations when we want knowledge of an object's displacement, velocity, or acceleration at any particular time. Such equations include:

$$\mathbf{d = v_i t + \frac{1}{2} a t^2}$$

$$\mathbf{v_f^2 = v_i^2 + 2ad}$$

Knowing which equation to use relies simply on the information **you are given** in the problem. In other words, it is important to write down **every** piece of information given by the problem including the variable that **you are looking for**.

For example:

1.) Roger starts from **rest** and accelerates at 4 m/s^2 for 3 seconds. How **far** has Roger travelled?

Notice how if an object starts from **rest**, v_i (initial velocity) will **always be zero.** Similarly, if an object **comes to rest**, the v_f (final velocity) will be zero.

2.) A bowling ball moving 20 m/s comes to rest at the end of the alley 20 meters away. Determine the acceleration of the bowling ball.

3.) A soccer ball kicked from rest travels 50 meters in 3 seconds. Determine the acceleration of the soccer ball.

4.) A car is initially moving at 20 m/s. The car then accelerates at a rate of 5 m/s^2. How fast will the car be moving after 400 meters?

5.) Superman is flying at 300 m/s. He then accelerates at a rate of 20 m/s^2 for 10 seconds. How fast is he now flying?