ACCELERATION

Acceleration – Any change in velocity is considered acceleration. Acceleration doesn't really concern itself with how fast an object is moving. Rather, it concerns itself with how fast the velocity of an object changes. Something can travel very fast, and at the same time not be accelerating as long as its velocity is constant or not changing.

We commonly use the term **accelerate** to indicate an increase in speed, like… "Did you see how quickly that car accelerated?" However, slowing down is also considered a change in velocity and is therefore considered acceleration – we say ***negative acceleration***. You may have used the term *deceleration* to indicate slowing down. Just be aware that in science when we say accelerating it could mean speeding up or slowing down.

When an object moves in a circle (also known as *circular motion*) it is said to be accelerating. Can you figure out why? Well, since velocity contains a speed AND direction component, if an object is moving in a circle, then its direction is changing and therefore it's velocity is changing. Since acceleration is considered a change in velocity then there you are… moving in circle is acceleration because its velocity is changing!

We can describe acceleration ***QUALITATIVELY*** –using words to describe the motion of an object or to compare the motion of two or more objects. We can also describe acceleration ***QUANTITATIVELY*** – using speed and time data in a calculation to give us some number that we can then use to describe the motion of an object or to compare the motion of two or more objects.

QUALITATIVE (using words)

The example I like to use in class is comparing the differences in acceleration for two cars. CAR A accelerates from 0 m/s to 30 m/s in 2 seconds. CAR B accelerates from 0 m/s to 30 m/s in 20 seconds. If I were to ask you what it would feel like to ride each of those cars you might say that CAR A would be a "rough" ride where you would feel yourself pressed into your seat while CAR B would be a smoother ride without the sensation as in CAR A.
CAR A changes it's speed very quickly (in 2 seconds) while CAR B changes it's speed in 20 seconds – which is relatively slow compared to CAR A.

QUANTITATIVE ANALYSIS (using numbers)

Acceleration can be expressed as a quantity or number. Since acceleration is considered a change in velocity, we need to know how much the velocity has changed. We also need to know how long it took for the velocity to change. Think about it… a car goes from 0 m/s to 20 m/s in 5 seconds. Compare that with a car that accelerates from 0 m/s to 20 m/s in 10 seconds. The second car accelerated much slower than the first. We use the following equation to calculate acceleration.

FINAL VELOCITY minus INITIAL VELOCITY divided by TIME to change velocity

$$\frac{V_f - V_i}{\text{time}}$$

So for the first car - $\dfrac{20\text{ m/s} - 0\text{ m/s}}{5\text{ s}} =$ **4 m/s *per* sec** or **4 m/s^2**

and for the second car - $\dfrac{20\text{ m/s} - 0\text{ m/s}}{10\text{ s}} =$ **2 m/s *per* sec** or **2 m/s^2**

Now consider a car that goes from 20 m/s to 0 m/s in 5 seconds.

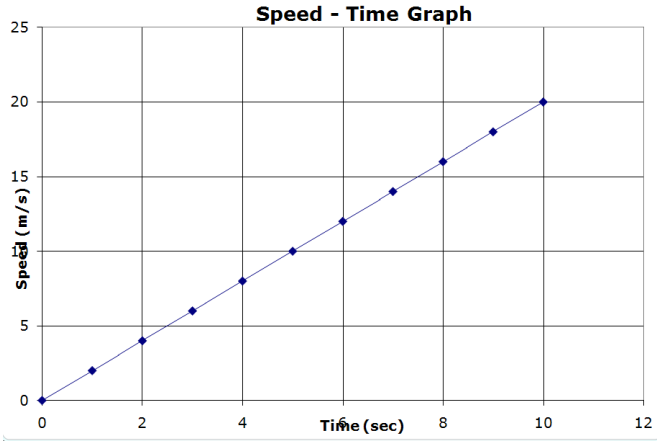
$$\frac{0\text{ m/s} - 20\text{ m/s}}{5\text{ s}} = \textbf{-4 m/s } \textbf{\textit{per}} \textbf{ sec} \quad \text{or} \quad \textbf{-4 m/s}^2$$

Notice that the sign is negative indicating *NEGATIVE ACCELERATION* or that the car is slowing down.

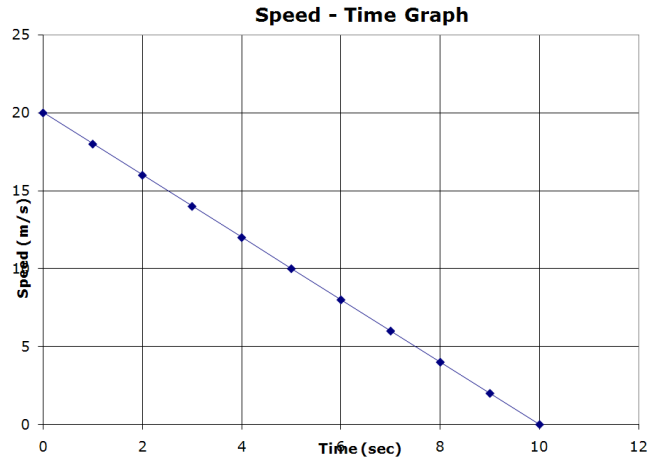
So what does accelerating look like on a graph? Be careful when you look at these graph(s), because it will look an awful lot like the distance-time graphs from before. This time however, you are looking at speed-time graphs.

The graph at top shows a car which is increasing it's speed over time. Since it's speed is changing, then it's velocity is changing and therefore is considered to be accelerating. The second graph shows a car which is decreasing it's speed. The car is said to be accelerating – negatively. The bottom graph shows a car which is moving at a constant or uniform speed.

Time (sec)	Speed (m/s) Car B
0	0
1	2
2	4
3	6
4	8
5	10
6	12
7	14
8	16
9	18
10	20



Time (sec)	Speed (m/s) Car B
0	20
1	18
2	16
3	14
4	12
5	10
6	8
7	6
8	4
9	2
10	0



Time (sec)	Speed (m/s) Car B
0	7
1	7
2	7
3	7
4	7
5	7
6	7
7	7
8	7
9	7
10	7