Speed Workshop

In this workshop we will be covering:

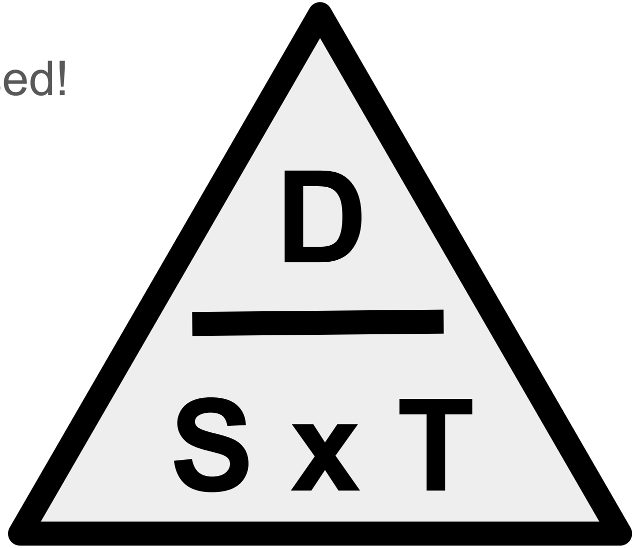
a. Average speed
b. Units
c. Relative Speeds
d. Distance/time graphs

Average speed

Speed is how quickly an object can cover a distance. You may also hear the word "velocity" to describe the same thing. There are subtle differences between the two terms but at KS3 you do not need to know the difference and the words are therefore interchangeable.

The formula for speed is simple and should be memorised!

Speed = Distance / Time



Calculating average speed

So now we know the formula we need. It's time to start calculating….

If a snail travels 15 cm in 30 minutes we are asked to calculate its speed.

So first it is important to note that we cannot calculate its speed at any particular point but we can calculate the average speed it must have had to travel that distance in that time. This means at points in the half an hour this snail was traveling it may have been traveling faster or slower than this average.

So the **average** speed of the snail would be:

Speed = distance / time → 15cm / 30 minutes = 0.5cm/minute

Units, Units, Don’t forget the units!

The units for speed are very important! Not knowing the difference between km/h (kilometers per hour) and mph (miles per hour) will get you in trouble with the law when driving!

In the previous example for the snail we were given the units cm and minutes. If speed is distance / time then we do the same with the units!

Cm / minutes is the same as cm per minute!

Converting Units!

Also we could try and convert these units into the more recognisable units of meters per second (m/s or ms^{-1})

Notice that meters per second can be written using a division sign but is more commonly written using the negative indices (s^{-1} is the same as 1/s) notation.

To convert cm/minute let's start with the cm. We need to convert cm into m, there are 100cm in 1 m so we have to divide 0.5cm/minute by 100!

0.5 / 100 = 0.005m/minute

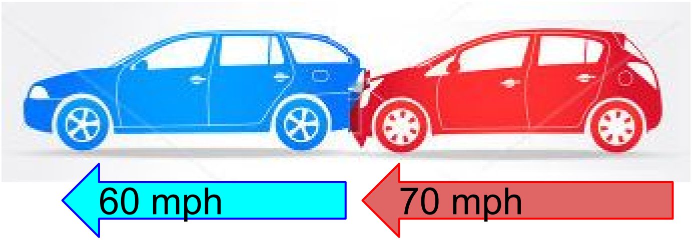
Next we need to deal with the minutes. There are 60 seconds in 1 minute so we need to divide the 0.005 by 60!

0.005 / 60 = 0.000083 ms^{-1}

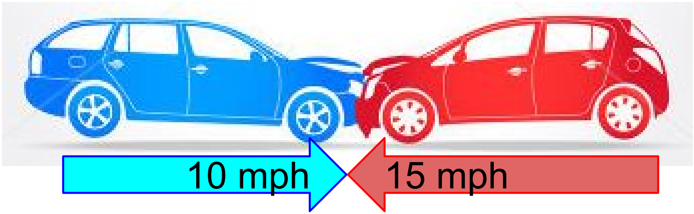
Relative speeds

Which situation would be worse?

1. Crashing into the back of a car that is traveling at 60 mph while you are going 70 mph

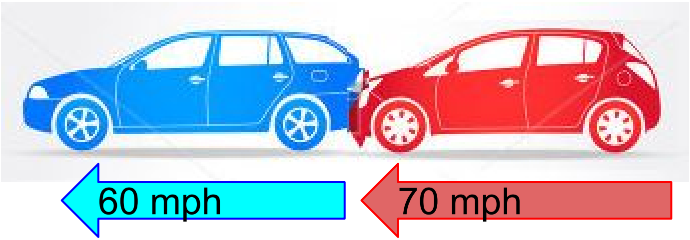


2. Crashing into the front of a car this is going 10 mph while you are going at 15 mph?



Relative speeds

To answer this question we need to consider the “relative” speed of each accident. The speed of the red car **relative** to the blue car in the example below would be 10 mph.

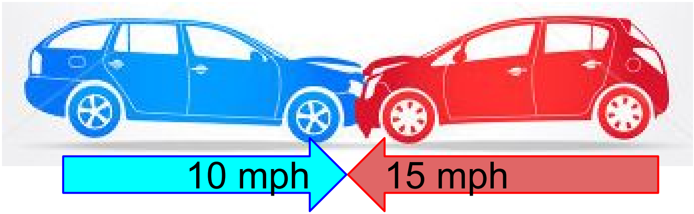


How? Well when objects are traveling in the same direction we would subtract the speed of the blue car from the object in question (red car).

Relative Speed = 70 mph - 60 mph = 10 mph

Relative speeds

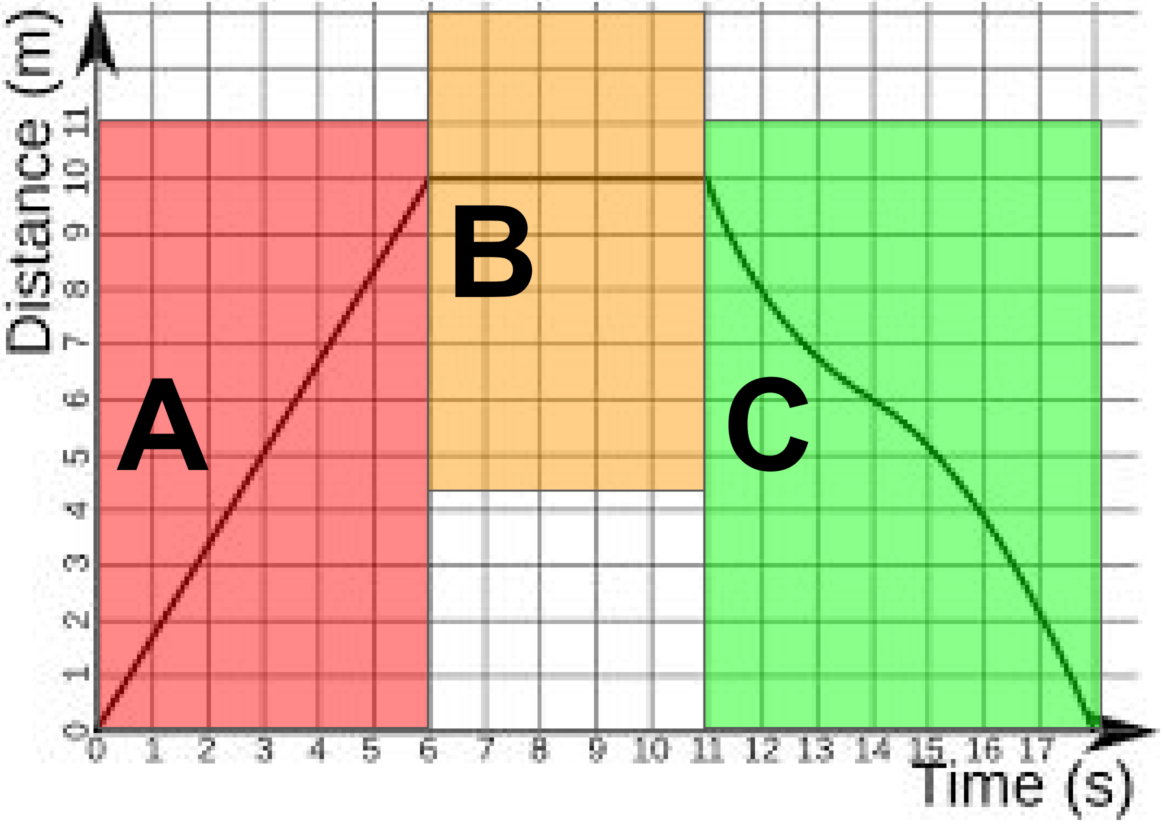
For cars traveling in opposite directions we would add the speeds together to calculate the relative speed.



Relative Speed = 15 mph + 10 mph = 25 mph

This means that although the speeds of the cars are far lower in the head on crash the **Relative Speed** is higher and therefore the crash would do far more damage!

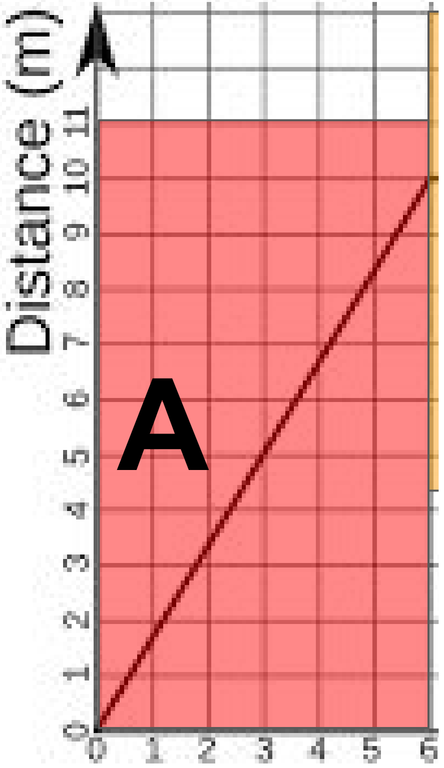
Distance-Time Graphs



It is often useful to plot a distance time graph to show a journey.

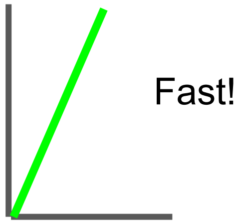
We will explore what this graph is showing us in sections starting with zone A, then move onto B and finish with zone C.

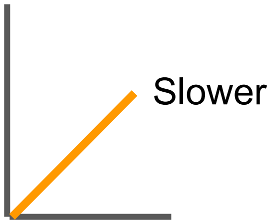
Distance-Time Graphs

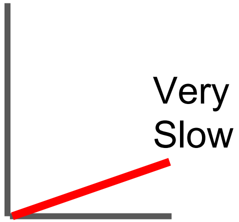


In zone A we can see that as time increases the distance is also increasing (the line is going up!). This means that the object is **moving away** from its starting point.

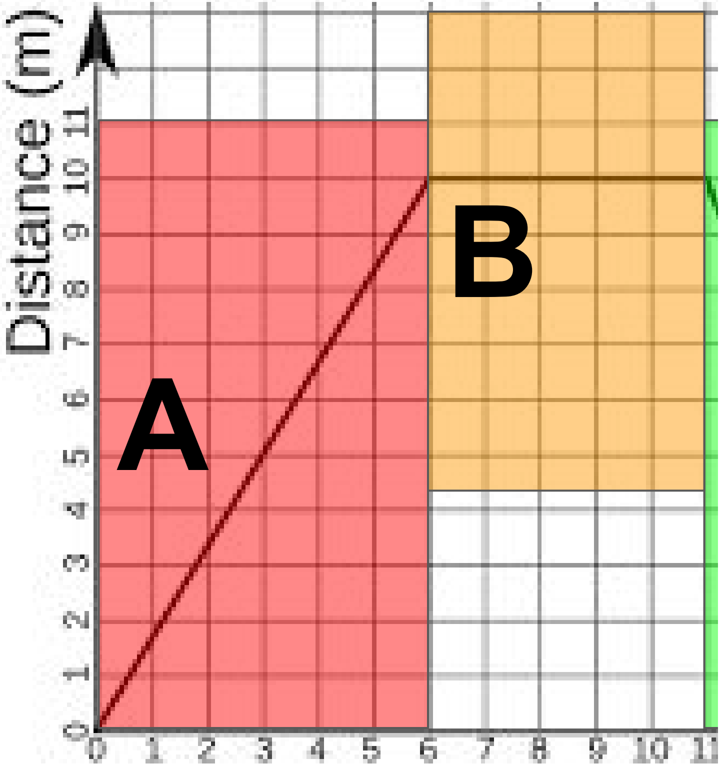
We can also calculate from this the average speed the object was travelling at. To do this we look at the gradient (how steep the slope is!) of the line. **The steeper the gradient the faster the object is traveling.**







Distance-Time Graphs

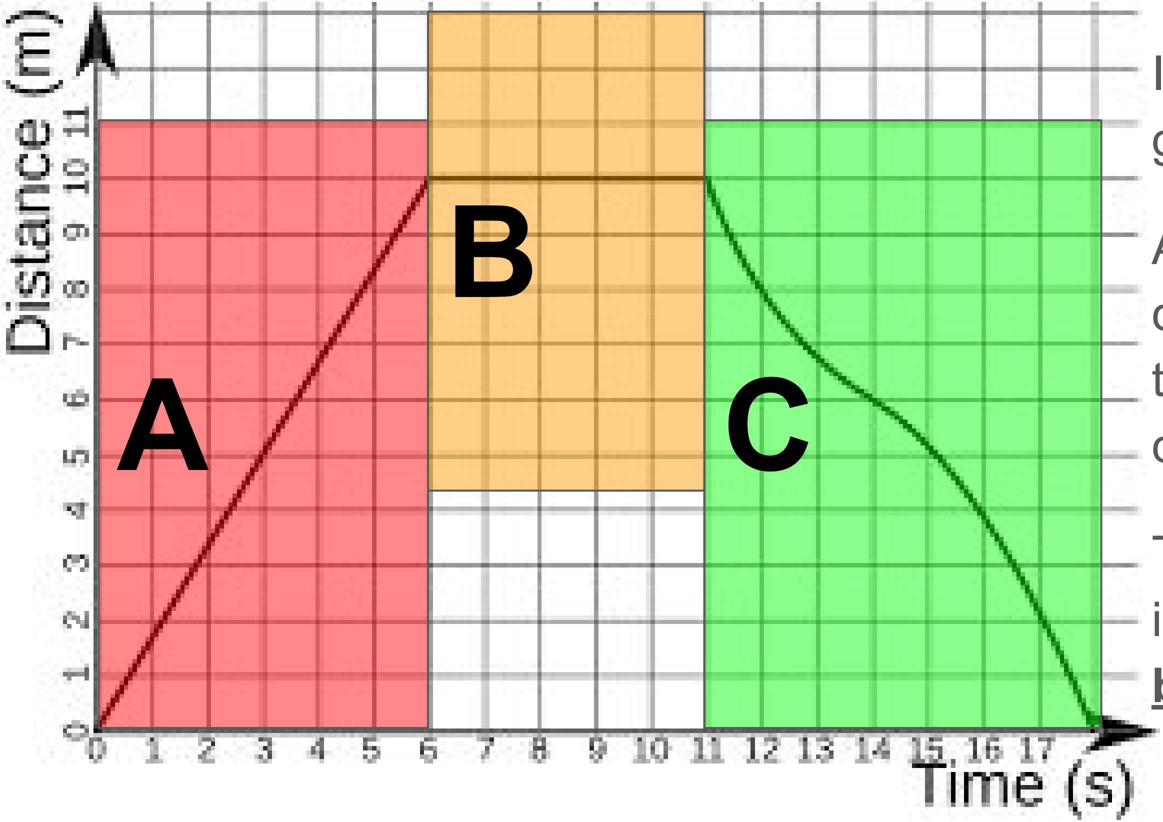


In zone B the gradient (steepness of the slope) is now **flat**. This means that **time** is increasing but **distance** is not. The object is **stationary** (not moving!).

Horizontal lines on distance-time graphs always mean the object is stationary.

This graph shows the object was stationary for 5 seconds!

Distance-Time Graphs

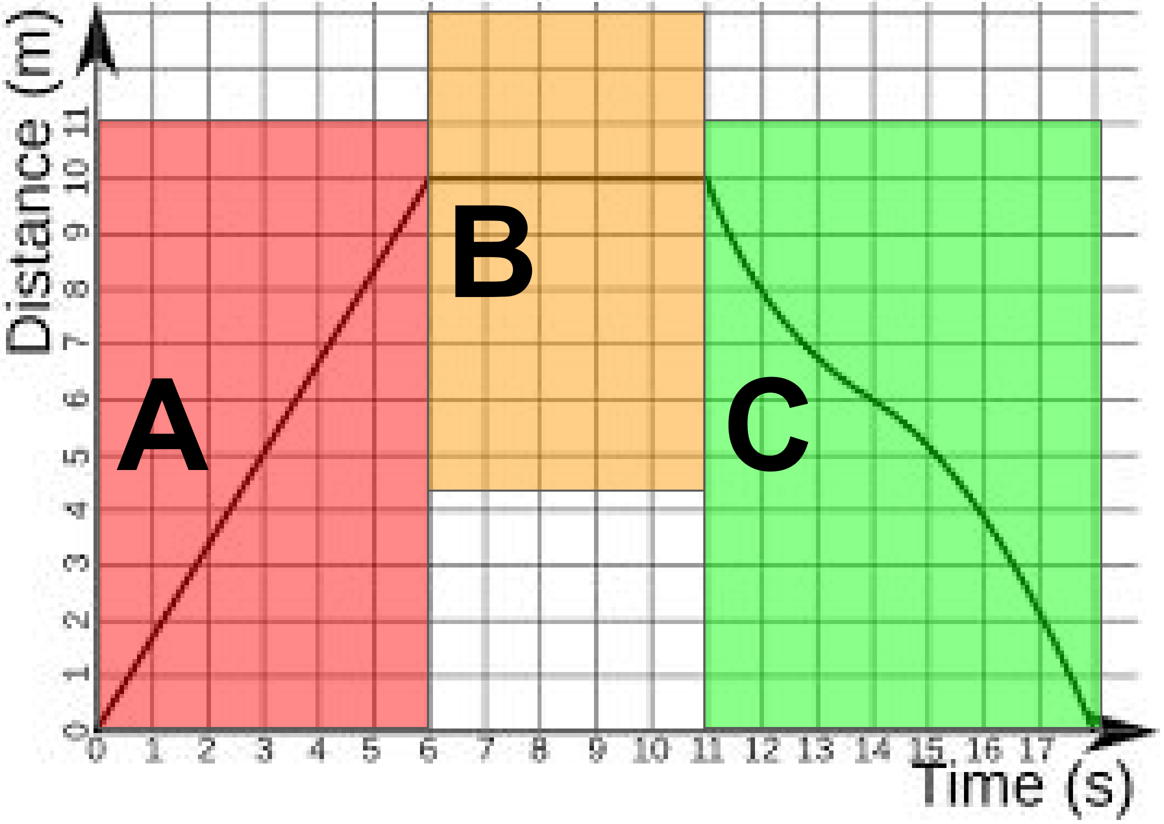


In zone C the line is now going down!

A line going down on a distance-time graph means that time is **increasing** but distance is **decreasing**.

The object is getting closer to its starting point (**it is coming back!!**)

Distance-Time Graphs



Again we can work out its average speed on its way back by looking at the gradient (steepness) of the slope. In zone A the **speed was constant** (straight line going up!) but in zone C the line is curved. **This means the speed changes** on its way back. It starts quick, slows and then speeds up again!