Speed and Distance Graphs

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Starter worksheet

This worksheet is for use with the racing car animation in this resource.

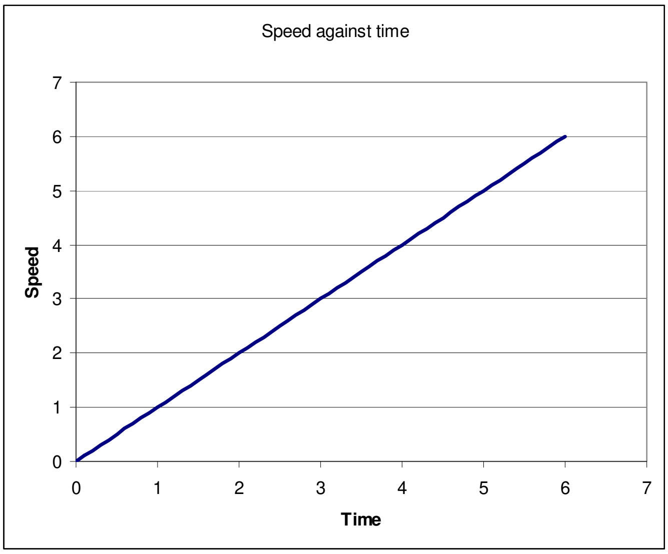
In the animation, set the car to start stationary (0 mph or 0 m/s). We will measure the distance travelled by the car and plot it in a graph against time. At zero time, the distance travelled is zero.

Acceleration measures how much speed changes over time. In a car there's a pedal called the accelerator which you push with your foot to change the acceleration. Push it right to the floor and you will give the car a high acceleration. This means that the car's speed will get faster and faster. When driving a normal car, it's hard to get it to go extremely fast because of the friction of the car's tyres rubbing against the ground and the force of the wind pushing back on the car. Racing cars are designed so that the air goes smoothly over them so that the car can go faster. In our animation we ignore these effects, but when designing a real car they're very important.

We can measure distance in metres and speed in metres per second. Acceleration measures how speed changes over time, so we measure it in units of **metres per second per second**. We can write "metres per second" as m/s and "metres per second per second as m/s^2.

If you have a constant acceleration of 1 metre per second per second that means that the speed of the car gets faster by 1 metre per second every second. Starting at time zero with a speed of 0 metres per second, we get the following table of values.

Time	0 seconds	1 second	2 seconds	3 seconds	4 seconds	5 seconds	6 seconds
Acceleration	1 m/s^2	1 m/s^2	1 m/s^2	1 m/s^2	1 m/s^2	1 m/s^2	1 m/s^2
Speed	**0 m/s**	**1 m/s**	**2 m/s**	**3 m/s**	**4 m/s**	**5 m/s**	**6 m/s**



But a car's speed doesn't suddenly jump from 0 m/s to 1 m/s without going through all the values in between. In fact, the graph of speed against time looks like this – it's a straight line.

Answer the following questions:

1. With a constant acceleration of 1 m/s^2 as shown in the table and graph, what's the speed of the car at the following times? (a) 0 seconds; (b) 4 seconds; (c) 2.5 seconds; (d) 8 seconds; (e) 0.5 seconds?

2. What do you notice?

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Core worksheet

Now let's think about the distance the car travels. You will be able to use the animation to help your understanding. Again we let the acceleration be 1 m/s^2.

How far does the car travel in the first six seconds? Guess an answer.

Here are three facts. See if you can convince yourself that they must be true.

Fact 1
The car's speed is 0 metres per second at the start and increases to 6 metre per second at the end. The speed goes steadily through all the values between 0 m/s and 6 m/s as shown in the graph on the previous worksheet.

Fact 2
Since the car is moving by the end, it must have moved some distance, so the answer is definitely bigger than 0 metres.

Fact 3
Since the car never goes faster than 6 metres per second, and it only travels for 6 seconds, the car cannot possibly have travelled more than 36 metres.

1. Use the animation. How far does the car actually travel in the first six seconds?

2. Use the animation to help you complete the table. What do you notice?

Time	0 seconds	1 second	2 seconds	3 seconds	4 seconds	5 seconds	6 seconds
Acceleration	1 m/s^2	1 m/s^2	1 m/s^2	1 m/s^2	1 m/s^2	1 m/s^2	1 m/s^2
Speed	0 m/s	1 m/s	2 m/s	3 m/s	4 m/s	5 m/s	6 m/s
Distance	0 metres						

3. Discuss what's going on with a partner or in a group. Here are some questions to explore.

What happens if you try different values of acceleration?
What happens if you try different starting speeds?