Unit 7 - Movement I

Key Concept - **Change -** All things move, Mothis change in position can be described using mathematics

Related Concepts - **Movement -** The mathematical description of movement is one of the fundamental pillars of modern scientific knowledge.

Global Concept - **Orientation in Time and Space -** not just the physical space is important, but the study of how our knowledge of motion has developed runs parallel to our deepest understanding of the Universe and how it works.

Key Words

- position
- trajectory
- velocity
- acceleration
- relative
- intial
- final
- graph
- axes
- uniform
- motion
- speed
- distance
- time
- equation
- re-arrange
- arithmetic mean

Task guide

The tasks and questions on the Weebly will be coloured to represent the different style of questions that you will find in your exams. The task should be completed in your "Natural Sciences" GoogleDrive document.

Green - Stating scientific knowledge
Orange - Applying scientific knowledge and understanding
Red - Analysing and evaluating information

If the task has two aspects, it will be coloured according to the higher level skill needed.

There will also be "**extension**" tasks for students who finish tasks quickly! Also look out for *links* to interactive resources and videos.

(Cbpr.me, 2015)

Kinematics - The study of movement.

Everything moves. Even things that you think are static, think of the moon, the earth, the sun, our galaxy; things you can't see, like air, bacteria and dust particles - but is this movement just random, or can we describe and predict it?

Task 7a - **calculate your average speed for your journey to school.**

If we want to know your average speed, we need to know several things

1. How far it is from your house to school. Use google maps to find out how far it is to your school. Watch the tutorial to find out how to do this:
2. You need to time how long it takes you to make this journey.

Do you think this speed would be the same every day? what would happen if there was an accident one day, or it rained? How could we find a way to take into account all these occurences?
In science we often have this problem - in order to get a respresentative, or **RELIABLE** result, to minimise the chance of an error (in this case doing the average speed on a day when there is no traffic, or a day when there is rain) and the solution is to take a series of results and calculate the **ARITHMETIC MEAN** value (la media).

We calculate this by taking all the indivdual values that we have measured adding them all up and then dividing the total by the number of values we have

$$\bar{x} = \frac{1}{n}(x_1 + x_2 + \ldots + x_n)$$

The 'x' with the line we call '**x bar**' this is the symbol for the mean value,

x is the value we have measured, in this task it is the time taken for the journey,

n is the number of times we have taken the measurement.

So, if you do the journey five times in one week, you can record your five journey times, add them up, then divide the total by five, you can complete the following table:

eek	Time taken for journey (minutes)	Time taken for journey (hours)
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		

You should now be able to calculate the average time taken.

With this value we can use this formula

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

And calculate your average speed.

What units would you use for this?

Include the correct unit in your final calculation

How to solve problems using the formula

(Drcruzan.com, 2015)

You need to **REMEMBER** this formula.

"speed equals distance over time"

when you use a formula you will have to **RE-ARRANGE** it sometimes.

For example we know the speed and the distance, but we want to know the time. so looking at our triangle, we cover the part laballed 't', which leaves us with 'd' / 's'. or distance divided by speed.

We can use the triangle method to re-arrange lots of formulae that we will see in the next couple of units.

Example worked problems.

A bicycle leaves Sevilla travelling to Huelva at an average speed of 12 km/h. If the journey to Huelva is 96 km. How long will it take to get there?

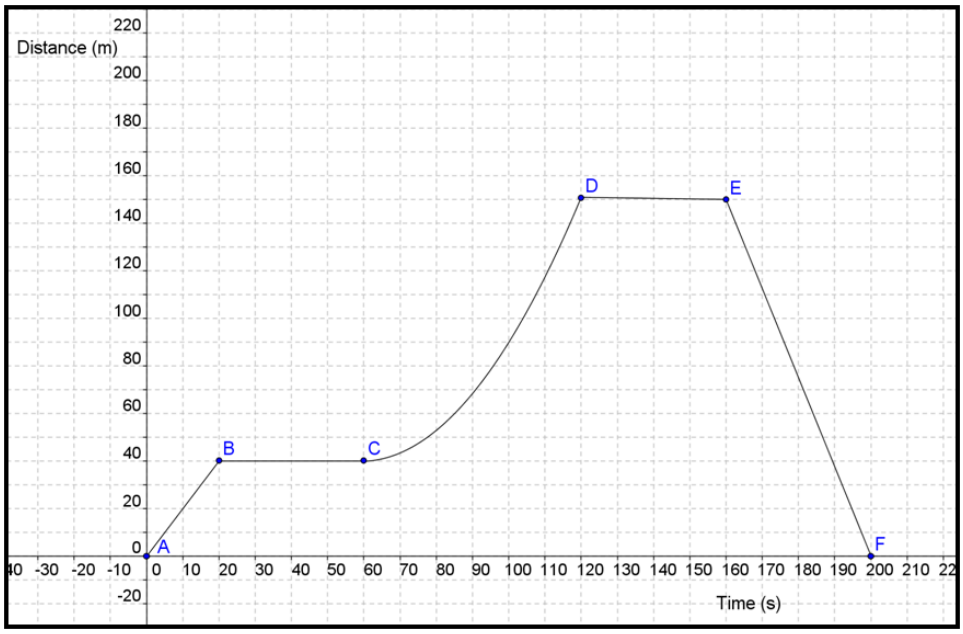
Using Graphs to solve problems

Write are the three quantities on the above formula, and what units can we use to quantify them?

We can use graphs to represent these problems too.. The first type we will look at is a '**distance - time**' graph

The graph below shows the journey of a meerkat early in the morning, while she is out checking if the coast is clear before all the other meerkats come out and start to do whatever it is that meerkats do.

In this case, from A to B, she exits the burrow at a constant speed and moves 40 metres from the exit. Then she waits for 40 seconds without moving, then she runs another 100m, getting faster all the time (accelerating). Then she rests for another 40 seconds, before running back to the burrow, all 140 m, in one go in 40 seconds.



(Ycecaxihex, 2014)

In this case we can use the graph to see many things.

From A to B:

There is a straight 'upwards sloping line - this indicates that the distance and the time change in the same proportion (**a directly proportional relationship)** we can calculate the

speed in this section by two methods:

1. distance from the graph = 40m / time from the graph 20s So speed = 40/20 = 2 m/s.
2. by calculating the **gradient** (pendiente) of the line.: Change in y/change in x - in this case (40-0)/(20-0) = +2 m/s

From B to C

There is a 'flat' line, this means that the y co-ordinate (distance) is not changing, so the object is still - it's speed is zero m/s

You can do the two calculations to check if you like! (in both cases the change in y is zero, so the answer is zero)

From C to D

This is called an **exponential** curve, mathematically you will not deal with these this year, but we can talk about what it means without going into the mathematcs yet!

In this case, we can see that curve gets steeper as the time increases, this means that the object is covering more distance in less time - or it is getting faster (accelerated movement). This year we won't be doing any calculations with this type of movement, it is enough for you recognise it, and what it means. In reality this type of movement is very common, so we will come back to this next year

From D to E

At rest no movement

From E to F

This is similar to A to B, in that it is a straight line, but in this case the slope is opposite, (**an indirectly proportional relationship).**

Doing the same calculations as before - the gradient comes out as negative,

(0-140)/((200-160)= -3.5 m/s.

The '-' sign will be very important in the future, for this year we can say that this means the movement is in the opposite direction - the meerkat is coming back. If this is hard for you to visualise, imagine you were a wildlife film-maker, and you decided to go to get a sandwich for about four minutes, just before the meerkat came out of the burrow. You wouldn't have seen anything would you? The meerkat is back where she started from.

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