Simultaneous Equations

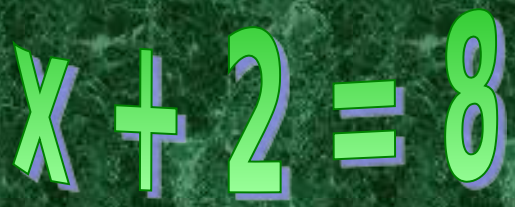
$$2x + 3y = 12$$

$$x + y = 5$$

Aims for this topic:

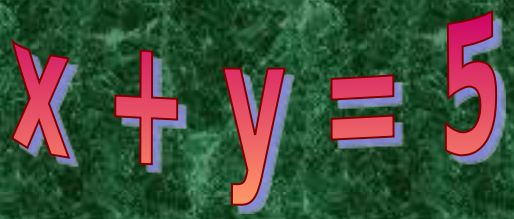
- You will know what simultaneous equations are
- You will be able to solve simultaneous equations using graphs
- You will be able to solve simultaneous equations using an algebraic method

What are simultaneous equations?



- If we have an equation like this with just <u>one</u> letter representing an unknown number, we can solve it.
- What number does x stand for?
- Obviously x = 6!

What are simultaneous equations?



- If we have two letters there are lots of possible solutions
- x could be 1 and y could be 4
- Or x could be 2 and y could be 3
- How many other possibilities can you think of?

What are simultaneous equations?

$$x + y = 5$$

$$2x + 3y = 12$$

- Suppose we have two equations
- We know there are lots of possible pairs of values for x and y that fit the first equation
- One of these pairs of values <u>also</u> fits the <u>second</u> equation

What are simultaneous equations?

$$x + y = 5$$

$$2x + 3y = 12$$

- If x=3 and y=2 **both** equations are true

- If you are asked to ***solve simultaneous equations***, you are being asked to ***find the values for x and y that fit both the equations***.

How do you solve simultaneous equations?

There are two main methods:

1. Using graphs
2. Using algebra

Solving simultaneous equations using graphs

There are just three easy steps:

- Do a table of values for each equation
- Draw the two graphs
- Write down the x and y values where the graphs cross

Solving simultaneous equations using graphs

Here is an example:

Solve simultaneously

$$y = 3 - x$$

$$x + 2y = 4$$

1. Do a table of values for each equation:

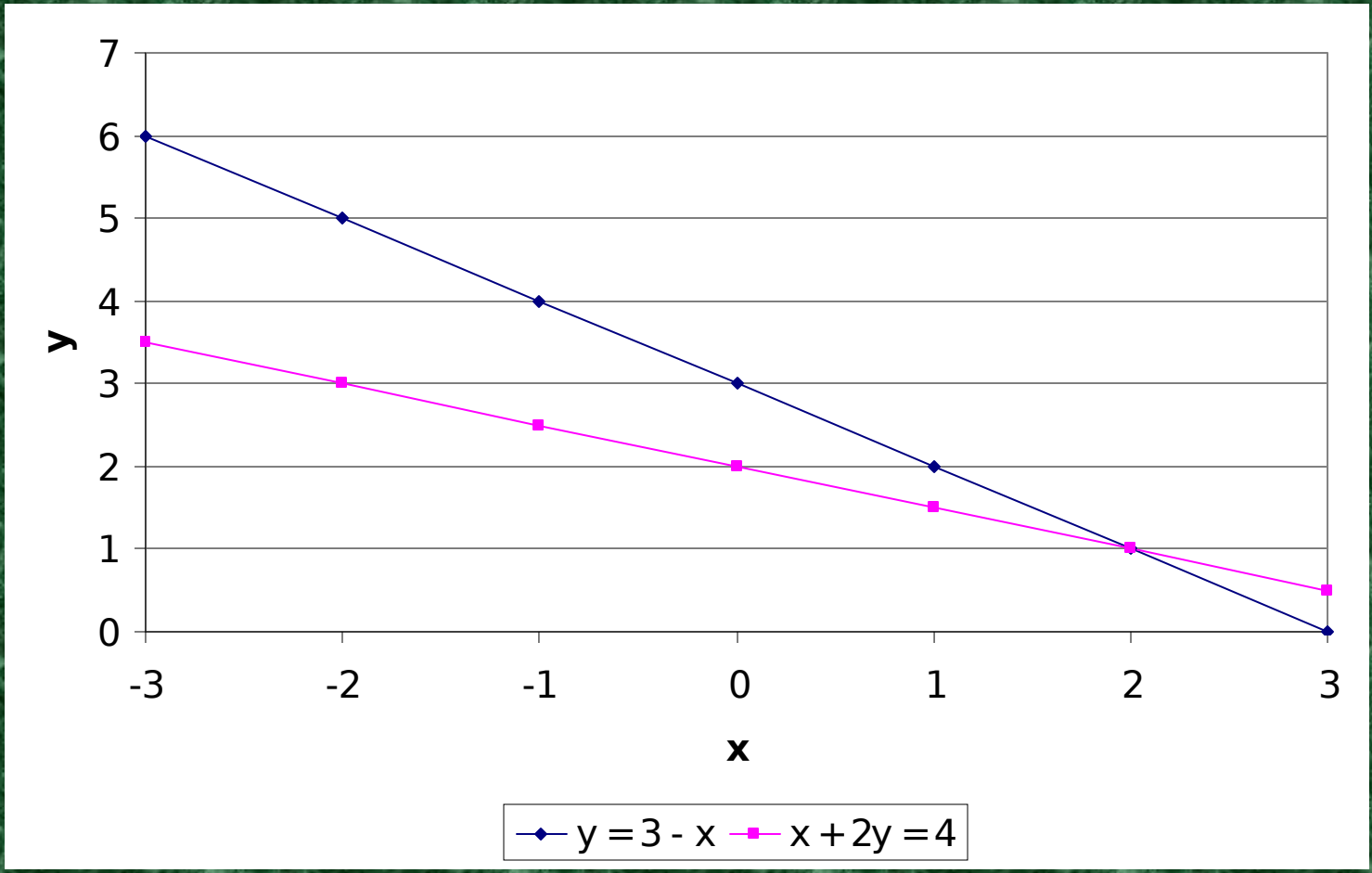
$y = 3 - x$

X	-3	-2	-1	0	1	2	3
y	6	5	4	3	2	1	0

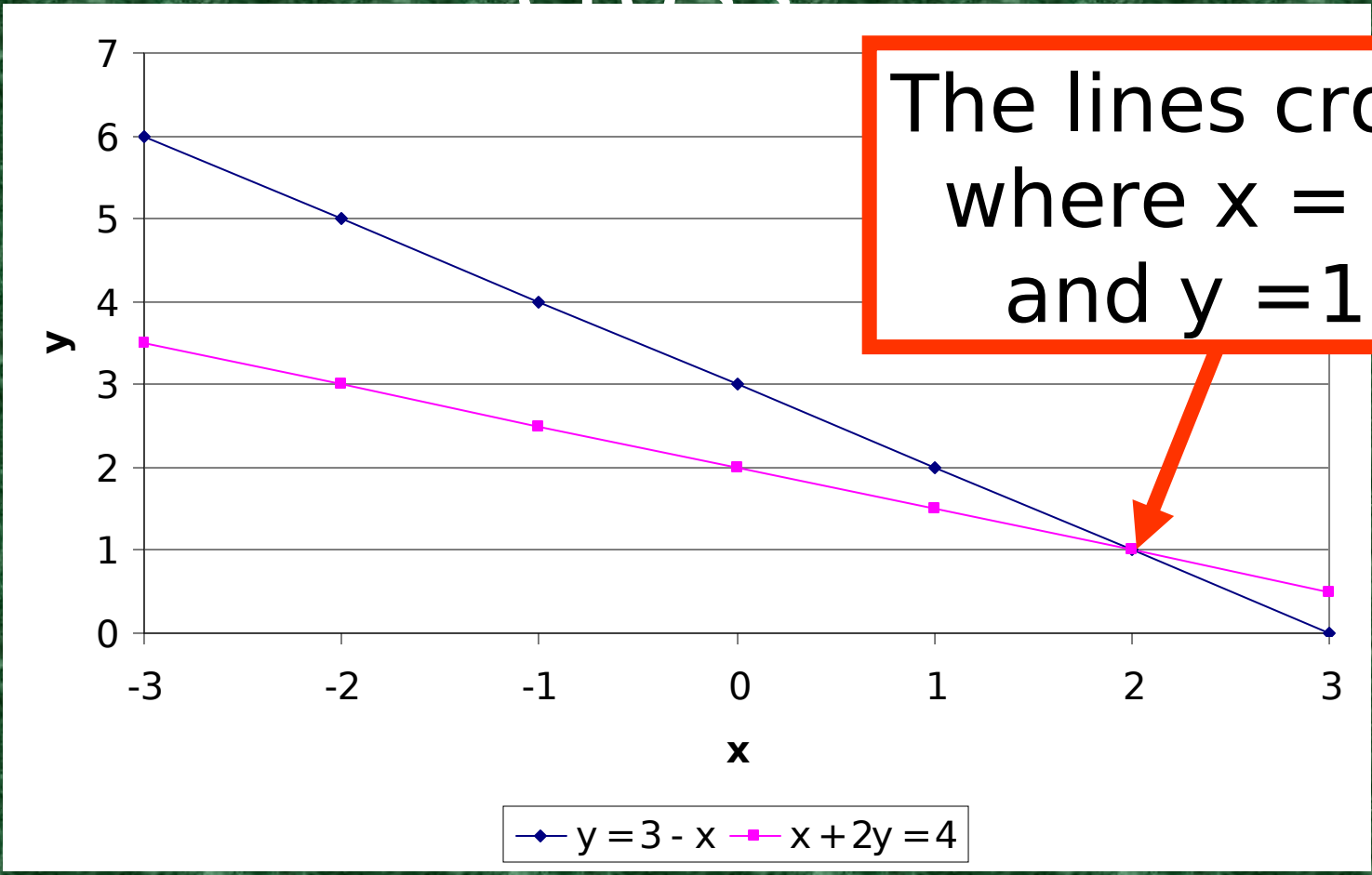
$x + 2y = 4$

X	-3	-2	-1	0	1	2	3
y	3.5	3	2.5	2	1.5	1	0.5

2. Draw the two graphs:

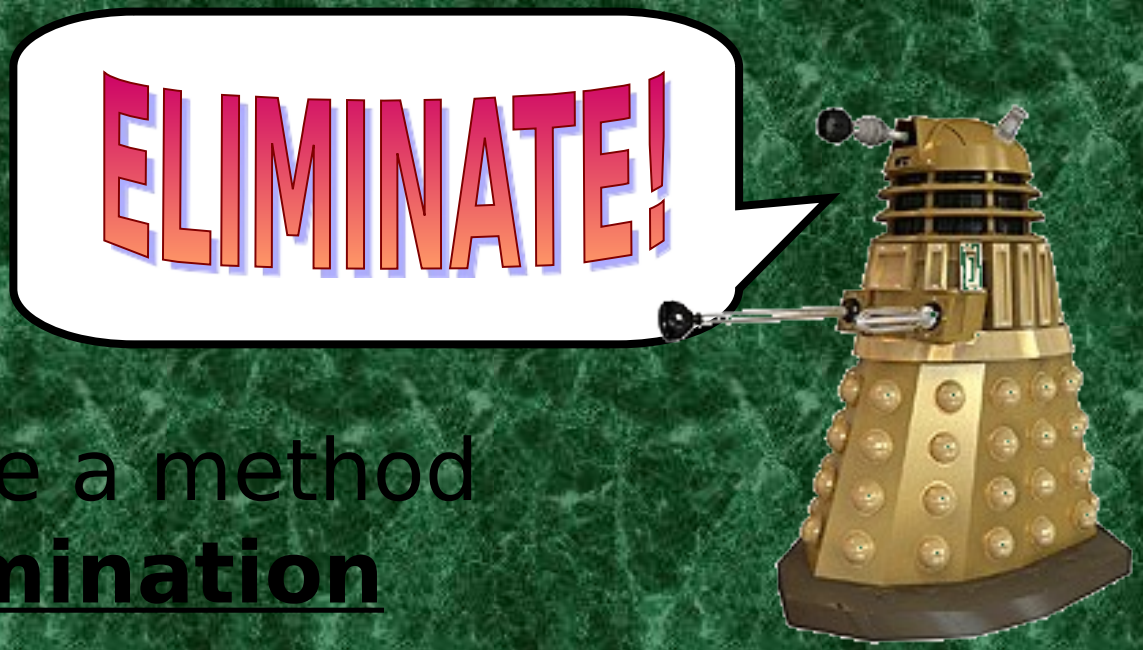


3. Write down the x and y values where the graphs cross :



Solving simultaneous equations algebraically

- There are several methods for solving simultaneous equations using algebra



- We will use a method called **elimination**

Solving simultaneous equations by elimination

There are six steps:

- **O**rganise your equations
- **M**ake sure two coefficients are equal
- **E**liminate a letter
- **S**olve the equation
- **S**ubstitute
- ...and finally **check** your answer!

Solving simultaneous equations by elimination

It sounds complicated, but just remember:

- N**O MESS**

  and **check** your answer

... easy...

lets try an example...

1. Organise your equations

For example, look at this question:

Solve $2a = 16 - 5b$

$a + b = 5$

This is much easier if we rearrange the first equation:

$2a + 5b = 16$

$a + b = 5$

2. Make Sure Two Coefficients are Equal

If we are going to eliminate a letter from our equations, we need to make the number of either a's or b's the same in both the equations:

$2a + 5b = 16$

$a + b = 5$

If we multiply the second equation by 2, we get:

$2a + 5b = 16$

$2a + 2b = 10$

3. Eliminate a Letter

Now we can get rid of a! Just subtract the second equation from the first:

$$2a + 5b = 16$$
$$2a + 2b = 10$$

$$3b = 6$$

(Sometimes you will need to add instead of subtracting – a reminder about this will appear later!)

4. Solve the equation

This is the easy part!

We worked out that

$$3b = 6$$

So

$$b = 2$$

5. Substitute

Now we know that b = 2, substitute this into one of our original equations:

$$a + b = 5$$
$$a + 2 = 5$$
$$a = 3$$

Now we have solved the equations $2a = 16 - 5b$ and $a + b = 5$, our final solutions are:

$a = 3$ and $b = 2$

6. Don’t forget to check your answer!

- All you have to do is substitute your answers into the other equation to make sure it works out correctly
- If it does, you know your answer is correct
- If it doesn’t, then you’ve gone wrong somewhere and sadly, you’ll have to do it all again…

Just checking:

- Our final solutions were:

$a = 3$ and $b = 2$

- Substitute these into

$$2a = 12 - 3b$$

$$2 \times 3 = 12 - (3 \times 2)$$

- Both sides equal 6, so it works!

Remember the six steps for the elimination method:

- **O**rganise your equations
- **M**ake two coefficients the same
- **E**liminate a letter
  - Same signs -> Subtract the equations
  - Alternate signs -> Add the equations

    (but ONLY use this rule when deciding whether to add or subtract simultaneous equations!)
- **S**olve the equation
- **S**ubstitute
- ...and finally **check** your answer!