Effective use of ICT
in
KS3/4 Mathematics

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This session will provide a hands on opportunity to explore some examples of the use of ICT to support the teaching and learning of mathematics at KS3 and 4.

The approaches used will focus on ways to develop and enrich pupils' conceptual understanding of mathematical topics at this level.

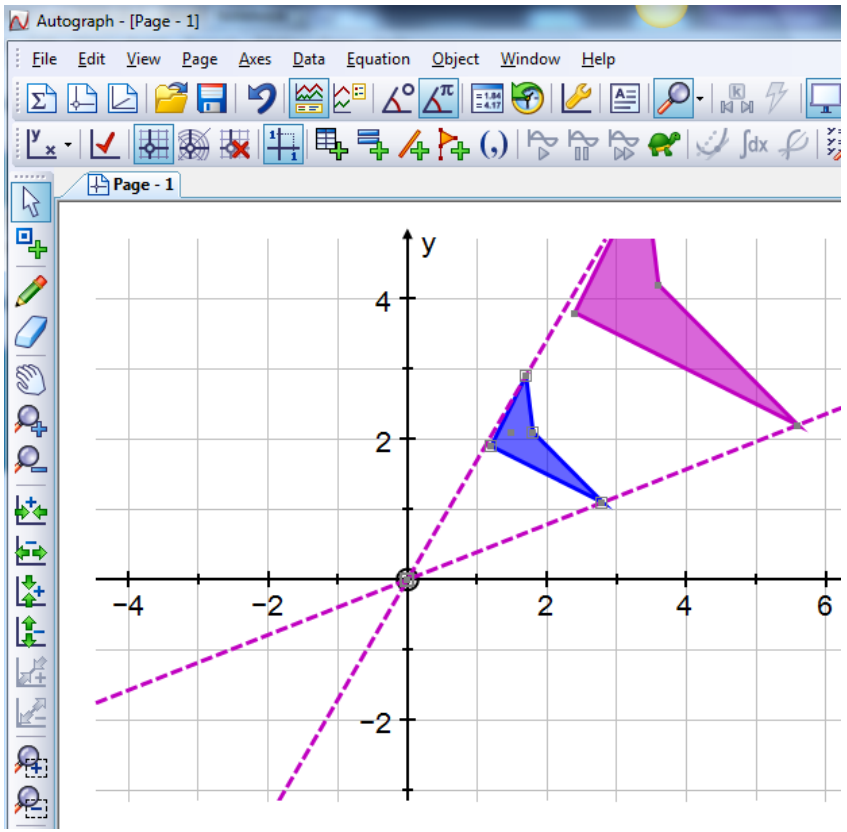
Schools should:

- tackle in-school inconsistency of teaching, making more good or outstanding, so that every pupil receives a good mathematics education
- increase the emphasis on problem solving across the mathematics curriculum
- **develop the expertise of staff:**
  - **in choosing teaching approaches and activities that foster pupils' deeper understanding, including through the use of practical resources, visual images and information and communication technology**

Ofsted Mathematics: made to measure; May 2012

Find the next two numbers in the sequence

3, 9, 15, 21, 27


Autograph - [Page - 1]
File Edit View Page Axes Data Equation Object Window Help
Page - 1
y
4
2
−2
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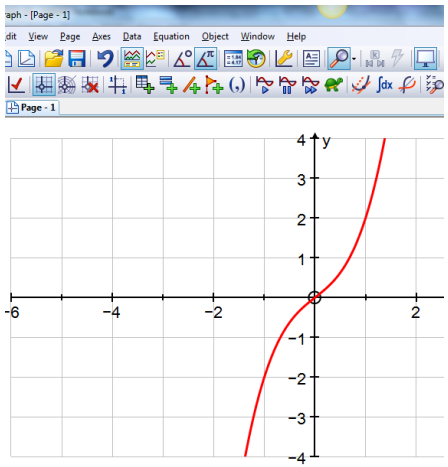
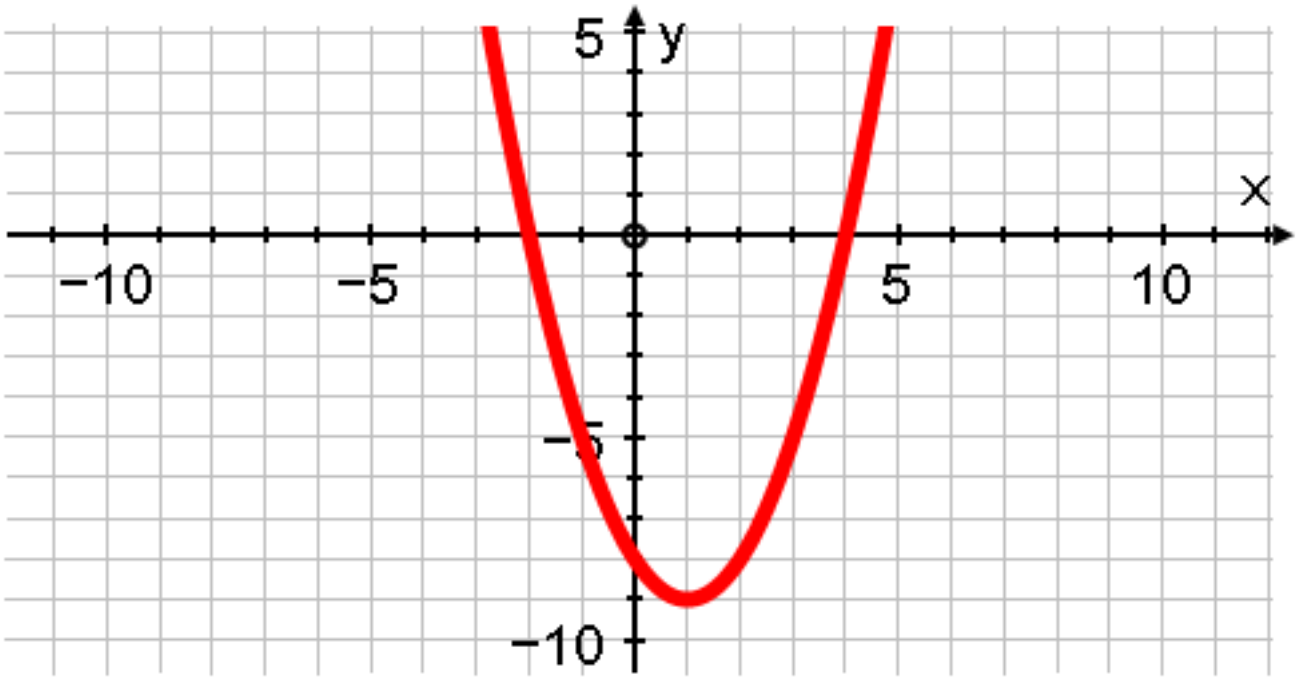
2
4
6

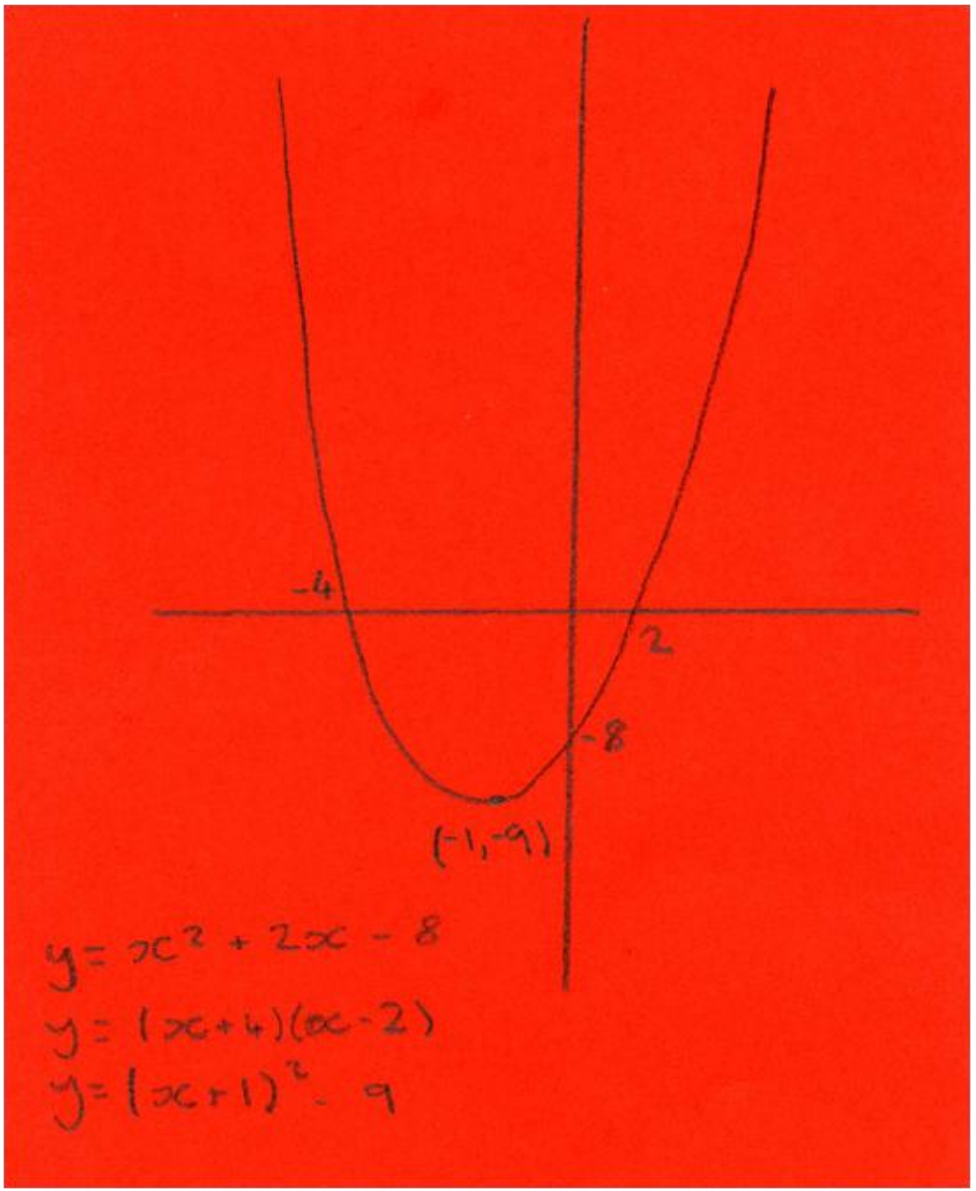
Solve the equation $x^3 + x = 80$

for x to 1 decimal place



Quadratics

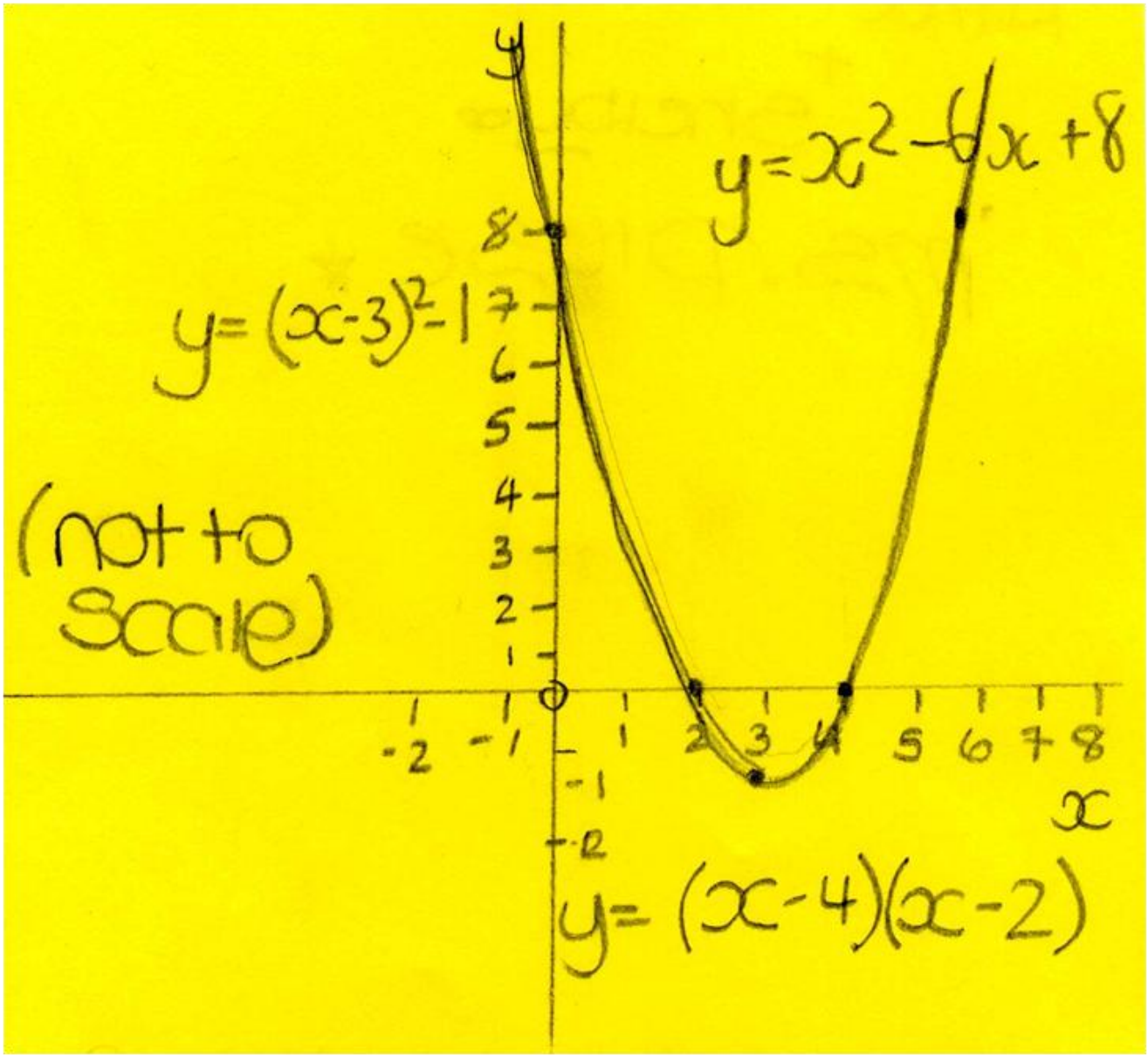


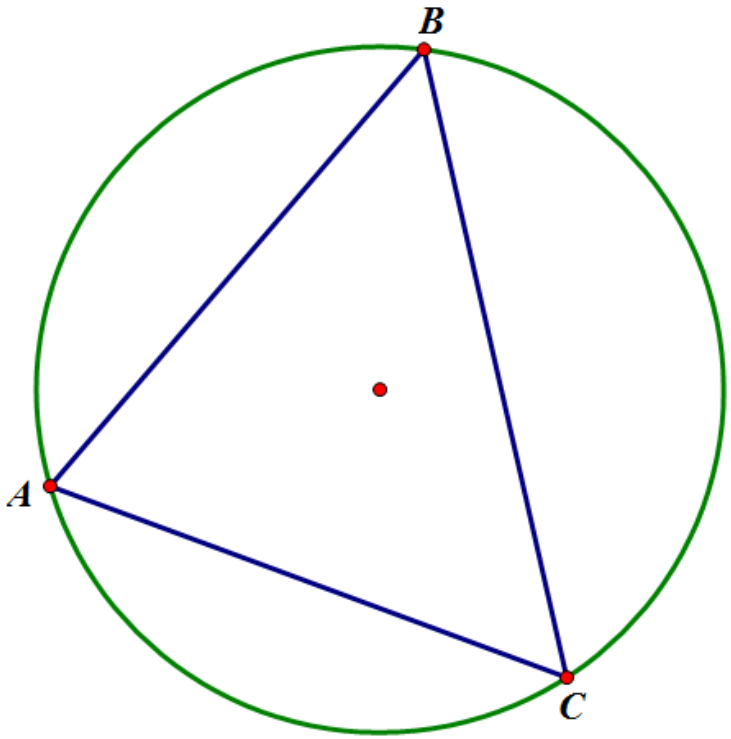


$y = x^2 + 2x - 8$

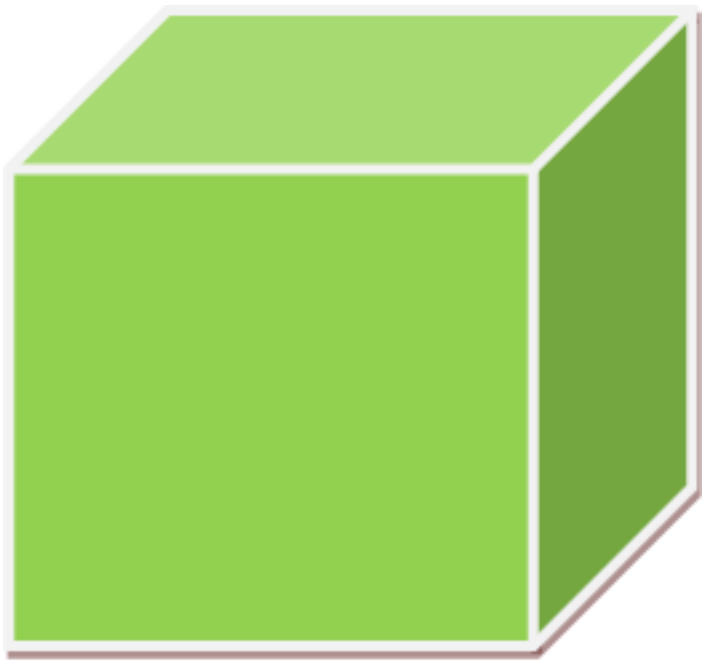
$y = (x+4)(x-2)$

$y = (x+1)^2 - 9$


y
x
y = x² − 6x + 8
y = (x − 3)² − 1
(not to scale)
y = (x − 4)(x − 2)
8
7
6
5
4
3
2
1
0
-1
-2
-2
-1
1
2
3
4
5
6
7
8


B
A
C

Think of .....



Principles for effective teaching

- Build on the knowledge learners bring to sessions.
- Expose and discuss common misconceptions.
- Develop effective questioning.
- Use cooperative small group work.
- Emphasise methods rather than answers.
- Use rich collaborative tasks.
- Create connections between mathematical topics.
- Use technology in appropriate ways.

Underexploited information and communication technology and practical resources

62. Carefully chosen practical activities and resources, including computer software, have two principal benefits: they aid conceptual understanding and make learning more interesting. Too few of the schools used these resources well.

O*fsted Mathematics: made to measure; May 2012*

"It lets us experiment!"

A systematic review of the use of ICTs in developing pupils' understanding of algebraic ideas

EPPI-Centre
Social Science Research Unit
Institute of Education
University of London
Report written by Maria Goulding and Chris Kyriacou

Report no. 1606R · May 2008

The Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre) is part of the Social Science Research Unit at the Institute of Education, University of London

Quotes from the Summary:

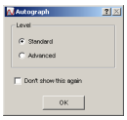
What did we find?

- pupils working in a computer environment reached higher levels of thinking and were able to explain their thinking better than pupils working in a paper and pencil medium.

Investigating Enlargement Using Autograph 3.3

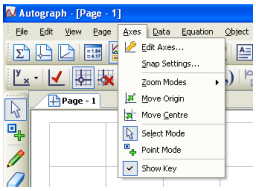
This worksheet should help you to use the *Autograph* software to investigate and practise enlarging shapes on a coordinate grid.

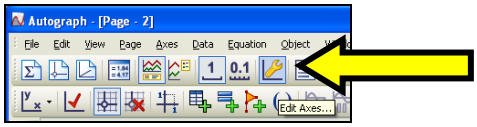
For this work Autograph needs to be running in ***Standard Level.***
You will be asked to select this when you first open Autograph.

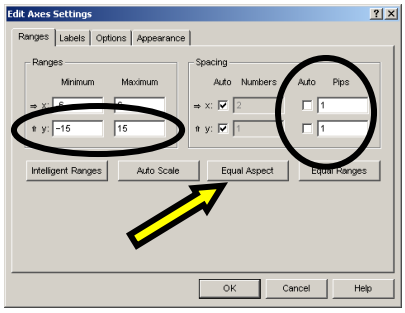


- Click on the **New 2D Graph page** button (near the top left of the window) to get a blank graph on the screen.

- From the main toolbar select ***Axes*** and then click on ***Show Key*** to uncheck the box.
  (If ***Show Key*** is ticked there will be a large white rectangle underneath the graph. A key is not needed for transformations.)







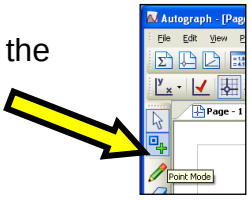
- Click on ***Edit Axes*** and select the values shown for the ***y-axis*** (*Minimum* –15, *Maximum* 15)

- Next uncheck the ***Auto*** box for ***x*** and ***y Pips***

- Finally click on the ***Equal Aspect*** button and then ***OK***

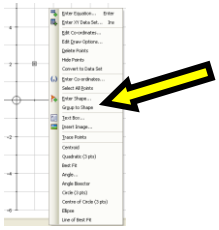
- Now select ***Add Point*** from the left hand side of the screen.

- Create yourself a shape by clicking where you want the vertices of the shape to be, click in the order you want them to be joined up.



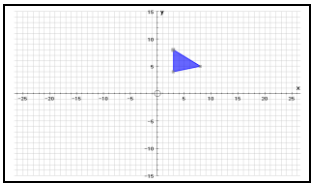
- Click ***Select Mode*** which is above ***Add Point.***

- Use the mouse to drag a box over all the points you have just created on the graph to ***Select*** them.



- Right click with the mouse and select ***Group to Shape.***

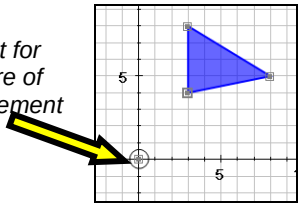
- The points then become the vertices of your shape.



- Click on ***Add Point*** again.

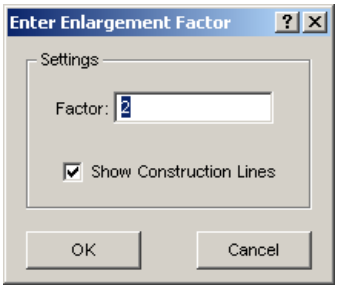
- Next click on the graph at the origin (0,0).
  This will create your centre of enlargement.

Point for centre of enlargement



- Return to ***Select mode***

- Select the point you have created at the origin **and** your shape by holding the ***shift*** key down and clicking on the point which is the centre of enlargement and then the shape.

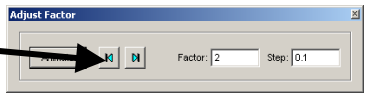


- Right click the mouse and select ***Enlargement*** from the menu of options. This dialogue box will appear.
- Check that the ***Show Construction Lines*** box is ticked and choose your Scale ***Factor*** before you click on ***OK.***

> ❖ ***Click on the centre of enlargement, move it around and see what happens.***
>
> ❖ ***Click on your original shape, move it around and see what happens.***

- Select your enlarged shape by clicking anywhere on it.
- Click on the ***Animation Controller*** button

- Click on the buttons, and to increase and decrease the scale factor of enlargement.
- Experiment with the options available when you click on the ***Animate*** button.



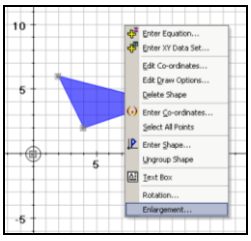
> ❖ ***What happens if you use 0.5 or 0.25 as the Scale Factor of Enlargement?***

Now try to create some enlargement challenges of your own:

- Starting with a ***New 2D Graph page*** create a new shape and a new point to be the centre of enlargement.
- Decide what scale factor you want to enlarge your shape by.
- Create a shape where you think the *image* of your shape will appear for your centre of enlargement.

When you are happy that you have created the enlarged *image* use Autograph to check your answer:

- Select the centre of enlargement **and** your original shape.
- Right click the mouse and select ***Enlargement*** from the menu of options and then enter the scale factor.

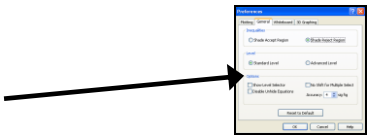


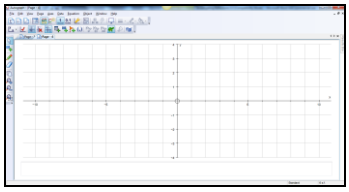
> ❖ ***Was your enlarged image in the correct place?***
>
> ❖ ***Click on the original shape and try moving it around***
>
> ❖ ***Set yourself some other similar challenges.***

Investigating Reflection Using Autograph 3.3

This worksheet should help you to use the *Autograph* software to practise reflecting shapes on a coordinate grid.

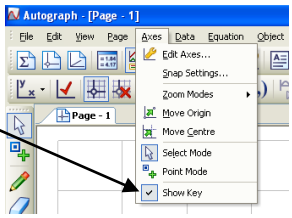
For this work Autograph needs to be running in ***Standard Level.*** You may be asked to select this when you first open Autograph. Otherwise select ***View-Preferences-General***.





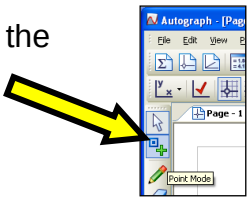
- Click on the ***New 2D Graph page*** button (near the top left of the window) to get a blank graph on the screen.

- From the main toolbar select ***Axes*** and then click on ***Show Key*** to uncheck the box.
  (If ***Show Key*** is ticked there will be a large white rectangle underneath the graph. A key is not needed for transformations.)



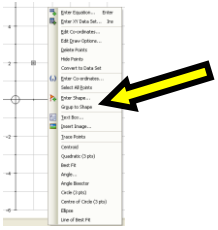
- Now select ***Add Point*** from the left hand side of the screen.

- Create yourself a shape by clicking where you want the vertices of the shape to be, click in the order you want them to be joined up.



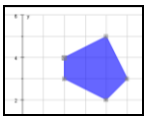
- Click on ***Select Mode*** which is above ***Add Point.***

- Use the mouse to drag a box over all the points you have just created on the graph to ***Select*** them.



- Right click with the mouse and select ***Group to Shape.***

- The points then become the vertices of your shape.

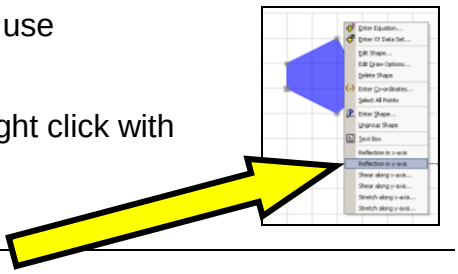


- In a similar way create the shape that you think would be the *image* of your shape if you reflected your shape in the ***y-axis.***

- If you want to change the colour of your *image*, click anywhere on the shape to select it, right click and then explore ***Edit Draw Options.***

When you are happy that you have created the reflected *image* use Autograph to check your answer:

- Click anywhere on the original shape to select it and then right click with the mouse.
- Select ***Reflection in y-axis***



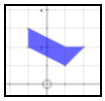
❖ ***Was your reflected image in the correct place?***

❖ ***Click on the original shape and try moving it around.***

❖ ***Set yourself some other similar challenges.***

❖ ***Try reflecting in the x-axis instead of the y-axis.***

- Create some shapes that are in more than one quadrant. (One or both of the axes pass through the shape.)
- predict where the reflected image will be
- use Autograph to reflect your shape so that you can check your predicition



❖ ***Keep creating shapes, predicting the reflected image and using Autograph to check your predicition until you feel confident about doing this.***

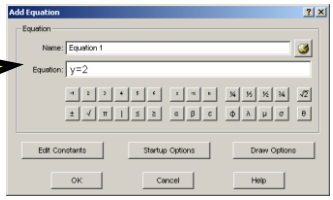
Now try some reflections in other lines:
To draw the line to reflect in:

- Press the ***Enter*** key on the keyboard.
- Type **y = 2** as the *Equation*.

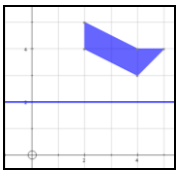
❖ ***Where do you think this line will be drawn?***

- Click on ***OK.***

❖ ***Was your prediciton correct?***



- Create a shape of your choice, as before.
- Now create a shape where you think the *image* of your shape will appear when it is reflected in the line ***y = 2***.

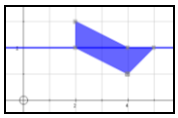


When you are ready to check your answer:

- Holding the ***shift*** key down, click on the line ***y = 2*** and then your original ***shape***.
- Release the ***shift*** key and right click with the mouse.
- Select ***Reflection*** from the list of options shown.

❖ ***Was your image in the correct place?***

❖ ***Click on the original shape and try moving it around.***



- Try creating some more shapes:
  - Create your predicted image
  - Use Autograph to check the prediction
- Include some shapes that are cut by the line of reflection.

❖ ***Try changing the equation of the line to y = x and then y = –x***

❖ ***Set yourself some more challenges.***

Investigating Rotation Using Autograph 3.3

This worksheet should help you to use the *Autograph* software to investigate and practise rotating shapes on a coordinate grid.

For this work Autograph needs to be running in ***Standard Level.***

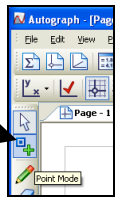
You will be asked to select this when you first open Autograph.

Follow the instructions on the sheet

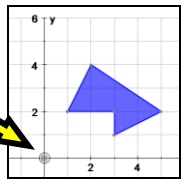
Investigating Reflections Using Autograph 3.3

to set up the axes and to create a shape of your choice.

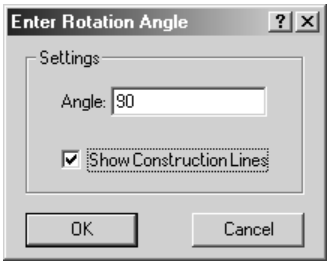
- Click on ***Add Point***
- Next click on the graph at the origin (0,0). **This will create your centre of rotation.**



Point for centre of rotation

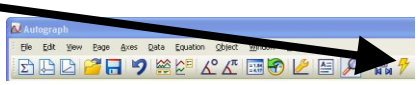


- Return to ***Select mode***
- Select the point you have created at the origin **and** your shape by holding the ***shift*** key down and clicking on the shape and then the point which is the centre of rotation.
- Right click the mouse and select ***Rotation*** from the menu of options. This dialogue box will appear.
- Check that the ***Show Construction Lines*** box is ticked and click ***OK.***



- ❖ ***Click on the centre of rotation, move it around and see what happens.***
- ❖ ***Click on your original shape, move it around and see what happens.***

- Select your rotated shape by clicking anywhere on it.
- Click on the ***Animation Controller*** button on the *Main* toolbar at the top of the screen



- Click on the arrow buttons and try to explain what is happening

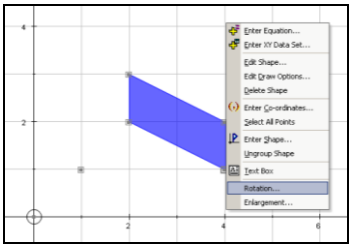
❖ ***When Autograph rotates a shape by 90^o is the shape rotated in a clockwise or anti-clockwise direction?***

❖ ***Create another shape. How many different ways can you use Autograph to rotate the shape by 90^o clockwise?***

- Starting with a ***New 2D Graph page*** create a new shape and a new point to be the centre of rotation.
- Decide what angle you want to rotate your shape through (it might be a good idea to start by choosing a multiple of 90°!).
- Create a shape where you think the rotated *image* of your shape will appear.

When you are happy that you have created the rotated *image* use Autograph to check your answer:

- Select the point you have created to be the centre of rotation **and** your original shape by holding the ***shift*** key down and clicking on the shape and then the point.
- Right click the mouse and select ***Rotation*** from the menu of options and then type in the anti-clockwise angle to rotate the shape through.



❖ ***Was your rotated image in the correct place?***

❖ ***Click on the original shape and try moving it around***

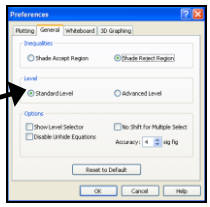
❖ ***Set yourself some other similar challenges.***

Investigating Translations Using Autograph 3.3

This worksheet should help you to use the *Autograph* software to investigate and practise translating shapes on a coordinate grid.

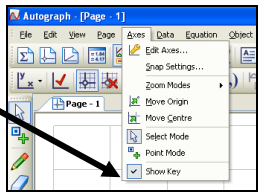
For this work Autograph needs to be running in ***Standard Level.***

You may be asked to select this when you first open Autograph.
Otherwise select ***View-Preferences-General***.



- Click on the **New 2D Graph page** button (near the top left of the window) to get a blank graph on the screen.

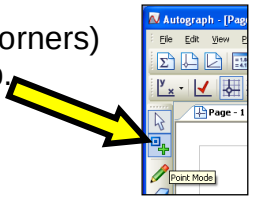
- From the main toolbar select ***Axes*** and then click on ***Show Key*** to uncheck the box.
(If ***Show Key*** is ticked there will be a large white rectangle underneath the graph. A key is not needed for transformations.)



- Now select ***Add Point*** from the left hand side of the screen.

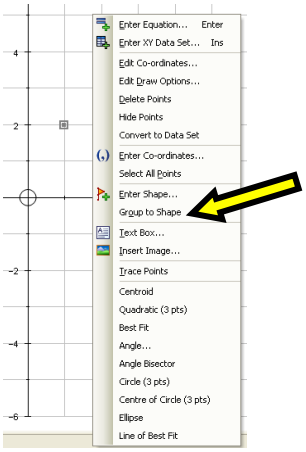
- Create yourself a shape by clicking where you want the vertices (corners) of the shape to be, click in the order you want them to be joined up.

- Click on ***Select Mode*** which is above ***Add Point.***

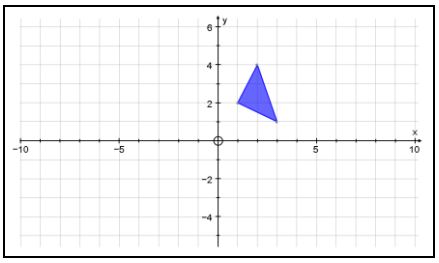


- Use the mouse to drag a box over all the points you have just created on the graph to ***Select*** them.

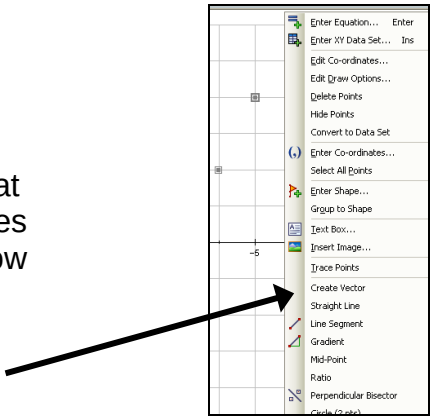
- Right click with the mouse and select ***Group to Shape.***

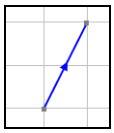


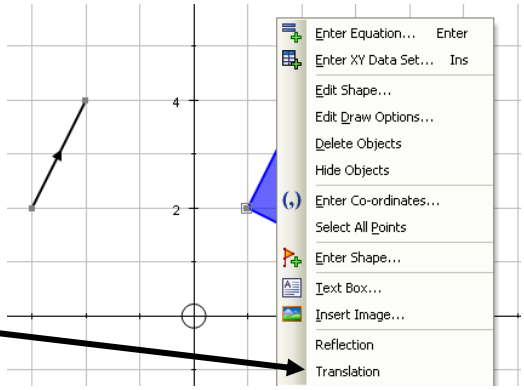
- The points then become the vertices of your shape.



- Click on ***Add Point*** again.
- Click anywhere on the coordinate grid to create a point.
- Hold the ***shift*** key down and click a second time at a point which is 1 square to the right and 2 squares up from your first point. The two points should now be ***selected***.
- Right click with the mouse and select the ***Create Vector*** option.



- You have created the vector $\begin{pmatrix} 1 \\ 2 \end{pmatrix}$ 
- Click on a space on the grid to make sure nothing is selected.
- ***Select*** both the ***vector*** and the ***shape*** by holding down the ***shift*** key while you click on them (to select the vector make sure you only click on the line with the arrow not the points at each end of it).
- Right click the mouse and select ***Translation***



❖ ***Click on your original shape, move it around and see what happens.***

❖ ***Click on one of the points that you used to create the vector, move it around and see what happens.***

Now create some translation challenges of your own:

- Starting with a ***New 2D Graph page*** create a new shape and a new translation vector.
- Create a second shape where you think the *image* of your shape will appear for the translation vector you have created.
- When you are happy that you have created the translated *image* use Autograph to check your answer.

❖ ***Was your translated image in the correct place?***

❖ ***Click on the original shape and try moving it around***

❖ ***Set yourself some other similar challenges.***