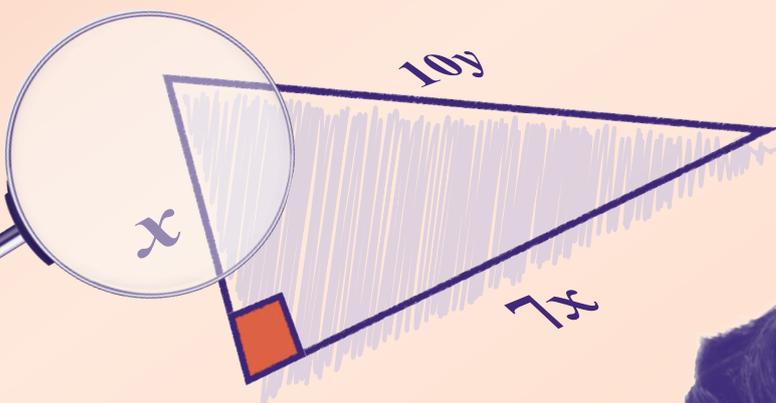


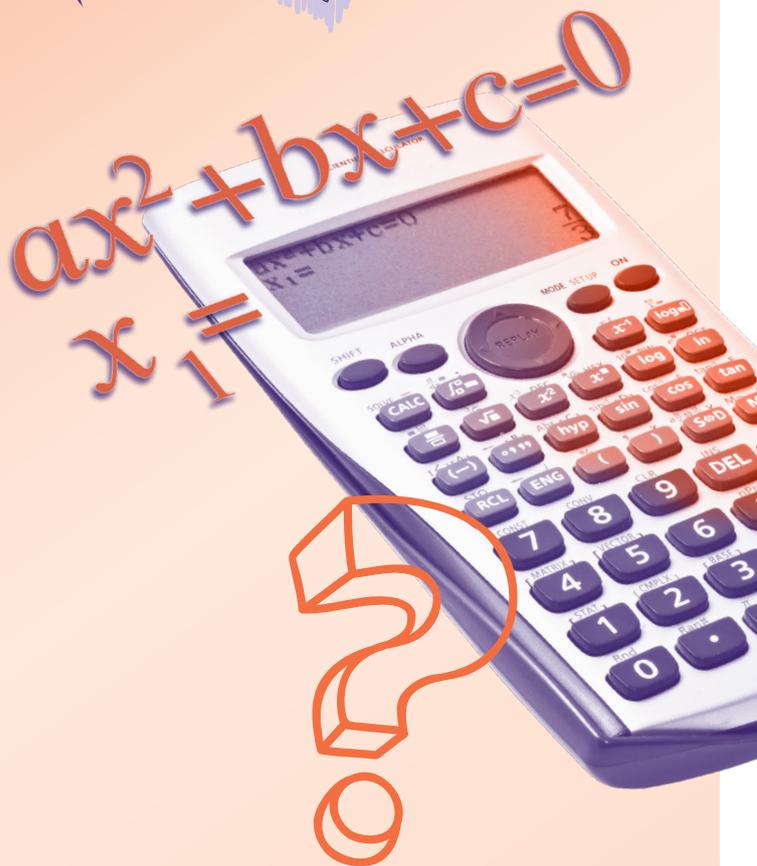
# GCSE Maths Focus on:

## Quadratics

Build on your students' assessment performance using our self-guided, modular training pack



Pre-reading  
booklet





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# Using this pack

This resource pack is intended to help you deliver a CPD session for teaching colleagues on quadratic expressions, equations and graphs in the Higher Tier of GCSE Maths, giving them the opportunity to explore how it is assessed, the strategies available for students and to consider implications for the classroom.

Using the completed Pre-session health check and Route map, you'll be able to design a bespoke session to focus learning on the areas that are most relevant for you and your colleagues. If you decide to cover all four activities in detail – with plenty of group discussion time – it is likely to take three or four hours in total.

## Before the session

- Ask your colleagues to each complete the Pre-session health check (page 9 in this booklet).
- Use the responses to the Pre-session health check to tailor the training session to the needs of your colleagues. The route map on page 8 will help you plan which activities to use in the session.
- Also ask your colleagues to complete the Pre-session activity (Command words). You may wish to provide this alongside the Pre-session health check or as an introductory activity at the very start of the session.
- Each colleague should be provided with a copy of the activities and handouts booklets. You may also wish to provide a printed version of the presentation for colleagues to make notes.

## Running the session

- Show the range of questions that are asked on quadratics in GCSE papers, and be aware of the meaning of a range of command words. Many, but not all questions, have performance data attached to give a sense of how they were tackled in live exams. It is important to discuss what each question is testing and the implications for the teaching of this. This may include some discussion of why students found the question challenging, but that should not become a distraction.
- Look at a number of classroom approaches that may work well for your students in approaching the content, either as revision or first teaching. This could be a discussion about how you may enhance your approach to teaching the content or a more interactive resources workshop. However, it is worth asking colleagues to work through the exercises as this is the only way to really appreciate them, especially the variation practice.
- Decide which resources you want to use more in your teaching and start to plan how to do this.

## After the session

- Ask your colleagues to each complete the Post-session health check (*Activities booklet*) to ensure the training has been successful.
- As a group, discuss how you can support each other to embed the learnings in your teaching, and how you can broaden the approach to different areas of the curriculum.

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# Introduction

This pack has been developed to support mathematics departments working collaboratively when:

- considering the range and style of GCSE Maths questions on the topic
- looking at 'intelligent practice' approaches to support teaching of the topic
- embedding these approaches into their practice and looking at how this model can be applied to other content areas.

The pack is based on a number of conference sessions and workshops led by Craig Barton and Andrew Taylor (Head of Curriculum - Mathematics) in 2018 and 2019, which were in-turn based on performance data from 2017 and 2018 AQA GCSE Mathematics exams as well as the content of Craig Barton's websites and book: *How I Wish I'd Taught Maths*, 1911382497, London, 2017.

It is not the intention of this pack to look deeply into the research that underpins intelligent practice approaches or to look at the wealth of classroom resources available. However, the approaches used are briefly described in the following pages with links to the relevant websites.

If you or your colleagues want to learn more about the research that underpins the approaches in this pack, or to view the available resources, an ideal jumping off point is [Mr Barton Maths](#) which has links to Craig Barton's websites, CPD, books and podcasts. If you decide to have a go at writing your own resources, the 'get involved' page on each site is invaluable.

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# Introduction to the ‘intelligent practice’ approaches

## Intelligent Variation (Reflect, Expect, Check)

This is an approach to writing sequences of questions with care so that each question is related to the one that precedes it, as opposed to being a random collection of questions on a topic.

Because of this relationship, students are able to form expectations of a result before carrying out the procedure, leading them to engage more actively when working through an exercise. It also allows them to think more deeply about the processes involved. To find out more about creating sequences of questions with variation and how to use them in the classroom, please go to:

[variationtheory.com](http://variationtheory.com)

## Same Surface, Different Deep (‘ssdd’) problems

Students are often presented with a series of problems based on the same topic, but set in different contexts. Same Surface, Different Deep (‘ssdd’) problems take a different approach by presenting problems that appear similar at first glance (same surface) but have a different underlying structure (different deep). Students are challenged to engage in the problems and recognise how they are different and what mathematics needs to be applied to solve each one. To find out more about creating and using ‘ssdd’ problems, please go to: [ssddproblems.com/about-the-site](http://ssddproblems.com/about-the-site)

## Fill in the gaps

As the name suggests, these are tables of interconnected knowledge and students use what they know and what they are given – together – to complete the table. They are particularly useful in helping students see connections between different representations and different facts, and can be very effective as revision exercises. Examples can be found at [variationtheory.com/](http://variationtheory.com/)

## ‘Goal-free’ problems

This approach removes the goal or specific question from a problem and replaces it with a much more open question such as ‘find out everything you can’. This stops students fixating on the end-point and frees them to explore all the maths within the situation. Longer, previous GCSE Maths exam questions provide excellent source material for ‘Goal-free’ problems and some teachers use mock exam papers derived entirely of ‘Goal-free’ questions with their students. For more explanation and examples, please go to: [goalfreeproblems.blogspot.com/](http://goalfreeproblems.blogspot.com/)

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# Summary of activities

## Pre-session activity (Command words)

This pre-session activity is intended to allow colleagues to see for themselves the range of questions that appear on quadratics and to begin thinking about the command words used in these questions and the challenges for students in understanding what to do.

Attendees will be required to:

- look at the three Higher Tier papers from any exam series and note the different command words used in algebra questions
- think about the challenges for students in understanding and following the instructions.

There is an answer template available at the back of this document should you wish to distribute this alongside the Pre-session health check template.

## Activity 1: Manipulating expressions

This activity focuses on manipulation of expressions stimulated by a range of GCSE Maths exam questions, including:

- factorising
- expanding and simplifying
- order of operations, particularly when brackets and squaring are involved.

Colleagues will then consider how carefully planned exercises using 'Reflect, Expect, Check' routines may help and reflect critically on different question sets. Finally, the idea of Same Surface, Different Deep (ssdd) problems is introduced.

## Activity 2: Solving equations

This activity looks at questions that require the solution of quadratic equations and considers the different methods students need to be familiar with to do this. A possible different approach is also introduced and colleagues will look more closely at creating exercises to encourage intelligent practice.

## Activity 3: Approaching graphs

This three-part activity looks at the questions in GCSE Maths on quadratic graphs and particularly the relationships between algebraic and graphical representations. Colleagues will look at the use of 'Fill in the gaps' and 'ssdd' tasks to develop understanding and fluency. Finally, the idea of 'Goal-free' problems is introduced.

## Activity 4: Next steps

This activity looks at thinking about how you will take the ideas from this session forward and how to build aspects into your teaching practice.

# Quadratics route map

$$ax^2 + bx + c = 0$$

$$x_1 =$$

## Area for development

Are colleagues familiar with GCSE questions testing quadratics content?

Exam questions

Presentation Slides 1-5

Pre-session activity: Command words

Are colleagues familiar with 'intelligent practice' approaches?

Presentation Slides 6-33

Activities 1, 2 and 3

Resource links

Does the team have plans to embed 'intelligent practice' approaches?

Presentation Slides 34

Activity 4

Further reading

# Pre-session health check

Grade the area of development statements according to your confidence where 0 is not confident at all and 5 is very confident.

Be sure to hand back to your Head of Department or nominated deliverer.

Area of development	Grading 0-5	Reasons/notes/previous training
I am familiar with the way quadratic expressions, equations and graphs are assessed in the Higher tier of GCSE Maths.		
I am familiar with the resources on Craig Barton's various websites.		
I understand the principles of variation theory and apply them in my teaching.		
I have good subject knowledge in this area and understand the most effective way to teach all aspects of this content.		

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# Pre-session activity: Command words

Which three Higher Tier papers have you examined?

What can you note about the different command words used in algebra questions?

What do you feel are the challenges for students in understanding and following the instructions identified in the exams reviewed?

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# Notes

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