Sustaining Mastery

Building Collaboration

Maths Hub Conference

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NATIONAL CENTRE FOR EXCELLENCE IN THE TEACHING OF MATHEMATICS

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Aims

To highlight key considerations within departments working on Sustaining Mastery and beneficial collaboration.

Coherence

Lessons are broken down into small, connected steps that gradually unfold the concept

Representation and Structure

Representations expose the mathematical structure being taught

Mathematical Thinking

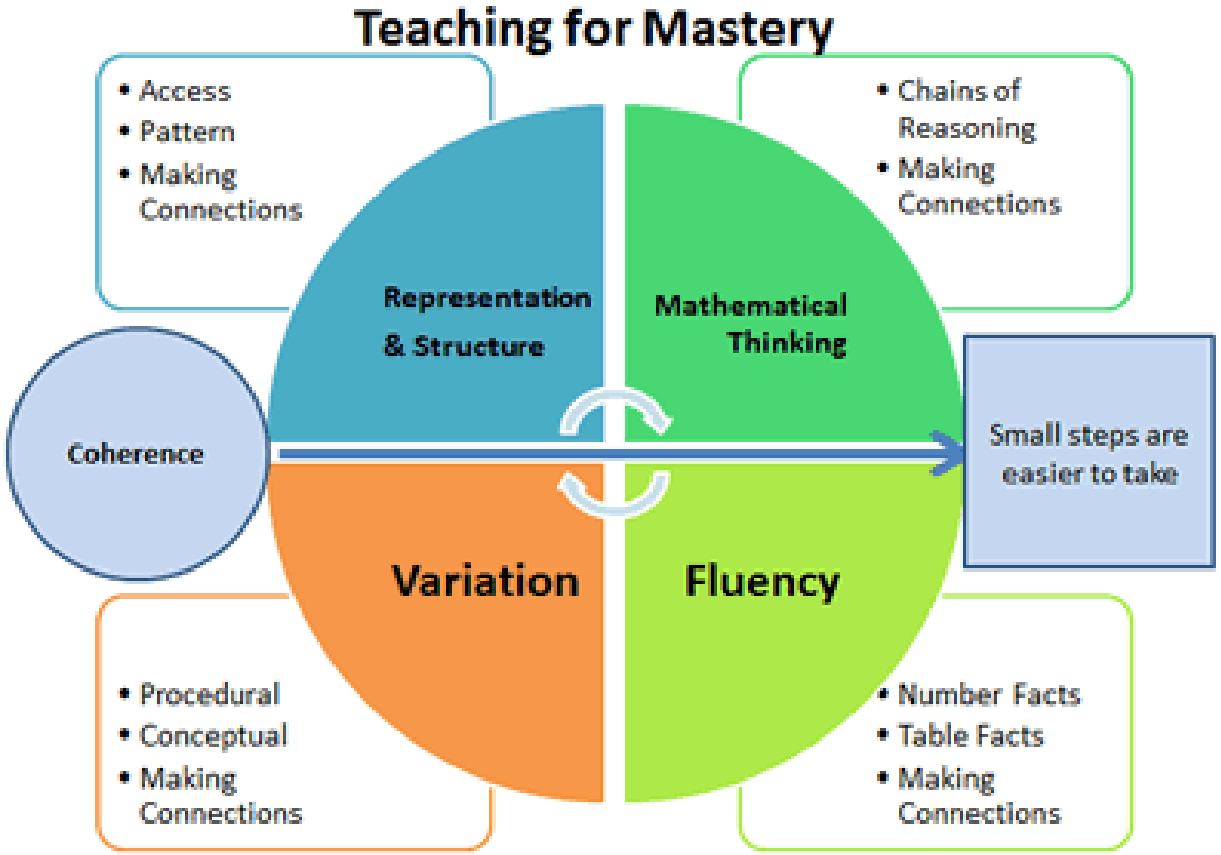
To be understood deeply, concepts must be thought about reasoned with and discussed with others

Fluency

Quick and efficient recall of facts and procedures, and the flexibility to move between different contexts and representations

Variation

How the activities and exercises are sequenced to draw attention to mathematical relationships and structure. Also, how the teacher represents the concept being taught, often in more than one way.



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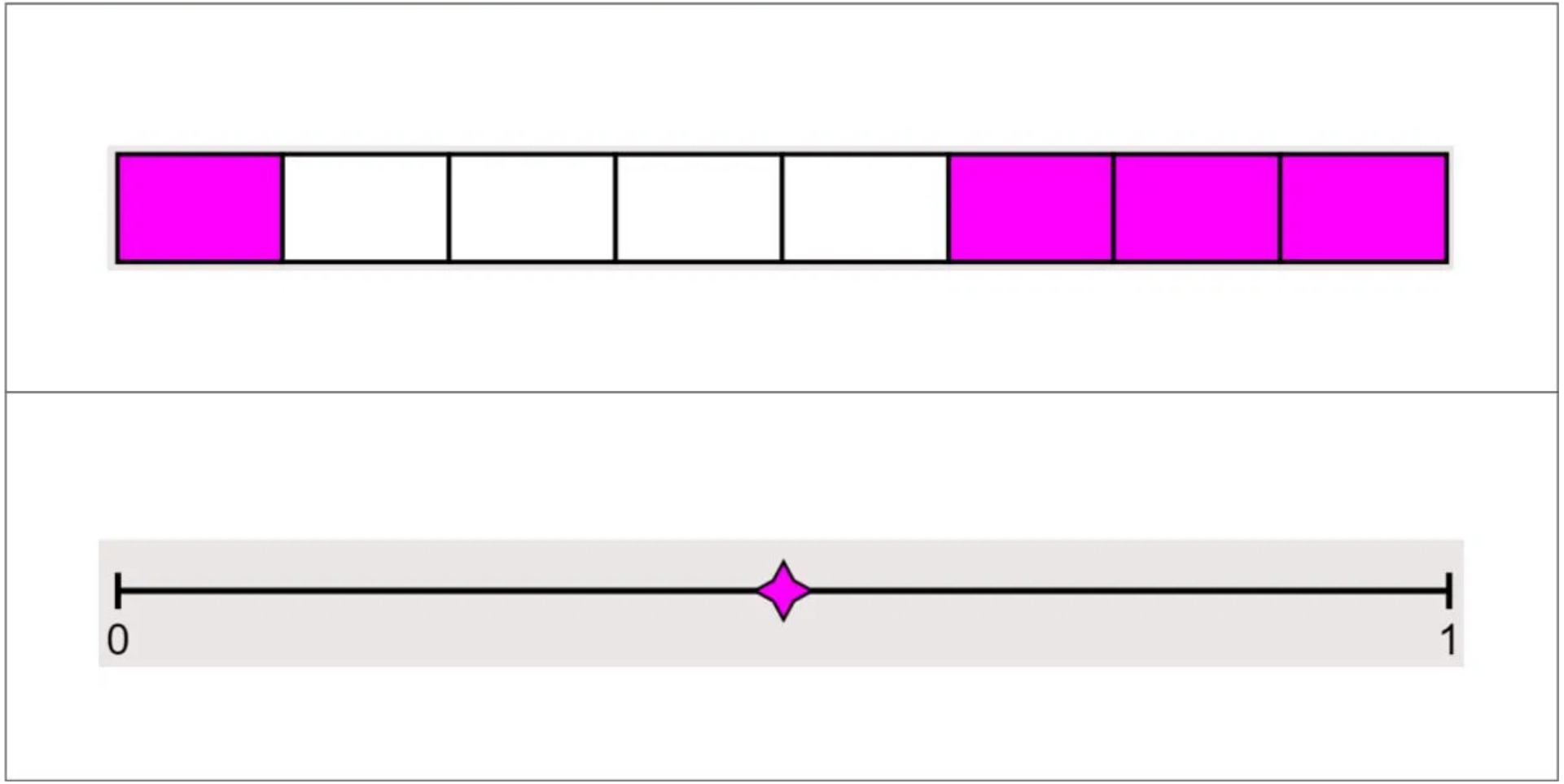
Mathematical Thinking

What does it look like and sound like when students are thinking mathematically?

Seven particularly good questions…

1. What is the same and what is different?



2. Can you give me an example of… and another…. and another?

Give me an example of a coordinate that lies on the line $y = 2x + 1$

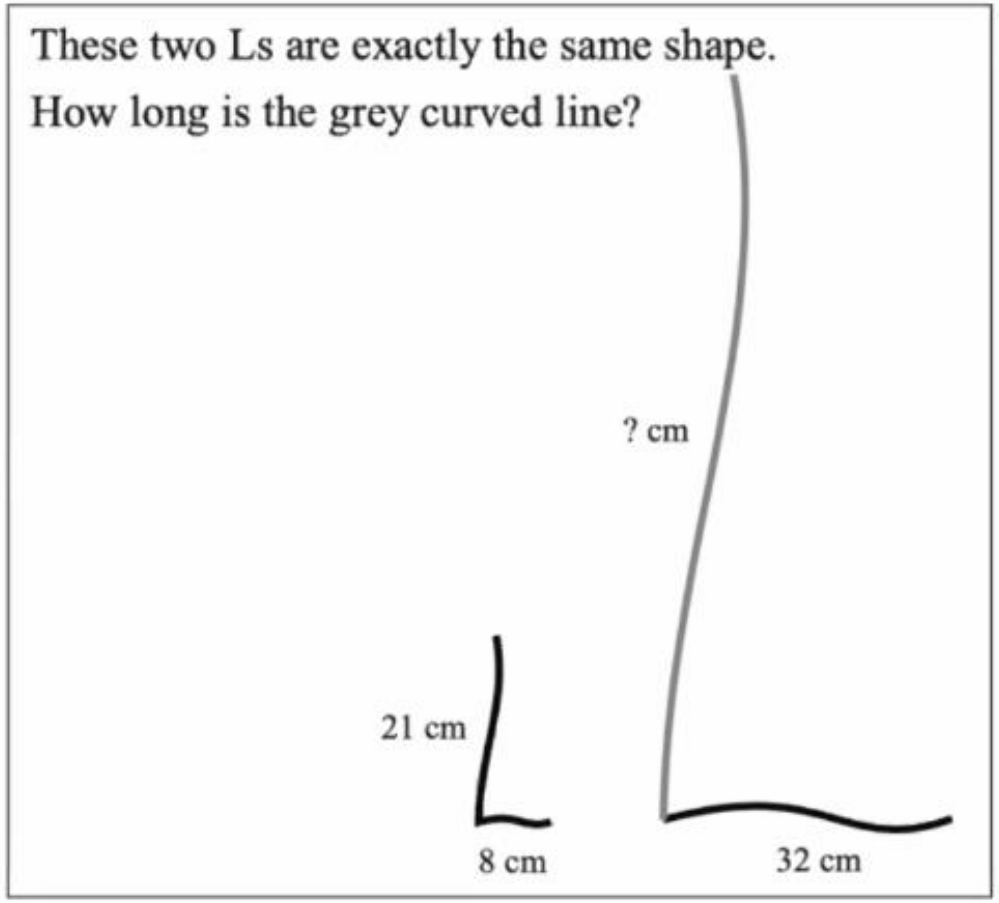
Particular

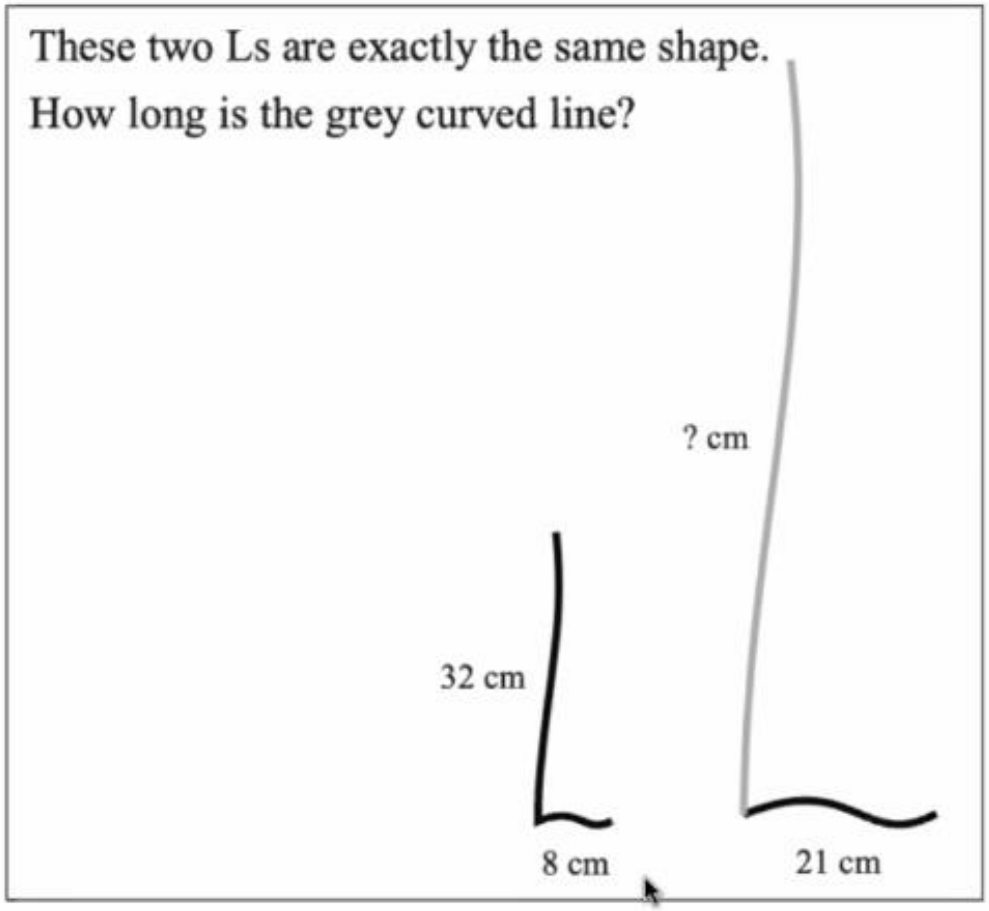
Peculiar

General

Non-example

3. Which is harder and which is easier?





4. What if I change...?

The solution to this equation is $x = 42$. →

$$3x + 77 = 203$$

Use this information to write down the solution to this equation. →

$$42x + 77 = 203$$

The solution to this equation is $x = 42$. →

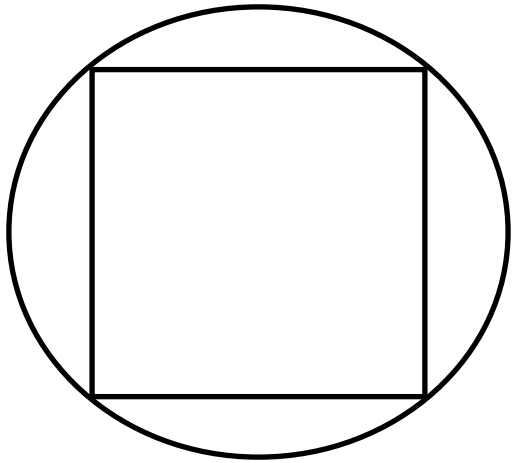
$$3x + 77 = 203$$

Use this information to write down the solution to this equation. →

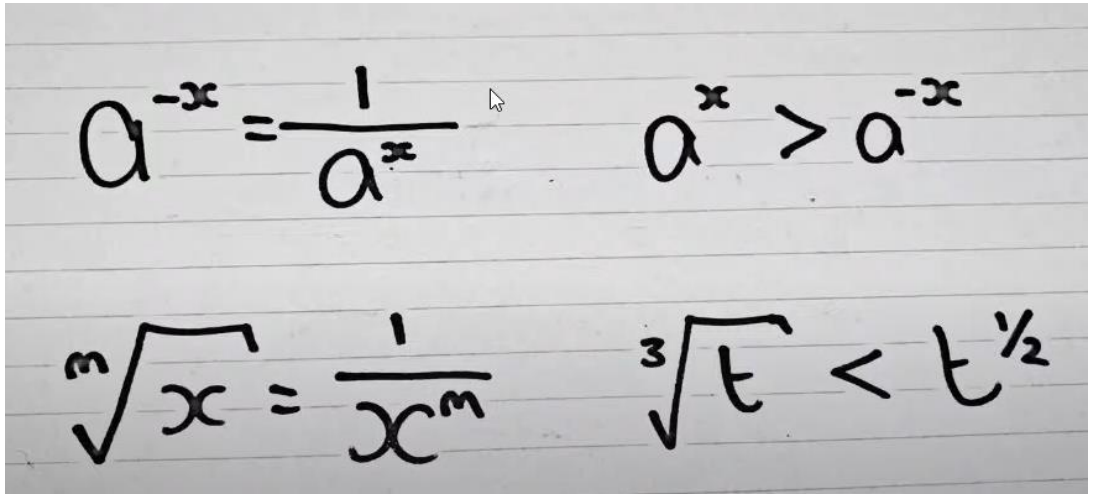
$$3x + 80 = 203$$

5. If I know this, then what else do I know?

The perimeter of the square is 24 cm



6. Always, sometimes or never true?



Investigate whether each of these statements are always, sometimes or never true.

Sort these statements into always true, sometimes true, never true

The perimeters of two congruent shapes are the same	Cut-out congruent shapes fit exactly on top of one another	If the angles of two shapes are the same then they are congruent
If two shapes have the same perimeter then they are congruent	The shapes which have the same area are congruent	The lengths of two corresponding sides are different

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7. What's the most efficient method?

Which is greater…?

$$\frac{27}{56} \text{ or } \frac{58}{118}$$

Departmental Collaboration task

Create questions for each of the question prompts on the A3 sheets for the topic area given.

Rotate the topics every 5 minutes

What impact would this collaboration task have on your teams?

What is the same and what is different?	Can you give me an example of… and another…. and another?	Which is harder and which is easier?
What if I change…?	If I know this, then what else do I know?	Always, sometimes or never true?

Variation

What does brilliant variation look like when you walk into a lesson?

How does this compare to what you see in your department?

Planning for Variation

For each topic given, give some examples of potential questions to use for…

CONCEPTUAL VARIATION

1. Standard and non-standard examples
2. Non-examples and negative variation

PROCEDURAL VARIATION

3. Tasks which draw attention to the specific learning point
4. Procedural variation (empty box, selecting a method etc.)

Standard and non-standard examples	Non-examples and negative variation
Procedural variation (empty box, selecting a method etc.)	Tasks which draw attention to the specific learning point

Key Considerations

- Representations and their progression
- Commonalities of methods and language
- Regular reflection on KS2 - is Year 7 challenging enough or a repeat?
- What does KS4 look like?

Representations

"Manipulatives and representations can be powerful tools for supporting pupils to engage with mathematical ideas."

EEF Improving Mathematics in Key Stages Two and Three
Guidance Report (2017)

Key Considerations – Working in Departments

- We need to consider how representations fit with COHERENCE in our schemes of work ?
- Should a department have a limited number of representations.
- What is too many types of Representations?
- May take time to embed but longer term gain important

The limitation of representations has to be well considered. The most appropriate representation needs to be chosen to reveal the structure and connections across the curriculum. The progression of the representation needs consideration and to be planned in advance.

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For example: Algebra Tiles Progression

Zero pairs (y7)

Area models for grid multiplication, area of rectangles (y7)

Collecting like terms (y7)

Expanding and factorising single brackets (y7, y8)

Solving linear equations (y8)

Solving simultaneous equations (y9)

Expanding and factorising quadratics (y9)

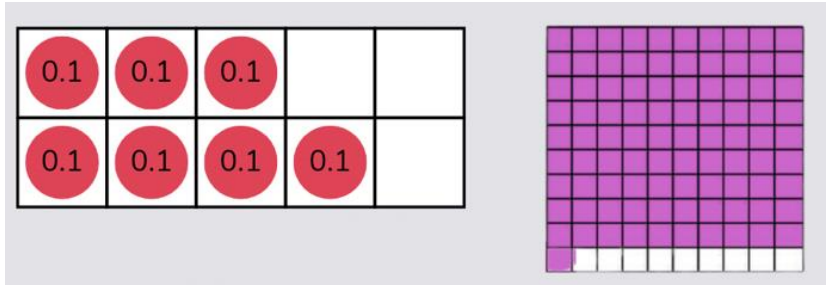
Completing the square (y10+)

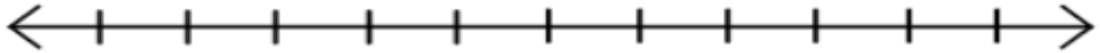
Successful implementation of representations

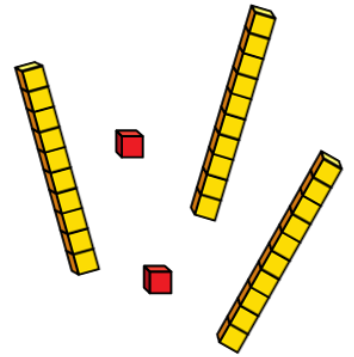
- Need to be spoken about and worked with by the department
- Consistency of language and actions when modelling
- Confidence is key
- Gradual release of support

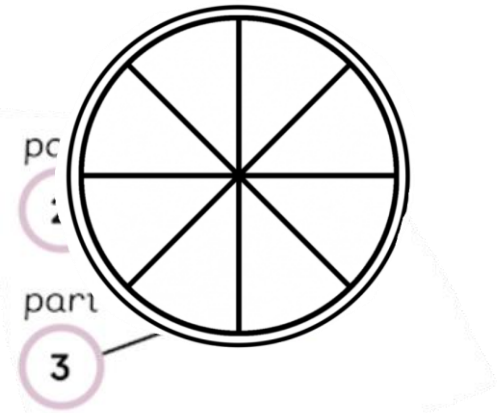
Physical → Diagram → Written Method

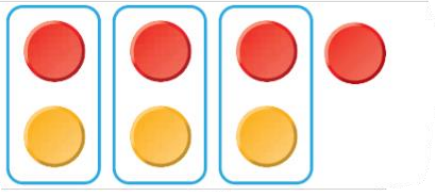
What do your feeder schools use?

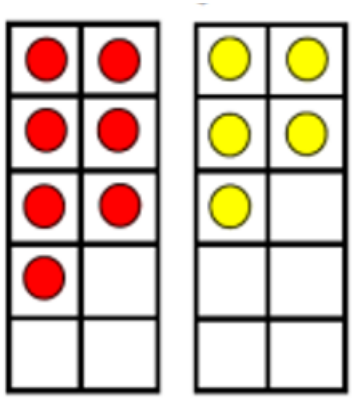


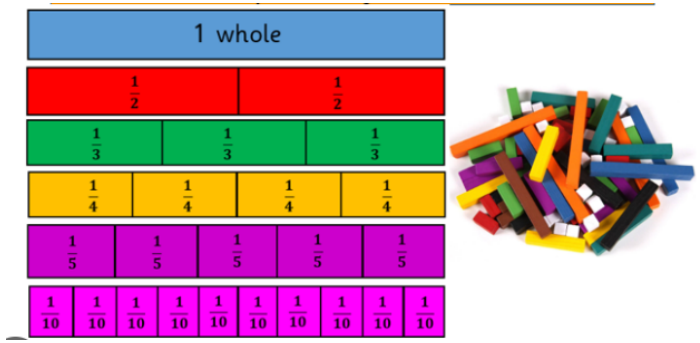


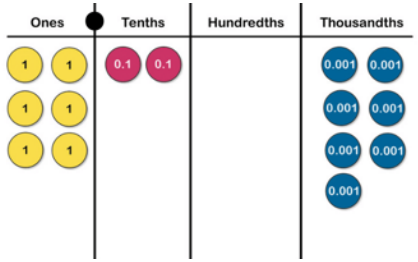












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Extra PP on basecamp if you want more info on KS2 use of representations

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Key Considerations as a team

Are these representations adding to the understanding?

What opportunities do these representations provide in the future?

Have students seen these representations before at KS2? How can we build on this?

Are we as teachers confident in modelling using these representations?

Common methods

Consistency of methods within the department can support student understanding especially when changes classes either within or at the end of the year.

Which methods provide the greatest understanding?

Which methods can we make connections between?

For example,

Factorising and expanding expressions

Common Language

Consistency and accuracy of language supports student understanding and avoids additional misconceptions.

What words are 100% consistent across your departments?

How is this communicated to staff?

What words would you like to achieve consistence?

Is there room in certain areas to be more forgiving?

Building on Key Stage 2

How confident are the team on what is covered at Key Stage 2?

Are there opportunities to have conversations with your Feeder schools?

How frequently is the Year 7 Scheme of learning refreshed?

Building on Key Stage 2

Shaping the Year 7 Curriculum: Building on Year 6

Key Idea 1: A deep understanding of place value

(6NPV–1 Powers of 10; 6NPV–2 Place value in numbers up to 10,000,000; 6NPV–3 Numbers up t in the linear number system; 6NPV–4 Reading scales with 2, 4, 5 or 10 intervals).

It is, of course, important that pupils know the names of the system. By the end of Year 6, they need to know all of them should be able to read and write all of these from 0.01 throu without an appreciation of the underlying structure that links

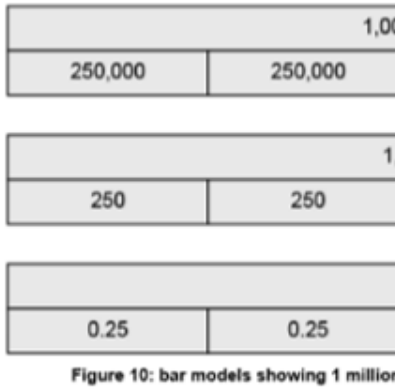


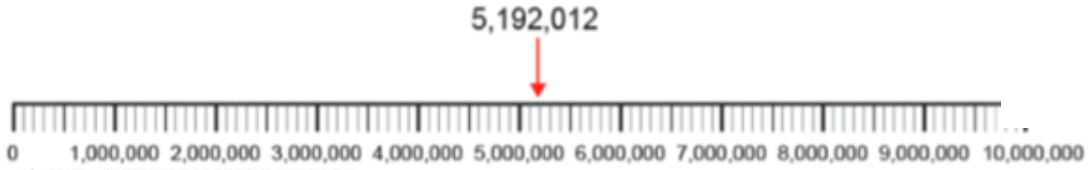
Figure 10: bar models showing 1 millio

Pupils should be able to describe any of the powers of ten i is a hundredth of 1,000,000" or "100 is a thousand times 0.1 all of the headings as powers of ten (and certainly not the d 10^3 (from Year 5) and appreciate that each column heading one.

They should be able to talk about a number like 275,600 in

- it is 100 times bigger than 2,756
- if you divide it by 1,000 you get 275.6
- 10 times this is 2,756,000.

Another key aspect of understanding place value deeply is the ability to place numbers on a numbe the related skill of being able to identify key numbers either side of a given number and round appr in these examples from the Year 6 guidance:

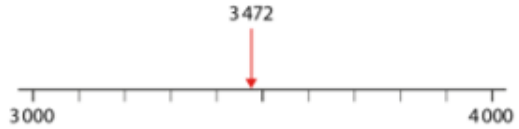


Progression to Key Stage 3

Two key ideas develop in Key Stage 3 for which a deep understanding of place value is needed:

- **Rounding to a number of decimal places or significant figures**
  Understanding the place value system and, in particular, being able to place numbers on a number line, is crucial for a deep, conceptual understanding of rounding.

  For example, once pupils are aware that when you place, for example, 3,472 on a number line between 3,000 and 4,000, it is nearer to 3,000 than 4,000, then they understand the purpose of rounding and are less likely to apply a rule mechanically.



(Taken from the Secondary Mastery PD Materials, Core Concept 1.1: Place value, estimation and rounding https://www.ncetm.org.uk/media/ounhep23/ncetm_ks3_cc_1_1.pdf)

- **Interpreting and writing numbers in standard form.**
  When pupils have a really deep understanding of place value and know that:
  - each place in the base 10 number system has a value 10 times bigger or smaller than the number in the adjacent place
  - multiplying and dividing by different powers of ten results in all the digits shifting to the right or left with the decimal place remaining fixed,

  and
  - are able to write numbers in different ways:
    e.g. $2453.12 = 245.312 \times 10 = 0.245312 \times 10{,}000 = 245{,}312 \div 100 = 2.45312 \times 1000$

… then they are very close to understanding the essence of standard form.

Work in Key Stage 3 can then build on this by teaching pupils to understand the meaning of 10^n for positive and negative values of n and that dividing by, for example, 100 (10^2) is equivalent to multiplying by 0.01 (10^{-2}).

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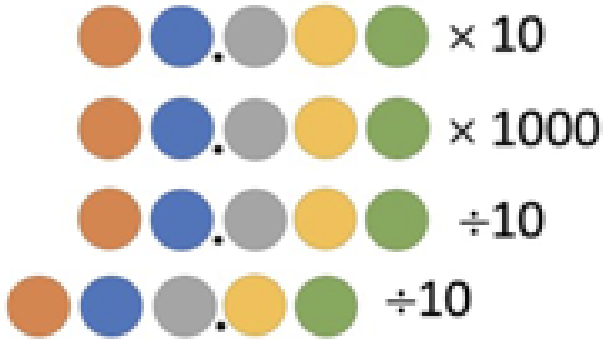
Checkpoints

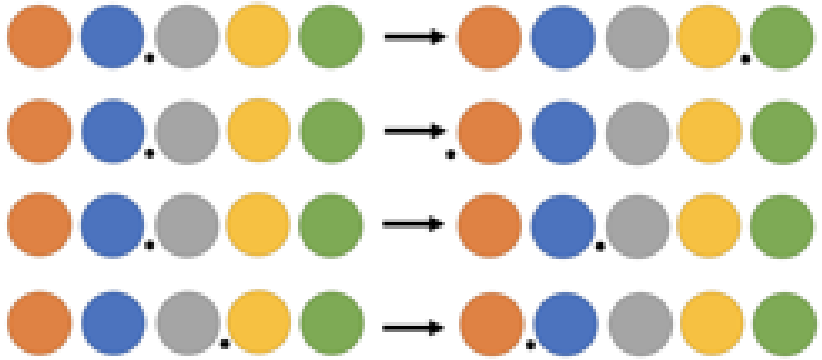
Checkpoints are a great opportunity to check prior learning without re-teaching.

In these calculations, coloured dots have replaced digits.

Describe how the dots and decimal points will be arranged after the calculation has been carried out.



What mathematical operations will result in the digits making these movements?



Building these into schemes of learning will result in consistency of all staff checking for prior learning, encouraging discussion and not re-teaching.

Do these need talking about as a team?

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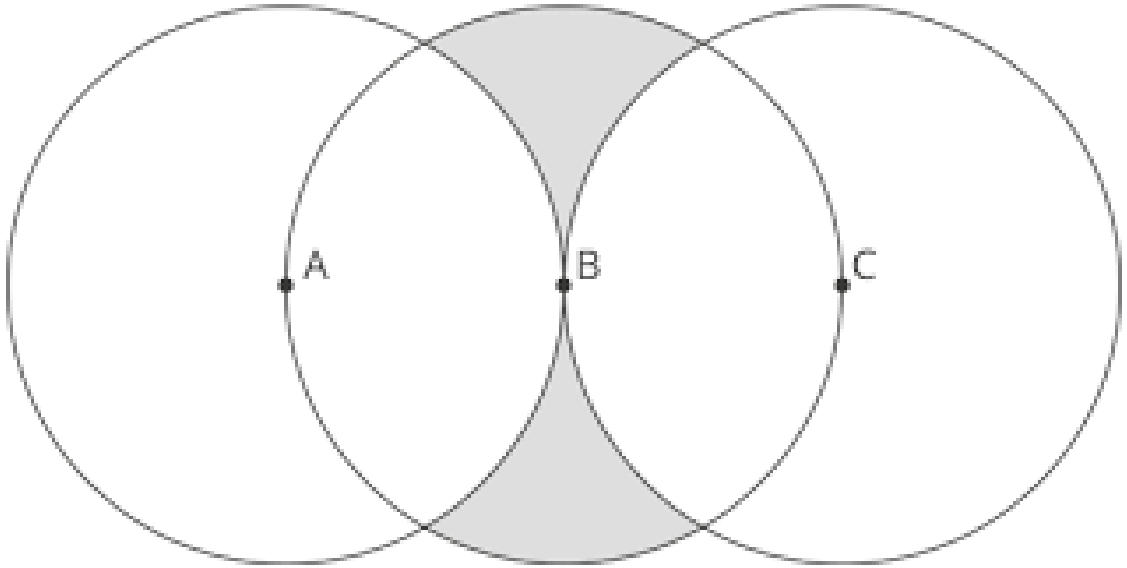
Key Stage 4

Building in aspects of the 5 Big Ideas will hugely benefit students at Key Stage 4.

What can we do to prepare students for questions like this on the exam papers?



Key Stage 4

Goal free problems encourage students to look for links between topics and consider questions that could be asked and then plan steps to answering.

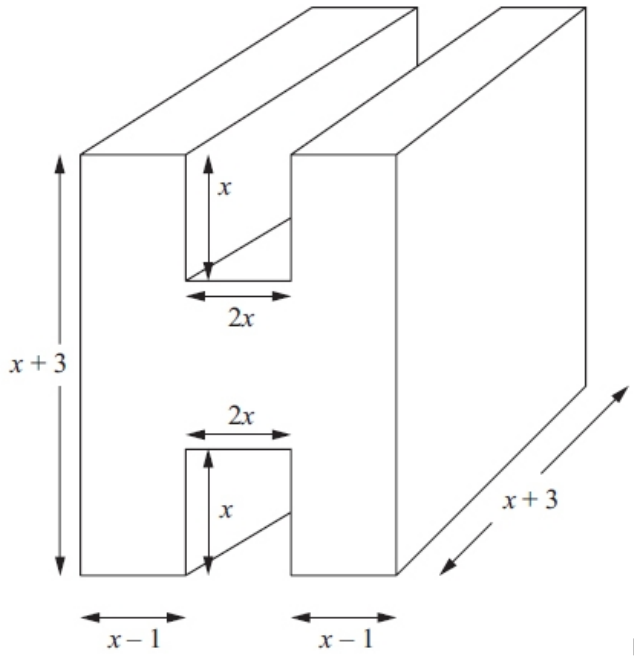


Diagram **NOT** accurately drawn

The diagram shows a prism.
All measurements are in cm.
All corners are right angles.
Work out what you can from this information.

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