Prompts and questions to support reasoning in Year 6

The three exemplified questions support teachers in developing aspects of the “five practices for productive mathematical discussion” (*see guidance document for further information*). These first three tasks are resourced in the accompanying powerpoint.

The succeeding pages provide suggested questions only but making use of these five practices is likely to improve quality of dialogue both for formative assessment and to develop learners’ understanding. The questions cover a range of content knowledge from the Upper Key Stage Two Programme of Study.

Number & place value

1. Show the image (slide 1) of a blank number line with only a zero marked at the left-hand end. Place an arrow at any point on the line and on mini whiteboards ask children to **“Write any number that you think could be represented by this arrow and be ready to explain why.”** After some time to think and record, “**Share your examples with a partner and take it in turns to convince each other why your estimate could be correct."**

Anticipate likely responses: Will all learners be able to do this without any other information on the number line? What questions will they want to ask before they start? How would you respond or adapt the task? How readily will learners accept that two very different responses could be equally correct? **What are the key mathematical ideas?** What explanations, models and representations are likely to support understanding?

E.g. Without additional information, that the arrow could be indicating <u>any</u> number greater than zero but not any number less than zero; arbitrarily assigning <u>any</u> specified value to any other point on the number line; clarifying that this doesn’t have to be at the right-hand end; understanding the need for a sense of scale; demonstrating that the visible segment of the number line could encompass any range of values until the scale is determined by adding more information; explaining the importance of equal intervals representing equal values to represent the linear number system; that using a number line is based on measurement and estimation; comparing the different position of a given number on two different scales positioned on top of each other; identifying other visible numbers based on the information given; extending the line to another number determined by reasoning.

During independent and then paired work, **monitor** the responses as learners convince their partners, listening out for ideas (including ideas that are incorrect) that will be useful to discuss with the class and looking for models/jottings or explanations that can be considered and discussed that are likely to move learning on. **Select** and **sequence** responses that are both complementary and contrasting to encourage learners to analyse and identify the similarities and differences and generalise about placing numbers on a number line or estimating the value of a given point on a number line. Be prepared to create additional examples that elaborate on key points missed by learners’ examples. Help learners to **make mathematical connections** to the key ideas through further questioning and/or use of representations/tools (e.g. Number Line ITP)

Geometry

A rectangle is a square	A trapezium is a kite	A kite is a rectangle	A rhombus is a rectangle
A trapezium is a square	A square is a rectangle	A rectangle is a parallelogram	A square is a kite
A parallelogram is a rhombus	A square is a rhombus	A square is a parallelogram	A quadrilateral is a kite

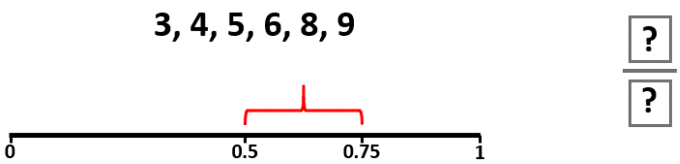
2. Show learners the set of statements (slide 2) on properties of quadrilaterals. Give them some thinking time to "**Choose one statement that you think you can convince each other is Always, Sometimes or Never true, using what you know about the properties of quadrilaterals**." Then ask them to convince their partner. Share some different examples from the paired talk in a whole class discussion, encouraging challenge, development and improvement of chains of reasoning. Then give each pair (or small group) a set of the cards to sort into Always, Sometimes or Never piles. Provide enough time to complete this work, listening to discussions and noting responses for further whole class discussion.

Anticipate likely responses: Will all learners be able to access the task without scaffolding? What questions will they want to ask before they start? How could you adapt the task to support more children to access it? (*e.g. provide definitions of shapes or properties, provide sets of shapes to compare, provide construction software, provide drawing equipment, reduce the number of quadrilaterals referenced or reduce the number of statements*) How could you extend the task? (*e.g. encourage learners to create their own statements to add; encourage learners to rewrite 'Sometimes' statements to make them 'Always' true)* **What are the key mathematical ideas?** What explanations, models and representations are likely to support understanding?

E.g. That squares are a special type of rectangle and a special type of rhombus; that all rectangles and rhombuses are types of parallelogram; that rhombuses and squares have four equal sides; that rectangles and squares have four right angles; that all parallelograms have exactly two pairs of parallel sides and that the opposite sides are of equal length; that kites have two pairs of sides with equal lengths and that the equal length sides are adjacent; that squares and rhombuses are special types of kite; that all trapezia have exactly one pair of parallel sides; that all of the shapes used are quadrilaterals; that quadrilaterals have internal angle sums of 360 degrees; that polygons can be classified and are defined by their properties alone and that these create similarities and differences

During paired and group work, **monitor** responses as learners convince their partners, listening out for ideas (including ideas that are incorrect) that will be useful to discuss with the class and looking for drawings and explanations that can be considered and discussed that are likely to move learning on. **Select** and **sequence** responses that are both complementary and contrasting to encourage learners to analyse and identify the similarities and differences and generalise about quadrilaterals. Encourage drawing of example shapes to support argument. Help learners to **make mathematical connections** to the key ideas through further questioning and use of sorting diagrams.

Fractions, decimals & percentages



3. Show the image (slide 3) and ask learners to "**Make a fraction using any of the given digits that is greater than 0.5 and less than 0.75"** After some time to think and record, "**Share your example with a partner and take it in turns to convince each other why your example is correct."** After the paired talk extend the task **"Can you find more examples?" and/or "Now find all the possibilities with these digits. How will you know**

you have found all the possibilities?" Provide enough time for this work (deciding whether learners should work independently, in pairs or in a group).

Anticipate likely responses: Will all learners be able to create an initial example? What questions will they want to ask before they start? How might you scaffold or constrain the task? What are the possible correct responses? What are the possible incorrect responses? What if denominators/numerators can be created using more than one digit? **What are the key mathematical ideas?** What explanations, models and representations are likely to support understanding?

E.g. To compare fractions as numbers (e.g. on a number line), we assume that the whole is one; that fractions and decimals are different ways of expressing parts or proportions of a whole; which common fractions are equivalent to 0.5 and 0.75; that non-unit fractions are made up of iterations of the same unit fraction; that equivalent fractions have the same proportional relationships between numerator and denominator; so that any fraction can be determined to be greater or less than one half by considering the relationship between its numerator and denominator; that fractions can be compared by reasoning <u>and</u> by calculating decimal equivalents; that fractions are a representation of division; bar models can demonstrate the relative magnitude of examples compared to the limits (0.5 and 0.75); that completed bar models are more challenging to create and use for fractions with larger denominators; that there are a finite number of possibilities from the given digits; that there are systematic ways of working to ensure all possibilities are found; that there are an infinite number of possible numbers (fractions or decimals) between two values on a number line

During independent and then paired work, **monitor** the responses as learners convince their partners, listening out for ideas (including ideas that are incorrect) that will be useful to discuss with the class and looking for models/jottings or explanations that can be considered and discussed that are likely to move learning on. **Select** and **sequence** responses that are both complementary and contrasting to encourage learners to analyse and identify the similarities and differences and generalise about comparing fractions and decimals. Be prepared to create additional examples that elaborate on key points missed by learners' examples. Help learners to **make mathematical connections** by keeping a record of the relative positions of the examples based on the explanations given and by recording models and representations suggested by learners in their convincing arguments, adding to or adapting these for clarity.

<u>Further questions/prompts</u>

The following books are good sources of activities to promote, develop and assess reasoning in Year 6. Some of the questions on the following page are based on ideas from these books.

ATM publication with tasks and activities ready to use: Talking Maths; (links to e-book but print copies also available)

I See Maths publication (Gareth Metcalfe): I See Reasoning UKS2 – with ready to use activities (download only)

ATM publications with question stems to create your own activities: Thinkers, Primary Questions & Prompts; (links to e-books but print copies also available)

Write in numerals an example of a 7-digit number that might be difficult to read out loud…and another…and another. Share your examples with a partner and take it in turns to explain why you think a number might be difficult to read.
Then we can share our ideas with the class. What's the same? What's different? What rules can we come up with about reading 7-digit numbers?

Give an obvious example of a fraction equivalent to 0.2; give a peculiar example of a fraction that is equivalent to 0.2; give a non-example of a fraction that is equivalent to 0.2; explain what makes an example of a fraction that is equivalent to 0.2

Which is the odd one out of these 3-D shapes: a cylinder, a triangular prism and a square-based pyramid? Convince me. Now convince me that another one is the odd one out?

How many different ways can you complete these fractions to make them equal? Can you find all the ways? How can you prove that you have found all the ways?

$$\frac{\square}{24} = \frac{3}{\square}$$

Place these calculations in order from easiest to hardest then convince each other of your choices: 200 ÷ 24 120 ÷ 24 72 ÷ 24 500 ÷ 24

"Numbers ending in 9 round up." Always, sometimes or never true? Convince me.

If you add four even numbers, the answer is a multiple of four. Always, sometimes or never true? Can you prove it?

If a fraction is in its simplest form, the numerator will be 1. Always, sometimes or never true?