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**Examples**<br>You have told me that there are twelve balls there. How could you record that mathematically? Questions like this are intended to give students the opportunity to practice their fluency in recording numbers.

**Pedagogical questions:**<br>• Can you remember a way to…?<br>• What is the name of…?<br>• What is the symbol for…?<br>• What is the formula for…?<br>• How many…?<br>• How much…? | **Examples**<br>What metric units of measurement are commonly used for length, area, volume, capacity and mass? Recall multiplication and division facts up to and including 10 x 10. Recall facts and definitions up to and including those used in the appropriate year level.

Can you remember a way to multiply a two digit number by a single digit number eg 36 x 7 ?

Can you remember a way to divide a two or three digit number by a single digit number (with remainders) eg 2847 ÷ 7?

Can you remember a way to divide a large number by a single digit number (with remainders) eg 2847 ÷ 7?

Can you remember a way to divide a two or three digit number by a single digit number (no remainders) eg 287 ÷ 7?

Can you remember a way to divide a large number by a single digit number (no remainders) eg 2847 ÷ 7? | **Examples**<br>What can you recall? (single digit additions at appropriate level): 2 + 2 1 + 3 6 + 4 etc

What is the name of… (a calculation that you would expect automatic recall of, eg number pairs to 10, to 100, times tables)?

What is the symbol for…?

What is the formula for…?

How many…?

How much…?

What is Pythagoras Theorem? What is the value of… (a calculation that you would expect automatic recall of eg times tables, some square numbers, square roots of perfect squares, some powers of 10 eg 102=100, 103=1000)?

What is the name of…?

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What is the value of 3/4 ÷ 1/3?

What is the value of 1/3 x 3/4?

What is the value of 3/4 - 1/3?

What is the value of 1/3 + 3/4?

What is the name of a circle.

What is the area of a circle?

What is the circumference of a circle?

What is the value of 3/4 – 1/3?

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<td><strong>Examples</strong>&lt;br&gt;Choose a way to arrange your counters, so that someone else can look at them and count them quickly/efficiently, or just see how many? Notice that the answer could have been developed as a result of students experiencing problem solving questions such as...&lt;br&gt;Are there ways of arranging collections of counters, that make it easier to see at a glance how many there are?&lt;br&gt;Choose a way to find out what day of the week that makes it easier to see at a glance how many there are?&lt;br&gt;There are 24 children in Pam’s class. Each child was allowed to bring up to 4 guests to their open day. What is the maximum number of guests that will be at the open day? How could you use a calculator to work out the total number of books in three boxes with 36 books in each?</td>
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<td><strong>Examples</strong>&lt;br&gt;Order a selection of angles from smallest to largest. Measure and record the size of each angle to verify the order that you have placed them in. Calculate how many millimetres there are in a metre square. Calculate how many centimetres there are in a kilometre square.</td>
<td><strong>Examples</strong>&lt;br&gt;Calculate how many centimetre squares there are in a metre square. Calculate how many metre squares there are in a kilometre square. Kym was driving to a concert. She used ⅓ of a tank of fuel to get there, but she took a different route home and used 1/3 of a tank of fuel to get there. If the tank was full before she left home and she didn’t put any additional fuel in, what fraction of a tank does Kym have left? Factorise: 6xy + 2x</td>
<td><strong>Examples</strong>&lt;br&gt;Calculate the surface area of a rectangular prism with dimensions 12cm, 15cm and 20cm. Factorise: 4x² + 6x + 2&lt;br&gt;Calculate the length of the hypotenuse of a right angled triangle with opposite side 10cm and adjacent side 15cm. Write 3 rational numbers with values between 1 and 2. Evaluate 2√(64)³</td>
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### Problem solving: Years F–2
Students benefit from working in a problem solving context in many aspects of the curriculum.

**Pedagogical questions:**
- What are you being asked to find out or show?
- What are you being asked to find out, demonstrate or prove?
- What are you being asked to do?
- What are you being asked to create or write about?

**In what ways can you model and plan?**
This is about describing a problem mathematically. Across years 3 to 6, ideas are represented using models, pictures, and symbols. The complexity of the pictures will develop from those representing an image of the problem (in years 3 and 4) to those that support thinking about the problem and are more abstract in appearance (in years 5 and 6).

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In what ways can you solve and check?
This is the mechanics of problem solving, the doing of calculations (the counting/adding/subtracting/sharing/grouping/building), and checking how appropriate the answer.

Pedagogical questions:
- How can you... (count that/add those numbers together/subtract that amount)?
- Does that seem right to you?
- How can you check your answer?
- Do other people think that too?

Pedagogical questions:
- If the sharing is happening part-way through the problem solving process:
  - Would you like to change your mind and try something different?
  - Which was easiest for you to understand?
  - What did you like about...?
  - What would you do differently now?
- If the sharing is happening at the end of the problem solving process:
  - Would you like to change your mind and try something different?

Pedagogical questions:
- How reliable was this strategy?
- Which was easiest for you to understand?
- What did you think about...?
- How reasonable/realistic is your answer?

Pedagogical questions:
- How can you calculate that?
- What processes could you try?
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The BitL tool – mathematics years F–10

Problem solving: Years F–2
Students benefit from working in a problem solving context in many aspects of the curriculum.

Examples
Teachers: Use your creative story telling skills to embellish these facts:
Matt and Jane have just finished playing a game. The winner is the person who has the highest score. The score is determined by the value of the counters they have collected. There are three colours of counters, worth 2, 5 and 10. Give the characters Matt and Jane a selection of counters and ask, “Who won?”

Extension Question 1: Matt thinks his counters add up to 40 points. Is that possible? Prove it!
Extension Question 2: Jane collects 5 counters. What is the highest and lowest score that Jane could have? What is the second highest/lowest score that Jane could have?

This problem facilitates a composite class working on the same problem because it has multiple entry points. It is possible to be successful in finding a solution to this problem through using a simple counting strategy: skip counting by 2, 5 and 10, and addition strategies or multiplicative thinking.

Are there ways of arranging collections of counters that make it easier to see (at a glance) how many counters are there?
This offers the opportunity to investigate part-whole and arrays. Notice a similar question in understanding and fluency.

Problem solving: Years 3–4
Students benefit from working in a problem solving context in many aspects of the curriculum.

Examples
Teachers: Use your creative story telling skills to embellish these facts:
Matt and Jane are playing a computer game. In the first part of the game they get 2 minutes to collect credits that they can use later on in the game. In the second part of the game, they get 4 minutes to collect credits that they can use later on in the game. There are three items that they can collect to earn credits, worth 14, 25 and 36 points (use an appropriate combination up to 10 x 10). Give the characters Matt and Jane a selection of counters and ask, “Who won?”

Extension Question 1: Matt thinks his counters add up to 40 (or some suitable number). Is that possible? Prove it!
Extension Question 2: Jane wonders if each of her counters has an even number value. Is it possible for her total score to be an odd number? What if one of the counters has an odd number value and two counters have an even number value. Now is it possible? How? Prove it!

This problem facilitates a composite class working on the same problem because it has multiple entry points. The values of the counters can easily be changed and children can be involved in selecting values that they feel are appropriate for them.

It is possible to be successful in finding a solution to this problem through using skip counting strategies, additive or multiplicative thinking. Notice the similarity in this problem solving question from Foundation to year 10.

This problem facilitates a composite class working on the same problem because it has multiple entry points. The values of the counters can easily be changed and children can be involved in selecting values that they feel are appropriate for them.

It is possible to be successful in finding a solution to this problem through using skip counting strategies, additive or multiplicative thinking. Notice the similarity in this problem solving question from Foundation to year 10.

Problem solving: Years 5–6
Students benefit from working in a problem solving context in many aspects of the curriculum.

Examples
Teachers: Use your creative story telling skills to embellish these facts:
Matt and Jane are playing a computer game. In the first part of the game they get 2 minutes to collect credits that they can use later on in the game. In the second part of the game, they get 4 minutes to collect credits that they can use later on in the game. There are three items that they can collect to earn credits, worth 1/2, 1/3 and 1/4 (use fractions as appropriate; these need not be unit fractions). Give the characters Matt and Jane a selection of items and ask, “Who has collected the most credits?”

Extension Question 1: What’s your first thinking about this? Why? Take a class vote. Prove it!
Extension Question 2: On a second game, Matt thinks his credits add up to 12½ (or some suitable number, related to the number of credits that you say he has collected). Is that possible? Prove it!

This problem facilitates a composite class working on the same problem because it has multiple entry points. The values of the credits can easily be changed and children can be involved in selecting values that they feel are appropriate for them.

It is possible to be successful in finding a solution to this problem through using pictures or equipment, fraction counting sequences, fraction addition or multiplication of fractions. Notice the similarity in this problem solving question from Foundation to year 10.

Problem solving: Years 7–8
Students benefit from working in a problem solving context in many aspects of the curriculum.

Examples
Teachers: Use your creative story telling skills to embellish these facts:
Matt and Jane are playing a computer game. In the first part of the game they get 2 minutes to collect credits that they can use later on in the game. There are three items that they can collect to earn credits, green, red and blue, worth 1/2, 1/3 and 2/5 respectively. Give Jane collected 25 credits.
Matt has eight blue credits and one more red credit than green. If Matt collected 30 reds, is his total greater than Jane’s?

What is the minimum number of red items that Matt can collect if his total is to be greater than Jane’s?

Extension Question 1: What’s your first thinking about this? Why? Take a class vote. Prove it!
Extension Question 2: In a second game, Matt thinks his credits add up to 12½ (or some suitable number, related to the number of credits that you say he has collected). Is that possible? Prove it!

Students benefit from working in a problem solving context in many aspects of the curriculum.

Examples
Teachers: Use your creative story telling skills to embellish these facts:
Matt and Jane are playing a computer game. In the first part of the game they get 2 minutes to collect credits that they can use later on in the game. There are three items that they can collect to earn credits, green, red and blue, worth 1/2, 1/3 and 2/5 respectively.

This problem facilitates a composite class working on the same problem because it has multiple entry points. The values of the credits can easily be changed and children can be involved in selecting values that they feel are appropriate for them.

It is possible to be successful in finding a solution to this problem through using pictures or equipment, fraction counting sequences, fraction addition or multiplication of fractions or algebraic modelling. Notice the similarity in this problem solving question from Foundation to year 10.

Problem solving: Years 9–10
Students benefit from working in a problem solving context in many aspects of the curriculum.

Examples
Teachers: Use your creative story telling skills to embellish these facts:
Matt and Jane are playing a computer game. In the first part of the game they get 2 minutes to collect credits that they can use later on in the game. There are three items that they can collect to earn credits, green, red and blue, worth 1/2, 1/3 and 2/5 respectively.

This problem facilitates a composite class working on the same problem because it has multiple entry points. The values of the credits can easily be changed and children can be involved in selecting values that they feel are appropriate for them.

It is possible to be successful in finding a solution to this problem through using pictures or equipment, fraction counting sequences, fraction addition or multiplication of fractions or algebraic modelling. Notice the similarity in this problem solving question from Foundation to year 10.

Deb says that it is possible to order the following equations from most to least steep. Using digital technologies or otherwise investigate this statement.

y = 2x + 3
y = 3x + 2
y = x + 5

Notice the connection to this concept in each of the proficiencies. It would be appropriate for students in year 7 to be investigating this concept, but it would be appropriate for students in year 8 to be plotting graphs of linear equations.

Lyn says that it is possible to do one simple addition sum to calculate the answer to questions such as:
11002 - 10992
- 892 - 882
32502 - 32492

Is there some truth in this? What do you think? Prove it!

Notice a question related to this in the reasoning proficiency. The reasoning question gives the students a structure to work with.

Problem solving questions can be detailed, but they can also be very brief.
Using the language of ‘first thinking’, implies that more thinking will be done and you may well change your mind. Keeping a record of changing ideas is an important part of the students being able to observe HOW they learn. Some students find it difficult to keep a record of ideas that they no longer believe to be true, preferring to erase their initial thoughts. If the teacher makes it clear that they are marking the students THINKING, not their final answer, then erasing their changing ideas is erasing the part of the validity of the solution is demanded.
Notice a question related to this in the reasoning proficiency. The reasoning question gives the students a structure to work with.

Problem solving questions can be detailed, but they can also be very brief.
Using the language of ‘first thinking’, implies that more thinking will be done and you may well change your mind. Keeping a record of changing ideas is an important part of the students being able to observe HOW they learn. Some students find it difficult to keep a record of ideas that they no longer believe to be true, preferring to erase their initial thoughts. If the teacher makes it clear that they are marking the students THINKING, not their final answer, then erasing their changing ideas is erasing the part of the validity of the solution is demanded.

Leading Learning – Making the Australian Curriculum work for us | Bringing it to life – essence meets context | OECD Teaching and Learning Services 5
The BitL tool – mathematics years F–10

Understanding: Years F–2

What patterns/connections/relationships can you see?
This is about noticing the characteristics of familiar shapes, objects, quantities and patterns that show similarity and difference, then using these characteristics to sort and order quantities, shapes and objects. It is about looking for patterns in everything—for patterns in number, in shape and in data.

Pedagogical questions:
- How are these... (values/number sentences/shapes) the same as each other?
- Which is the odd one out?
- What if... (change something), is it still...

Generalising:
- How are these... (values/number sentences/shapes) different to each other?
- Is it still a square?
- Which is greater/bigger/larger/taller?
- Which is less/smaller/shorter/shallower?

Examples
Change the object or the physical arrangement, but keep the quantity the same (eg 5 marbles/5 basketballs) and vice versa. What's the same/different?
Use 10 flip tiles; 6 orange, 4 grey. What if... (turn an orange to grey) is it still 10?
When we ask this type of question, we need to observe if the student is calculating or if they build on their understanding.
Count 6 beads into a container. Shake and tip out, asking how many will there be now?
What if I rotate a square... (sides not horizontal and vertical), is it still a square?

Understanding: Years 3–4

What patterns/connections/relationships can you see?
This is about noticing and using the characteristics of shapes, objects, quantities and patterns that show similarity and difference. It is about looking for patterns and connections in number, in shape, and in data.

Pedagogical questions:
- How are these... (values/number sentences/shapes) the same as each other?
- Which is the odd one out?
- What if... (change something), is it still...
- Which is greater/bigger/larger/taller?
- Which is less/smaller/shorter/shallower?

Examples
How are 4 and 6 the same as each other? How are 5 and 3 the same as each other? How is the first pair (4 and 6) different to the second pair (5 and 3)?
How is 3 x 4 different to 4 x 3?

Understanding: Years 5–6

What patterns/connections/relationships can you see?
This is about noticing and using the characteristics of shapes, objects, quantities and patterns that show similarity and difference. It is about looking for patterns and connections in number, in shape, and in data.

Pedagogical questions:
- How are these... (values/number sentences/shapes) the same as each other?
- Which is the odd one out?
- What if... (change something), is it still...
- Which is greater/bigger/larger/taller?
- Which is less/smaller/shorter/shallower?

Examples
What is 3 x 4 the same as?
How is 3 x 4 different to 4 x 3?

Understanding: Years 7–8

What patterns/connections/relationships can you see?
This is about noticing and using characteristics in number, algebra, measurement, geometry, probability and data.

Pedagogical questions:
- How are these... (values/number sentences/shapes) the same as each other?
- Which is the odd one out?
- What if... (change something), is it still...
- Which is greater/bigger/larger/taller?
- Which is less/smaller/shorter/shallower?

Examples
How are these expressions the same as each other?
How is 3 x 4 the same as 4 x 3?

Understanding: Years 9–10

What patterns/connections/relationships can you see?
This is about noticing and using characteristics in number, algebra, measurement, geometry, probability and data. It is about representing the patterns/relationships/rules in abstract ways, using variables. It is about identifying relationships so that we are able to reason (see reasoning: inference and generalisation) and make predictions.

Pedagogical questions:
- How are these... (values/number sentences/shapes) the same as each other?
- Which is the odd one out?
- What if... (change something), is it still...
- Which is greater/bigger/larger/taller?
- Which is less/smaller/shorter/shallower?

Examples
What is the connection between...?
Connect to reasoning: Inference
What's the same about the graphs?
What's different about the graphs?
Connect to reasoning: Generalisation
What's the same about the equations?
What's different about the equations?
The BitL tool – mathematics years F–10

Understanding: Years F–2
- Can you answer backwards/inverse questions?
  - This is about working flexibly with a concept.

Pedagogical questions:
- If the answer is... what might the question have been?
- What’s missing in this number sentence/from this group/in this pattern?

Examples
I’m thinking of an addition sum and the answer to my sum is 10. What might the question have been?
I need 10 children to help me, but so far we only have 6. How many more volunteers do I need?
The answer is ‘A SQUARE’. What might the question have been?
You could use puppets for this activity. E.G. Today Mr Maths (puppet) can only say 4 squares. What question can you ask him so that he can answer you?

Understanding: Years 3–4
- Can you answer backwards/inverse questions?
  - This is about working flexibly with a concept.

Pedagogical questions:
- If the answer is... what might the question have been?
- What’s missing in this number sentence/from this group/in this pattern?

Examples
I’m thinking of a multiplication sum and the answer to my sum is 12. What might the questions have been?
In ten minutes time it will be 3 o’clock. What time is it now?
Extension: In ten minutes my watch will show 3 o’clock, but I know that my watch is running 5 minutes too fast. What time is it now?
This extension question is still a ‘flip or backwards’ style question, but a slight change requires a higher level of reasoning. Notice that the content has remained the same, but the thinking has been extended.
If the answer is 12. What might the question have been?
Is it possible to use each of the four operations in the question.

Understanding: Years 5–6
- Can you answer backwards/inverse questions?
  - This is about working flexibly with a concept.

Pedagogical questions:
- If the answer is... what might the question have been?
- What’s missing in this number sentence/from this group/in this pattern?

Examples
23 + 8 = 131
34 + 21 = 55 + 18
I’m thinking of a rectangle. It’s area is 24cm. The length is 6cm. What is the width?
One third of a class brought lunch today. If 9 students brought lunch, how many students are in this class?
In year 5 it would be appropriate for students to investigate questions such as this in a problem solving situation in order to build understanding. Notice, notice that questions similar to this are in the problem solving proficiency.

Understanding: Years 7–8
- Can you answer backwards/inverse questions?
  - This is about working flexibly with a concept.

Pedagogical questions:
- If the answer is... what might the question have been?
- What’s missing in this number sentence/from this group/in this pattern?

Examples
80  –  64
I’m thinking of a number. When my number has been divided by one third I get twenty seven. What is my number?

Understanding: Years 9–10
- Can you answer backwards/inverse questions?
  - This is about working flexibly with a concept.

Pedagogical questions:
- If the answer is... what might the question have been?
- What’s missing in this number sentence/from this group/in this pattern?

Examples
A rectangle of area 10cm² was enlarged to create a rectangle of area 40cm². What was the scale factor of enlargement?
Given the hypotenuse is 15cm and one other side length is 9cm. Use Pythagoras to calculate the length of the third side.

Can you represent or calculate in different ways?
- This is about representing amounts, patterns, shapes and data in different ways.

Pedagogical questions:
- What is another way...?
- What is another way to represent that?
- What is another way to work that out?
- What is another way to check that?

Examples
Is there more than one way to represent five?
Five can be represented as a name, numeral or a quantity, but other versions such as a word or touch could be shown upon in representing or representing an amount.
Is there more than one way to count a large amount quickly/efficiently?
Notice a similar question in problem solving and fluency. The problem solving question gives the student the opportunity to establish the law that arrangement does matter. The fluency question gives students the opportunity to show that they have an appropriate strategy. The understanding question gives students the opportunity to show that they appreciate that there are different possible strategies, that all work.

Can you represent or calculate in different ways?
- This is about representing amounts, patterns, shapes and data in different ways and calculating using different processes. This is also about finding different ways to calculate the answer to computation problems involving all operations (addition, subtraction, multiplication and division).

Pedagogical questions:
- What is another way...?
- What is another way to represent that?
- What is another way to work that out?
- What is another way to check that?
- What is another way to do that calculation?
- Simplify...
- Rename...
- Represent... in multiple ways.

Examples
Rename 1250.
(1250 can be made from 1 thousand, 2 hundreds and 5 tens OR 12 hundred and 5 tens etc)
Represent ½ in multiple ways.
Fractions of a shape, a collection, an amount, a line.
Represent 36 in as many different arrays as possible.
Work out 282 ÷ 7 in two (or more) different ways.
By the end of year 4 we would expect students to have a method to be able to answer questions such as this, but students often have different suitable approaches, so they can begin to choose the most appropriate approach for a particular calculation. For instance a student might reason that 7 x 17 = 119 and 70 x 4 = 280, so there are 477 in 287 and so there would be 41 7's in 287.

Can you represent or calculate in different ways?
- This is about representing amounts, patterns, shapes and data in different ways and calculating using different processes. This is also about finding different ways to calculate the answer to computation problems involving all operations (addition, subtraction, multiplication and division).

Pedagogical questions:
- What is another way...?
- What is another way to represent that?
- What is another way to work that out?
- What is another way to check that?
- What is another way to do that calculation?
- Simplify...
- Express that in another way.
- Represent that algebraically.

Examples
Given a symmetrical trapezium. What are three different ways to calculate the area?
Simplify.
Given the connection to reasoning.

Can you represent or calculate in different ways?
- This is about representing quantities in different ways and manipulating algebraic expressions. This is also about finding different methods for doing the same calculation. EG different algebraic methods for solving simultaneous equations. Different processes for solving a proportioning problem.

Pedagogical questions:
- What is another way...?
- What is another way to represent that?
- What is another way to work that out?
- What is another way to check that?
- What is another way to do that calculation?
- Simplify...
- Express that in another way.
- Represent that algebraically.

Examples
Given the connection to reasoning.

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Examples
Given the connection to reasoning.
<table>
<thead>
<tr>
<th>Reasoning: Years F–2</th>
<th>Reasoning: Years 3–4</th>
<th>Reasoning: Years 5–6</th>
<th>Reasoning: Years 7–8</th>
<th>Reasoning: Years 9–10</th>
</tr>
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<tbody>
<tr>
<td><strong>In what ways can you prove...?</strong>&lt;br&gt;This is about convincing yourself and others about your mathematical thinking. At this stage proof would involve using equipment, drawings and simple calculations. It is important to evaluate different ways of proving the same idea and justify the choices that are made.</td>
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<td><strong>In what ways can you prove...?</strong>&lt;br&gt;This is about convincing yourself and others about your mathematical thinking. Across years 3 to 6; proof, like under-standing, will be represented using models, diagrams and symbolic representations. The complexity of the diagrams will develop to be more abstract in appearance and will use mathematical conventions, such as those for labeling angles or calculating length. It is important to evaluate different ways of proving the same idea and justify the choices that are made.</td>
<td><strong>In what ways can you prove...?</strong>&lt;br&gt;This is about convincing yourself and others about your mathematical thinking. At this stage proof would still involve diagrams (using mathematical conventions) and calculations. It would also start to involve algebraic representation. It is important to evaluate different ways of proving the same idea and justify the choices that are made.</td>
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<tr>
<td>• Convince me, yourself, someone who thinks differently...</td>
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<td>• Try not to ask me if you are correct, but instead try to tell when you KNOW that you are correct. Then share how you know.</td>
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<td>In what ways can you communicate?&lt;br&gt;This is about making thinking visible. At this stage of development it will often be achieved using simple mathematical language (spoken or written) and drawings. It is important to evaluate different ways to communicate the same idea.</td>
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<tr>
<td>• Explain it/why? (To a peer)</td>
<td>• Why did you choose to...?</td>
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<tr>
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### Reasoning: Years F–2

**In what ways can your thinking be generalised?**

This is very strongly connected to looking for patterns and relationships. This is about making statements that describe a pattern that always exists. At this stage generalisations may be verbal or written. Across years 3 and 4, age-appropriate mathematical terminology will be used increasingly.

**Pedagogical questions:**
- Why are these always the same/different?
- Is there a rule that we could use to describe…?
- Is there a rule that always works?
- What makes these the same?

**Examples**

Sammy has found three ways to make 27 using tens and ones (RAAB). Can you find these three ways? Will there always be three ways to make a number?

Of course, it's not the same for all numbers there are 4 ways for numbers in the 30's, 5 ways for numbers in the 40's etc.

### Reasoning: Years 3–4

**In what ways can your thinking be generalised?**

This is very strongly connected to looking for patterns and relationships. This is about making statements that describe a pattern that always exists. At this stage generalisation will often be written. Across years 5 and 6, age-appropriate mathematical terminology will be used.

**Generalisations are certainties. They will always be true and it is not necessary to collect further information.**

**Pedagogical questions:**
- Why are these always the same/different?
- Is there a rule that we could use to describe…?
- Is there a rule that always works?
- What makes these different processes the same?

**Examples**

What is it about all odd numbers that makes them the same?

What is it about all even numbers the same?

What makes these odd numbers different to the even numbers?

### Reasoning: Years 5–6

**In what ways can your thinking be generalised?**

This is very strongly connected to looking for patterns and relationships. This is about making statements that describe a pattern that always exists. At this stage generalisations will often be written. Across years 7 and 8, age-appropriate mathematical terminology and conventions will be used.

**Generalisations are certainties. They will always be true and it is not necessary to collect further information.**

**Pedagogical questions:**
- Why are these always the same/different?
- Is there a rule that we could use to describe…?
- Is there a rule that always works?
- What makes these different processes the same?

**Examples**

Draw a rectangle and enlarge it with a scale factor of two. What do you notice about the area of the enlarged rectangle compared to the area of the original rectangle? Start with a rectangle of a different area. What do you notice about the area of the enlarged rectangle compared to the area of the original rectangle? Exchange some results with a peer. Is there a rule about how the area of the enlarged rectangle compares to the area of the original? Does this rule work if you enlarge your rectangle by a scale factor of three?

**Enlargement is a year 5 content description, but investigating it in this way brings in square numbers, which is a year 6 content description.**

### Reasoning: Years 7–8

**In what ways can your thinking be generalised?**

This is very strongly connected to looking for patterns and relationships. This is about making statements that describe a pattern that always exists. At this stage, generalisations will be written. Across years 9 and 10, age-appropriate mathematical terminology and conventions will be used. Generalisations will be expressed algebraically where appropriate. Generalisations are certainties. They will always be true and it is not necessary to collect further information.

**Pedagogical questions:**
- Why are these always the same/different?
- Is there a rule that we could use to describe…?
- Is there a rule that always works?
- What makes these different processes the same?

**Examples**

You have shown the angle sum of a triangle to be 180 degrees. You have shown the angle sum of a triangle to be 180 degrees. You have shown the angle sum of any polygon to be 180 degrees. You have shown the angle sum of any polygon to be 180 degrees. Could you simplify this process? Can you write an algebraic expression relating the number of sides that the polygon has and the total of the internal angles?

### Reasoning: Years 9–10

**In what ways can your thinking be generalised?**

This is very strongly connected to looking for patterns and relationships. This is about making statements that describe a pattern that always exists. At this stage, generalisations will be written. Across years 9 and 10, age-appropriate mathematical terminology and conventions will be used. Generalisations will be expressed algebraically where appropriate. Generalisations are certainties. They will always be true and it is not necessary to collect further information.

**Pedagogical questions:**
- Why are these always the same/different?
- Is there a rule that we could use to describe…?
- Is there a rule that always works?
- What makes these different processes the same?

**Examples**

Use repeated applications of simple interest to show compound interest of 3% p.a on an initial investment of $500 for 5 years.

Could you simplify this process? Could you write an algebraic expression relating the number of periods that the investment has and the total amount of money that the investment has?

**Reasoning:**

- The older/younger the…
- The further/closer the…
The BitL tool – mathematics years F–10

Reasoning: Years F–2

What can you infer?
This is about developing logical thought processes. These processes sometimes follow the structure: if…, then…

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
I'm thinking of a number. If I tell you that you can ask me some questions to help you to work out what it is, but I can only answer yes or no.

Pedagogical questions:

• Now that you know… can you work out…?

Reasoning: Years 3–4

What can you infer?
This is about developing logical thought processes. These processes sometimes follow the structure: if…, then…

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
I'm thinking of a fraction between 0 and 1. I can answer yes or no to your questions. You can't ask the same type of question more than once. Can you work out what my fraction is?

Pedagogical questions:

• Now that you know… can you work out…?

Reasoning: Years 5–6

What can you infer?
This is about developing logical thought processes. These processes sometimes follow the structure: if…, then…

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
The arm spans of six people were recorded. Here are the measurements: 63, 70, 65, 68, 71, 64

Pedagogical questions:

• Now that you know… can you work out…?

Reasoning: Years 7–8

What can you infer?
This is about developing logical thought processes. These processes sometimes follow the structure: if…, then…

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
When are 3a, 3a² and 3a³ equal to each other?

Pedagogical questions:

• Now that you know… can you work out…?

Reasoning: Years 9–10

What can you infer?
Logical thought can also be about working out a set of possibilities and narrowing them down as you get more information.

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
What are the possible answers are?

Pedagogical questions:

• Now that you know… can you work out…?

Further reasoning (proof):
Why is it still the same? How does that work?

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
Try these questions: 10² – 9² = 92² – 82² = 92² – 72² = 72² – 62²

Pedagogical questions:

• Now that you know… can you work out…?

Further information/ testing may show an initial inference to be true or false.

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
When are 3a, 3a³ and 3a² equal to each other?

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
Is it possible to make a generalisation? Do you need more information? How could you test your idea?

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
What do you notice about the answers to these questions? What can you infer from these observations about the case when the difference between the square numbers is two, so that the questions become: 3a², 3a³ and 3a²?

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
What can you infer from these observations about the case when the difference between the square numbers is two, so that the questions become: 3a², 3a³ and 3a²?

Pedagogical questions:

• Now that you know… can you work out…?

Reasoning:
Reasoning:

Years F–2

What can you infer?
This is about developing logical thought processes. These processes sometimes follow the structure: if…, then…

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
I'm thinking of a number. If I tell you that you can ask me some questions to help you to work out what it is, but I can only answer yes or no.

Pedagogical questions:

• Now that you know… can you work out…?

Reasoning:
Reasoning:

Years 3–4

What can you infer?
This is about developing logical thought processes. These processes sometimes follow the structure: if…, then…

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
I'm thinking of a fraction between 0 and 1. I can answer yes or no to your questions. You can't ask the same type of question more than once. Can you work out what my fraction is?

Pedagogical questions:

• Now that you know… can you work out…?

Reasoning:
Reasoning:

Years 5–6

What can you infer?
This is about developing logical thought processes. These processes sometimes follow the structure: if…, then…

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
The arm spans of six people were recorded. Here are the measurements: 63, 70, 65, 68, 71, 64

Pedagogical questions:

• Now that you know… can you work out…?

Reasoning:
Reasoning:

Years 7–8

What can you infer?
This is about developing logical thought processes. These processes sometimes follow the structure: if…, then…

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
When are 3a, 3a² and 3a³ equal to each other?

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
What are the possible answers are?

Pedagogical questions:

• Now that you know… can you work out…?

Further reasoning (proof):
Why is it still the same? How does that work?

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
Try these questions: 10² – 9² = 92² – 82² = 92² – 72² = 72² – 62²

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
When are 3a, 3a³ and 3a² equal to each other?

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
What do you notice about the answers to these questions? What can you infer from these observations about the case when the difference between the square numbers is two, so that the questions become: 3a², 3a³ and 3a²?

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
What can you infer from these observations about the case when the difference between the square numbers is two, so that the questions become: 3a², 3a³ and 3a²?

Pedagogical questions:

• Now that you know… can you work out…?

Examples:
Is it possible to make a generalisation? Do you need more information? How could you test your idea?

Pedagogical questions:

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Examples:
What do you notice about the answers to these questions? What can you infer from these observations about the case when the difference between the square numbers is two, so that the questions become: 3a², 3a³ and 3a²?