Fluency: Years 9-10

What can you recall?
This is about remembering/identifying mathematical, names, shapes, symbols, facts, processes and formulas that are important to know when working with mathematical ideas.

Can you choose and use your mathematics flexibly?
To be able to choose and use mathematics efficiently, students need to be able to recall processes and facts. Choosing and using is about selecting (age appropriate) processes, facts and mathematical language appropriate to the context.

Pedagogical questions:
- How can you record that mathematically?
- How could you... (eg calculate that)?
- How could you use a calculator to...?
- Can you remember a way to...?
- 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 and some powers of 10?)
- What is the name of...?
- What is the formula for...?
- How many...?
- How much...?
- What is the name of...?
- What is the symbol for...?
- What is the formula for...?
- How many...?
- How much...?

Examples
What formula can be used to calculate the volume of a rectangular prism/triangular prism?

What is Pythagoras Theorem?

Problem solving: Years 9-10

How can you interpret?
This is about creating meaning from the problem that has been presented or created by the student in response to curiosity about real world applications of mathematics that are relevant to the student.

What is the formula for...?

What could you do to...?

Pedagogical questions:
- What are you being asked to find out, demonstrate or prove?
- What information is helpful?
- What information is not useful?
- What additional information would be useful?

Examples
Calculate the surface area of a rectangular prism with dimensions 12cm, 15cm and 20cm.
Factorise: $4x^2 + 6x + 2$
Calculate the length of the hypotenuse of a right angled triangle with opposite side 12cm and adjacent side 15cm.
Write 3 rational numbers with values between 1 and 2.
Evaluate $6^{\frac{1}{2}} \times \sqrt{64}$

Examples
Deb says that it is possible to order the following equations from most to least steep.
$3y = 3x + 2$
$y = 2x + 3$
$2x + 5$.

Pedagogical questions:
- Do you have an idea?
- What could you try?
- Have you done a problem like this one before?
- How would you test your idea?
- How might you start?
- Can you represent the problem as a picture or by using equipment?
- Can you represent the information numerically or symbolically?
- What questions could you ask to find that out?
- What information could you put in a diagram to support your thinking?
- What strategies have you used in the past when you have been stuck?
- Speak to a peer. Ask them to show you what they are thinking.

Pedagogical questions:
- What was the question from Foundation to year 10.
- What would be an efficient way to... (count/measure/order/compute/record/express)?
- How could you use a calculator to...

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?
  - How reasonable is your answer?
  - Were you expecting an answer in that range?

Pedagogical questions:
- If the sharing is happening at the end of the problem solving process:
  - Would you use a different strategy next time?
  - Which was easiest for you to understand?
  - What did it feel like about...?
  - What would you do differently now?
  - How reasonable is your answer?
  - Were you expecting an answer in that range?

Pedagogical questions:
- Would you like to change your mind in light of new information, rather than just congratulating them when they get to an answer, will help to build a disposition of sharing ideas.

Pedagogical questions:
- What strategies have you used in the past when you have been stuck?
- What is the name of...?
- What is the formula for...?
- How many...?
- How much...?

Reflect
Students need to reflect on how reasonable their solution is. They should consider if they have made an appropriate interpretation in relation to the context of the problem.

There are different ways to solve problems and different ways to explain your thinking. At every stage of development, students benefit from sharing and reflecting on the strategies and reasoning of others.

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The BitL tool - mathematics years 9-10

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. This 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. Noticing similarity and difference helps students to build conceptual understanding.

Can you answer backwards/inverse questions?
This is about working flexibly with a concept.

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, or different processes for solving a proportional reasoning problem.

Reasoning: Years 9-10

In what ways can you prove...?
This is about convincing yourself and others about your mathematical thinking.

In what ways can you communicate?
This is about making thinking visible and sharing your ideas using mathematical terminology, diagrams and symbolic representations (including algebraic representations). It is important to evaluate different ways of communicating the same idea.

Pedagogical questions:
- Why are these... (values/objects/apply/evaluate) different from each other?
- What is the same about the equations?
- What's the same about the y = x + 2 and y = x² + 2?
- What patterns/connections/relationships can you see?
- How would you find the answer to this question?
- How do you think of the connections that the student is not making, even if the student can't articulate the connections? These questions can help the teacher identify the root of the misconception.

Examples
- A rectangle of area 10cm² was enlarged to create a rectangle of area 40cm². What was the scale factor of enlargement?
- Show that the area of a trapezium with parallel sides of length 'a' and 'b' and perpendicular height 'h', will have an area of: ½(a + b)h
- How could you use this thinking to multiply out these brackets?
- How do you think of the connections that the student is not making, even if the student can't articulate the connections? These questions can help the teacher identify the root of the misconception.

Pedagogical questions:
- What's the connection between...?
- What is another way to do that calculation?
- What's the connection between...?
- What's the same about these... (values/expressions/equations) the same as each other?
- What's the connection between...?
- What's the same about these... (values/expressions/equations) different to each other?
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