

Mathematics process categories

PT MATHS 6

PT

All of the UK curricula define multiple categories of mathematical proficiency that require pupils to be able to use and apply mathematics, beyond simple recall of facts and standard procedures. While the intentions are very similar, the terminology varies between regions. *Progress Test in Maths' (PTM)* categories are based on the *Curriculum Aims* in the KS1, KS2 and KS3 National Curriculum for England (2013), and are also comparable with the GCSE Assessment Objectives: they adopt some language from both. The main change has been to divide 'Fluency' into two strands.

FF: Fluency in facts and procedures

Pupils can, for example:

- recall mathematical facts, terminology and definitions (such as the properties of shapes);
- recall number bonds and multiplication tables;
- perform straightforward calculations.

FC: Fluency in conceptual understanding

Pupils can, for example:

- demonstrate understanding of a mathematical concept in the context of a routine problem (for example, calculate with or compare decimal numbers, identify odd numbers, prime numbers and multiples);
- extract information from common representations, such as charts, graphs, tables and diagrams;
- identify and apply the appropriate mathematical procedure or operation in a straightforward word problem (for example, knowing when to add, multiply or divide).

MR: Mathematical reasoning

Pupils can, for example:

- make deductions, inferences and draw conclusions from mathematical information;
- construct chains of reasoning to achieve a given result;
- interpret and communicate information accurately.

PS: Problem solving

Pupils can, for example:

- translate problems in mathematical or non-mathematical contexts into a process or a series of mathematical processes;
- make and use connections between different parts of mathematics;
- interpret results in the context of the given problem;

- evaluate methods used and results obtained;
- evaluate solutions to identify how they may have been affected by assumptions made.

There is a limit to how thoroughly MR and PS can be assessed in a short, whole-curriculum test such as *PTM*, especially at younger ages where reading and English comprehension restrict the sorts of questions that can be asked. Teachers are urged to ensure that their curriculum includes a balanced diet of extended tasks, investigations, problem solving and collaborative activities.

This table shows how the questions in *PTM6* map onto these process categories.

Process category	
FF: Fluency in facts and procedures	2a, 2b
FC: Fluency in conceptual understanding	1a, 1b, 1c, 2c, 4b, 4c, 5a, 6a, 6d, 7c, 8a
MR: Mathematical reasoning	1d, 3a, 3c, 4a, 5b, 6b, 7a, 7b, 8b, 8c
PS: Problem solving	3b, 6c, 7d

Mathematics process categories in Wales, Scotland and Northern Ireland

The process categories shown above are based on the National Curriculum and GCSE syllabuses for England. The curricula for Wales, Scotland and Northern Ireland have similar requirements, although there is wide variation in the way they are defined.

Wales	Closest <i>PTM</i> process categories			
Foundation Phase Skills	FF	FC	MR	PS
1. Solve mathematical problems				•
2. Communicate mathematically		•	•	
3. Reason mathematically		•	•	
Foundation Phase Range	•			

The Mathematics National Curriculum for Northern Ireland does not list separately any process categories for pupils in the age range 4-6. This table shows how the questions in *PTM6* map onto the process categories listed for pupils in the age range 6-8.

Northern Ireland	Closest <i>PTM</i> process categories			
Processes in Mathematics	FF	FC	MR	PS
Making and monitoring decisions				•
Communicating mathematically		•	•	
Mathematical reasoning		•	•	•
Individual mathematical topics	•			

Scotland *	Closest PTM process categories			
<i>Experiences and outcomes</i>	FF	FC	MR	PS
develop a secure understanding of the concepts, principles and processes of mathematics and apply these in different contexts, including the world of work			•	•
engage with more abstract mathematical concepts and develop important new kinds of thinking			•	
understand the application of mathematics, its impact on our society past and present, and its potential for the future				
develop essential numeracy skills which will allow me to participate fully in society	•			
establish firm foundations for further specialist learning	•	•		
understand that successful independent living requires financial awareness, effective money management, using schedules and other related skills			•	•
interpret numerical information appropriately and use it to draw conclusions, assess risk, and make reasoned evaluations and informed decisions				•
apply skills and understanding creatively and logically to solve problems, within a variety of contexts			•	•
appreciate how the imaginative and effective use of technologies can enhance the development of skills and concepts				

* Education Scotland 'Curriculum for Excellence: Numeracy and Mathematics' 14 May 2009.
 Accessed: 31 July 2014. www.curriculumforexcellencescotland.gov.uk

Assessment for learning: following up the test activities

Each *PTM* assessment test is designed to align with the mathematics curriculum at a level appropriate for the pupils in the relevant age group. The activities may therefore be used to obtain diagnostic information about each pupil's strengths and weaknesses, and may also be used to provide a basis from which pupils' mathematical understanding may be further developed.

This section discusses some of the ways in which pupils may be helped to improve areas of weakness and to build on what they already know in order to deepen their understanding. These notes cover only a few of the possibilities. In talking to pupils and discussing the activities in which they did well, in addition to those they were unable to complete correctly, you may find approaches that are helpful to them, building on their own strengths and interests.

You will need to refer to the activities in the Pupil Booklet and the Teacher's script in the At a Glance Guide when reading these notes, as they form the basis of the ideas suggested. The activities are referred to here by both their numbers and their names.

Formative notes on the questions

The standardised total scores on *PTM* give you an indication of the overall performance of your pupils, and a basis for progress monitoring. This section is intended to help you identify the specific difficulties that pupils have with individual questions, and to suggest possible activities to help guide your future teaching.

Question 1: Bus numbers

This first activity asks the pupils to order numbers less than 10 (part a); recognise odd and even numbers (parts b and c); finally identify a number which is between two others (part d).

Suggested activities include counting sets of objects, such as buttons, and checking whether the number of objects in each set can be divided into two equal parts ('even') or whether there is one object left over ('odd'). Other activities could include answering questions such as 'Is there an odd or an even number of children sitting at this table?', 'Is today an odd date?', 'Who has a birthday that falls on an even number?', 'Can you spot any patterns in the numbers on the calendar?'

Question 2: Football team

This activity requires pupils to be adept at using the terms: more than (part a), double (part b) and less than (part c), and also to add, multiply and subtract single-digit numbers. Playing games like dominoes, which use terms such as 'double', can be useful. 'More than' and 'less than' can be practised using the standard number line. Also board games such as snakes and ladders and similar computer games encourage pupils to add and subtract in a meaningful and enjoyable way. Games like these can be found on the internet or on BBC Number Time.

Question 3: Watches

This question requires pupils to be able to tell the time on the hour and half hour, and draw the hands on a clock face to show these times. Pupils have to be able to read the time on a digital watch and draw the hands on a clock face to show this time (part a). They then need to find the time half an hour later and show this time on a digital watch (part b), before showing the same time on a clock face (part c).

It is possible that some pupils will be more familiar with analogue timepieces and others will be more familiar with digital watch faces. It is useful to have both kinds of clocks available in the classroom so that comparisons can be made throughout the normal school day.

The activities can involve an element of problem solving; for example, questions such as 'How long will it be before the lunch break?', 'How long do we get for games lessons?', 'Show the time on the clock face when we will be back from P.E.', 'What will this look like on the digital clock?'

Question 4: Crackers

This activity begins by asking pupils to find numbers exactly half way between two numbers (part a). They then need to calculate and write in numerals the number for six groups of four (part b); finally six groups of five (part c). The question requires pupils to be able to count in multiples of twos, fives and tens.

Simple repetition can be both fun and useful when practised creatively. Playground chanting games and skipping games and using the number line to 'hop' count are all useful practice. Counting together around their tables in fives, each pupil putting one hand in the air; counting in twos by putting both arms out, and then counting in tens by putting both hands in the air. If all the pupils chant together this can be helpful for less able pupils.

Question 5: Chickens and eggs

This question begins by asking pupils to calculate six groups of three (part a); then fill in the empty spaces in a table in which the second column is two more than the first column (part b).

As with the previous question, the same kinds of games can be played. However, extensions of both of these questions could be discussed with the class. Pupils could be asked to explain how they solved the problems. If some pupils had simply counted in ones, then others might explain how they found the answers to the questions more quickly by counting in steps.

Question 6: How much?

In this activity pupils need to find the total of three coins (part a); find the change from 10p after spending 6p and find the cost of two 6p stickers (part b); select three coins from five to pay 35p (part c); finally find half of 40p (part d).

Pupils could practise identifying and applying appropriate mathematical procedures in money situations. As well as using practical shopping situations, there are many websites that offer useful money experiences.

Question 7: Three bears

In this activity pupils need to solve problems using the words: taller, shorter, more than, and less than in the context of comparing the heights, weights and the volume of the drinks for the three bears. Lots of practical work such as measuring lengths and heights around the classroom will be beneficial.

Baking can provide useful practice in weighing ingredients, but pupils need to have these skills highlighted. Recipes can be provided and questions based on these can be posed; for example, 'To bake 10 biscuits you need 30 grams of butter, 10 grams of caster sugar, 60 grams of flour'. Pupils can add the ingredients to find the total weight of the biscuits and decide whether they need less or more butter than sugar and so on.

Question 8: Bed cover

The bed cover task asks pupils to identify squares and rectangles (part a); recognise shapes in a sequence and continue the pattern (part b); recognise three pentagons (part c). Much of the shape work done at this level tends to be restricted to identifying regular shapes.

The notion that any polygon shape with five sides is a pentagon is a rather more challenging idea. Classifying sets of polygon shapes that are not regular can be interesting for pupils. Card games such as Number Snap can be played, using pictures of shapes in different orientations and sizes. Also, some excellent computer games are available.

Feedback to parents and carers

A report on the individual pupil is available to support feedback to parents or carers. This *Individual report for parents* strips away much of the technical detail that is included in the *Group report for teachers*. A series of statements, tailored for parents, is included to explain what the results mean and how learning may be affected. Recommendations focus on how the parent or carer can work with the school to support the pupil at home.

In addition to the *Individual report for parents*, you may wish to provide supporting information, either orally or in writing, explaining the process and outcomes. The following list provides you with guidelines to assist with this communication.

- Stress the school's commitment to identifying and addressing the needs of each individual pupil in order to understand and maximise their potential.
- Explain that testing with *PTM6* is part of the school's regular assessment regime and that all pupils in the year group(s) have been tested.
- You may wish to summarise the specific outcomes and recommendations from the test for that individual pupil (which are also shown on the *Individual report for parents*).
- Parents or carers should be reassured that if they have any questions or concerns or would like any further advice on how best to support their child, then they should contact the school.

A sample letter (Figure 1) is provided to support your communications with parents/carers after testing with *PTM6*.

Figure 1: Sample parent/carer feedback letter

Dear Parent or Carer,

In school, we wish to assess all our pupils to see what their needs are and how we can best help them learn and achieve.

As part of this process, your child has completed the Progress Test in Maths 6, which assesses key aspects of maths, such as shape, number and mathematical concepts (like money, place value and time).

A copy of the Individual report for parents is included*. This shows your child's results and describes what these mean in terms of the ways in which he/she will learn best and how you can support him/her at home.

[If the report is not included a relevant short extract can be included instead.]

If you have any queries or concerns please contact us.

Yours faithfully,

[School/Establishment name]

* If possible, it is helpful to parents to discuss the report with them on a suitable occasion before sending it out.