Practical numbers: Part 1

|  |  |
| --- | --- |
| Year level  Strand(s)  Lesson length  CD Code: | Year 7  Number  60 mins (part 1)  [AC9M7N09](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7N09&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick), [AC9M7N08](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7N08&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick), [AC9M7N04](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7N04&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick), [AC9M7N06](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7N06&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) |
| Lesson summary | In this lesson, students are transported to a bustling ancient bazaar before the introduction of standardised measuring systems. They encounter the challenge of a shopkeeper who must determine how to weigh different quantities of spices most efficiently. Working in a financial context, students model this scenario using fractions, percentages and ratios, and communicate their solution in the form of a sign for their stall. This lesson is in two parts with the second part named: Practical numbers: Part 2 |
| Learning intention | * We can use rational numbers and percentages to model a problem in a financial context. * We can communicate our solution and reasoning to the problem with appropriate vocabulary and context. |
| Success criteria | By the end of this lesson, students can:   * articulate, with the correct mathematical vocabulary, what makes a number ‘practical’ and why they are superior in this content * represent their calculations as fractions, percentages and ratios * produce a sign that could be displayed in their theoretical spice store to advertise its pricing structure. |
| Why are we learning about this? | We take the metric system for granted, and sometimes poke fun at other systems that seem less logical to us, but have you ever questioned whether a system based on powers of 10 is best? You have all the tools necessary to investigate this. Imagine yourself living in a time before measurements became standardised, trying to sell spices in a local market. How do you measure quantities? What prices do you charge? |
| Prerequisite student knowledge and language | Students are:   * developing competence with decimals, place value and equivalent fractions * identifying common denominators * understanding percentage is a proportional relationship and a complete whole * using percentages to represent relative sizes in real-world scenarios * recognising and understanding complementary percentages add to 100% * understanding basic levels of commerce * calculating a given quantity with respect to unit fractions * converting fractions to percentages using a calculator * learning the meaning of factors and factor pairs * developing core arithmetic skills. |
| **Resources** | * Teacher’s slides (PowerPoint) * Fractions warm-up worksheet (Word) * Clay/Play-Doh or similar * Craft materials for creating posters |

Curriculum information

|  |  |
| --- | --- |
| **Achievement standard** | Students use mathematical modelling to solve practical problems involving rational numbers, percentages and ratios, in financial and other applied contexts, justifying choices of representation. [They use all 4 operations in calculations involving positive fractions and decimals, choosing efficient calculation strategies.](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10?view=quick&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0) [Students choose between equivalent representations of rational numbers and percentages to assist in calculations.](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10?view=quick&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0) |
| **Content description(s)** | Students use mathematical modelling to solve practical problems, involving rational numbers and percentages, including financial contexts; formulate problems, choosing representations and efficient calculation strategies, using digital tools as appropriate; interpret and communicate solutions in terms of the situation, justifying choices made about the representation. [AC9M7N09](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7N09&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)  Students recognise, represent and solve problems involving ratios. [AC9M7N08](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7N08&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)  Students find equivalent representations of rational numbers and represent rational numbers on a number line. [AC9M7N04](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7N04&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)  They use the 4 operations with positive rational numbers including fractions, decimals and percentages to solve problems using efficient calculation strategies. [AC9M7N06](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7N06&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) |
| **General capabilities**  **Cross-curriculum priority** | **General capabilities**  Numeracy   * multiplicative strategies ([Level 9](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7N09&general-capability-code=N&element-code=NN&sub-element-index=2&sub-element-code=NNMuS&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)) * interpreting fractions ([Level 8](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7N09&general-capability-code=N&element-code=NN&sub-element-index=1&sub-element-code=NNInF&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)) * proportional thinking ([Level 2](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7N09&general-capability-code=N&element-code=NN&sub-element-index=3&sub-element-code=NNPrT&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)) * understanding money ([Level 8](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7N09&general-capability-code=N&element-code=NN&sub-element-index=4&sub-element-code=NNUnM&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)) * additive strategies ([Level 10](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7N09&general-capability-code=N&element-code=NN&sub-element-index=0&sub-element-code=NNAdS&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick))   Critical and creative thinking:   * interpret concepts and problems ([Level 5](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7N09&general-capability-code=CCT&element-code=CCTANA&sub-element-index=0&sub-element-code=CCTANAA&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)) * draw conclusions and provide reasons ([Level 5](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7N09&general-capability-code=CCT&element-code=CCTANA&sub-element-index=1&sub-element-code=CCTANAB&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick))   Digital literacy:   * select and operate tools ([Level 5](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7N09&general-capability-code=DL&element-code=DLMO&sub-element-index=0&sub-element-code=DLMOC&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick))   Related content  Civics and citizenship, Economics and business, Geography, Literacy |
| Areas of challenge | Some students:   * do not possess strong multiplicative strategies, or quick recall of the times-tables and will find it difficult to compare solutions to this problem * find understanding the scenario and restrictions of the problem very difficult without sufficient demonstration of the scenario * find fractions notoriously tricky and require a diagnostic assessment to highlight their interpretation of various fractions. There is also likely to be a wide variety of skill in this area among classes and cohorts.   It is recommended to familiarise yourself with this lesson and feel confident to explain the scenario in intricate detail and to describe the links with fractions, percentages and factors to a variety of skill levels. Prepare extra scaffolding materials, such as multiplication tables, if needed to support students as they progress through the parts of this lesson. |
| Strategies | [Mathematics investigation](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/mathematics-investigation/)  [Classroom talks](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/classroom-talks/)  [Questioning](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/questioning/)  [Concrete, Representational, Abstract](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/concrete-representational-abstract-cra/) |

Learning structure

|  |  |
| --- | --- |
| Learning hook  25 mins | This lesson is designed to be presented over two classes: Practical numbers: Parts 1 and Practical Numbers: Parts 2. Adjust this lesson to suit your timetable requirements. The two parts of the lesson are hands on, so it is recommended that you are pre-prepared with the materials, especially the Play-Doh, ready to go.  **Skills check**   * Introduce the students to the lesson using the downloadable teacher’s slides and discuss the learning intentions (slides 1–3). * Move to a quick diagnostic activity, the downloadable fractions warm-up worksheet. Edit the word doc to suit your students if required. * The purpose here is two-fold. You can ascertain which students have knowledge gaps in key areas and make a mental note to offer them additional scaffold during the investigation. At the same time, you can reinforce the underlying skills that will be needed and transition students into a mathematics learning mindset. There are several ways to deliver this activity, but they should all include fluency-style questions that assess students’ ability to list the factors of a two-digit number and convert fractions to percentages with the use of technology. * Collecting data on student performance in this task is critical, so the answers will need to be provided for review. This could be done formally by sighting each student’s work, or informally through a qualitative rating scale, such as ‘Fist to Five’ or chilli rating scale*.* You may feel it necessary to explicitly model an example on the board for some or all students. * Move to the class warm-up challenge shown for students in slide 4. Say: ‘List the smallest set of numbers that can be used to sum each number from 1 to 10. Each number can only be used once per sum*.’* Model one attempt for the class before releasing them to work independently. Select the numbers 1, 2, 5 and 10 (the factors of 10 – this choice will be relevant to the investigation). Go to the slide for further detailed teaching notes and suggestions for differentiation.   **Learning hook**  On the following slide, hook students in by presenting the context for the mathematical investigation. Students may wish to guess to what the investigation will be about. Remind them of the learning criteria. Move to slide 6 to give the scenario and investigative task. |
| Explore  25 mins | Note: This is a hands-on and detailed activity and so it is recommended to feel comfortable and familiar with its progression before class begins.  Allow sufficient time to present the market scenario, discussions of the problem task and in general terms what students need to do. The steps for a teacher demonstration are included below and more detailed discussion questions and adjustments for differentiation can be found in the teaching notes in the teacher’s slides (slides 6–8).  The investigation unfolds in progressive steps. This allows you to pause and prompt students at each step to allow students to consider how the mathematics imbedded in the market context work together. It might be that students will connect later in part 2 once they are independently working with the Play-Doh **after** your teacher demonstration.   * Scenario: You are a spice trader with a small stall in the Grand Bazaar of Istanbul on opening day in 1461. At the crossroads of Europe and Asia, the bazaar is filled with traders from East and West, all used to different systems of measurement. Learning and memorising all these systems seems too confusing, so you decide to create your own simplified one. You will need to design a set of weights that can be used to weigh any quantity of spice. Crafting these weights will be expensive, as they need to be precise, so you can only have one of each weight. Go to slide 7. * Problem: There are 12 inches in a foot and 14 pounds in a stone. A centimetre is 10 millimetres, and a gallon is 128 fluid ounces. You need to select a name and base number for your system of weights. However, you need to select carefully. Each weight in your set must be a unit fraction of the base, and you only get one of each. Using the weights in your set you need to be able to weigh every quantity up to and including the base number.   **Teacher demonstration**   * Ask students to gather round a desk that provides everyone a decent view. Take a lump of clay and designate it as 14 pounds, which is equivalent to 1 stone. You could be creative here and come up with fictional names for your units of mass that will be engaging to your students. * Split the lump in half, and ask students, ‘How many pounds does each half weigh?’ * You have now demonstrated two different weights in your set. A 14-pound and a 7-pound weight. Keep track of these on the screen/board. Continue the questioning: Are there other ways I could **evenly** divide this lump? The exhaustive list of possible weights is: 1 pound, 2 pounds, 7 pounds and 14 pounds. This is the complete set of weights available to the spice trader who chooses a base-14 system. * Model for students how to represent these weights as fractions of the whole: and as respective percentages: . * Now assign a price to your spices. At your stall you will sell 1 stone of spice for 28 Gold Dragons. This is an opportunity to include ratios in the lesson. If 1 stone = 28 Gold Dragons, then 14 pounds = 28 Gold Dragons and 1 pound = 2 Gold Dragons. Show students how to use this ratio to calculate the cost of 1, 2 or 7 pounds of spice. * A customer enters your stall and wants to buy 9 pounds of spice. They ask you to weigh it out for them. Can you do it with your set of weights? Show students that even by combining 3 of the 4 weights in the set it is only possible to weigh 8 pounds of spice. This limits your ability to make sales and earn money. Base-14 is evidently a poor choice. * Spend time discussing why this is. For those students who appear confused, assure them that in the next lesson they will get to investigate this themselves and they will have time to explore and ask clarifying questions. |
| Summary and reflection  10 mins | Note that this is the natural point to end the demonstration in a 60-minute lesson; if you have time in your class for students to explore with their own lump of Play-Doh, which is the task at the beginning of Practical numbers: Part 2 of this sequence, feel free to continue from here. Otherwise, take further questions and explain what will be happening in the next part of the lesson to prepare students mentally. |
| Assessment | Review the warm-up sheets handed in to you and make a judgement on each student’s needs and requirements. Take a few minutes to think about how the class is responding to the lesson so far and whether you need to make any adjustments to Practical numbers: Part 2 ahead of time. |