# Practical numbers: Part 2

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| Year levelStrand(s)Lesson lengthCD Code | Year 7Number60 minutes[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 we use the context of an ancient bazaar to investigate measurement systems. Students select a name and base number for their system of measurement, using weights made from clay or similar material. They divide their clay into possible unit fractions to generate their set of weights. They assign a fictional currency name to the value of their clay. This lesson follows Practical numbers: Part 1. |
| 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.
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| 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.
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| 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.
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| **Resources** | * Teacher’s slides (PowerPoint)
* Exit slip
* Clay/Play-Doh
* Craft materials for creating posters
* Kitchen scales (optional)
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Curriculum information

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| **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 contentCivics 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/) |

Lesson structure

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| **Learning hook**5 mins | Use the slides 1–4 to revise the investigation from Practical numbers: Part 1.  |
| **Explore** 40 mins | **Explore and investigate** Simplified instructions are given in slide 5. However, the following instructions to students are more detailed and designed to suggest engaging examples of the task than the simple instructions. You may wish to conduct this lesson step by step with the steps on the slide, allowing for questions and exploration and for the whole class to move forward at the same time. You may wish students to go at their own pace. The idea is that the teacher is roaming, noticing, guiding and questioning.* Distribute a lump of clay to each student (or pairs/groups if this works better for your class).
* Students decide on a base number and names for their system of measurement,

For example, 1 proton = 19 electrons or 1 brainfreeze = 12 slurpees.* Students split their clay into all possible unit fractions to generate their set of weights. A student who started with base-12 will produce the following fractions: $\frac{1}{12}=1,\frac{1}{6}=2,\frac{1}{4}=3,\frac{1}{3}=4,\frac{1}{2}=6,\frac{1}{1}=12$. This student has a large set of weights: 1, 2, 3, 4, 6 and 12. Throughout the process students must be reminded to keep a record of their calculations.
* Students convert their unit fractions to percentages. The student with base-12 has weights representing $8.3\%, 17.7\%, 25\%, 33.3\%, 50\%, 100\% $of the original lump of clay.
* Students now assign a fictional currency name and value to their original lump.
* Students determine the associated ratio of weight : price.

For example, 1 brainfreeze = 12 slurpees = 50 Silver Snakes. In the example provided here, the ratio can only be simplified to 6:25. This would not be a suitable choice, as students will be unable to determine a whole number price for each of their weights. Students can be extended through questioning that prompts then to select an appropriate ratio or supported by advising them to select the name price as their base number. In the example provided, this would mean 1 brainfreeze = 12 slurpees = 12 Silver Snakes.* Using this fictional currency, they assign prices to each of the weights in their set,

For example, 1 slurpee = 1 Silver Snake, 2 slurpees = 2 Silver Snakes.Now students need to check whether they have chosen a ‘practical number’ as their base. In the example above, the student already has the weights 1, 2, 3, 4, 6 and 12 in their set. They need to determine if it’s possible for them to also weigh 5, 7, 8, 9, 10 and 11. If they can find combinations of the weights in their set that can weigh out each of those numbers then they have achieved the goal of a practical system of measurement. 12 is a practical number and so this is certainly possible:$$2+3=5 $$$$3+4=7 $$$$1+3+4=8 $$$$2+3+4=9 $$$$4+6=10 $$$$2+3+6=11$$This student would be able to sell spices of any weight to their customers and has maximised their profit potential! It is possible that students will select a practical number on their first try. If so, the next challenge to pose to them is why: * Why did the number they selected turn out to be practical while the number demonstrated by the teacher was not?
* Can you create a model to determine if a number is practical?

Students who do not select a practical number on their first try should be encouraged to repeat the process and try again. Before they do it is important to support them through questioning: * What do you notice about your number that prevented it from being a practical base?
* Can you find a peer with a practical number to compare against?

Encourage students who found practical numbers to explain their findings to those who did not. Once sufficient time has been provided for independent work, students should summarise their findings in a simple poster/PowerPoint/Canva template (slide 6). The poster should include:* base number and name of units
* set of unit fractions and percentages
* list of weights in set
* name of currency and cost of each weight of spice
* calculations to check for practicality of base number
* whether the base number is practical, with reasoning.

Refer to slide 5 showing an image of the Grand Bazaar of Istanbul to spark their creativity when designing the poster’s aesthetic.  |
| **Summary and reflection**15 mins | Display posters on a wall of the classroom exhibited to students in the class. Before they walk through the exhibition, students should be prompted to observe any patterns that exist between the ‘practical’ base numbers. After students have a chance to explore, the investigation should be concluded with a class discussion about the patterns they observed.Prompt students to reflect and demonstrate their learning by answering the following questions in their exercise books or handing out the downloadable Exit slip (slide 7): * Is 10 a practical number? (Give reasons for your answer.)
* Was it a good decision for our civilisation to use a measurement system based on powers of 10? Why or why not?’
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| **Assessment** | The formative assessment items for this investigative project are given below. * Preserve time to evaluate and provide posters and exit slips in the manner of your choice.
* Students create a poster in the last half of the lesson, as described above. Evaluate posters and provide feedback to students/groups.
* Revisit the success criteria for this lesson. Ask students to use the Exit slip to assess as to whether they have attained a level of appropriate understanding for this lesson and met the success criteria.
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