Mathematics Stage 3 – Unit 40

Our number system extends infinitely to very large and very small numbers

Contents

[Unit description and duration 5](#_Toc176893637)

[Syllabus outcomes 5](#_Toc176893638)

[Working mathematically 6](#_Toc176893639)

[Student prior learning 6](#_Toc176893640)

[Lesson overview and resources 8](#_Toc176893641)

[Lesson 1 13](#_Toc176893642)

[Daily number sense – Which is more? – 10 minutes 13](#_Toc176893643)

[Core lesson – exploring integers – 40 minutes 15](#_Toc176893644)

[Discuss and connect the mathematics – 10 minutes 19](#_Toc176893645)

[Lesson 2 21](#_Toc176893646)

[Daily number sense – grocery discounts – 10 minutes 21](#_Toc176893647)

[Core lesson – decimal comparisons – 40 minutes 23](#_Toc176893648)

[Discuss and connect the mathematics – 10 minutes 26](#_Toc176893649)

[Lesson 3 29](#_Toc176893650)

[Daily number sense – shopping spree – 15 minutes 29](#_Toc176893651)

[Core lesson – problem solving – 40 minutes 31](#_Toc176893652)

[Consolidation and meaningful practice – 10 minutes 34](#_Toc176893653)

[Lesson 4 36](#_Toc176893654)

[Daily number sense – 10 minutes 36](#_Toc176893655)

[Core lesson – decimal, percentage, fraction family – 40 minutes 36](#_Toc176893656)

[Discuss and connect the mathematics – 10 minutes 41](#_Toc176893657)

[Lesson 5 43](#_Toc176893658)

[Daily number sense – number patterns – 15 minutes 43](#_Toc176893659)

[Core lesson – estimating percentage discounts – 35 minutes 45](#_Toc176893660)

[Discuss and connect the mathematics – 10 minutes 48](#_Toc176893661)

[Lesson 6 50](#_Toc176893662)

[Daily number sense – closest product – 15 minutes 50](#_Toc176893663)

[Core lesson 1 – multiplying decimals – 20 minutes 51](#_Toc176893664)

[Core lesson 2 – reasonable estimates – 20 minutes 56](#_Toc176893665)

[Discuss and connect the mathematics – 10 minutes 58](#_Toc176893666)

[Lesson 7 60](#_Toc176893667)

[Daily number sense – ‘Dice division’ – 15 minutes 60](#_Toc176893668)

[Core lesson 1 – brackets matter – 20 minutes 61](#_Toc176893669)

[Core lesson 2 – ‘Closest to x’ – 20 minutes 65](#_Toc176893670)

[Discuss and connect the mathematics – 10 minutes 66](#_Toc176893671)

[Lesson 8 69](#_Toc176893672)

[Daily number sense – 10 minutes 69](#_Toc176893673)

[Core lesson – Cartesian plane – 40 minutes 69](#_Toc176893674)

[Discuss and connect the mathematics – 10 minutes 73](#_Toc176893675)

[Resource 1 – elevator challenge cards 74](#_Toc176893676)

[Resource 2 – decimal recording sheet 75](#_Toc176893677)

[Resource 3 – 4 decimats 76](#_Toc176893678)

[Resource 4 – seasonal sales 77](#_Toc176893679)

[Resource 5 – worded problems 78](#_Toc176893680)

[Resource 6 – student tasks 79](#_Toc176893681)

[Resource 7 – ‘Spirals’ 80](#_Toc176893682)

[Resource 8 – gift card 82](#_Toc176893683)

[Resource 9 – ‘Arcade zone’ 84](#_Toc176893684)

[Resource 10 – ‘Hit the target’ 85](#_Toc176893685)

[Resource 11 – multiplication chart 86](#_Toc176893686)

[Resource 12 – ‘Dice division’ instructions 87](#_Toc176893687)

[Resource 13 – ‘Dice division’ gameboard 88](#_Toc176893688)

[Resource 14 – delicious discounts 89](#_Toc176893689)

[Resource 15 – party supplies 90](#_Toc176893690)

[Resource 16 – Cartesian plane 91](#_Toc176893691)

[Syllabus outcomes and content 92](#_Toc176893692)

[References 98](#_Toc176893693)

[Further reading 100](#_Toc176893694)

# Unit description and duration

This unit develops the big idea that our number system extends infinitely to very large and very small numbers.

In this 2-week unit students are provided opportunities to:

* determine benchmark percentage discounts
* connect decimals, percentages and fractions
* explore the use of brackets and the order of operations.

## Syllabus outcomes

* **MAO-WM-01** develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly
* **MA3-RN-01** applies an understanding of place value and the role of zero to represent the properties of numbers
* **MA3-RN-02** compares and orders decimals up to 3 decimal places
* **MA3-RN-03** determines percentages of quantities, and finds equivalent fractions and decimals for benchmark percentage values
* **MA3-AR-01** selects and applies appropriate strategies to solve addition and subtraction problems
* **MA3-MR-01** selects and applies appropriate strategies to solve multiplication and division problems
* **MA3-MR-02** constructs and completes number sentences involving multiplicative relations, applying the order of operations to calculations
* **MA3-GM-01** locates and describes points on a coordinate plane

## Working mathematically

In the Mathematics K–10 Syllabus, there is one overarching Working mathematically outcome (**MAO-WM-01**). The Working mathematically processes should be embedded within the concepts being taught. The Working mathematically processes present in the Mathematics K–10 Syllabus are:

* communicating
* understanding and fluency
* reasoning
* problem solving.

[Mathematics K–10 Syllabus](https://curriculum.nsw.edu.au/learning-areas/mathematics/mathematics-k-10-2022/overview) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2022.

## Student prior learning

Before engaging in these teaching and learning activities, students would benefit from prior experience with:

* identifying, describing and applying multiplicative patterns
* applying place value knowledge to recognise, name and order decimals to hundredths
* using mental strategies to estimate percentage discounts.

In NSW classrooms there is a diverse range of students, including Aboriginal and/or Torres Strait Islander students, students learning English as an additional language or dialect, high potential and gifted students, and students with disability. Some students may identify with more than one of these groups or possibly all of them. Refer to [Curriculum planning for every student – advice](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/advice-on-curriculum-planning-for-every-student-k-12) for further information.

# Lesson overview and resources

The table below outlines the sequence and approximate timing of lessons, learning intentions and resources.

|  |  |  |
| --- | --- | --- |
| Lesson | Content | Duration and resources |
| [**Lesson 1**](#_Lesson_1)  **Daily number sense learning intention**:   * determine percentage discounts of 10%, 25% and 50% | **Lesson core concept**: negative numbers can be a result of subtraction and represented on a number line.  **Core concept learning intention**:   * locate and represent integers on a number line | **Lesson duration**: 60 minutes   * [Resource 1 – elevator challenge cards](#_Resource_1_–) (enlarged on A3 paper) * 6-sided dice * Counters * Scissors * Writing materials |
| [**Lesson 2**](#_Lesson_2)  **Daily number sense learning intention**:   * determine percentage discounts of 10%, 25% and 50% | **Lesson core concept**: the place value system can be extended.  **Core concept learning intention**:   * compare, order and represent decimals | **Lesson duration**: 60 minutes   * [Resource 2 – decimal recording sheet](#_Resource_2_–) * [Resource 3 – 4 decimats](#_Resource_3_–) * Individual whiteboards * Playing cards * Student workbooks * Writing materials |
| [**Lesson 3**](#_Lesson_3_1)  **Daily number sense learning intention**:   * determine percentage discounts of 10%, 25% and 50% | **Lesson core concept**: known strategies for addition and subtraction can be applied to decimals.  **Core concept learning intentions**:   * choose and use efficient strategies to solve addition and subtraction problems * applies known strategies to add and subtract decimals | **Lesson duration**: 65 minutes   * [Resource 3 – 4 decimats](#_Resource_3_–) * [Resource 4 – seasonal sales](#_Resource_4_–) * [Resource 5 – worded problems](#_Resource_5_–) * [Resource 6 – student tasks](#_Resource_6_–) * Calculators * Individual whiteboards * Writing materials |
| [**Lesson 4**](#_Lesson_4_1)  **Daily number sense learning intention**:   * teacher-identified task based on student needs | **Lesson core concept**: connections can be made between decimals, percentages and fractions.  **Core concept learning intention**:   * make connections between benchmark fractions, decimals and percentages | **Lesson duration**: 60 minutes   * [Resource 7 – 'Spirals'](#_Resource_7_–) * A4 plastic sleeves * Coloured whiteboard markers * Pegs * Skipping rope or length of string * Writing materials |
| [**Lesson 5**](#_Lesson_5_1)  **Daily number sense learning intention**:   * represent and describe number patterns formed by multiples | **Lesson core concept**: mental strategies help estimate percentage discounts.  **Core concept learning intention**:   * determine percentage discounts of 10%, 25% and 50% | **Lesson duration**: 60 minutes   * [Resource 8 – gift card](#_Resource_8_–) * [Resource 9 – 'Arcade zone'](#_Resource_9_–) * Counters * Writing materials |
| [**Lesson 6**](#_Lesson_6_1)  **Daily number sense learning intention**:   * select and apply strategies to solve problems involving multiplication and division with whole numbers | **Lesson core concept**: estimating helps when multiplying decimals.  **Core concept learning intention**:   * multiply and divide decimals by powers of 10 | **Lesson duration**: 65 minutes   * [Resource 10 – 'Hit the target'](#_Resource_10_–) * [Resource 11 – multiplication chart](#_Resource_11_–) * Website: [4-Function Calculator](https://www.desmos.com/fourfunction?lang=en-GB) * Calculators * Individual whiteboards * Markers * Writing materials |
| [**Lesson 7**](#_Lesson_7_1)  **Daily number sense learning intention:**   * represent and solve division problems with whole number remainders | **Lesson core concept**: the order of operations includes grouping symbols.  **Core concept learning intention**:   * explore the use of brackets and the order of operations to write number sentences | **Lesson duration**: 65 minutes   * [Resource 12 – ‘Dice division; instructions](#_Resource_12_–) * [Resource 13 – ‘Dice division’ gameboard](#_Resource_13_–) * [Resource 14 – delicious discounts](#_Resource_14_–) * [Resource 15 – party supplies](#_Resource_15_–) * 10-sided dice * Individual whiteboards * Markers * Writing materials |
| [**Lesson 8**](#_Lesson_8)  **Daily number sense learning intention**:   * teacher-identified task based on student needs | **Lesson core concept**: coordinates define the point on a number plane.  **Core concept learning intentions**:   * explore the Cartesian coordinate system * use the 4 quadrants of the coordinate plane | **Lesson duration**: 60 minutes   * [Resource 16 – Cartesian plane](#_Resource_16_–) * Website: [Demonstrate Coordinates](https://www.teacherled.com/2015/05/07/demonstrate-coordinates-3/) interactive * Coloured pencils * Digital devices * Writing materials |

# Lesson 1

**Core concept**: negative numbers can be a result of subtraction and represented on a number line.

## Daily number sense – Which is more? – 10 minutes

Daily number sense activities for Lessons 1 to 3 ‘activate’ prior number knowledge and support the learning of new content in the unit. These activities can also assist teachers to identify the starting points for learning by revealing the extent of students’ existing knowledge.

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Daily number sense learning intention | Daily number sense success criteria |
| Students are learning to:   * determine percentage discounts of 10%, 25% and 50%. | Students can:   * use mental strategies to estimate discounts of 10%, 25% and 50%. |

This activity is an adaptation of ‘[Calculating percentages](https://resources.education.nsw.gov.au/detail/IPT-06)’ from the [Universal Resources Hub](https://resources.education.nsw.gov.au/home) by the State of NSW (Department of Education).

1. Pose the following ‘Which is more?’ questions:

* 10% of $200 or 50% of $40?
* 10% of $500 or 25% of $200?
* 10% of 50 or 50% of 10?

1. Ask students to first estimate using mental strategies, without any formal calculations.
2. Students [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) to decide on their answers.
3. Select students to share the strategies used to estimate the answer.
4. Pose another set of ‘Which is more?’ questions:

* 10% of $200 or 50% of $38.95?
* 10% of $495.95 or 25% of $185.95?

1. Discuss how the rounding of numbers can support estimating with benchmark percentages.
2. Repeat with other percentage pairs for benchmark percentages.

This table details an opportunity for assessment.

|  |  |
| --- | --- |
| Assessment opportunity | Links |
| What to look for:   * Can students use mental strategies to estimate discounts of 10%, 25% and 50%? **[MAO-WM-01, MA3-RN-03]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * PrT1, PrT2 * UuM8.   Links to suggested [Interview for Student Reasoning](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/assessment-resources/ifsr) (IfSR) tasks:   * **IfSR-PT:** 2A.5, 2A.8. |

## Core lesson – exploring integers – 40 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intention | Core concept success criteria |
| Students are learning to:   * locate and represent integers on a number line. | Students can:   * recognise the location of negative whole numbers in relation to zero and place them on a number line * recognise that negative whole numbers can result from subtraction. |

This activity is an adaptation of ‘[Directed Number – Lesson 1: Elevator Challenge](https://resolve.edu.au/v84-sequences/directed-number)’ from [reSolve](https://resolve.edu.au/) by the Australian Academy of Science.

1. Draw a number line on the board with arrows pointing in both directions and a zero marked on the number line.
2. Write the numbers 4, −3 and −6 on the whiteboard. Students [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) to discuss the following questions:

* Which numbers would go to the left of the zero?
* Where would the −6 go?
* Would the −3 go to the left or right of the −6?

1. Regroup as a class to share student ideas.
2. Select students to place the numbers on the number line.
3. Draw a vertical number line on the board with arrows pointing in both directions and a zero marked on the number line. Ask:

* How is a vertical number line similar and/or different to the horizontal number line?
* Where would negative numbers be placed on this number line?

1. Check for understanding by asking students to place a variety of positive and negative numbers on the vertical number line.

**Note**: vary the numbers according to the needs of your class. For the ‘Elevator challenge’ game, students will be working with numbers ranging from −6 to 6.

1. Explain to students that they will be playing the ‘Elevator challenge’ game. Lisa and Phoebe are employees at Hotel Integer. The manager has given each of them 6 jobs to complete on 6 different floors of the hotel. They need to share the elevator to get up and down to complete each task. The person who finishes all their jobs first will be the ‘Employee of the Month’.
2. Explain and model the rules of the ‘Elevator challenge’ game to students using [Resource 1 – elevator challenge cards](#_Resource_1_–):
3. Deal out the 12 elevator floor cards equally between 2 players. These are your 6 jobs.
4. A counter (the elevator) is placed at Floor 0, the Lobby, on the elevator gameboard.
5. Roll a 6-sided die to see which player goes first. The player who rolls the largest number goes first.
6. Player 1 rolls the die and chooses to move the elevator up or down, according to the number shown on the die. For example, if a 5 is rolled, the elevator could move up to Floor 5, the Spa, or down to Floor −5, Deliveries. Whoever holds the card matching the floor the elevator lands on, can discard it. The job is complete!
7. Player 2 then rolls the die and chooses to move the elevator either up or down from the level the elevator is currently sitting on. For example, if a one is rolled and the elevator is on Floor −5, the elevator could move up to Floor −4 or down to Floor −6. Once again, when the elevator stops, the owner of the card for that level can discard it.
8. You cannot go above Floor 6, below Floor −6 or ‘bounce’ the elevator off the top or bottom. For example, if you are on Floor 5 and roll a 3, you must go down. Each journey can be in one direction only. You must move the total of your die roll.
9. The winner is the first player to complete all their jobs and be awarded ‘Employee of the Month’.
10. Provide pairs of students with [Resource 1 – elevator challenge cards](#_Resource_1_–), scissors, a 6-sided die and a counter. Students cut out the elevator cards.
11. Move around the room as students play the ‘Elevator challenge’ game. Observe how students are moving up and down the number line.
12. Regroup as a class and ask:

* How did you decide whether to move the elevator up or down?
* Which moves took you from a positive number to a negative number?
* Is it possible to move from a negative number to another negative number? Explain your thinking.
* If the elevator was on Floor 3 and moved down 5 floors, which floor would you end up on?
* Does subtraction always result in a positive number? Explain your thinking.
* What are some examples where subtraction can result in a negative whole number?

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot recognise that negative whole numbers can result from subtraction.   * Draw a horizontal number line on students’ whiteboards, labelled from −6 to 6. Support students to move a counter along the number line to identify situations where a negative whole number can result in subtraction. | Students can recognise that negative whole numbers can result from subtraction.   * Challenge students to record the movements of the elevator using number sentences. * Pose the following scenario: ‘You have just started the game at the Lobby. You notice after 3 turns that you are back at the Lobby. What might the 3 rolls have been?’ Students record possibilities using a number sentence. |

## Discuss and connect the mathematics – 10 minutes

1. Draw a vertical number line on the board, labelled from −6 to 6.
2. Pose the following question: ‘You have just landed at Floor −2. What might your dice roll have been to get there? What level did you come from?’
3. Students [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) to generate possibilities. Ask:

* What strategy did you use to determine a possibility?
* How did the number line help you?
* What are all the possibilities for how you got to Floor −2?
* How can you show that you have found all possibilities?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students recognise the location of negative whole numbers in relation to zero and place them on a number line? **[MAO-WM-01, MA3-RN-01]** * Can students recognise that negative whole numbers can result from subtraction? **[MAO-WM-01, MA3-RN-01]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * NPV9. |

# Lesson 2

**Core concept**: the place value system can be extended.

## Daily number sense – grocery discounts – 10 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Daily number sense learning intention | Daily number sense success criteria |
| Students are learning to:   * determine percentage discounts of 10%, 25% and 50%. | Students can:   * use mental strategies to estimate discounts of 10%, 25% and 50% * calculate the sale price of an item after a discount of 10%, 25% and 50%. |

1. Share the story: Lila has a membership card for her local grocery store. As part of the December promotions, the owner gave selected shoppers an option to ‘take $10 off your total shop’ or ‘25% off your total shop’. Lila finished her Christmas shopping with a total bill of $250. Which discount voucher should Lila use?
2. In pairs, students determine the better promotion for Lila.
3. Ask the following questions:

* Is it possible to determine the best option with just an estimate?
* How much would Lila have to pay if she took $10 off her total shop of $250?
* How much is 25% of $250?
* How much would Lila have to pay if she took a 25% discount off her total shop?
* When would $10 off be a better choice than a 25% discount?
* When would both deals be worth the same?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students use mental strategies to estimate discounts of 10%, 25% and 50%? **[MAO-WM-01, MA3-RN-03]** * Can students calculate the sale price of an item after a discount of 10%, 25% and 50%? **[MAO-WM-01, MA3-RN-03]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * PrT1, PrT2 * UuM8.   Links to suggested [Interview for Student Reasoning](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/assessment-resources/ifsr) (IfSR) tasks:   * **IfSR-PT:** 2A.5, 2A.8. |

## Core lesson – decimal comparisons – 40 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intention | Core concept success criteria |
| Students are learning to:   * compare, order and represent decimals. | Students can:   * compare and order decimal numbers of up to 3 decimal places * interpret zero digit(s) at the end of a decimal * approximate the size of decimals * place decimal numbers of up to 3 decimal places on a number line. |

1. Provide students with [Resource 2 – decimal recording sheet](#_Resource_2_–), a deck of playing cards (picture cards removed) and individual whiteboards.
2. Explain that each suit in the deck of playing cards represents a different place value.
3. Instruct students to organise their deck of cards into 4 piles, categorised by suits.
4. Shuffle each pile and place them facedown.
5. In pairs, students draw one card from each pile and place each of the cards in the place value order.
6. Students record their number on their whiteboards and read the number out loud to each other. The student with the larger number gains a point.

**Note**:if required, students use [Resource 3 – 4 decimats](#_Resource_3_–) to confirm the larger decimal. To support place value conceptual understanding, ensure that students use the correct decimal language. For example, 6.332 would be read as ‘six and three hundred and thirty-two thousandths’.

1. Return all 8 cards to the piles and play again.
2. At the end of 10 rounds, students return all the picture cards to the piles.
3. Explain that the picture cards represent zero.
4. Demonstrate an example of drawing a picture card by displaying Figure 1

Figure 1 – example of drawn cards

Four playing cards: a 3 of spades, an Ace of hearts, a 2 of diamonds and a Jack of clubs.

The playing cards are positioned in individual spaces to represent the placement of numbers for decimal numbers.

There is a decimal placed between the 3 of spades and the Ace of hearts.

1. Explain that in this example, the cards represent 3.120 (three and one hundred and twenty thousandths).
2. Ask the following questions:

* How is this the same as 3.12 (three and twelve hundredths)?
* How can this be represented using a decimat?

1. Draw an empty number line with the numbers 0–10 and model marking out an estimated position for 3.12.
2. Demonstrate estimating the position of the decimal by first attending to the value in the ones place, then the tenths and hundredths. In this example, 3.12 is about 3.1 and must be positioned close to 3.
3. Repeat the example of comparing the decimals by drawing another 4 cards from the pile.
4. Record the decimal on the number line and ask students to check if the decimal is placed correctly on the number line.
5. Provide students with writing materials.
6. In pairs, students draw an empty number line in their workbooks.
7. They repeat the activity by drawing 4 cards each and placing the cards in the correct order.
8. Students record at least 5 decimals on the number line.
9. Regroup as a class and ask pairs of students to select a decimal from their workbooks.
10. Select each pair to record their decimals on the class number line.

**Note**: this is an opportunity to address any misconceptions that students may have when comparing decimals. The Mathematics K–10 Syllabus Stage 3 [Teaching advice for Represents Numbers A: Decimal misconceptions](https://curriculum.nsw.edu.au/learning-areas/mathematics/mathematics-k-10-2022/content/stage-3/fa87632ef7?show=advice) states that ‘When zero is in the tenths place, students sometimes ignore it and treat the following digit as if it is in the tenths place (eg 0.07 is the same as 0.7). Some students assume that adding a zero on the end of a decimal increases its magnitude (eg 0.320 is greater than 0.32)’ (NESA 2022a).

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot compare and order decimal numbers of up to 3 decimal places.   * Modify the activity by reducing the number of cards available in a deck. Provide students with cards between one and 5 for a maximum draw of 2 cards in each round. Students compare up to one decimal place before increasing to 2 decimal places. | Students can compare and order decimal numbers of up to 3 decimal places.   * In pairs, students draw up to 20 cards to create 5 decimal numbers. The cards can be arranged in any place value order to represent a decimal number with up to 3 decimal places. Challenge students to have the smallest range between their lowest and highest decimal numbers. |

## Discuss and connect the mathematics – 10 minutes

1. Provide students with individual copies of [Resource 3 – 4 decimats](#_Resource_3_–).
2. Display the decimals: 0.12, 0.21, 0.021, 0.012 and 0.120 on the whiteboard.
3. Explain to students that they will be representing the decimals using [Resource 3 – 4 decimats](#_Resource_3_–). Students complete this task independently or with a partner.
4. Ask the following questions:

* Was it possible to represent all the decimals using the decimats provided? Explain how you know.
* Are there other decimals that are not on the whiteboard that can also be represented by the decimats?
* Does adding a zero to the end of a decimal change its value?
* When does a zero change the value of a decimal?

1. Students draw a number line between 0–1 and record the 5 decimals along the number line.
2. Select students to share their number lines with the class and explain how they positioned the decimals on their number lines.

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students compare and order decimal numbers of up to 3 decimal places? **[MAO-WM-01, MA3-RN-01, MA3-RN-02]** * Can students interpret zero digit(s) at the end of a decimal? **[MAO-WM-01, MA3-RN-01, MA3-RN-02]** * Can students approximate the size of decimals**? [MAO-WM-01, MA3-RN-01, MA3-RN-02]** * Can students place decimal numbers of up to 3 decimal places on a number line? **[MAO-WM-01, MA3-RN-01, MA3-RN-02]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * NPV8.   Links to suggested [Interview for Student Reasoning](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/assessment-resources/ifsr) (IfSR) tasks:   * **IfSR-NP:** 4D.4, 4D.5, 4D.6 |

# Lesson 3

**Core concept**: known strategies for addition and subtraction can be applied to decimals.

## Daily number sense – shopping spree – 15 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Daily number sense learning intention | Daily number sense success criteria |
| Students are learning to:   * determine percentage discounts of 10%, 25% and 50%. | Students can:   * use mental strategies to estimate discounts of 10%, 25% and 50% * calculate the sale price of an item after a discount of 10%, 25% and 50%. |

1. Provide students with individual copies of [Resource 4 – seasonal sales](#_Resource_4_–).
2. Explain that the orange label indicates the discount that should be applied to that item.
3. Students [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) to estimate the discounts for each of the items.
4. Regroup as a class and select students to share their estimations. Ask:

* What strategy did you use to estimate the discount of each item?
* How did rounding help you make an estimate?

1. In pairs, students:

* determine the sale price of each item after the discount
* use calculators to check their answers.

1. Regroup as a class and ask:

* What strategy did you use to determine the percentage discount?
* How did your knowledge of fractions and percentages help you determine the discount?
* What other mathematical concepts did you use to solve these problems?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students use mental strategies to estimate discounts of 10%, 25% and 50%? **[MAO-WM-01, MA3-RN-03]** * Can students calculate the sale price of an item after a discount of 10%, 25% and 50%? **[MAO-WM-01, MA3-RN-03]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * PrT1, PrT2 * UuM8.   Links to suggested [Interview for Student Reasoning](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/assessment-resources/ifsr) (IfSR) tasks:   * **IfSR-PT:** 2A.5, 2A.8. |

## Core lesson – problem solving – 40 minutes

The table below contains suggested learning intentions and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intentions | Core concept success criteria |
| Students are learning to:   * choose and use efficient strategies to solve addition and subtraction problems * applies known strategies to add and subtract decimals. | Students can:   * solve multistep word problems, including problems that require more than one operation * solve word problems involving the addition and subtraction of decimals of up to 3 decimal places * justify why the strategy used to solve addition and subtraction word problems is appropriate. |

1. Provide pairs of students with [Resource 3 – 4 decimats](#_Resource_3_–), calculators and individual whiteboards.
2. Display [Resource 5 – worded problems](#_Resource_5_–) and read Problem 1 aloud.
3. Ask students to compare both decimal numbers to determine which bag is heavier.
4. Select students to justify their response.
5. Ask the following questions:

* What strategies did you use to compare the weight of both bags?
* How can this comparison be represented using a number line?
* How can this comparison be represented using a decimat?
* Which comparison strategy is most effective? Why?

1. Draw an empty number line on the whiteboard with the numbers 0–1.
2. Select students to identify the position of 0.124 and 0.376 along the number line.
3. Pose the question: ‘If we know that 0.376 is further away from zero, indicating that it is the heavier bag, can you work out how much heavier?’
4. Model using the number line to subtract from 0.376 and repeat modelling the use of a number line to add from 0.124 to arrive at 0.376.
5. Ask students to [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) to determine if it is a more appropriate strategy to use a number line or a decimat to compare and subtract decimal numbers.
6. Allow students to use their calculators to check the class’s answer.
7. Read the problem again and ask if students can calculate the total weight of pretzels purchased.
8. Rewrite the weight as partition statements to reflect tenths, hundredths and thousandths. For example:

* the weight of bag one is one tenths + 2 hundredths + 4 thousandths
* the weight of bag 2 is 3 tenths + 7 hundredths + 6 thousandths.

1. Model adding both weights to find the total weight of the pretzels, represented as a non-standard partition and a standard partition. For example, 4 tenths + 9 hundredths + 10 thousandths = 5 tenths.
2. State: ‘When Cat arrived home, she ate some pretzels and repackaged the rest into 2 equal bags. She gave one bag to Andrew.’
3. Ask the following questions:

* How many grams of pretzels might Cat have eaten?
* What is the total weight of the pretzels that remain before repackaging into 2 equal bags?
* What is the weight of each bag after repackaging?

1. Regroup as a class and select students to share their answers.
2. Display [Resource 5 – worded problems](#_Resource_5_–) and read Problem 2 aloud.
3. Provide [Resource 6 – student tasks](#_Resource_6_–) to complete in pairs.
4. Regroup as a class and select pairs to share their answers.

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot solve word problems involving the addition and subtraction of decimals of up to 3 decimal places.   * Provide students with a copy of [Resource 2 – decimal recording sheet](#_Resource_2_–) to support standard partitioning of numbers. Guide students to add and subtract using each place value part, regrouping where necessary. | Students can solve word problems involving the addition and subtraction of decimals of up to 3 decimal places.   * Present the decimal numbers 12.341 kg, 1.121 kg and 1.02 kg. Ask students to compare and order the 3 decimal numbers. Challenge students to write problems for a partner to solve using the 3 given decimal numbers. |

## Consolidation and meaningful practice – 10 minutes

1. Display and read Problem 3 from [Resource 5 – worded problems](#_Resource_5_–).
2. Allow students to work in pairs to find:

* the total weight of both bags when first filled
* the weight of soy crisps Jack needs to remove.

1. Regroup as a class and discuss strategies used.

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students solve multistep word problems, including problems that require more than one operation? **[MAO-WM-01, MA3-AR-01]** * Can students solve word problems involving the addition and subtraction of decimals up to 3 decimal places? **[MAO-WM-01, MA3-AR-01]** * Can students justify why the strategy used to solve addition and subtraction word problems is appropriate? **[MAO-WM-01, MA3-AR-01]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * AdS8, AdS9 * MuS8.   Links to suggested [Interview for Student Reasoning](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/assessment-resources/ifsr) (IfSR) tasks:   * **IfSR-AT:** 4A.1, 4A.2, 4A.3, 4A.4. |

# Lesson 4

**Core concept**: connections can be made between decimals, percentages and fractions.

## Daily number sense – 10 minutes

1. From a class need surfaced through formative assessment data, identify a short, focused activity that targets students’ knowledge, understanding and skills. Example activities may be drawn from the following resources:

* [Mathematics K–6 resources](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/mathematics-curriculum-resources-k-12/mathematics-k-6-resources)
* [Universal Resources Hub](https://resources.education.nsw.gov.au/home).

## Core lesson – decimal, percentage, fraction family – 40 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intention | Core concept success criteria |
| Students are learning to:   * make connections between benchmark fractions, decimals and percentages. | Students can:   * represent common percentages of quantities and lengths as fractions and decimals * recognise that 10% is one-tenth of 100% and use this to find 10% of a quantity. |

This activity is an adaptation of [Spiralling Decimals](https://nrich.maths.org/games/spiralling-decimals) from [NRICH](https://nrich.maths.org/) by the University of Cambridge. In this version, students are using their knowledge of common percentages to estimate and order percentages, decimals and fractions.

1. Write 10% and on the board. Draw an empty number line and ask:

* Using words and this number line, can you show why these 2 representations are equivalent?
* How can of a quantity be found? (divide by 10)
* Can you use this understanding to find 10% of 100, 120 and 80?

1. Remind students that once one fractional part of a number is known such as one-tenth, it can be used to find other fractional parts. For example, two-tenths is equal to double one-tenth, and four-tenths is equal to 4 lots of one-tenth. Ask:

* If of 120 is 12, what would of 120 be?
* What is another way to represent ? (20%, equivalent fractions, 0.2)

1. Explain to students that they will be given a series of related problems, called a problem string. These will help build and apply understanding of using tenths to find percentages of quantities.

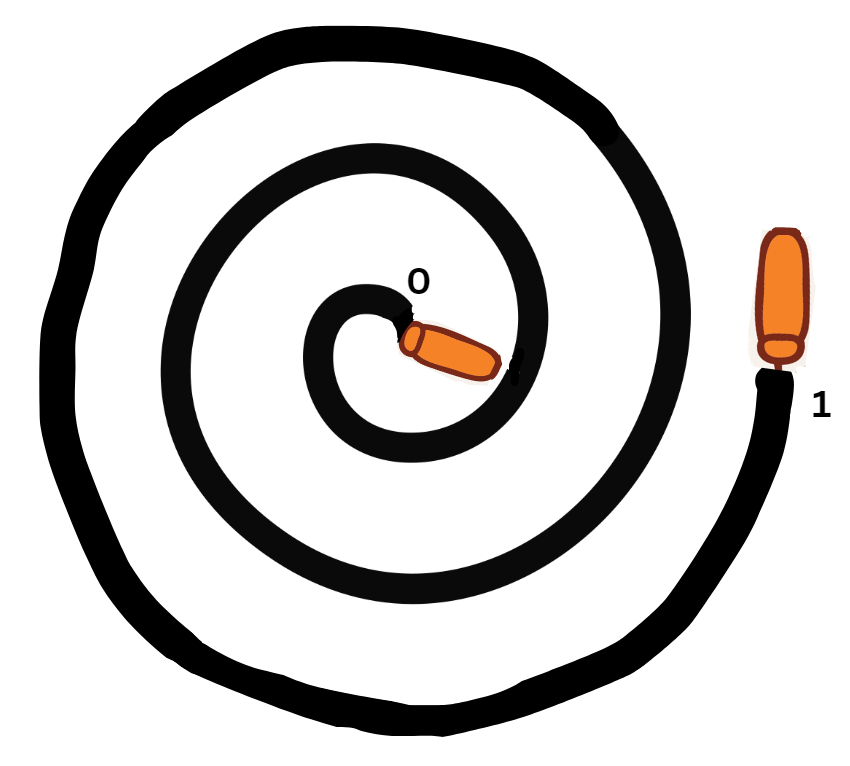
**Note**: a problem string is a series of related problems purposefully sequenced to help students mentally construct mathematical relationships. An illustration of practice, along with identified ‘teacher moves’ and an annotated transcript is available from [Experience the Problem String (14:59)](https://www.mathisfigureoutable.com/ps3-512sticksexperience) from [Math is Figure-out-able](https://www.mathisfigureoutable.com/) by Harris.

1. Ask the following questions to the whole class. Discuss each question and represent student thinking on the board so that new information can be used in the subsequent problems. Draw out the important connections and relationships between percentages and tenths.

* 3 is 100% of what number? (3)
* 3 is 10% of what number? (30)
* What is one-tenth of 30? (3)
* What is 20% of 30? (6)
* 6 is of what number? (30)
* What is 40% of 30? (12)
* What is 50% of 30? (15)
* 15 is of what number? (30)
* What is 90% of 30? (27)

1. Explain that students will be developing their understanding of the size and connections between decimals, fractions and percentages.
2. Place a skipping rope or length of line in a spiral shape on the ground. Place pegs with 0 and 1 at either end (see Figure 2). Remind students that they have used number lines in previous lessons to visualise equivalence between decimals, fractions and percentages.

Figure 2 – spiral example



1. Select students to estimate where benchmark numbers could be placed on the spiral according to their size. Include 50%, 0.1, 90%, 25% and . Students fix their estimates to the line using a peg and paper.
2. Prompt student thinking by asking:

* Is the number bigger or smaller than 50%?
* Is it bigger or smaller than the last number placed on the spiral?
* How do you know the number goes there?
* Is there another number you could place between those 2 numbers?
* What other ways could you represent one of these numbers on the spiral?

1. Ask: ‘How could you check if the numbers have been placed correctly according to their size?’ (unloop the rope and fold it in half to find the middle, or measure the length and divide it)
2. Explain that students will play a game to improve their skill at ordering fractions, decimals and percentages.
3. Display and read [Resource 7 – 'Spirals'](#_Resource_7_–).
4. If required, play an introductory game of teacher against the class to model the activity.
5. Provide pairs of students with a copy of [Resource 7 – 'Spirals'](#_Resource_7_–) in plastic sleeves and 2 different coloured markers.

**Note**: students can find it challenging to visualise the size of benchmark numbers on a spiral. This activity is designed to provide students with a collaborative focus on the magnitude of numbers as they place them. Even though the 2 players are opponents, they can work together to decide where to put their numbers as the game is won by strategically ordering rather than correctly placing numbers.

1. After students have played a few rounds, regroup and ask:

* Can you work out a winning strategy? (Try to get 2 numbers a row, then build at either end.)
* Does it matter who went first?
* Which numbers in the table were most challenging to place?

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot represent common percentages of quantities and lengths as fractions and decimals.   * Students place the benchmark percentages on a straight skipping rope, then spiral the rope. They use the spiral skipping rope as the gameboard for playing a joint game. * Students play the game on a thin strip of paper to represent a straight number line. When they have finished the game, they roll up the strip to make a spiral to see where the numbers appear. | Students can represent common percentages of quantities and lengths as fractions and decimals.   * Students make up a different table of numbers that would make the game more challenging. * If the start number was zero and the end number was 10, would this change the way you play the game? Justify your response. |

## Discuss and connect the mathematics – 10 minutes

1. Write , 0.50 and 50% on the board. Ask:

* What do these representations all have in common? (the digit 5, they can represent a proportion)
* What mathematical symbols can you see that provide clues about the different values of the digits? (decimal point, fraction bar, percent sign)
* Which 2 representations are equal and which is the odd one out? Explain your reasoning and include your understanding of the mathematical symbols.
* What relationship do each of these representations have with 10% or ?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students represent common percentages of quantities and lengths as fractions and decimals? **[MAO-WM-01, MA3-RN-03]** * Can students recognise that 10% is one-tenth of 100% and use this to find 10% of a quantity? **[MAO-WM-01, MA3-RN-03]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * InF7 * PrT2 * UnM8.   Links to suggested [Interview for Student Reasoning](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/assessment-resources/ifsr) (IfSR) tasks:   * **IfSR-PT:** 2A.5, 2A.6, 2A.7, 2A.8. |

# Lesson 5

**Core concept**: mental strategies help estimate percentage discounts.

## Daily number sense – number patterns – 15 minutes

Daily number sense activities for Lessons 5 to 7 ‘loop’ back to concepts and procedures covered in previous units to assist students to build an increasingly connected network of ideas. These concepts may differ from the core concepts being covered by the unit.

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Daily number sense learning intention | Daily number sense success criteria |
| Students are learning to:   * represent and describe number patterns formed by multiples. | Students can:   * describe a pattern formed by multiples in words, in terms of multiplication rather than addition * determine a rule describing the relationship between the bottom number and the top number in a table. |

1. Draw the following table on the board, leaving out the title and row headings (see Table 1).

Table 1 – drawn table

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  | 7 | 14 | 21 | 28 | 35 | 42 | 49 | 56 | 63 | 70 |

1. Select students to identify and share a rule. They apply it to a value not displayed in the table. For example, if the number in the first row is 12, the number in the second row will be 84.
2. Ask students to suggest headings for the rows and justify their suggestions. Possible headings include number of weeks and number of days, number of heptagons and number of sides, number and number multiplied by 7, teams and players for rugby sevens or water polo.
3. Ask the following questions:

* What would the number in the second row be if 240 was in the top row? How did you work out the answer?
* If 308 was the bottom number, what would the top number be? How did you work out your answer?
* How does the table help determine the relationship between the top and bottom rows?

1. Have students create their own tables to describe patterns they identify in daily life, omitting headings and some of the values.
2. Students swap with a peer who can suggest headings and missing values to complete the table.

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students describe a pattern formed by multiples in words, in terms of multiplication rather than addition? **[MAO-WM-01, MA3-MR-01]** * Can students determine a rule describing the relationship between the bottom number and the top number in a table? **[MAO-WM-01, MA3-MR-01]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * NPA4, NPA5. |

## Core lesson – estimating percentage discounts – 35 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intention | Core concept success criteria |
| Students are learning to:   * determine percentage discounts of 10%, 25% and 50%. | Students can:   * use mental strategies to estimate discounts of 10%, 25% and 50% * calculate the sale price of an item after a discount of 10%, 25% and 50%. |

This lesson revisits content covered in [Stage 3 Year B Unit 31](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/mathematics-curriculum-resources-k-12/mathematics-k-6-resources/mathematics-stage-3-year-b-unit-31). The ‘Arcade zone’ game is an adaptation of [Playzone Discount](https://newzealandcurriculum.tahurangi.education.govt.nz/playzone-discount/5637202338.p) from [New Zealand Curriculum Online](https://newzealandcurriculum.tahurangi.education.govt.nz/) by the New Zealand Ministry of Education. In this version, students use their knowledge of benchmark numbers to calculate and apply discounts.

1. Students [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) about the different contexts percentages that can be found in daily life, for example, battery life, download percentage, health in a game, discounts, weather predictions, GST on receipts and so on.
2. Display [Resource 8 – gift card](#_Resource_8_–). Remind students that they are looking for efficient strategies for Anna to solve the problem rather than calculating an answer. Read and discuss the question prompts.
3. Ask the following questions:

* What is the question asking you?
* What information do you need?
* What steps do you need to take to solve this problem? (find 25% of the total price, subtract this amount from the total price to find the discounted price, check if the discounted price is greater or less than $45, or work out what 100% would be if 45 is 75% and compare to total price)
* What do you know about 25% that would help you start? (it means 25 out of 100 or 25 hundredths, 0.25, one-quarter)
* What are some mental strategies to find 25% or one-quarter of a whole amount? (divide the whole by 4, find the half of one-half, find one-tenth and multiply it by 2 and a half)

**Note**: as is standard in Australia, prices should be rounded to the nearest 5c to find the purchase price. Students are required to undertake the rounding process before finding percentage discounts.

1. Explain that students will [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) to try and solve the problem in [Resource 8 – gift card](#_Resource_8_–) using mental strategies.
2. Regroup as a class to share answers and strategies.
3. Ask students to recall and discuss a range of strategies for estimating and calculating other percentage amounts such as 50% and 10%.
4. Draw a number line and ask students to show the equivalent values of the percentages as fractions (see Figure 3).

Figure 3 – number line

A double number line labelled ‘percentage’ on the top and ‘fraction’ on the bottom.

The top of the number line has labels for 0, 25, 75 and 100 percent.

The bottom of the number line has labels for zero, one-tenth, three-tenths and one-half.

1. Display [Resource 9 – 'Arcade zone'](#_Resource_9_–). Explain that ‘Arcade zone’ is played in pairs. Students calculate percentage discounts and use a winning strategy to connect 4 in a row on the gameboard.
2. Students use mental strategies to estimate discounts. Ask:

* Which ‘Arcade zone’ game would be easiest to estimate? (Blitz, as it is $99.99)
* How much would a 50% discount of Blitz be? ($50)
* What about the other discounts?
* What other relationships between discounts and prices can you see?
* How can these support your mental strategies to calculate other discount amounts? (For example, 3 lots of 10% is 30% and 3 lots of 25% is 75%)

1. Group students into pairs and provide them with one copy of [Resource 9 – 'Arcade zone'](#_Resource_9_–) and counters to play the game.

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot calculate the sale price of an item after a discount of 10%, 25% and 50%.   * Students make a table showing discount amounts for each of the ‘Arcade zone’ games that they can refer to during the game. * Students use a 3 × 3 grid board and start with games costing multiples of $100. | Students can calculate the sale price of an item after a discount of 10%, 25% and 50%.   * Develop a table of prices for discount problems using percentages other than multiples of 10%, 25% and 50%. * Students discuss and test strategies which would ensure they always win the game. |

## Discuss and connect the mathematics – 10 minutes

1. Regroup as a class and ask:

* Why is it important to have mental strategies to work out discounts and apply them?
* What are the most important steps in working out how much something costs when a discount is applied?
* Do you prefer to think about proportions as fractions, decimals or percentages? Why?

1. Pose the question: ‘We have learned 3 different ways to talk about proportions of quantities. When would it be more likely to use one than the other, for example, more likely to use a percentage than a fraction?’ (Percentages are typically used to compare, for example, 50% cheaper or 50% faster. Fractions are often used in cooking, such as half a cup or a quarter kilo. Decimals are often used when precision is required, for example, 0.5 mm thick, 1.42 m wide or 18.7 km).

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students use mental strategies to estimate discounts of 10%, 25% and 50%? **[MAO-WM-01, MA3 RN-03]** * Can students calculate the sale price of an item after a discount of 10%, 25% and 50%? **[MAO WM-01, MA3-RN-03]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * InF7 * PrT2 * UnM8.   Links to suggested [Interview for Student Reasoning](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/assessment-resources/ifsr) (IfSR) tasks:   * **IfSR-PT**: 2A.1. |

# Lesson 6

**Core concept**: estimating helps when multiplying decimals.

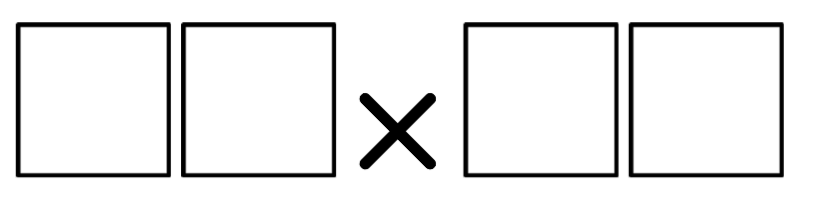
## Daily number sense – closest product – 15 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Daily number sense learning intention | Daily number sense success criteria |
| Students are learning to:   * select and apply strategies to solve problems involving multiplication and division with whole numbers. | Students can:   * select and use efficient strategies to multiply whole numbers of up to 4 digits by one- and 2-digit numbers. |

1. Draw 2 boxes multiplied by 2 boxes on the board (see Figure 4).

Figure 4 – closest product



1. Tell students they will be placing the digits 1–9 in each box to find the closest product to 500. Once a digit has been used, it cannot be used again.
2. Provide some thinking time. Students [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) their digits for the boxes and explain their strategy and reasoning.

**Variation**: students draw 4 empty boxes multiplied by 2 empty boxes. Explain that the target product is now 50 000. Students report back on their closest product and discuss their reasoning. If not elicited, draw students’ attention to using powers of 10 to simplify their placement of digits.

This table details an opportunity for assessment.

|  |  |
| --- | --- |
| Assessment opportunity | Links |
| What to look for:   * Can students select and use efficient strategies to multiply whole numbers of up to 4 digits by one- and 2-digit numbers?  **[MAO-WM-01, MA3-MR-01]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * MuS7, MuS8. |

## Core lesson 1 – multiplying decimals – 20 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intention | Core concept success criteria |
| Students are learning to:   * multiply and divide decimals by powers of 10. | Students can:   * use mental strategies to multiply benchmark decimals by single-digit numbers * compare the relative place value of digits to multiply and divide a decimal by powers of 10 * estimate the product of a decimal and a whole number to determine the magnitude of a calculator answer. |

This activity is an adaptation of ‘Shortcuts when multiplying numbers with decimal parts’ from Challenging Mathematical Tasks by Sullivan.

**Note**: a ‘problem string’ is a series of related problems purposefully sequenced to help students mentally construct mathematical relationships. An illustration of practice, along with identified ‘teacher moves’ and an annotated transcript, is available on [Experience the Problem String (14:59)](https://www.mathisfigureoutable.com/ps3-512sticksexperience) from [Math is Figure-out-able](https://www.mathisfigureoutable.com/) by Harris.

1. Provide students with individual whiteboards and markers.
2. Display the statement: 21 × 7 = 147. Use a [think aloud](https://evidenceforlearning.org.au/news/planning-a-think-aloud-in-mathematics) or ask students to confirm why it is correct.
3. Explain that students will use this information to work out the answers to a problem string. Describe a problem string to students as a series of related problems. Each answer should help students approach the next problem.
4. Display 21 × 0.7*.* Use a think aloud to model how to use the information from the original statement to solve this. For example, ‘I know that 0.7 is one-tenth of 7, so the answer will be one-tenth of 147, which is 14.7’. Another example might be ‘0.7 is equivalent to 7 ÷ 10, so the answer will be 147 ÷ 10, which is 14.7’.
5. Select students to share any patterns that they notice. If necessary, model a second example.
6. Display each of the following statements, one at a time in the order below, for students to record an answer.

* 21 × 0.07
* 2.1 × 7
* 0.7 × 2.1
* 0.7 of 2.1
* 22 × 7
* 2.2 × 7.

1. Select students to share a response with reasoning.
2. Record student responses for each statement so that new information can be used in the subsequent problems.

The table below outlines stimulus prompts to generate conversation about the topic, along with anticipated responses from students.

|  |  |
| --- | --- |
| Prompts | Anticipated student responses |
| 21 × 0.07 | * 0.07 is one hundred times smaller than 7. 1.47 is one hundred times smaller than 147. * 0.07 is equivalent to 7 ÷ 100, so the answer would be 147 ÷ 100, which is 1.47. |
| 2.1 × 7 | * 2.1 is one-tenth of 21, so the answer will be 14.7 because that is one-tenth of 147. * 2.1 is equivalent to 21 ÷ 10, so the answer would be 147 ÷ 10, which is 14.7. * A tenth is a benchmark fraction. One-tenth of 7 is 0.7. So, using the distributive property, it would be 14 + 0.7 = 14.7. |
| 0.7 × 2.1 | * Both numbers are equivalent to the original numbers, each divided by 10. Dividing by 10 and then 10 again makes a number 100 times smaller, which is 1.47 |
| 0.7 of 2.1 | * ‘Of’ means the same as multiplication, so it’s the same as the last answer. |
| 22 × 7 | * This is one more 7 than 21 × 7, so it is 154. |
| 2.2 × 7 | * 2.2 is 10 times smaller than 22, so the answer will also be 10 times smaller which is 15.4. |

1. Students [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) to discuss another 2 items that could be added to this problem string. Ask:

* How are your new problems related to previous items in the problem string?
* How can you use responses from previous problems to help you solve these problems?

1. For a second problem string, remind students of the benchmark decimals 0.25, 0.5 and 0.75. Then choose one of the following:

* ask students to write their own problem string based on 25 ÷ 10 = 2.5
* guide students through a different sequence using benchmark decimals such as
* 25 ÷ 10 = 2.5
* 25 ÷ 100
* 0.25 × 2
* 0.25 × 4
* 2.5 × 4
* 2.25 × 4
* 2.25 × 8
* 2.75 × 8
* 27.5 × 80.

## Core lesson 2 – reasonable estimates – 20 minutes

This activity is an adaptation of ‘Hit the target: Continuous input’ from Primary and Middle Years Mathematics: Teaching Developmentally by Van de Walle et al.

**Note**: student estimation of products is essential in building a deeper understanding of multiplying decimals. A key consideration in estimating is using whole numbers to estimate the multiplication of fractions, decimals and percentages. For example, ‘for 5.91 × 6.1, a student might reason: “This is about 6 times 6, so the product will be about 36”’ (Van de Walle et al. 2019:422–423).

1. Explain that students will play a calculator game that focuses on reasonable estimates when multiplying decimals.
2. Display and read the instructions and variations on [Resource 10 – 'Hit the target'](#_Resource_10_–).
3. Play a whole class game using an interactive calculator, such as the [4-Function Calculator](https://www.desmos.com/fourfunction?lang=en-GB).
4. Decide on a target number and a starting number. Ask:

* What would be an estimate that is much too large?
* What would be an estimate that is much too small?
* How can you adjust these estimates to make them closer to the target?

1. Use the [think aloud](https://evidenceforlearning.org.au/news/planning-a-think-aloud-in-mathematics) strategy to model rounding, multiplying by powers of 10, estimating using whole numbers and reasoning.
2. Students [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) their ideas for their own estimates. Ask:

* What is your estimate? How did you make that estimate?
* Does anyone have a different suggestion? Why?

1. Record each step of the game. For example:
2. Target number: 178
3. Starting number: 5.3
4. Player 1: 5.3 × 30 = 159 (19 away from the target)
5. Player 2: 5.3 × 35 = 185 (7.5 away from the target)
6. Player 3: 5.3 × 36 = 190.8 (12.8 away from the target)
7. Player 2 wins a point and explains their estimating strategy.
8. Display [Resource 10 – 'Hit the target'](#_Resource_10_–). Provide groups of students with calculators and writing materials.
9. Students play ‘Hit the target’, recording the steps for each game that they play.

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot multiply and divide decimals by powers of 10.   * Provide students with the statement: 21 × 7 = 147. Vary the number string to include multiples of each number, without using decimals. For example, 210 × 7 = 1470 or 210 × 70 = 1470. Then introduce decimal multiplication. * Provide students with a calculator and a copy of [Resource 11 – multiplication chart](#_Resource_11_–). Guide students to complete the missing parts on the chart and identify any patterns. Use the patterns to estimate the multiplication of other numbers by benchmark decimals. | Students can multiply and divide decimals by powers of 10.   * Students select any 2-digit by 2-digit whole number fact, such as 18 × 15 is 270. Students write their own problem string related to that number fact for other students to work through. * Explain that you are thinking of 2 numbers whose product is 60. At least one of the numbers is a decimal number. What might the numbers be? Students provide at least 5 different responses. |

## Discuss and connect the mathematics – 10 minutes

1. After playing ‘Hit the target,’ ask:

* Who had an estimate that was a long way off the target?
* What can make it difficult to estimate when multiplying with decimals?
* Who had an estimate that was very close to the target?
* What strategies did you use to estimate accurately?
* How can knowledge of whole number multiplication help make reasonable estimations?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students use mental strategies to multiply benchmark decimals by single-digit numbers? **[MAO-WM-01, MA3-MR-01]** * Can students compare the relative place value of digits to multiply and divide a decimal by powers of 10? **[MAO-WM-01, MA3-MR-01]** * Can students estimate the product of a decimal and a whole number to determine the magnitude of a calculator answer? **[MAO-WM-01, MA3-MR-01]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * NPV8 * MuS9.   Links to suggested [Interview for Student Reasoning](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/assessment-resources/ifsr) (IfSR) tasks:   * **IfSR-MT:** 4A.1, 4A.2, 4A.3, 4A.4, 4A.5, 4A.6, 4A.7. |

# Lesson 7

**Core concept**: the order of operations includes grouping symbols.

## Daily number sense – ‘Dice division’ – 15 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Daily number sense learning intention | Daily number sense success criteria |
| Students are learning to:   * represent and solve division problems with whole number remainders. | Students can:   * use known multiplication fact families to solve division problems for which answers may include a remainder * use the term quotient to describe the result of a division calculation. |

This lesson is an adaptation from [Damult Dice Division](https://mathforlove.com/2019/11/damult-dice-division/) from [Maths for Love](https://mathforlove.com/) by Finkel and Cook and [Remainders](https://nrich.maths.org/problems/remainders) from NRICH by the University of Cambridge. It revisits content covered in [Stage 3 Year B Unit 27](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/mathematics-curriculum-resources-k-12/mathematics-k-6-resources/mathematics-stage-3-year-b-unit-27).

1. Present a division problem such as 48 ÷ 5.
2. Ask students which multiplication fact they might use to help solve it. Identify the quotient and the remainder.
3. Display and read [Resource 12 – ‘Dice division’ instructions](#_Resource_12_–).
4. Provide students with 3 dice and a copy of [Resource 13 – ‘Dice division’ gameboard](#_Resource_13_–).
5. Students play the game and record each calculation and score.

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students use known multiplication fact families to solve division problems for which answers may include a remainder? **[MAO-WM-01, MA3-MR-01]** * Can students use the term quotient to describe the result of a division calculation? **[MAO-WM-01, MA3-MR-01]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * MuS6, MuS7, MuS8 * NPA3, NPA4.   Links to suggested [Interview for Student Reasoning](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/assessment-resources/ifsr) (IfSR) tasks:   * IfSR-MT: 3A.6, 3A.7, 3A.8, 3A.9, 3A.10. |

## Core lesson 1 – brackets matter – 20 minutes

The table below contains a suggested learning intention and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intention | Core concept success criteria |
| Students are learning to:   * explore the use of brackets and the order of operations to write number sentences. | Students can:   * recognise the need to agree on the order in which to perform operations * investigate the order of operations using real-life contexts * solve problems involving grouping symbols. |

**Note**: the Mathematics K–10 Syllabus Stage 3 [Teaching advice for Multiplicative relations B: Order of operations](https://curriculum.nsw.edu.au/learning-areas/mathematics/mathematics-k-10-2022/content/stage-3/fa1ff4d43b?show=advice) elaborates on the need for the order of operations convention. The advice states: ‘Mnemonics like BOMDAS, BIDMAS or PEMDAS are often misleading as they suggest an absolute order between addition (A) and subtraction (S) or multiplication (M) and division (D).

A further limitation is that the second term in the mnemonic corresponding to powers and roots (Orders, Indices or Exponents) is taught in the Stage 4 curriculum.

Students can be supported in understanding the conventions by constructing anchor charts or using drawings or sentences to assist in recalling the agreed-upon order’ (NESA 2022b).

1. Display an incorrect equation using addition, division and brackets such as 4 + 8 ÷ 2 = (4 + 8) ÷ 2.
2. Ask if the statement is true or false.
3. Students [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) a response.
4. Select students to explain their responses.
5. Remind students of the need for the order of operations convention. If needed, co-construct an anchor chart of the order.
6. Display [Resource 14 – delicious discounts](#_Resource_14_–).
7. Ask students to explain whether the character is correct in using order of operations to justify their response.

The table below outlines stimulus prompts to generate conversation about the topic, along with anticipated responses from students.

|  |  |
| --- | --- |
| Prompts | Anticipated student responses |
| * What is the discount for buying 10 packets, one at a time? | * If the price was $5.00 a bag, the discounted price would be $2.50 each. 10 packets would cost $25. |
| * What is the discount for buying all 10 packets at once? | * 10 bags would cost $50. Half price would mean that you pay $25. |
| * How can these scenarios be represented using order of operations? | * 50% is the same as halving. Halving is the same as dividing by 2 or multiplying by 0.5. * It does not matter what order you do multiplication and division in. You will still get the same answer. * $5 × 10 ÷ 2 = $5 ÷ 2 × 10. |

1. Display and read [Resource 15 – party supplies](#_Resource_15_–). Discuss the imprecise meaning of the word ‘most’.
2. Ask the following questions:

* How many vegetarians might there be?
* How can we use brackets to help calculate the total number of snacks needed?

1. For 11 non-vegetarians, model how to represent the total number of snacks with and without brackets.

* 11 × 4 + 11 × 3 + 9 × 6
* 11 × (4 + 3) + 9 × 6.

1. Ask the following questions:

* Are brackets needed? Why or why not?
* How does the bracket affect the order of operations?
* Do the brackets make the calculations easier? Why or why not?

1. In pairs, students write number sentences for at least 2 of the other snack options.
2. Students determine the most and the least number of snacks required.

## Core lesson 2 – ‘Closest to x’ – 20 minutes

This lesson is an adaptation of ‘Closest to x’ from Unpacking game mechanics: Five types of whole-class mathematical games by Russo and Russo. In this version, students know all 5 numbers prior to calculating, removing the element of chance when placing numbers.

1. Provide students with an individual whiteboard and markers.
2. Draw up an empty equation that includes more than one operator, brackets and 5 blank spaces. An example might be: (\_\_ + \_\_) × \_\_ − \_\_ + \_\_ = ?
3. Students copy the empty equation on their board.
4. Choose a target number.
5. Roll a 10-sided dice, 5 times, recording each roll on the board.
6. Students allocate the numbers rolled to calculate a total closest to the target number. Monitor for the correct use of the order of operations.
7. Share and compare student solutions.
8. Design a new board and repeat with a new target number.
9. After the second whole-class game, students make small groups of 4 to construct their own gameboards. Groups select their own target number and play using their own dice.
10. Variations include:

* making the target number the highest number or smallest number possible from the 5 numbers rolled
* reducing or increasing the number of blank spaces
* changing the number and type of operations included, such as addition and subtraction only.

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot solve problems involving grouping symbols.   * Guide students to solve an equation that uses multiplication and addition only, such as 3 × 4 + 6 = 18. Use brackets and solve 3 × (4 + 6) = 30. Repeat with a range of similar equations to establish the effect of the brackets. * Vary the rules for ‘Closest to x’ so that students use the order of operations without brackets. With a completed gameboard, use a calculator to investigate what effect one set of brackets has on the calculations. | Students can solve problems involving grouping symbols.   * For [Resource 15 – party supplies](#_Resource_15_–), students use a digital device to determine prices for each item. Students use the prices to calculate the minimum and maximum cost of hosting the party. * Vary the rules for ‘Closest to x’ so that students use multi-digit numbers or decimal numbers. |

## Discuss and connect the mathematics – 10 minutes

1. Select students from different groups to share a gameboard from ‘Closest to x’ in [Core lesson 2](#_Core_lesson_2).
2. Record 2 boards that have brackets for students to see and label the gameboards ‘A’ and ‘B’.
3. Ask the following questions:

* In what ways are they similar and different?
* What is the order of operations?
* What effect do the brackets have on the order of operations?

1. Write 5 single-digit numbers on the board.
2. Students use Gameboard A to calculate any total. Record all the different totals on the board.
3. Students use Gameboard B to try to match any of the totals from Gameboard A.
4. Select students who could find a match (or a close match) to share the calculations.

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students recognise the need to agree on the order in which to perform operations? **[MAO-WM-01, MA3-MR-01, MA3-MR-02]** * Can students investigate the order of operations using real-life contexts? **[MAO-WM-01, MA3-MR-01, MA3-MR-02]** * Can students solve problems involving grouping symbols? **[MAO-WM-01, MA3-MR-01, MA3-MR-02]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * NPA5. |

# Lesson 8

**Core concept**: coordinates define the point on a number plane.

## Daily number sense – 10 minutes

1. From a class need surfaced through formative assessment data, identify a short, focused activity that targets students’ knowledge, understanding and skills. Example activities may be drawn from the following resources:

* [Mathematics K–6 resources](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/mathematics-curriculum-resources-k-12/mathematics-k-6-resources)
* [Universal Resources Hub](https://resources.education.nsw.gov.au/home).

## Core lesson – Cartesian plane – 40 minutes

The table below contains suggested learning intentions and success criteria. These are best co-constructed with students.

|  |  |
| --- | --- |
| Core concept learning intentions | Core concept success criteria |
| Students are learning to:   * explore the Cartesian coordinate system * use the 4 quadrants of the coordinate plane. | Students can:   * recognise that the grid-map reference system gives the area of a location and the number plane identifies a specific point * identify and record the coordinates of given points on the number plane in all 4 quadrants. |

This lesson builds on concepts covered in [Stage 3 Year A Unit 8](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/mathematics-curriculum-resources-k-12/mathematics-k-6-resources/mathematics-stage-3-year-a-unit-08) and [Stage 3 Year B Unit 28](https://education.nsw.gov.au/teaching-and-learning/curriculum/mathematics/mathematics-curriculum-resources-k-12/mathematics-k-6-resources/mathematics-stage-3-year-b-unit-28). The game ‘Snakes on a Cartesian Plane’ is adapted from an activity formerly on the [reSolve](https://resolve.edu.au/) website by the Australian Academy of Science.

1. Display the [Demonstrate Coordinates](https://www.teacherled.com/2015/05/07/demonstrate-coordinates-3/) interactive tool, showing all 4 quadrants.
2. Students [turn and talk](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/numeracy/talk-moves) to share what they know about the Cartesian plane. Select students to share their responses.
3. Students or players use the [Demonstrate Coordinates](https://www.teacherled.com/2015/05/07/demonstrate-coordinates-3/) interactive tool to position counters in various places on the plane.
4. Cover the coordinate pairs using the red sliders to check for student understanding that the:

* Cartesian plane is formed by 2 number lines that intersect at right angles at zero
* number lines include negative integers
* origin is (0, 0)
* correct recording of ordered pairs, describes the horizontal position first, followed by the vertical position
* ordered pairs represent a point at the intersection of the lines, not an area
* brackets are used to group the pairs.

1. Explain that students will play a game where each player creates a snake on the Cartesian plane. The aim of the game is to capture the other player’s snake by intersecting with the head of their opponent’s snake (see Figure 5).

Figure 5 – ‘Snakes on a Cartesian plane’

A Cartesian plane with a blue line and an orange line drawn to represent the snakes of players in the game called ‘Snakes on a plane’.

The blue line starts at −4, 6. It travels through 10 points before intersecting the orange line at 4, −3.

The orange line starts at −4, −6. It travels through 9 points before intersecting with the blue line at 4, −3.

1. Each player starts at a chosen position in a different quadrant, drawing a dot and labelling this coordinate.
2. Student A draws a line from their starting point to a new position within 3 units of the previous coordinate (lengthening the snake in a single direction). They label the coordinate at their new position and Student B checks it.
3. Student B then has their turn.
4. Each student takes turns lengthening their snake and labelling the new coordinates.
5. Provide pairs of students with [Resource 16 – Cartesian plane](#_Resource_16_–).
6. Allow time for students to play the game twice.

This table details opportunities for differentiation.

|  |  |
| --- | --- |
| Too hard? | Too easy? |
| Students cannot identify and record the coordinates of given points on the number plane in all 4 quadrants.   * Provide students with a digital device to access the [Demonstrate Coordinates](https://www.teacherled.com/2015/05/07/demonstrate-coordinates-3/) interactive tool in one or 2 quadrants. Students to place 2 dots in adjacent positions. Support students to identify patterns in how coordinates change for items in different positions. * Provide students with a digital device to access the [Show The Coordinate](https://www.teacherled.com/2015/05/05/show-the-coordinate/) interactive tool. Students identify and record coordinates in one or 2 quadrants. Support students to identify patterns in how coordinates change for items in different positions. | Students can identify and record the coordinates of given points on the number plane in all 4 quadrants.   * Students plot snake locations that involve benchmark decimals, for example, (1.5, 3.25) and justify the accuracy of each location. * Students play ‘Snakes on a Cartesian plane’ in groups of 3 or they can play using set criteria, for example, ‘Your snake must visit all 4 quadrants before catching another player.’ |

## Discuss and connect the mathematics – 10 minutes

1. As a class, discuss:

* What did you consider when labelling the coordinates?
* Did you notice a pattern in how the coordinates changed when moving your snake horizontally compared to vertically?
* What did you notice about the coordinates when you crossed into a new quadrant?

This table details opportunities for assessment.

|  |  |
| --- | --- |
| Assessment opportunities | Links |
| What to look for:   * Can students recognise that the grid-map reference system gives the area of a location and the number plane identifies a specific point? **[MAO-WM-01, MA3-GM-01]** * Can students identify and record the coordinates of given points on the number plane in all 4 quadrants? **[MAO-WM-01, MA3-GM-01]** | Links to [National Numeracy Learning Progressions](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (NNLP):   * n/a. |

# Resource 1 – elevator challenge cards

Number line, gameboard and cards for the game ‘Elevator challenge’, with a dotted line to the left of the Elevator cards for cutting. The cards align with the same locations and positions on the gameboard.

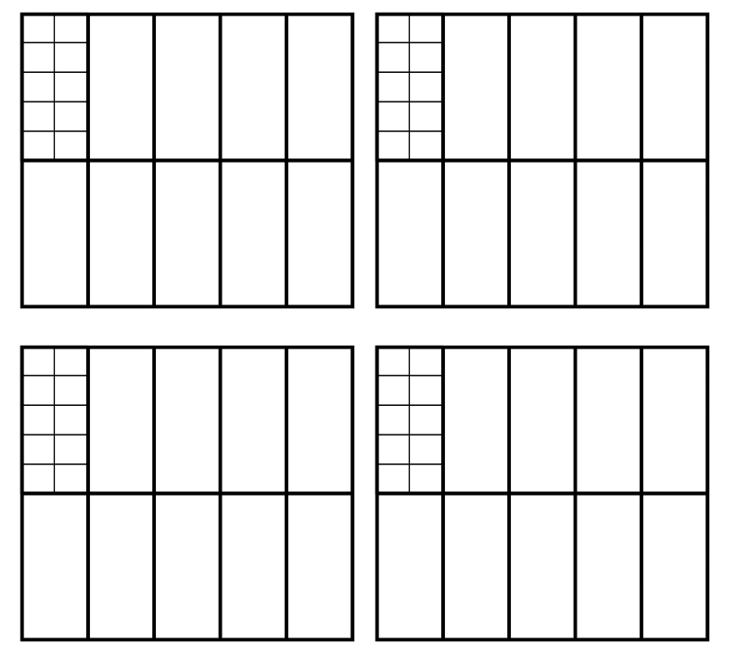
The floors on the gameboard and elevator cards are as follows: Floor 6: Pool, Floor 5: Spa, Floor 4: Restaurant, Floor 3: Guest rooms, Floor 2: Business centre, Floor 1: Café, Floor 0: Lobby, Floor −1: Gym, Floor −2: Car park, Floor −3: Kitchen, Floor −4: Laundry, Floor −5: Deliveries, Floor −6: Storage.


# Resource 2 – decimal recording sheet

Four blank card templates with a decimal marker after the first card.

The 4 suits from a standard deck of playing cards are represented under each blank card template for place value – spades for the ones place, hearts for tenths, diamonds for hundredths and clubs for thousandths.

# Resource 3 – 4 decimats



# Resource 4 – seasonal sales

A collection of objects on seasonal sales. There are percentage discounts next to each of the item with its original cost.

The following items are 10% off: Wireless earphones was $125, Laptop was $1235 and Digital Watch was $215.

The following item is 50% off: Multi Games Pack was $67.

The following items are 25% off: Electro Box was $885 and a Glow Bike was $455.

# Resource 5 – worded problems

**Problem 1**:

Cat went into her local supermarket and bought a bag of pretzels from the self-serve scoop-and-pay counter. It weighed 0.124 kg. She decided to buy a bag of pretzels for her friend Andrew. The second bag weighed 0.376 kg.

**Problem 2**:

Cat went into her local supermarket the next day and bought a bag of dried mango slices from the self-serve scoop-and-pay counter. It weighed 0.234 kg. She bought an additional bag for her friend Andrew. The second bag weighed 0.452 kg.

When she arrived home, she ate 2 slices from the heaviest bag. She weighed that bag again to realise she had eaten 0.086 kg.

**Problem 3**:

Jack stopped by the supermarket to purchase 2 bags of soy crisps. He wanted both bags to weigh 1.25 kg altogether. He filled both bags separately. The first bag weighed 0.521 kg. The second bag weighed 0.862 kg. He realised that he had too much and needed to remove some.

# Resource 6 – student tasks

Read Problem 2 from [Resource 5 – worded problems](#_Resource_5_–) and complete the following tasks:

1. Record the weight of each bag of dried mango slices.
2. Calculate the total weight of dried mango slices before Cat arrived home.
3. Calculate the difference in weight between the bags before Cat arrived home.
4. Calculate the total weight of dried mango slices after Cat had eaten 2 slices.
5. Calculate the difference in weight between both bags after Cat had eaten 2 slices

# Resource 7 – ‘Spirals’

**Instructions**:

1. Take turns to choose a number from the grid below and mark it on the spiral. Make sure you know where 0 and where 1 is!
2. Keep taking turns until one of you has marked 3 consecutive numbers on the spiral.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 50% | 25% | 75% |  | 0.33 |  | 0.99 | 0.999 |
|  | 0.01 | 0.05 | 0.79 | 60% | 0.341 | 0.54 | 0.865 |

A black line arranged into a spiral. 

The end of the line at the centre of the spiral is labelled zero. 

The other end of the line is labelled one.

# Resource 8 – gift card



Anna has a $45 gift card for a shop. She found out the shop has a sale of 25% off, store-wide.

The computer game she wants sells for $59.99 at full price.

Can she pay for the game with her gift card?

Answer the following questions:

* What is this problem about?
* What do you know?
* What problems have you solved that are similar?
* Where can you begin?
* What patterns or relationships can you see that could help you?

# Resource 9 – ‘Arcade zone’

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Arcade zone game** | **Exotic raiders** | **Blitz** | **Metal strike** | **Team pro** | **Lightning** | **Sound barrier** |
| **Price** | $39.99 | $99.99 | $119.99 | $1199.99 | $149.99 | $599.99 |

|  |  |
| --- | --- |
| Four discount stickers showing 30%, 10%, 50%, 25% and 75%.  **How to play**   1. **Choose a game to buy and a discount code.** 2. **Apply the discount and find the price of your game on the board.** 3. **If the price is already taken, skip a turn. If not, place a counter on it.** 4. **The first player to get 4 counters in a row wins.** | A selection of prices for students to match to their chosen game and discount. |

# Resource 10 – ‘Hit the target’

1. Players agree on a **target number** less than 1000, for example, 178.
2. Players agree on a **starting number** less than 10 with one decimal place, for example, 5.3.
3. Players **estimate** a whole number to **multiply** the starting number by to hit the target.
4. Players use a calculator to multiply the starting number by their estimate.
5. The player who is the closest to the target number wins a point.
6. The winner explains their estimating strategy to the other players.
7. Repeat with a new target and starting number.

**Variations**

* Limit the decimals to benchmarks of 0.1, 0.25, 0.5 and 0.75
* Widen or narrow the range for the target number
* Use a starting number or a target number smaller than one

# Resource 11 – multiplication chart

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Benchmark fraction | Equivalent decimal | × | 2 | 4 | 8 | 10 | 100 | 1000 |
| One-tenth | 0.1 | × |  |  |  |  |  |  |
| One-quarter | 0.25 | × |  |  |  |  |  |  |
| One-half | 0.5 | × |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |

# Resource 12 – ‘Dice division’ instructions

1. Take turns to be the roller. Roll 3 dice.
2. Using the numbers rolled, everyone writes down a division problem formed by making a 2-digit number and dividing by the third number.
3. Solve the division problem and leave your answer in the remainder form.
4. Your score is the quotient. You get a +10-point bonus if there is no remainder when you perform the division.
5. Players reveal their responses. If 2 or more players write down the same equation, they score zero points.
6. The winner is the first to 150 points.

**Note**: If 2 players have the same equation, they each score zero!

**Examples**: If I roll 2, 5 and 6, some possibilities are:

|  |  |
| --- | --- |
| * 62 ÷ 5 = 12, r2: 12 points | * 25 ÷ 6 = 4, r1: 4 points |
| * 65 ÷ 2 = 32, r1: 32 points | * 26 ÷ 5 = 5, r1: 5 points |
| * 56 ÷ 2 = 28, plus the 10-point bonus is 38 points! | * 52 ÷ 6 = 8, r4: 8 points |

# Resource 13 – ‘Dice division’ gameboard

|  |  |  |  |
| --- | --- | --- | --- |
| Division equation | Score | No remainder bonus (+10) | Total so far |
| ****65 ÷ 5 = 13**** | 13 | 10 | 23 |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
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|  |  |  |  |
|  |  |  |  |

# Resource 14 – delicious discounts

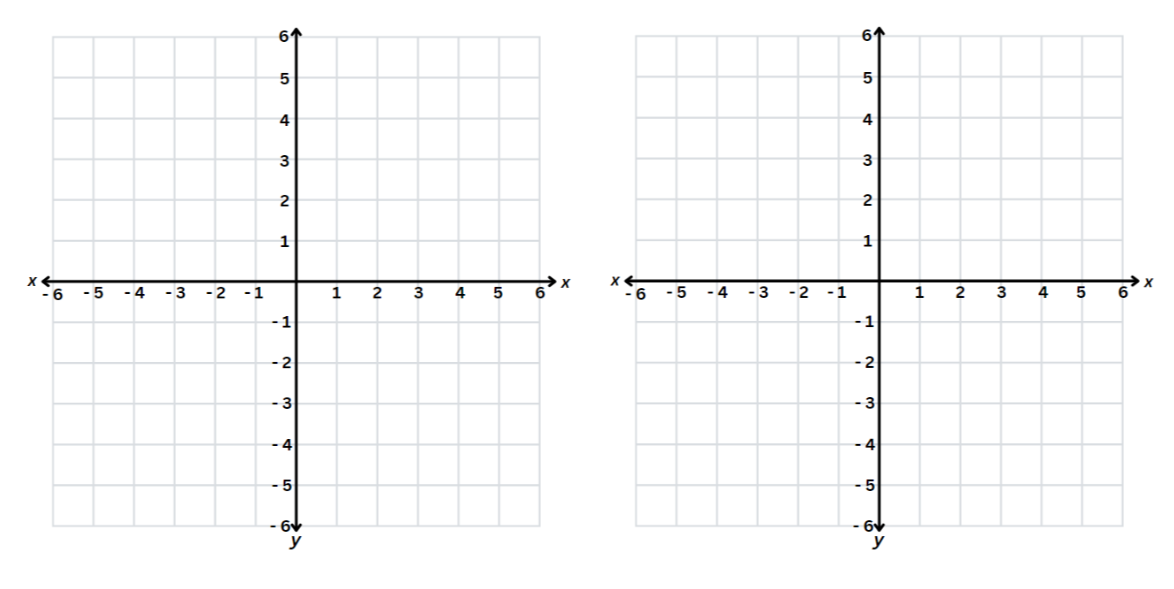
A packet of chips on sale for 50% off.

A person says: These chips are normally $5 a bag. I need 10 packets for my party. I’ll save more if I buy them one at a time, than if I buy all 10 at once.

# Resource 15 – party supplies



# Resource 16 – Cartesian plane



# Syllabus outcomes and content

The table below outlines the [syllabus outcomes](https://curriculum.nsw.edu.au/learning-areas/mathematics/mathematics-k-10-2022/overview) and range of relevant syllabus content covered in this unit. Content is linked to [National Numeracy Learning Progression](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) (version 3).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcomes and content | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| **Represents numbers A**: Decimals and percentages: Compare, order and represent decimals  **MAO-WM-01, MA3-RN-01, MA3-RN-02** |  |  |  |  |  |  |  |  |
| * Compare and order decimal numbers of up to 3 decimals |  | x |  |  |  |  |  |  |
| * Interpret zero digit(s) at the end of a decimal |  | x |  |  |  |  |  |  |
| * Approximate the size of decimals |  | x |  |  |  |  |  |  |
| * Place decimal numbers of up to 3 decimal places on a number line |  | x |  |  |  |  |  |  |
| **Represents numbers B:** Whole numbers: Locate and represent integers on a number line  **MAO-WM-01, MA3-RN-01** |  |  |  |  |  |  |  |  |
| * Recognise the location of negative whole numbers in relation to zero and place them on a number line | x |  |  |  |  |  |  |  |
| * Recognise that negative whole numbers can result from subtraction (Reasons about quantity) | x |  |  |  |  |  |  |  |
| **Represents number B**: Decimals and percentages: Make connections between benchmark fractions, decimals and percentages  **MAO-WM-01, MA3-RN-03** |  |  |  |  |  |  |  |  |
| * Represent common percentages of quantities and lengths as fractions and decimals |  |  |  | x |  |  |  |  |
| * Recognise that 10% is one-tenth of 100% and use this to find 10% of a quantity (Reasons about relations) |  |  |  | x |  |  |  |  |
| **Represents number B**: Decimals and percentages: Determine percentage discounts of 10%, 25% and 50%  **MAO-WM-01, MA3-RN-03** |  |  |  |  |  |  |  |  |
| * Use mental strategies to estimate discounts of 10%, 25% and 50% | x | x | x |  | x |  |  |  |
| * Calculate the sale price of an item after a discount of 10%, 25% and 50% |  | x | x |  | x |  |  |  |
| **Additive relations B**: Choose and use efficient strategies to solve addition and subtraction problems  **MAO-WM-01, MA3-AR-01** |  |  |  |  |  |  |  |  |
| * Solve multistep word problems, including problems that require more than one operation |  |  | x |  |  |  |  |  |
| **Additive relations B**: Applies known strategies to add and subtract decimals  **MAO-WM-01, MA3-AR-01** |  |  |  |  |  |  |  |  |
| * Solve word problems involving the addition and subtraction of decimals up to 3 decimal places |  |  | x |  |  |  |  |  |
| * Justify why the strategy used to solve addition and subtraction word problems is appropriate (Reasons about quantity) |  |  | x |  |  |  |  |  |
| **Multiplicative Relations A:** **Represent and solve division problems with whole number remainders**  **MAO-WM-01, MA3-MR-01** |  |  |  |  |  |  |  |  |
| * Use known multiplication fact families to solve division problems for which answers may include a remainder |  |  |  |  |  |  | x |  |
| * Use the term quotient to describe the result of a division calculation |  |  |  |  |  |  | x |  |
| **Multiplicative relations B**: Select and apply strategies to solve problems involving multiplication and division with whole numbers  **MAO-WM-01, MA3-MR-01** |  |  |  |  |  |  |  |  |
| * Select and use efficient strategies to multiply whole numbers of up to 4 digits by one- and 2-digit numbers |  |  |  |  |  | x |  |  |
| **Multiplicative relations B**: Multiply and divide decimals by powers of 10  **MAO-WM-01, MA3-MR-01** |  |  |  |  |  |  |  |  |
| * Use mental strategies to multiply benchmark decimals by single-digit numbers |  |  |  |  |  | x |  |  |
| * **Compare the relative place value of digits to multiply and divide a decimal by powers of 10** |  |  |  |  |  | x |  |  |
| * Estimate the product of a decimal and a whole number to determine the magnitude of a calculator answer |  |  |  |  |  | x |  |  |
| **Multiplicative Relations B**: Represent and describe number patterns formed by multiples  **MAO-WM-01, MA3-MR-01** |  |  |  |  |  |  |  |  |
| * Describe a pattern formed by multiples in words, in terms of multiplication rather than addition |  |  |  |  | x |  |  |  |
| * Determine a rule describing the relationship between the bottom number and the top number in a table (Algebraic reasoning) |  |  |  |  | x |  |  |  |
| **Multiplicative relations B: Explore the use of brackets and the order of operations to write number sentences**  **MAO-WM-01, MA3-MR-01, MA3-MR-02** |  |  |  |  |  |  |  |  |
| * Recognise the need to agree on the order in which to perform operations |  |  |  |  |  |  | x |  |
| * Investigate the order of operations using real-life contexts |  |  |  |  |  |  | x |  |
| * **Solve problems involving grouping symbols** |  |  |  |  |  |  | x |  |
| **Geometric measure A:** Position: Explore the Cartesian coordinate system  **MAO-WM-01, MA3-GM-01** |  |  |  |  |  |  |  |  |
| * Recognise that the grid-map reference system gives the area of a location and the number plane identifies a specific point |  |  |  |  |  |  |  | x |
| **Geometric measure B**: Position: Use the 4 quadrants of the coordinate plane  **MAO-WM-01, MA3-GM-01** |  |  |  |  |  |  |  |  |
| * Identify and record the coordinates of given points on the number plane in all 4 quadrants |  |  |  |  |  |  |  | x |

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# References

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[National Numeracy Learning Progression](https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/version-3-of-national-literacy-and-numeracy-learning-progressions/) © Australian Curriculum, Assessment and Reporting Authority (ACARA) 2010 to present, unless otherwise indicated. This material was downloaded from the [Australian Curriculum](http://www.australiancurriculum.edu.au/) website (National Numeracy Learning Progression) (accessed 14 June 2024) and was not modified.

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## Further reading

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