# Perimeter pals

Students use the concept of perimeter to delve into solving equations with pronumerals on both sides using bar models.

## Visible learning

### Learning intention

* To be able to solve equations with pronumerals on both sides.

### Success criteria

* I can represent the perimeter of a shape as an equation.
* I can solve an equation with pronumerals on both sides.
* I can explain different ways to solve an equation with pronumerals on both sides.
* I can check my solutions to equations using substitution.

### Syllabus outcomes

A student:

* 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 **MAO-WM-01**
* applies knowledge of the perimeter of plane shapes and the circumference of circles to solve problems **MA4-LEN-C-01**
* solves linear equations of up to 2 steps and quadratic equations of the form
**MA4-EQU-C-01**

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## Activity structure

Please use the associated PowerPoint *Perimeter pals*to display images in this lesson.

### Launch

1. Place students in visibly random groups of 3 ([bit.ly/visiblegroups](https://bit.ly/visiblegroups)) at vertical non-permanent surfaces ([bit.ly/VNPSstrategy](https://bit.ly/VNPSstrategy)).
2. Distribute Appendix A ‘Launch problem’ to each group of students and ask them to attempt the problem. The problem involves an isosceles triangle and a rectangle that share a side and the same perimeter. Students must find the length of the shared side.

Figure 1 – find the value of if the rectangle and triangle have the same perimeter



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1. Walk around the room asking each group about their approach to the problem.

The aim of the activity is not to find the correct answer but to use it as a formative assessment opportunity to see what approaches students take to find the correct answer.

### Explore

1. Display slide 2 from the PowerPoint *Perimeter pals*. This displays an approach to the problem above using a bar model.

Figure 2 – bar model



Image created using [Desmos](https://www.desmos.com/?lang=en) and is licensed under the [Desmos Terms of Service](https://www.desmos.com/terms?lang=en).

1. Ask students how they could redraw the bar model to make it simpler.
2. In a Think-Pair-Share ([bit.ly/thinkpairsharestrategy](https://bit.ly/thinkpairsharestrategy)) ask students what their first step would be, if they were to solve this equation.
3. Have students return to their vertical non-permanent surfaces in their groups of 3.
4. Distribute Appendix B ‘Lengthy equations’ and ask students to try and find the values of the pronumerals in each question. Ask students to check their answers by substituting their answers into the initial equation.
5. On a gallery walk ([bit.ly/DLSgallerywalk](https://bit.ly/DLSgallerywalk)), students are to think about if it matters if we remove constants first or the pronumerals.
6. Display slide 3 from the PowerPoint *Perimeter pals* to show how to solve Derek’s equation from the launch both ways.

Figure 3 – solved bar models



Image created using [Desmos](https://www.desmos.com/?lang=en) and is licensed under the [Desmos Terms of Service](https://www.desmos.com/terms?lang=en).

1. In a Think-Pair-Share, ask students why it does not matter if we deal with the constants or the pronumerals first.

This activity should show students that they can choose to simplify the constants or the terms with pronumerals first, as one step does not depend on the other.

### Summarise

1. Distribute Appendix C ‘Incorrect worked examples’ to individual students and have them complete.
2. Individually, students are to attempt the Open Middle problem ‘Two-step equations 3’ (<bit.ly/twostepequations3>) to try and find the combination that gives a solution closest to zero using the numbers 1–9 to fill the boxes.
3. By selecting random students, discuss the solution students found and the strategies they used to get to the solution they found.

### Apply

1. Issue each pair of students with a copy of Appendix D ‘Sharing sides’.
2. By working in pairs, students are to try and explain each of the situations presented, justifying their responses mathematically.
3. Using Pose-Pause-Pounce-Bounce (PDF 557KB) ([bit.ly/posepausepouncebounce](https://bit.ly/posepausepouncebounce)), share people reasoning and solutions to the problems.

## Assessment and differentiation

### Suggested opportunities for differentiation

**Launch**

* When discussing with students, teachers can encourage their students to think about their decisions.

**Explore**

* Using the same colours when changing representations can help students with how they are connected.
* Working in groups to solve problems help students with feedback from others before attempting on their own.
* Teachers can provide alternate questions that include fractions to challenge students.

**Summarise**

* Students can be prompted to use bar models to find the incorrect steps in Appendix C.
* Students can be grouped in twos or threes to complete the Open Middle problem.
* Extend students in the Open Middle problem by using the numbers -9 to 9.

**Apply**

* All students should be able to write the equation but may understand and be able to explain why they don’t work at different depths.

### Suggested opportunities for assessment

**Launch**

* When placed in groups of 3, students provide and receive peer feedback on their understanding.

**Explore**

* Students will demonstrate their working mathematically skills in discussions and justifications.

**Summarise**

* Appendix C can be collected as evidence of learning.
* Create an exit ticket with one solution from the Open Middle problem.

## Appendix A

### Launch problem

An isosceles triangle and a rectangle share a side.

They also have the same perimeter.

Find the length of the shared side.



## Appendix B

### Lengthy equations

This activity has been modified from ‘Lengthy equations’ on the website ‘Median’ by Don Steward ([bit.ly/lengthyequations](https://bit.ly/lengthyequations)).

Find the value of the pronumeral in each of the equations below.

|  |  |
| --- | --- |
| Number | Equation |
|  | Bar model of 7n=n+48 |
|  | Bar model of 9k=60+5k |
|  | Bar model of 10b=2b+2b+420 |
|  | bar model of 14e=e+5e+72 |
|  | Bar model of 20a=3a+4a+52 |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

## Appendix C

### Incorrect worked examples

1. Sam **didn’t** solve this problem correctly. Here is their working:
2. Why is it incorrect to remove the pronumeral when subtracting?
3. Your turn:
4. Renee **didn’t** solve this problem correctly. Here is her working:
5. How did Renee get the value of -4? Explain what mistake she made.
6. Your turn:
7. Shannon **didn’t** solve this problem correctly. Here is their working:
8. Explain what Shannon did incorrectly to get to line 3 of their working. Give reason why.
9. Your turn:

## Appendix D

### Sharing sides

1. An isosceles triangle and a rectangle share a side. They also have the same perimeter. Explain why this situation cannot exist with these dimensions.



1. These 2 shapes share a side. They also have the same perimeter. Explain why this is not enough information to find the missing side.



1. These 2 shapes share a side. They also have the same perimeter. Explain why this is not true.



## Sample solutions

### Appendix B – lengthy equations

Find the value of the pronumeral in each of these equations.

|  |  |
| --- | --- |
| Number | Equation with sample solutions |
|  | Bar model of 7n=n+48.Bar model of 6n=48.Bar model of n=8. |
|  | Bar model of 9k=60+5k.Bar model of 4k=60.Bar model of k=15. |
|  | Bar model of 10b=2b+2b+420.Bar model of 6b=420.Bar model of b=70. |
|  | Bar model of 14e=e+5e+72.Bar model of 8e=72.Bar model of e=9. |
|  | Bar model of 20a=3a+4a+52.Bar model of a=4.Bar model of 13a=52. |
|  |  |
|  |  |
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### Appendix C – incorrect worked examples

1. Sam **didn’t** solve this problem correctly. Here is their working:
2. You can’t remove the pronumeral because if I have 2 lots of a number and take one of them away, I still have one of the number.
3. Your turn:
4. Renee **didn’t** solve this problem correctly. Here is her working:
5. Renee added 1 to the -5, rather than doing the inverse which is to subtract 5.
6. Your turn:
7. Shannon **didn’t** solve this problem correctly. Here is their working:
8. Shannon divided by 3, which is incorrect. We should be doing the order of operations backwards which means we should have dealt with the -3 before dividing.
9. Your turn:

### Appendix D – sharing sides

1. can be any number.
2. This must not be true

## References

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