# Area of composite shapes

Students consider real-life scenarios where they need to calculate the area of composite shapes that include circles.

## Visible learning

### Learning intention

* To be able to calculate the area of composite shapes.

### Success criteria

* I can recognise basic shapes within a composite shape, including circles and sectors.
* I can substitute into area formulas of different shapes.
* I can add or subtract areas to find the area of a composite shape.
* I can explain how to calculate the area of a composite shape.

### 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**
* represents and operates with fractions, decimals and percentages to solve problems   
  **MA4-FRC-C-01**
* solves linear equations of up to 2 steps and quadratic equations of the form    **MA4-EQU-C-01**
* applies knowledge of area and composite area involving triangles, quadrilaterals and circles to solve problems **MA4-ARE-C-01**

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Table 1: lesson summary

|  |  |  |  |
| --- | --- | --- | --- |
| Section | Summary of activity | Teaching strategies | Teaching points |
| Launch | Display slide 3 of the PowerPoint *Area of composite shapes* (AOCS PPT) showing an image of the Aboriginal flag and ask students what they notice and wonder. Ask students what they would need to know to work out the area of each section of the flag. | Think-Pair-Share  Notice and wonder | Students consider situations where areas are not regular shapes. |
| Explore | Students work out the area of each section of the flag from the launch. | Mini whiteboards  Pose-Pause-Pounce-Bounce  Think-Pair-Share | Students look at splitting up an area into known plane shapes. |
| Summarise | Students are explicitly shown the steps to solve the question from the Explore section, before constructing notes and completing [Appendix A](#_Appendix_A) to assist in their understanding. | Worked examples (Your turn)  Notes to future forgetful selves  Faded examples | Students are consolidating work from previous lessons on area and applying that to composite shapes. |
| Apply | Students look at finding the turf required for composite-shaped areas in [Appendix B](#_Appendix_B) and then complete an exit ticket ([Appendix C](#_Appendix_C)). | Visibly random groups of 3  Vertical non-permanent surfaces  Gallery walk | Students apply the skills of finding composite areas to real-life scenarios. |

## Activity structure

Please use the associated PowerPoint *Area of composite shapes* (AOCS PPT) to display images in this lesson.

### Launch

1. Display slide 3 of the PowerPoint (AOCS PPT) which displays an image of the Aboriginal flag and ask students what they notice and wonder.

Luritja man Harold Thomas designed the Aboriginal flag in 1970.

Students should notice the 3 sections, the top black section, the middle yellow circle and the bottom red section. The top half of the flag is black to symbolise Aboriginal peoples. The red in the lower half stands for the earth and the colour of ochre, which has ceremonial significance. The circle of yellow in the centre of the flag represents the sun. Students might wonder what this has to do with their maths lesson or how big the circle is.

1. In a Think-Pair-Share ([bit.ly/thinkpairsharestrategy](https://bit.ly/thinkpairsharestrategy)), ask students what information they would need to know to determine the area of each section of the Aboriginal flag.

Students should recognise that they need the dimensions of the flag as well as the size of the circle to calculate the amount of colour in each section.

### Explore

1. Tell students the following information: The diameter of the sun circle is 50% of the height of the flag.
2. Display slide 5 of the PowerPoint (AOCS PPT) to show the dimensions of the Aboriginal flag. In a Think-Pair-Share, ask students to discuss how they would approach calculating each section of the flag.

Students should suggest calculating the diameter of the circle by using the measurements provided which have been obtained from the manufacturer’s guidelines ([bit.ly/manufacturingguidelines](https://bit.ly/manufacturingguidelines)), before finding the radius.

1. Distribute mini whiteboards ([bit.ly/miniwhiteboards](https://bit.ly/miniwhiteboards)) and a marker to each pair of students.
2. Using the mini whiteboards, ask each pair of students to calculate the area of the flag.

The area of the yellow section would be approximately 0.16 m2.

The black and red sections equate to approximately 0.72 m2 each.

### Summarise

1. Use slides 7–14 from the PowerPoint (AOCS PPT) for explicit teaching of area of composite shapes using the Worked examples (Your turn) method ([bit.ly/supportingstrategies](https://bit.ly/supportingstrategies)).
2. Students are to create notes to their future forgetful selves ([bit.ly/notestofutureself](https://bit.ly/notestofutureself)) on how to find the area of composite shapes.
3. Students are to complete the faded worked examples ([bit.ly/fadedexamplesstrategy](https://bit.ly/fadedexamplesstrategy)) in Appendix A ‘Faded examples’.

### Apply

1. Assign students to visibly random groups of 3 ([bit.ly/visiblegroups](https://bit.ly/visiblegroups)) on vertical non-permanent surfaces ([bit.ly/VNPSstrategy](https://saskmath.ca/vertical-non-permanent-surfaces-and-mini-white-boards/)).

Distribute Appendix B ‘Garden designs’ to each group of 3. Have students choose one area and work out the area of this space using their vertical non-permanent surface. These spaces are to be turfed with lawn. If turf costs $15 per m2, calculate the cost of turfing the area.

These questions have been split into mild, medium and spicy but not labelled. The teacher can choose whether to inform students about the levels. The first column contains mild questions. Teachers may also choose to be strategic and allocate each group one or 2 designs before comparing solutions with another group who were given the same design.

1. Students are to do a gallery walk ([bit.ly/DLSgallerywalk](https://bit.ly/DLSgallerywalk)) of each other’s solutions. Ask them to verify that the solution is correct and consider if there was another way the garden design could have been divided up to calculate the area.
2. Ask each group of 3 to calculate the area of one of the composite shapes they didn’t see on their gallery walk.
3. Students are to complete the exit ticket ([bit.ly/exitticketstrategy](https://bit.ly/exitticketstrategy)) in Appendix C ‘Exit ticket’.

## Assessment and differentiation

### Suggested opportunities for differentiation

**Launch**

* A notice and wonder strategy is used where there is no correct answer, so that all students can participate in the discussion.
* Students may need support in recalling the area formulas needed for the different parts of the flag.

**Explore**

* The sun circle of the Aboriginal flag can be adjusted to 60% of the flag’s height in certain designs to introduce an added challenge.
* The dimensions could be modified to change the complexity of the calculation.

**Summarise**

* The worked examples could be modified to include different dimensions.
* The worked examples could be modified to include proposed flags with designs of an appropriate level of difficulty.
* Students are supported through faded examples.
* Students should be challenged to make connections with prior knowledge.

**Apply**

* Students could be challenged to find multiple ways to divide up their garden area.

### Suggested opportunities for assessment

**Launch**

* Students have opportunities to contribute to and hear from pair and class discussions, these act as opportunities for self- and peer-reflection.

**Explore**

* Students give each other peer feedback, before sharing with the class in a Think-Pair-Share.
* The use of mini whiteboards gives the teacher opportunity to assess all students’ working.

**Summarise**

* Monitor student responses with the faded examples to check for understanding.
* Review students’ notes to future forgetful selves for understanding of finding the area of composite shapes.

**Apply**

* When placed in groups of 3, students provide and receive peer feedback on their understanding.
* The exit ticket can be used as evidence of understanding of calculating area of composite shapes.

## Appendix A

### Faded examples

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Find the area of the figure  A composite shape constructed by combining a semicircle with a radius of 8 m and a 16 m by 6 m rectangle. | Find the area of the figure  A composite shape constructed by combining a semicircle with a radius of 3 m and a 2 m by 6 m rectangle. | Find the area of the figure  A composite shape constructed by combining a semicircle with a diameter of 6 m and a 6 m by 6 m square. | Find the area of the figure  A composite shape constructed by combining a semicircle with a diameter of 3 m and an 8 m by 3 m rectangle. | Find the area of the figure  A composite shape constructed by combining a semicircle with a diameter of 2 m and a 2 m by 2 m square. |
|  |  |  |  |  |

## Appendix B

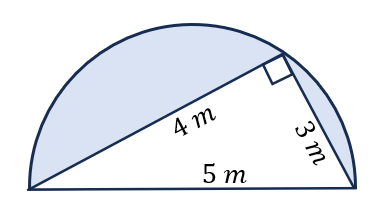
### Garden designs

|  |  |  |
| --- | --- | --- |
| A composite shape composed of a square with side lengths of 8 metres and a quadrant with a radius of 8 metres. | A composite shape composed of a small semicircle with a diameter of 8 metres and a large semicircle with a radius of 8 metres. | Circle of radius 6 metres with semicircle of diameter 8.5 metres removed from it. |
| A composite shape composed of a semicircle with a diameter of 10 metres and a right-angled triangle with a height of 8 metres and a base of 6 metres. | Two semicircles touching at the corner. One semi circle has a diameter of 9 metres and the other has a diameter of 10 metres. | A composite shape composed of a circle with a radius of 20 metres and a regular hexagon constructed out of 6 equilateral triangles, with a base of 20 metres and a height of 17.3 metres. |
| Annulus with outer circle radius being 8 metres and inner circle radius being 6 metres. | A composite shape composed of a semicircle with a diameter of 6 metres and a trapezium with perpendicular height of 8 metres and the length of the parallel sides equalling 6 metres and 10 metres respectively. | A composite shape composed of a rhombus with a perpendicular height of 8 metres and a base of 10 metres and 4 identical semicircles with diameter 10 metres. |
| A composite shape composed of a rectangle with dimensions 10 metres by 6 metres and 2 identical semicircles with a diameter of 6 metres. | A composite shape composed of a semicircle with a diameter of 8 metres and a quadrant with a radius of 8 metres. | A composite shape composed of a semicircle with the diameter of 10 metres and a semicircle with radius of 3 metres cut out of it. |

## Appendix C

### Exit ticket

Calculate the shaded area (2 segments).



## Sample solutions

### Appendix A – faded example

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Find the area of the figure  A composite shape constructed by combining a semicircle with a radius of 8 m and a 16 m by 6 m rectangle. | Find the area of the figure  A composite shape constructed by combining a semicircle with a radius of 3 m and a 2 m by 6 m rectangle. | Find the area of the figure  A composite shape constructed by combining a semicircle with a diameter of 6 m and a 6 m by 6 m square. | Find the area of the figure  A composite shape constructed by combining a semicircle with a diameter of 3 m and an 8 m by 3 m rectangle. | Find the area of the figure  A composite shape constructed by combining a semicircle with a diameter of 2 m and a 2 m by 2 m square. |
|  |  |  |  |  |

### Appendix B – garden designs

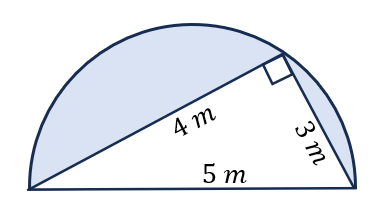
|  |  |  |
| --- | --- | --- |
| A composite shape composed of a square with side lengths of 8 metres and a quadrant with a radius of 8 metres. | Annulus with outer circle radius being 8 metres and inner circle radius being 6 metres. | A composite shape composed of a semicircle with a diameter of 10 metres and a right-angled triangle with a height of 8 metres and a base of 6 metres. |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| A composite shape composed of a small semicircle with a diameter of 8 metres and a large semicircle with a radius of 8 metres. | Two semicircles touching at the corner. One semicircle has a diameter of 9 metres and the other has a diameter of 10 metres. | A composite shape composed of a semicircle with a diameter of 8 metres and a quadrant with a radius of 8 metres. |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| Circle of radius 6 metres with semicircle of diameter 8.5 metres removed from it. | A composite shape composed of a circle with a radius of 20 metres and a regular hexagon constructed out of 6 equilateral triangles, with a base of 20 metres and a height of 17.3 metres. | A composite shape composed of a rhombus with a perpendicular height of 8 metres and a base of 10 metres and 4 identical semicircles with diameter 10 metres. |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| A composite shape composed of a semicircle with a diameter of 6 metres and a trapezium with perpendicular height of 8 metres and the length of the parallel sides equalling 6 metres and 10 metres respectively. | A composite shape composed of a rectangle with dimensions 10 metres by 6 metres and 2 identical semicircles with a diameter of 6 metres. | A composite shape composed of a semicircle with the diameter of 10 metres and a semicircle with radius of 3 metres cut out of it. |
|  |  |  |

### Appendix C – exit ticket



## References

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