National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Exemplar for Internal Achievement Standard

Mathematics and Statistics Level 1

This exemplar supports assessment against:

Achievement Standard 91034

Apply transformation geometry in solving problems

An annotated exemplar is an extract of student evidence, with a commentary, to explain key aspects of the standard. These will assist teachers to make assessment judgements at the grade boundaries.

New Zealand Qualification Authority

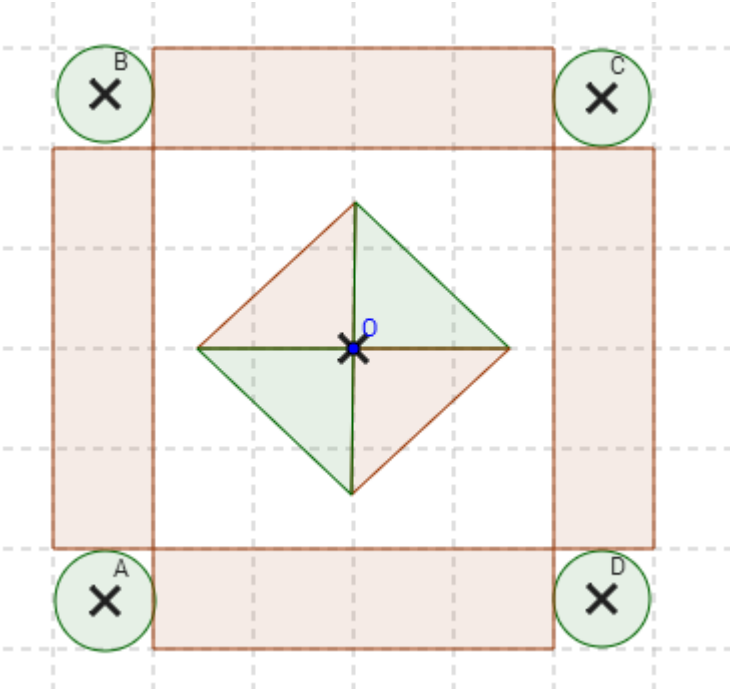
To support internal assessment from 2014

	Grade Boundary: Low Excellence
1.	For Excellence, the student needs to apply transformation geometry, using extended abstract thinking, in solving problems. This involves one or more of: devising a strategy to investigate a situation, identifying relevant concepts in context, developing a chain of logical reasoning, or proof, forming a generalisation and also using correct mathematical statements, or communicating mathematical insight. This student's evidence is a response to the Vocational Pathways assessment resource 'Geometric gardens'. This student has identified relevant concepts in context in designing the garden using rotations (1), translations (2), enlargement (3) and symmetry (4). Correct mathematical statements have been used to describe these concepts throughout the task. Insight has been shown by the consideration of the invariant features of the transformations (5) and of the impact of colour in describing the symmetries of the garden (6). For a more secure Excellence, the student would need to strengthen the descriptions of invariance and the discussion of the impact of colour and height on the symmetry of the garden.

Student 1: Low Excellence

I have been asked to design a new garden to go where the old tennis court was in front of the school office. I am going to make a mock tudor garden with green hedging and a browny/red hedge, all half a metre high.

This is the main part of the garden



To make this I did

Drew a circle centre A
Translated it 5 units to the right to make circle centre D
Translated it 5 units up to make circle centre B
Translated the circle centre B 5 units right to make the circle centre C
Drew the rectangle between circles A and D
Rotated this 90^0 anticlockwise about A to get the rectangle on the left
Translated it 5 units up to get the rectangle on the top
Translated the second rectangle 5 units to the right to get the fourth one.
Drew the top right triangle in the middle
Rotated it through 90^0 and 180^0 and then 270^0 clockwise about O to the other three triangles.
Coloured them in to show which has which coloured hedging.

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Because translations and rotations don't change angles or lengths the shapes are all the same, but other ways up.

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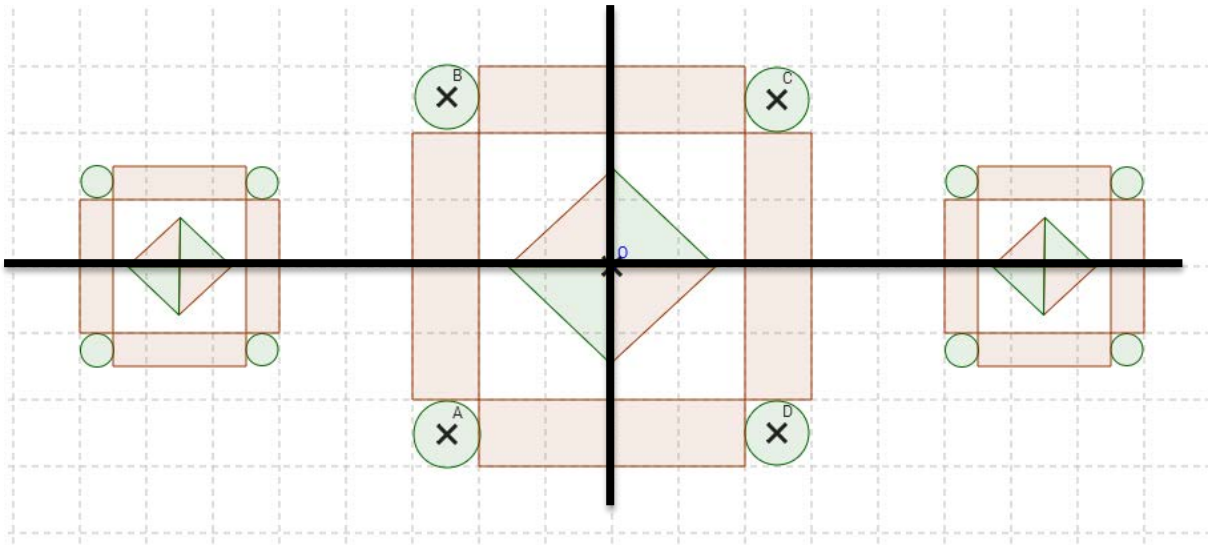
To finish off the garden I am going to have smaller gardens to the left and right of the main garden.



To make these I took the main garden and enlarged it by one half, centre O and moved this smaller shape 6.5 units to the right.

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I repeated this but moved it 6.5 units to the left.

These two smaller gardens have the same angles but the lengths are all one half, because this is what happens with a shrink.

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If you ignore the colours the final gardens have a vertical and a horizontal line of symmetry through the middle, but these are not lines of symmetry if you count the colours. The black lines are the mirror lines on the graph.

4

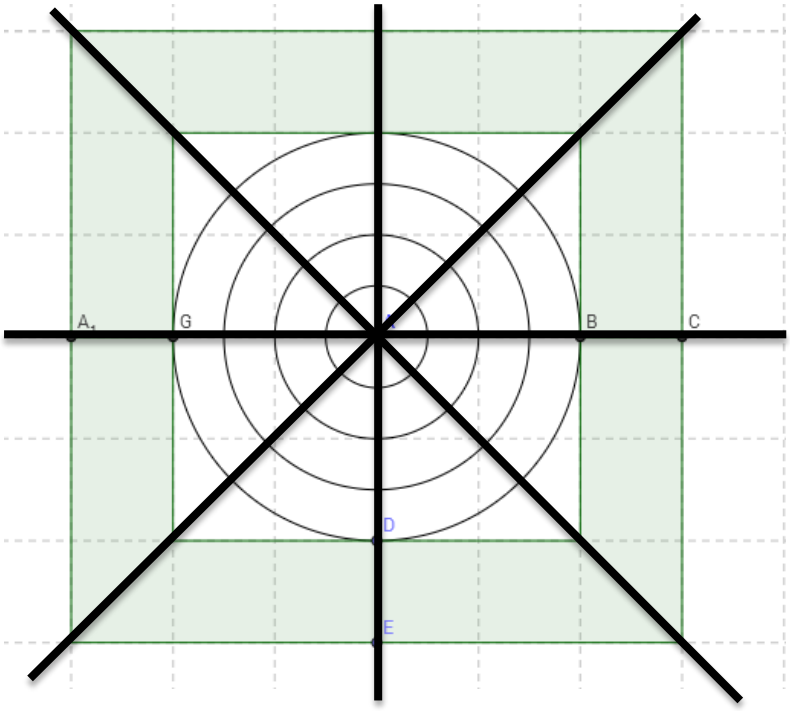
6

	Grade Boundary: High Merit
2.	For Merit the student needs to apply transformation geometry, using relational thinking, in solving problems. This involves one or more of: selecting and carrying out a logical sequence of steps, connecting different concepts and representations, demonstrating understanding of concepts, forming and using a model and also relating findings to a context, or communicating thinking using appropriate mathematical statements. This student's evidence is a response to the Vocational Pathways assessment resource 'Geometric gardens'. This student has demonstrated an understanding of concepts in designing the garden using and describing enlargement (1), reflections (2), rotation (3) and symmetry (4). Appropriate mathematical statements have been used throughout the response. To reach Excellence, the student could produce the design of the finished garden, describe the symmetry of the garden and the invariant features of the transformations.

Student 2: High Merit

I have been asked to design a new garden to go where the old tennis court was in front of the school office.

This is the basic shape of the garden. There will be a tree at A surrounded by an empty circle. The bit between the next two circles will be a green hedge, then a blank, then another green hedge. The L shape pieces will be a green hedge.



To make this garden

Mark point in the middle
Draw a circle radius one unit with this point as centre (A)
Enlarge this circle centre A by a factor of 2, then 3 and then 4 to get the other circles, all centre A.
Draw the bottom right L shape.
Reflect it in BC to get the top right L
Rotate this second L 180^{o} about A to get the bottom left L
Reflect this third L in A_1G to get the last L shape.

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Symmetry

This garden has four mirror lines: horizontal, vertical and the two diagonals. I have drawn them on the diagram in black. This garden also has four rotation symmetries about the centre of the garden.

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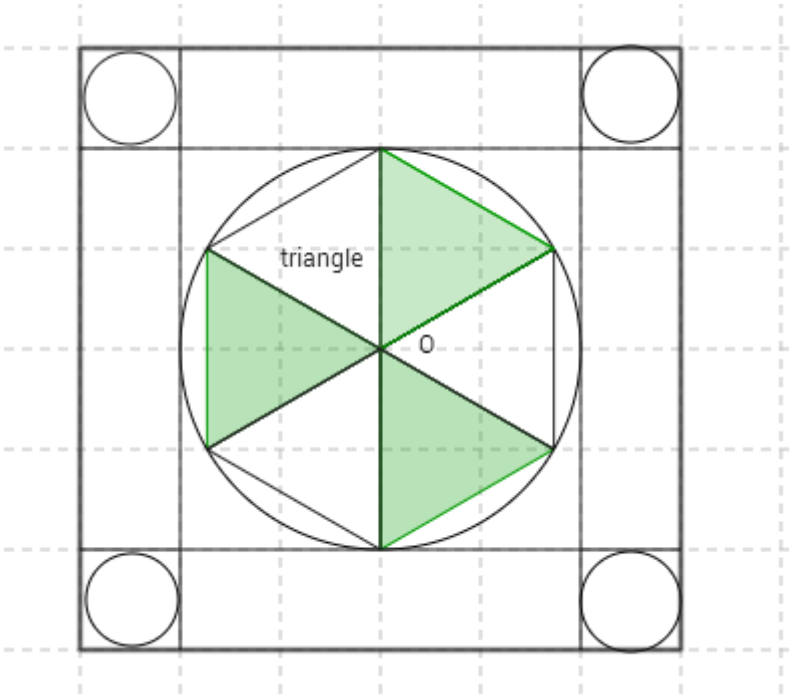
Adding on

The finished garden will have four of these designs. To get this translate the basic shape 14 units to the right and then reflect these about a horizontal line you get 4 in a nice square. This will have a horizontal and a vertical mirror line.

	Grade Boundary: Low Merit
3.	For Merit, the student needs to apply transformation geometry, using relational thinking, in solving problems. This involves one or more of: selecting and carrying out a logical sequence of steps, connecting different concepts and representations, demonstrating understanding of concepts, forming and using a model and also relating findings to a context, or communicating thinking using appropriate mathematical statements. This student's evidence is a response to the Vocational Pathways assessment resource 'Geometric gardens'. This student has demonstrated an understanding of concepts in designing the garden by using and describing the reflections (1), rotation (2), translation (3) and symmetry (4). Appropriate mathematical statements have been used in the response. For a more secure Merit, the student would need to accurately describe the reflective and rotational symmetries in the design of their garden.

Student 3: Low Merit

This is my garden design for the court.



I started by marking the centre point O and drawing the equal sided triangle I have named.
I then rotated this 5 times by 60, 120, 180, 240 and 300 degrees about O to get the other five triangles.
I then drew the circle entre O so it went through the corners of the triangles.
I then drew the left hand rectangle and reflected it through the vertical middle line of the garden to get the right hand rectangle.
I also rotated it by 90^0 clockwise about O to get the bottom rectangle.
This rectangle was translated 5 units up to get the top rectangle.
I then filled in the corner squares and put a circle in each of them because that is where the trees are going.

If you ignore the colours there are lines of symmetry: horizontally and vertically through the middle of the square and also the two diagonals.

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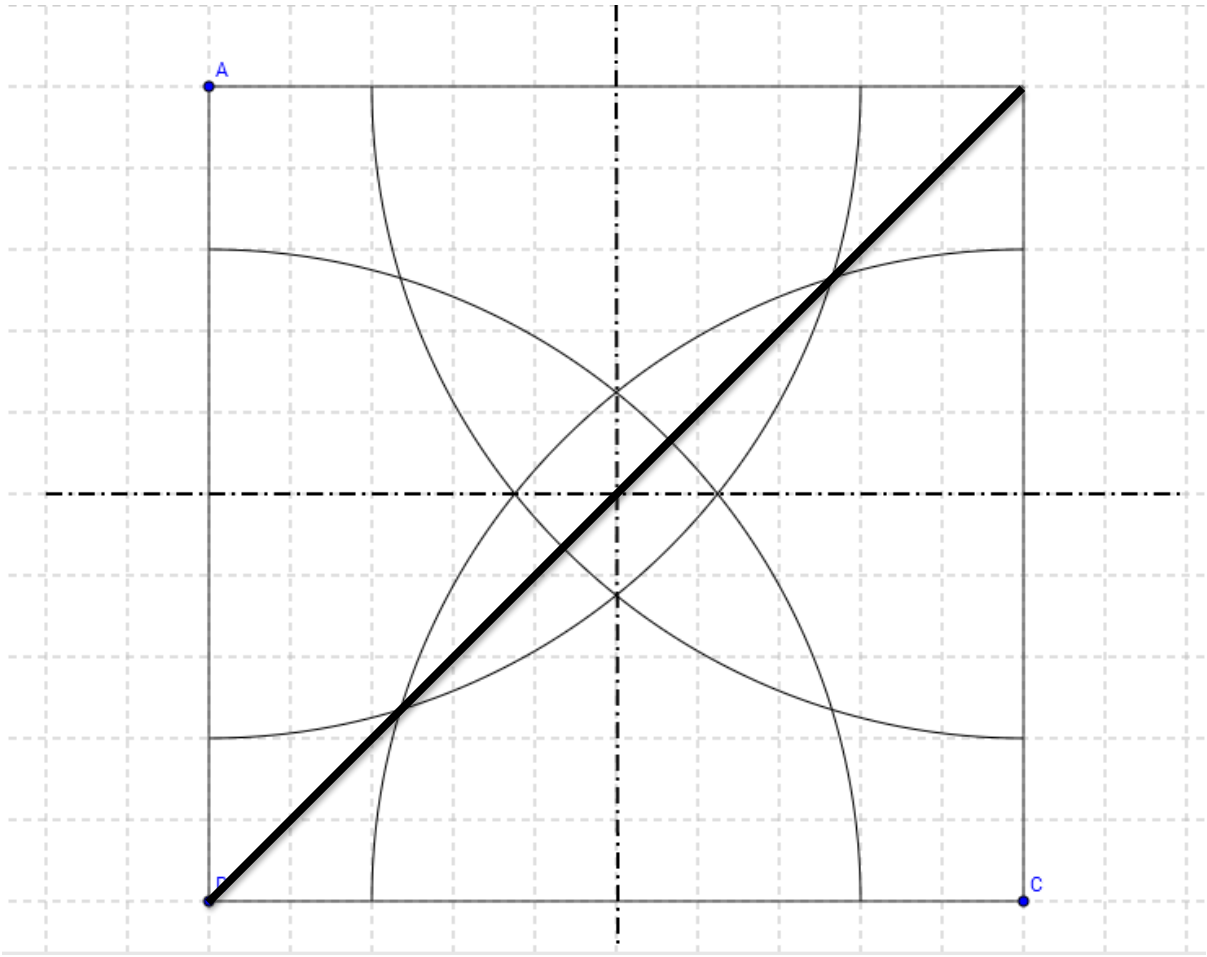
	Grade Boundary: High Achieved
4.	For Achieved, the student needs to apply transformation geometry. This involves selecting and using a range of methods in solving problems, demonstrating knowledge of geometrical concepts and terms and communicating solutions using geometrical terms or representations. This student's evidence is a response to the Vocational Pathways assessment resource 'Geometric gardens'. This student has, in designing the garden, selected and used a reflection (1) and a rotation (2). The student has identified line and rotational symmetries in the final design (3). To reach Merit, the student would need to describe completely the transformations used in the design of the garden.

Student 4: High Achieved



I designed my garden by drawing the square that its going to fit inside.

I then draw quarter of a circle with A in the middle to make the quarter of a circle in the top left hand bit of the square.
I reflected this to make the second quarter of a circle in the bottom right hand bit of the square.
I rotated the first part of the circle clockwise and anticlockwise about the middle point of the square to get the next two quarters of a circle.
That's all I did.

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My final design has two mirror lines which I have marked with dotted lines on the diagram. The solid black line is also a mirror line and there is another one across the other diagonal. There are four angles you can rotate this garden through and leave it the same.

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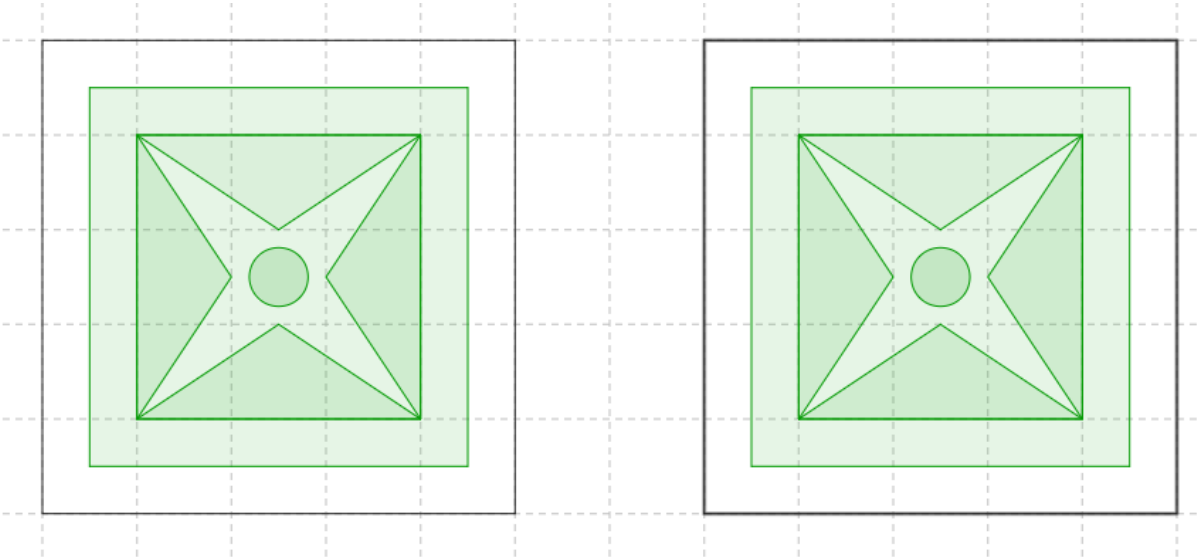
	Grade Boundary: Low Achieved
5.	For Achieved, the student needs to apply transformation geometry. This involves, selecting and using a range of methods in solving problems, demonstrating knowledge of geometrical concepts and terms and communicating solutions using geometrical terms or representations. This student's evidence is a response to the Vocational Pathways assessment resource 'Geometric gardens'. This student has selected and used a reflection (1), rotation (2) and translation (3) in designing the garden. For a more secure Achieved, the student would need to identify the mirror line for the reflection and give more detail about the translation.

Student 5: Low Achieved



My garden has two identical gardens next to each other.
I made the left hand garden first.

I drew the outside and inside squares first..
I then drew the top triangle.
I rotated this through a quarter turn about the centre of the square both ways to get the left and right hand triangles.
I reflected the first triangle to get the bottom triangle.
I drew the circle in the middle (that is going to be where a tree is).
The triangles are going be flower beds and the star shape in the middle and the outside will be paths of crushed shells.

Then I got all this garden together and translated it to the right to make the second garden and so the whole thing.

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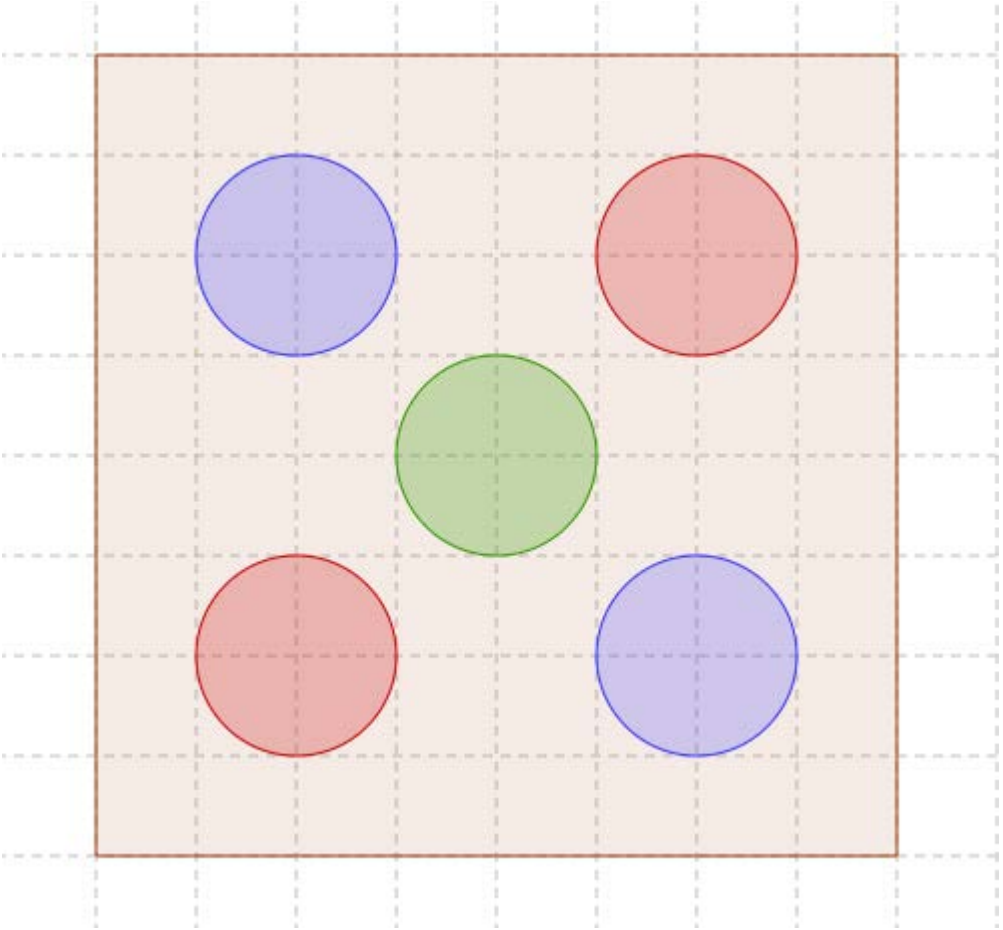
	Grade Boundary: High Not Achieved
6.	For Achieved, the student needs to apply transformation geometry. This involves, selecting and using a range of methods in solving problems, demonstrating knowledge of geometrical concepts and terms and communicating solutions using geometrical terms or representations. This student's evidence is a response to the Vocational Pathways assessment resource 'Geometric gardens'. This student has selected and used a translation (1) and a rotation (2) in designing the garden. To reach Achieved, the student would need to select and use one further method in designing the garden.

Student 6: High Not Achieved

My garden looks like this.



First I drew the square.
Then the green circle in the middle (that is going to be a tree)
Then the blue circle top right (planted with blue flowers)
I translated the blue circle 4 across and 4 down to get the other blue circle.
Then I drew the top right red circle and rotated it 180^0 about the middle of the square to get the other red circle.

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