


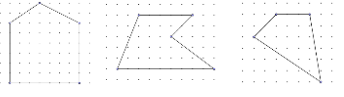





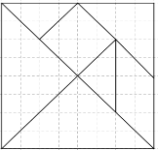


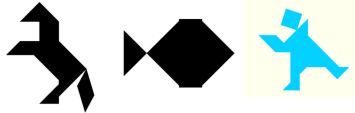


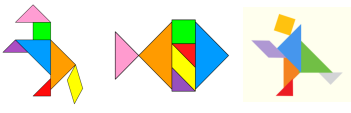

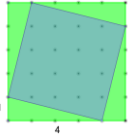
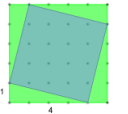

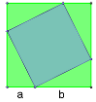





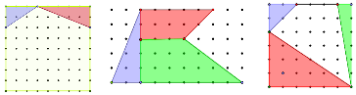



Slide 1	 <p>Advanced Mathematics Support Programme®</p>	
Slide 2	  <p>Compound shapes</p> <ul style="list-style-type: none"> We're going to explore areas of shapes and how we can interpret our findings. To start, can you work out the areas of the shapes below? 	It is easiest to work out the area of the final shape by taking the large square and subtracting the 3 triangles from it. This is a good method as it is one we will be using through this activity.
Slide 3	  <p>Tangrams</p>  <ul style="list-style-type: none"> Being able to visually move shapes around in our mind is a very useful skill. Tangram puzzles are a great way to practise this skill. You can make your own set of tangram pieces, instructions and puzzles on the next slides. Or you can do some online tangram puzzles here. 	It is not essential to cover tangrams to access this activity, however using spatial awareness and geometrical reasoning is a skill that will be used later.
Slide 4	  <p>Tangrams</p> <ul style="list-style-type: none"> Tangrams are shapes cut from a square. You can cut out your own set from this diagram (or recreate it on square paper). 	It is not essential to cover tangrams to access this activity, however using spatial awareness and geometrical reasoning is a skill that will be used later.
Slide 5	  <p>Tangrams</p> <ul style="list-style-type: none"> Can you rearrange your shapes to make the shapes below Answers on the next page!  <p><small>The puzzles were taken from https://www.tangram-channel.com/ and the world of tan puzzles from https://www.tangram-channel.com/</small></p>	It is not essential to cover tangrams to access this activity, however using spatial awareness and geometrical reasoning is a skill that will be used later. Additional work on tangrams can be found: https://www.tangram-channel.com/tangram-worksheets/ https://www.tangram-channel.com/tangram-cards/essential-cards/
Slide 6	  <p>Tangrams possible solutions</p> 	

<p>Slide 7</p>	<p>Drawing squares</p> <ul style="list-style-type: none"> We will be exploring drawing squares on dotted paper. Starting with a 5x5 grid, how many different squares can you draw on the grid? Here are some examples 	<p>Encourage students to have a systematic approach – they could visualise moving vertices or rotating squares. Encourage students to discuss how they could describe the square they are drawing. There are 13 squares they can draw.</p>																												
<p>Slide 8</p>	<p>Area of squares</p> <ul style="list-style-type: none"> The square below we can describe as [4,1]. Label the squares you have drawn using the same convention. 	<p>Here students might find they have drawn congruent squares – you can discuss whether [4,1] is the same as [1,4] for example. Does order matter?</p>																												
<p>Slide 9</p>	<p>Area</p> <ul style="list-style-type: none"> We can work out the area of the smaller square below using the following technique  <p>Area of large square = $5 \times 5 = 25 \text{ units}^2$ Area of triangle = $\frac{1}{2} \times 4 \times 1 = 2 \text{ units}^2$ Area of small square = $25 - (4 \times 2) = 16 \text{ units}^2$</p>	<p>Some students may find the area using another method. Encourage students to use this method as they will need to use this approach in the next steps.</p>																												
<p>Slide 10</p>	<p>Area</p> <ul style="list-style-type: none"> Can you use the same technique to work out the area of all the squares you have found on your 5x5 grid?  <p>Area of large square = $5 \times 5 = 25 \text{ units}^2$ Area of triangle = $\frac{1}{2} \times 4 \times 1 = 2 \text{ units}^2$ Area of small square = $25 - (4 \times 2) = 16 \text{ units}^2$</p>	<table border="1" data-bbox="624 981 1066 1547"> <thead> <tr> <th>Square</th> <th>Size</th> </tr> </thead> <tbody> <tr><td>[1,0]</td><td>1</td></tr> <tr><td>[1,1]</td><td>2</td></tr> <tr><td>[2,0]</td><td>4</td></tr> <tr><td>[2,1]</td><td>5</td></tr> <tr><td>[2,2]</td><td>8</td></tr> <tr><td>[3,0]</td><td>9</td></tr> <tr><td>[3,1]</td><td>10</td></tr> <tr><td>[3,2]</td><td>13</td></tr> <tr><td>[4,0]</td><td>16</td></tr> <tr><td>[4,1]</td><td>17</td></tr> <tr><td>[3,3]</td><td>18</td></tr> <tr><td>[4,2]</td><td>20</td></tr> <tr><td>[5,0]</td><td>25</td></tr> </tbody> </table> <p>Students may also realise that there is a [4,3] square with area 25.</p>	Square	Size	[1,0]	1	[1,1]	2	[2,0]	4	[2,1]	5	[2,2]	8	[3,0]	9	[3,1]	10	[3,2]	13	[4,0]	16	[4,1]	17	[3,3]	18	[4,2]	20	[5,0]	25
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<p>Slide 11</p>	<p>Area and algebra</p> <ul style="list-style-type: none"> We now have square [a,b] where a and b are any integers. What is the area of the small square?  <ul style="list-style-type: none"> Can you make a formula that links the areas of the different shapes? 	<p>This is a lovely way to prove Pythagoras. It is explained in the numberphile video, but some students may already see the connection.</p>																												
<p>Slide 12</p>	<p>Impossible squares</p> <ul style="list-style-type: none"> Watch this video Look at your list of squares from your 5x5 grid Did you get them all? Did you get any duplicates? 																													

<p>Slide 13</p>	 <h3>Impossible squares</h3> <ul style="list-style-type: none"> What squares with area less than 25 units² can you not draw with vertices on the dots? 	<p>3,6,7,11,12,14,15,19,21,22,23,24</p>																														
<p>Slide 14</p>	 <h3>Impossible squares</h3> <ul style="list-style-type: none"> When working with squares with small (<50) area, we can calculate manually using the formula given in the video which factors will result in $a^2 + b^2 \neq c^2$ Using the formula $(4k+3)^{\text{odd power}}$, what factors result in an impossible square? You can use the table below to help <table border="1" data-bbox="284 607 539 651"> <thead> <tr> <th></th> <th>K=0</th> <th>K=1</th> <th>K=2</th> <th>K=3</th> </tr> </thead> <tbody> <tr> <td>Power = 1</td> <td>3</td> <td>7</td> <td></td> <td></td> </tr> <tr> <td>Power = 3</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		K=0	K=1	K=2	K=3	Power = 1	3	7			Power = 3					<p>Encourage students to realise that the odd power is important, so neither 9 or 18 are impossible squares as they have 3² which is an even power.</p> <table border="1" data-bbox="624 510 1198 618"> <thead> <tr> <th></th> <th>K=0</th> <th>K=1</th> <th>K=2</th> <th>K=3</th> </tr> </thead> <tbody> <tr> <td>Power = 1</td> <td>3</td> <td>7</td> <td>11</td> <td>15</td> </tr> <tr> <td>Power = 3</td> <td>27</td> <td>343</td> <td>1331</td> <td>3375</td> </tr> </tbody> </table>		K=0	K=1	K=2	K=3	Power = 1	3	7	11	15	Power = 3	27	343	1331	3375
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<p>Slide 15</p>	 <h3>Impossible squares</h3> <ul style="list-style-type: none"> Can you prove why all your impossible squares on your 5x5 grid are impossible? Which are the factors that make them impossible? In the video Ben Sparks details which numbers can't be made up to 25. Can you work out all the impossible squares between 30 and 40? 	<p>30,31,33,35,38,39</p>																														
<p>Slide 16</p>	 <h3>Further reading</h3> <ul style="list-style-type: none"> To explore summing cubes watch this followed by this To explore different number theory ideas, this time looking at prime numbers watch this To explore more squares watch this 																															
<p>Slide 17</p>	 <h3>Compound shapes answers</h3>  <p>Large square - two triangles = 64 - 3 - 5 = 56 units²</p> <p>Triangle + two trapeziums = 5 + 8 + 15 = 28 units²</p> <p>Large square - three triangles = 36 - 2 - 12 - 3 = 19 units²</p>																															
<p>Slide 18</p>	 <h3>Contact the AMSP</h3> <ul style="list-style-type: none"> 📞 01225 716 492 ✉️ admin@amsp.org.uk 🖱️ amsp.org.uk 🐦 Advanced_Maths 	<p>Stay informed about the AMSP and receive updates: https://amsp.org.uk/subscribe</p>																														

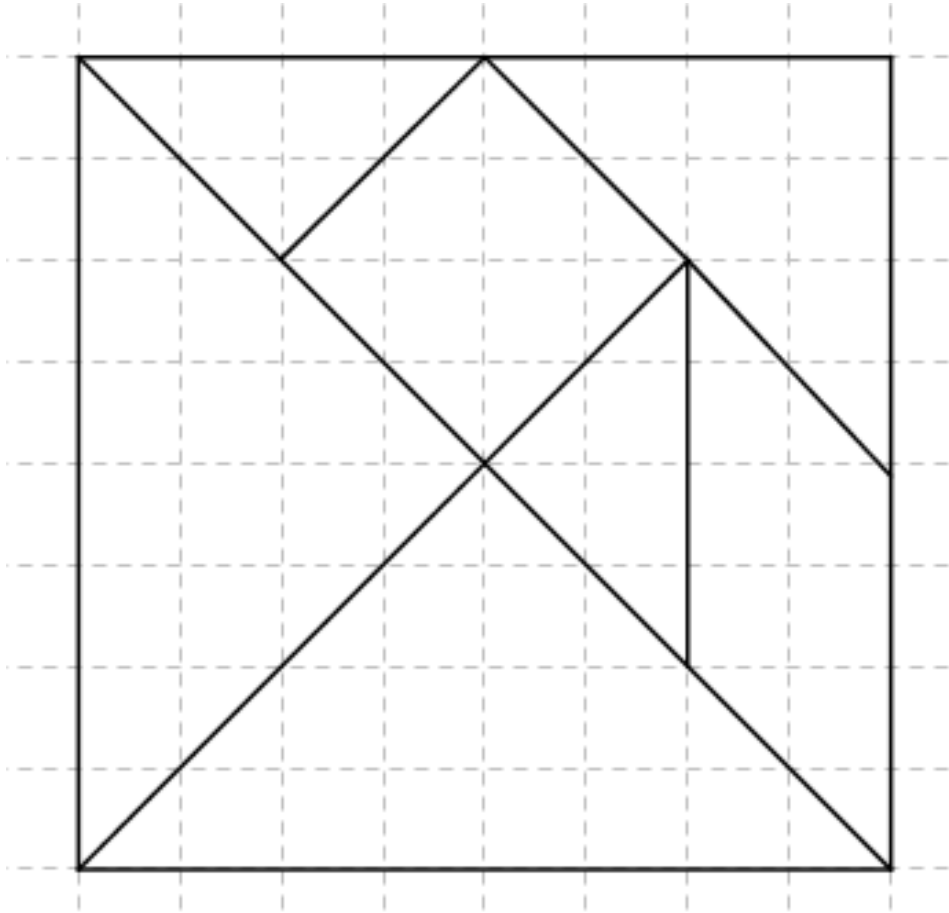
Tangrams

Making a tangram set

Tangrams are shapes cut from an 8x8 square.

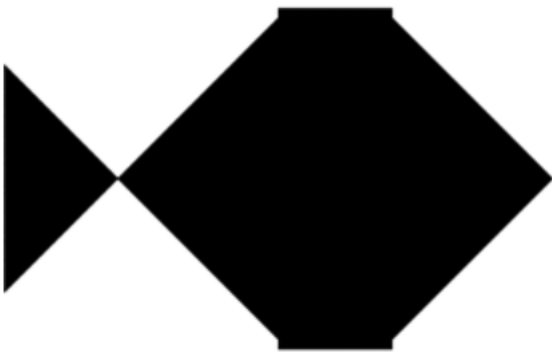
You can cut out your own set from this diagram (or recreate it on square paper)

You may wish to stick it on to card and colour in the shapes to make them distinct.



Can you cut out your set and make the following shapes?

The puzzles were taken from <https://www.tangram-channel.com/> and the world of tan puzzles from www.nrich.maths.org



Solutions below:

