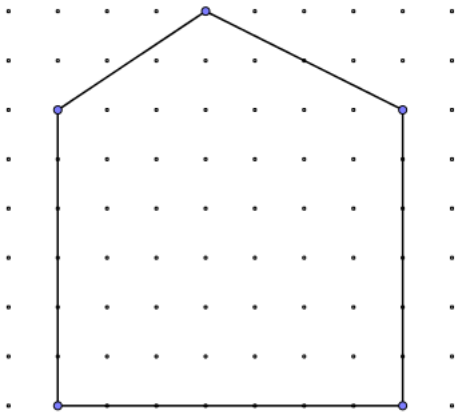
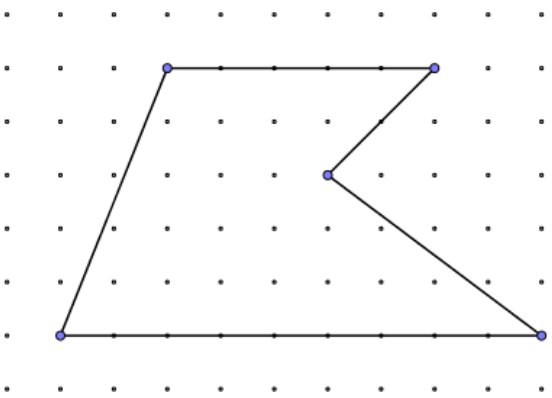
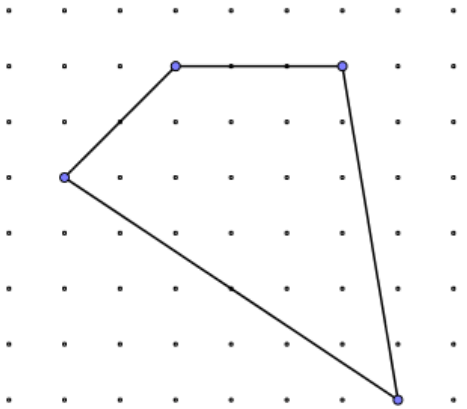
Advanced Mathematics Support Programme®

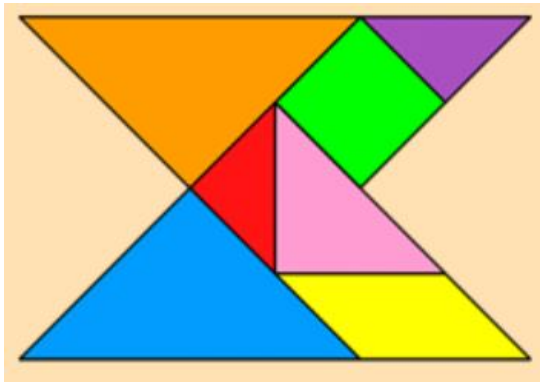
Compound shapes

- 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?

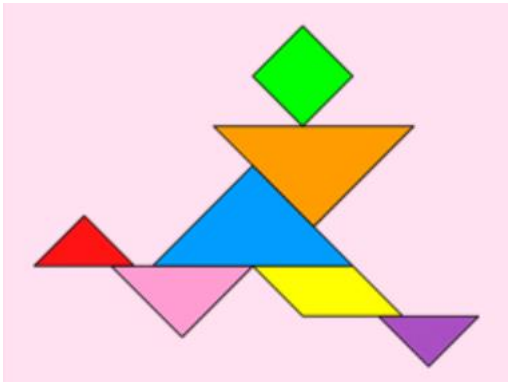






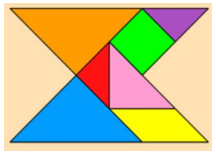


Tangrams

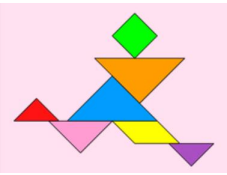


- Being able to visually move shapes around in our mind is a very useful skill.
- Tangram puzzles are a great way to practise this skill.
- You can make your own set of tangram pieces, instructions and puzzles on the next slides.
- Or you can do some online tangram puzzles here.

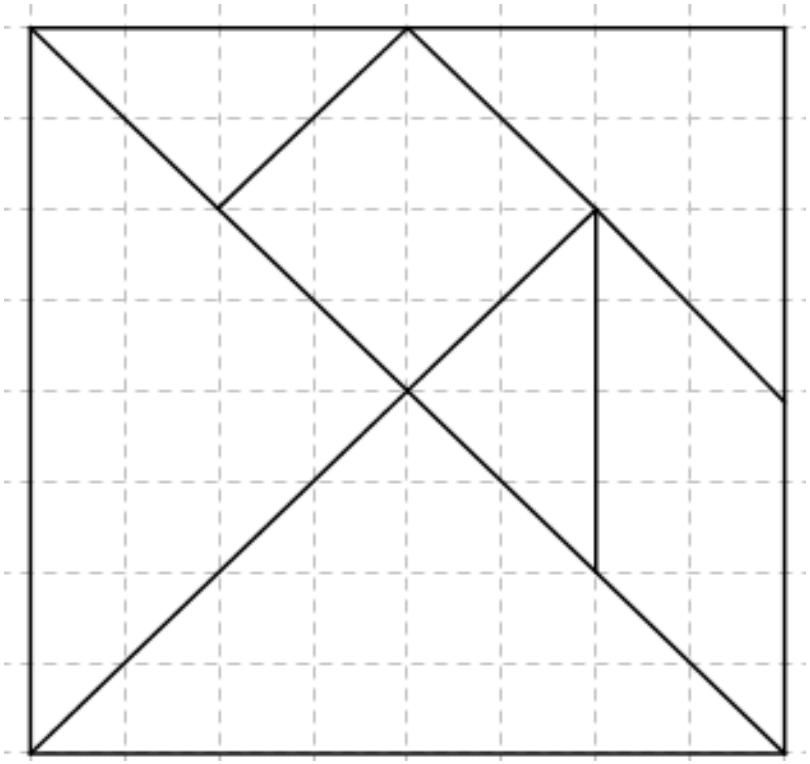
images from www.tangram-puzzles.com



Tangrams



- Tangrams are shapes cut from a square.
- You can cut out your own set from this diagram (or recreate it on square paper).



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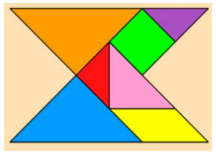
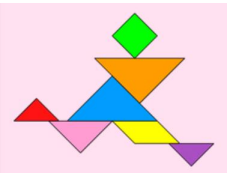
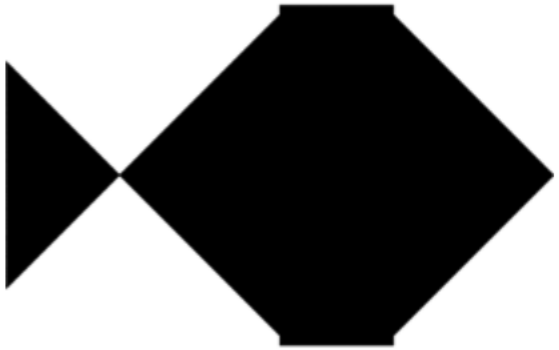


Tangrams

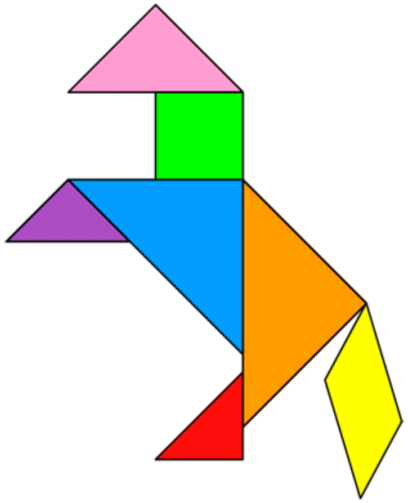


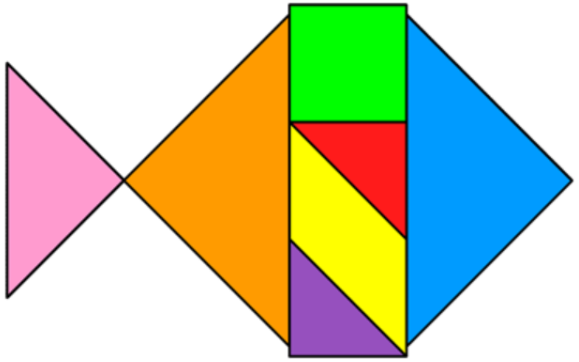
- Can you rearrange your shapes to make the shapes below
- Answers on the next page!



The puzzles were taken from *https://www.tangram-channel.com/* and the world of tan puzzles from https://nrich.maths.org/14074

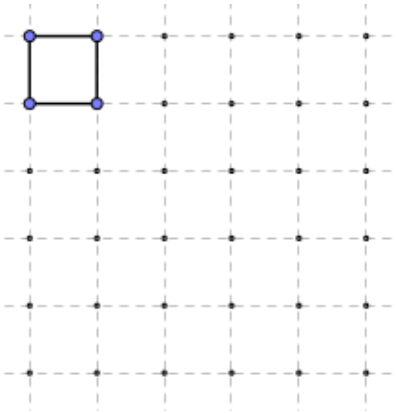
Tangrams possible solutions

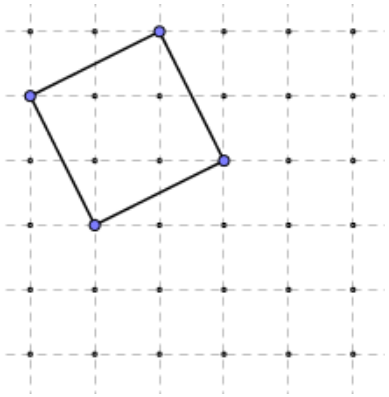




Drawing squares

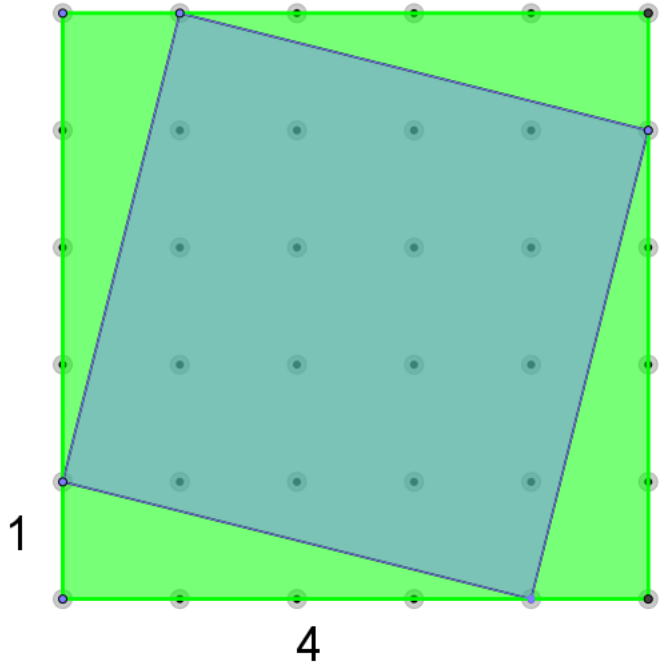
- We will be exploring drawing squares on dotty paper.
- Starting with a 5x5 grid, how many different squares can you draw on the grid? Here are some examples





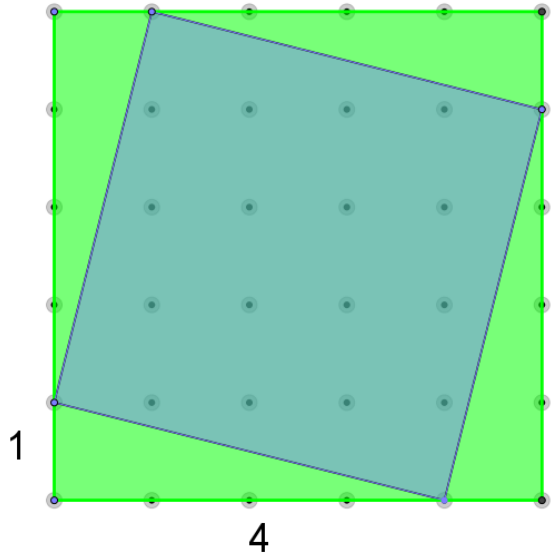
Area of squares

- The square below we can describe as [4,1].
- Label the squares you have drawn using the same convention.



Area

- We can work out the area of the smaller square below using the following technique



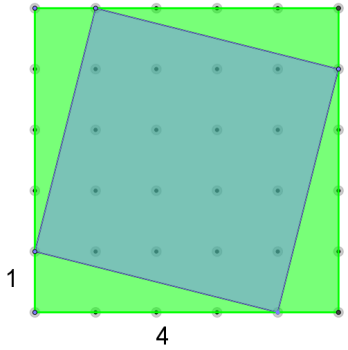
Area of large square $= 5\text{x}5 = 25 \text{ units}^2$

Area of triangle $= \frac{1}{2} \times 4 \times 1 = 2 \text{ units}^2$

Area of small square $= 25 - (4 \times 2) = 16 \text{ units}^2$

Area

- Can you use the same technique to work out the area of all the squares you have found on your 5x5 grid?



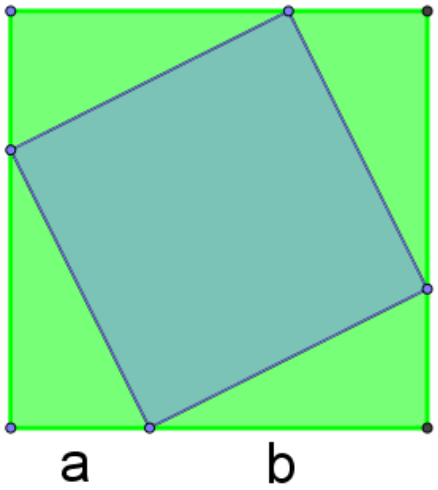
Area of large square $= 5\text{x}5 = 25 \text{ units}^2$

Area of triangle = $\frac{1}{2} \times 4 \times 1 = 2 \text{ units}^2$

Area of small square = $25 - (4 \times 2) = 16 \text{ units}^2$

Area and algebra

- We now have square [a,b] where a and be are any integers.
- What is the area of the small square?



- Can you make a formula that links the areas of the different shapes?

Impossible squares

- Watch this video

- Look at your list of squares from your 5x5 grid
- Did you get them all?
- Did you get any duplicates?

Impossible squares

- What squares with area less than 25 units^2 can you not draw with vertices on the dots?

Impossible squares

- 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

	K=0	K=1	K=2	K=3
Power = 1	3	7		
Power = 3				

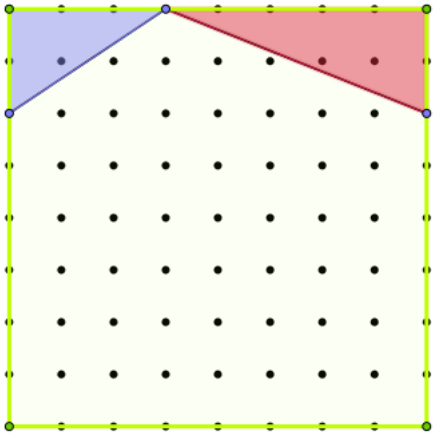
Impossible squares

- 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?

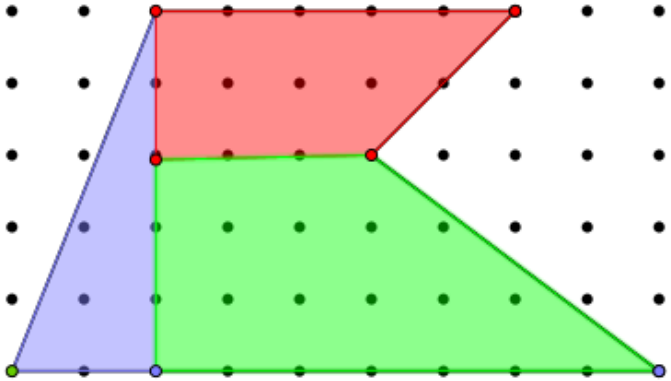
Further reading

- 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

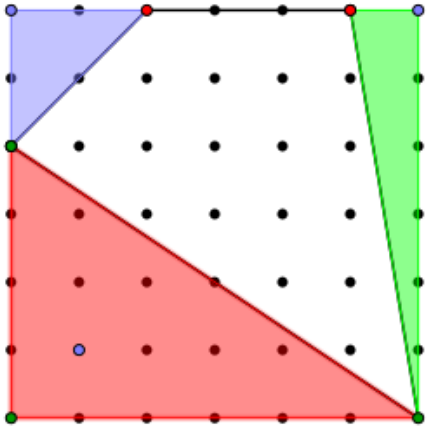
Compound shapes answers



Large square
- two triangles
= 64 – 3 – 5
= 56 units^2



Triangle + two trapeziums
= 5 + 8 + 15
= 28 units^2



Large square
- three triangles
= 36 – 2 – 12 – 3
= 19 units^2

Contact the AMSP

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