

Mathematical reasoning and proof

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List of resources

1. *T-shapes*
Using a T-shape and a number grid to explore algebraic expressions.
2. *Further resources to follow shortly*

Scott joined the Farnley Academy in 2011 as Director of Mathematics. Prior to this, he was Head of Mathematics at Crofton High School for five years. Since joining the Farnley Academy, Maths results have been transformed, from 49% of students gaining A*–C grades to 81% in 2013. His transformational work as a Subject Leader of Education has extended beyond the Gorse Academies Trust (Farnley and Morley), to working with Leeds schools and more recently with Todmorden and Bridlington High School. One school saw a 12% increase in students achieving A*–C grades.

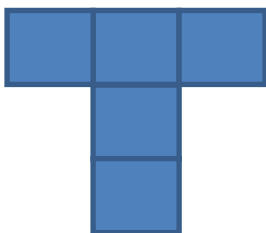
T- shapes

The number square below will be used for the following task.

You will develop your problem solving and algebra skills in this task.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Using the T shape below you will form algebraic expressions and make generalisations using the skills and process you have studied.



Trace this shape and place it on the number square.

Task 1

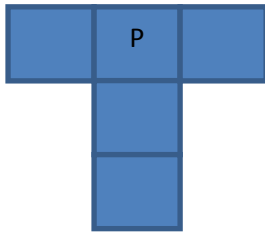
Place the T shape on the number grid. You can place it in any orientation, but each box must contain a number. Label one value as a letter and use your algebra skills to decide all the other values in the T shape.

Move the position of the starting letter within the T. How does this change the expressions within the T?

Task 2

Change the orientation of your T shape and complete Task 1 again. There are 4 orientations you could use. Remember to change the position of your starting letter.

Task 3



- The total of all the values in the T shape are 140. Can you use expressions and solving equations to find where the T shape is located?
- The total of all the values in the T shape is 410. Where is the T shape located?
- The total of all the values in the T shape is 255. Where is the T shape located?

Can you make a **general rule** for finding the location of the T shape when your starting letter (P) is located here?

Task 4

If you move the position of the starting letter (P), how does this change your general rule? If you change the orientation of the T shape then how does the rule change?

Task 5

Can you design a task similar to Task 3 for a T shape in a different orientation?

Teacher guidance

This task should be open-ended: students should be allowed to experiment with the positioning of their T and initially prompted to ask questions regards location and orientation. **You will need to provide tracing paper.**

The task sheet can be used to extend and scaffold the use of algebra to solve the problem and allow them to reason decisions they have made. A hint card is available for students who may struggle to understand the concept –this should allow students to access the first two tasks. For students who lack resilience this may be initially modelled using a visualiser.

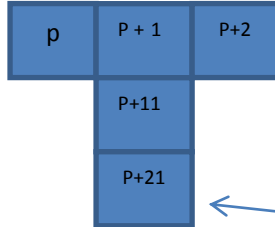
For weaker students, the T shape could be made smaller and a smaller grid used.

For brighter students, multiplication of values/expressions in the T shape would prove difficult.

Students could present their findings to the class to try and fine tune the language of reasoning.

Hint Card

This value is always 1 more than P
hence P + 1



This value is always 21 more than P
hence P + 21