

## Pentominoes on a Hundreds Grid

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**Materials required:** A **Hundreds Grid** and the set of the **12 pentominoes** printed and cut out from thick paper or card stock.

- I) a) Place the T-pentomino (The blue T in the figure) in an upright position anywhere on the hundreds grid.

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

Add the numbers that it covers (21, 22, 23, 32, and 42 in this figure), and find the remainder when the sum is divided by 5.

- b) Move the pentomino piece to other locations on the grid, sliding it horizontally or vertically, and place it in three different positions. For each of these positions:
- i) Find the sum of the numbers that the T-pentomino covers.
  - ii) The remainder when this sum is divided by 5.

*To keep things simple, let's call this remainder **R** from now on.*

- c) What do you notice about these remainders? Do you think your observation would still be true if the T-pentomino is moved to yet another location? Why do you think this is so? How would you convince a friend of your reasoning?
- d) Now rotate the pentomino to other possible orientations so that it covers exactly five cells on the grid (For example: the yellow and pink T's in the figure) and find **R** for these orientations. What do you notice?

## Worksheet

- e) Based on your observations, formulate a statement about the remainder when the sum of the numbers covered by the T-pentomino at any position and orientation on the hundreds grid is divided by 5. How do you know that your statement is true?
- f) Can you come up with an easy way to find the remainder when the sum of numbers covered by the pentomino is divided by 5 without actually calculating the sum?
- II)** a) Choose a different pentomino piece, say the U-pentomino. Place it at different positions on the hundreds grid and find **R**.
- b) Repeat the above for different orientations of the piece. Try rotating the piece and reflecting it about one of its edges and notice how these transformations change **R**.
- c) Based on your observation in a) and b) above, come up with a general statement about the **R** values when the U-pentomino is placed at different locations and orientations on the hundreds grid.
- III)** Explore with another pentomino of your choice, placing it in different positions and orientations on the hundreds grid. What can you say about the different **R** values obtained? How will you convince a friend of your generalisation?
- IV)** Based on your explorations in I, II, and III, what can you say about how the **R** value changes when you:
- i) Slide the same pentomino on the hundreds grid
- ii) Reflect it about a line of the hundreds grid
- iii) Rotate it about a point in such a way that the piece covers five grid squares in final position as well.
- How will you convince your friend that your statement is true?
- V)** Can you predict the **R** value of any pentomino piece without actually placing it on the hundreds grid and doing the calculation? Justify your method.
- VI)** State a property shared by those shapes that give an **R** value of 0.

