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# Mathematics Exploration Problems

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## Instructions:

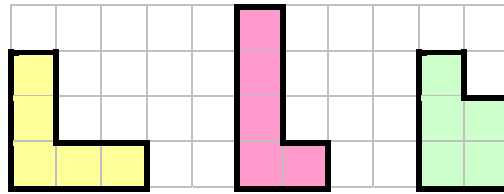
- Write down your name and country on every page of the answer sheet.
- Write your answer on the answer sheet.
- You have 120 minutes to work on this test.
- Each problem is worth 6 points, and partial credit may be awarded.
- Use black or blue colour pen or pencil to write your answer.



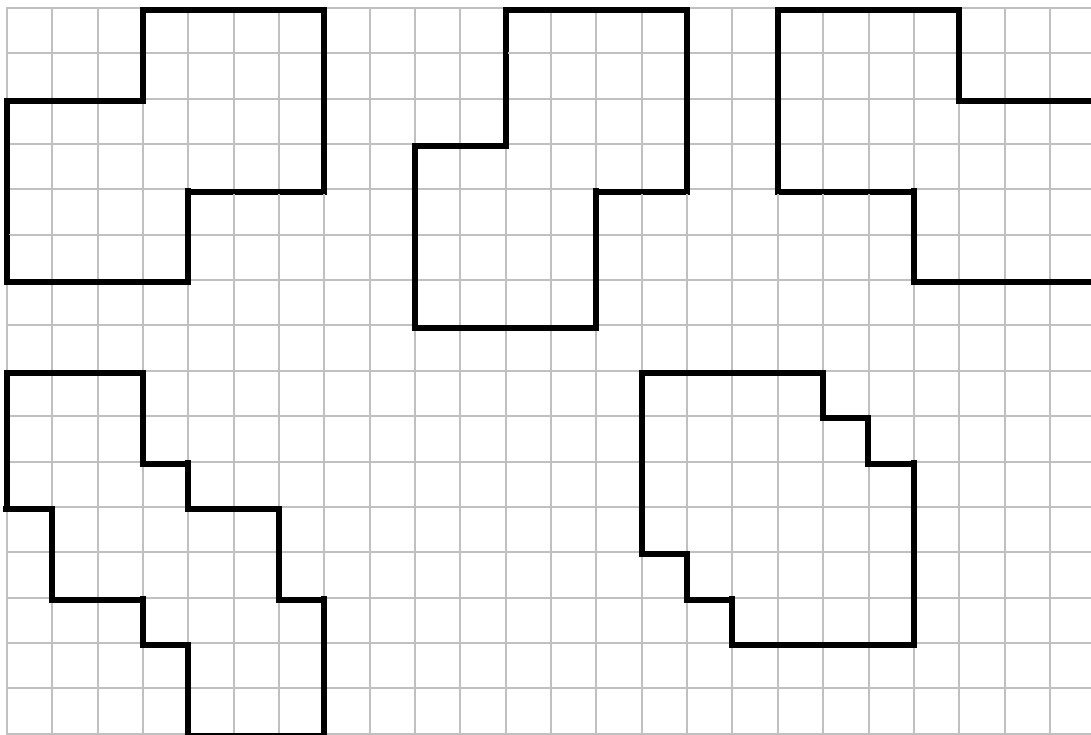
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# EXPLORATION PROBLEMS

- (1) The diagram below shows the V-, L- and P-pentominoes.



Use two copies of each to construct each of the given figures. The pieces may be rotated or reflected. *(To solve this problem, you may use scissors to cut the puzzle pieces in the attached colour page.)*

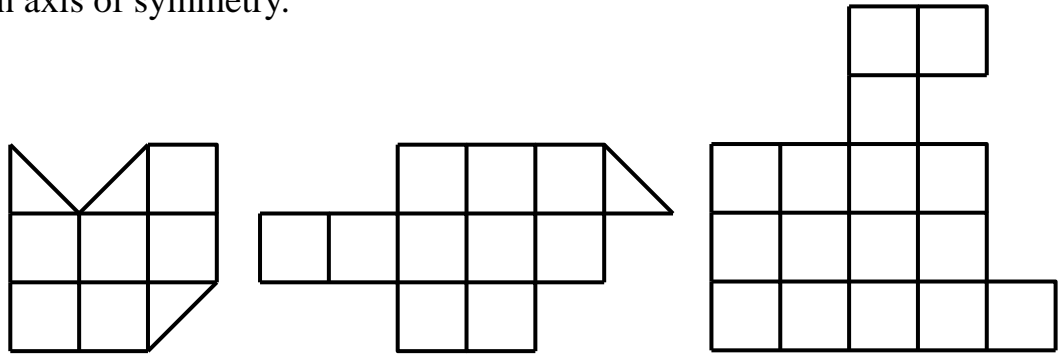


- (2) Find all ways of filling in the nine boxes with the digits 1 to 9, using each once, in order to make the addition and the multiplication correct.

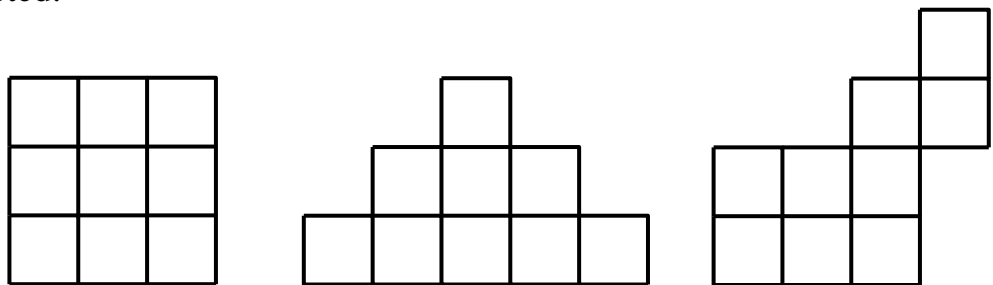
$$\begin{array}{r}
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 \times \quad \square \\
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 \end{array}$$

- (3) Two of 13 coins are counterfeit with equal weight. The other 11 coins are genuine coins also with equal weight, but a different weight from that of the counterfeit coins. We are not trying to identify the counterfeit coins but to determine whether a counterfeit coin is heavier or lighter than a genuine coin. How can this be done in three weighings on a balance?

- (4) (a) Cut each figure in the diagram below into two pieces such that each piece has an axis of symmetry.



- (b) Cut each of the figures in the diagram below into two pieces so that the six pieces consist of three identical pairs. The pieces may be rotated and reflected.



- (5) We introduce a new chess piece called a Catapult. Its range of attack is shown below.

			X			
		X	X	X		
	X	X		X	X	
X	X		C		X	X
	X	X		X	X	
		X	X	X		
			X			

In the  $8 \times 8$  chessboard below, place as many catapults as possible, so that no two them can attack each other. (*Mark a C on the chessboard for a catapult*)


- (6) The diagram below shows seven pieces on the left and a board on the right. On the pieces are black circles which represent the binary digit 1, and white circles which represent the binary digit 0. Use the seven pieces to cover the board so that the resulting configuration is a correct multiplication in binary numbers. The pieces may be rotated or reflected. (*To solve this problem, you may use scissors to cut the puzzle pieces in the attached colour page.*)

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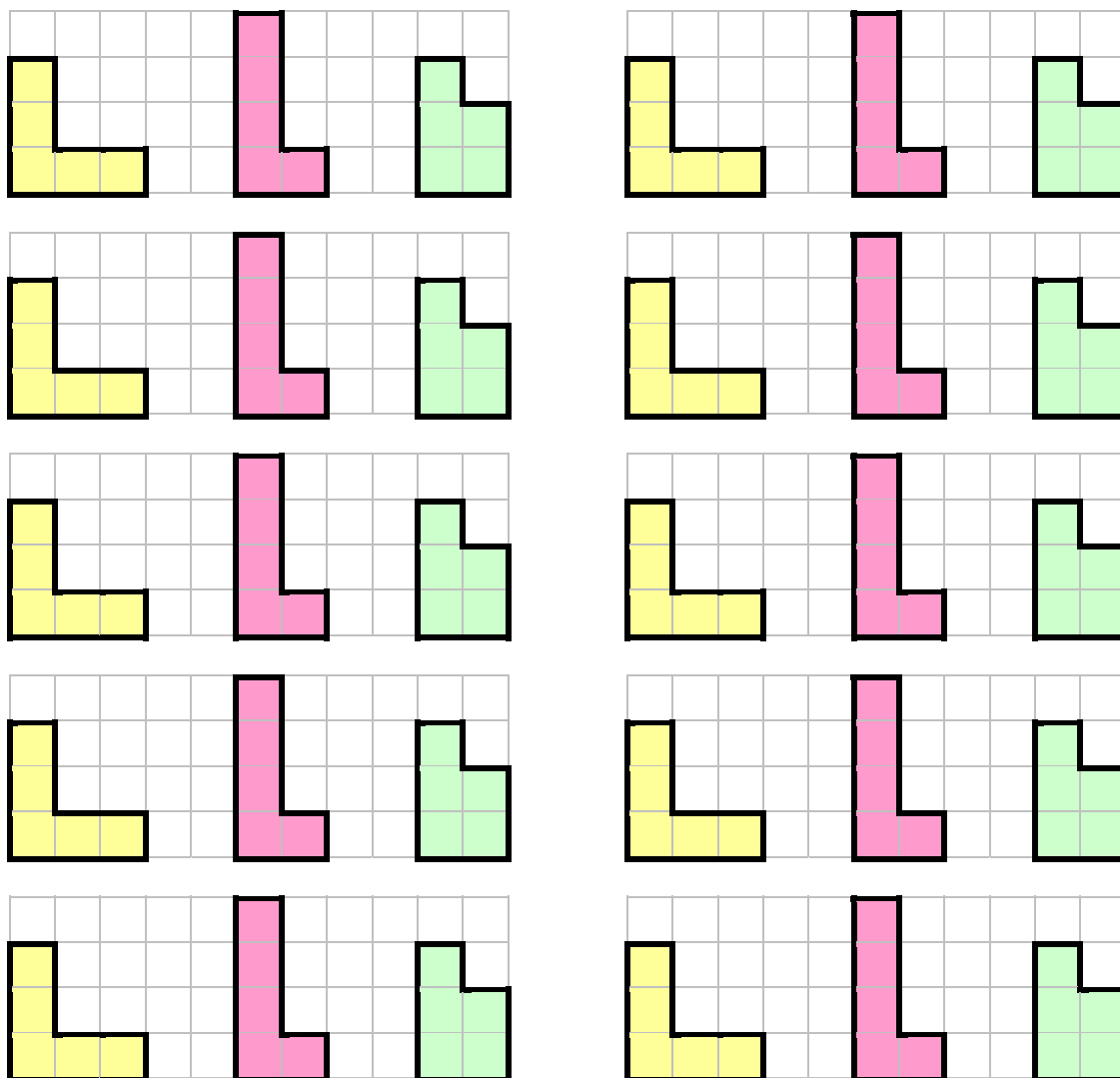
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You may use the scissors to cut the following shapes as you need.

For Problem 1:



For Problem 6:

