

SPRINGBOARD 6 LESSON 28 PROBLEM SOLVING 7

TOTAL TIME

45
MINUTES

Objectives:

- Identify and use the properties of shapes to solve problems
- Explain methods and reasoning orally and in writing

Vocabulary:

- isosceles
- equilateral
- vertices
- regular pentagon
- symmetry
- edges
- perimeter

By the end of the lesson the children should be able to:

- calculate the perimeters of compound shapes and explain the strategies they have used.

Resources:

- small equilateral triangles
- OHT 28.1
- OHT 28.2
- Activity Sheet 28.1
- Activity Sheet 28.2
- Activity Sheet 28.3
- Resource Sheet 28.1
- Resource Sheet 28.2

ORAL AND MENTAL STARTER

10
MINUTES

Show OHT 28.1. Point to the pentagon, trace your finger around the perimeter and ask:

Q: What is the name of this shape?

Establish that the shape is called a pentagon and that the perimeter of the pentagon is the distance made up by the five outside edges.

Q: Is the pentagon regular?

Remind the children that regular means all edges are equal and all angles are equal. Agree that this is a regular pentagon. Write the words 'Regular pentagon' on OHT 28.1. Explain that the vertices are identified by the letters and the pentagon is labelled ABCDE. Trace a triangle in the pentagon and ask for its label using the letters, e.g. CDE, DEC, ECD. Say that these labels represent the same triangle.

Q: How many different sizes of triangle can you see in this shape?

Give each child Activity Sheet 28.1. Get the children to work in pairs and record the different triangles on the Activity Sheet by shading the triangle. Encourage them to label the vertices of the triangle they have found.

Refer to triangle EAB on OHT 28.1.

Q: What type of triangle is triangle EAB?

Establish that the triangle EAB must be isosceles because two of its sides are equal as they are edges of the regular pentagon, which has equal edges.

Q: Which two angles must be equal?

Establish that angle AEB must be equal to angle ABE.

Q: Are any of the other triangles you found isosceles triangles?

Discuss other triangles found by the children. Identify them on the OHT and ask them to say if they think they are isosceles. Note the children's responses and say that you will look at these triangles again at the end of the lesson.

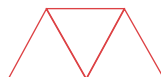
MAIN TEACHING ACTIVITY

Give out 10 equilateral triangles and Activity Sheet 28.2 to each pair of children.

Q: What different shapes can you make using 3 triangles.

Ask children to use the equilateral triangles to make the shape and record these on the Activity Sheet.

Discuss the shapes that the children make. Establish that triangles must be joined edge to edge and agree that there is only one possible shape as all the others are either a reflection or rotation of this shape (isosceles trapezium):



Say that you want children to imagine that the perimeter of one equilateral triangle is 6 cm.

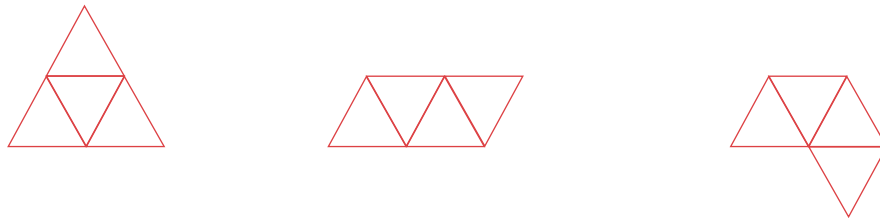
Q: What is the perimeter of this new shape?

Discuss the children's responses and reasons and establish that the side length of each equilateral triangle is 2 cm, so the new shape has a perimeter of 10 cm.

Q: How many different shapes can you make with 4 equilateral triangles?

Ask children to record these on the Activity Sheet.

Discuss the different shapes made and agree that 3 different shapes can be made, one of which is a larger equilateral triangle:



Q: What is the perimeter of this larger triangle?

Establish that the sides of this large triangle are 4 cm and that the perimeter is 12 cm.

Give out Activity Sheet 28.3.

Q: Can we answer the question on the activity sheet?

Establish that we need more information about the size of some of the shapes. Explain that the perimeter of a small equilateral triangle is 21 cm and get the children to record this on their Activity Sheet.

Q: How many small equilateral triangles are in Maria's shape?

Take the children's responses and get them to justify their reasons.

Q: How can we show that the large triangle is made up of 4 small equilateral triangles?

Explain that we can draw in the other triangles on the Activity Sheet. Get the children to do so.

Ask the children to work in pairs to find the perimeter of the shape. Explain that the children should show all their working in the box provided.

Take the children's responses and discuss the solution.

Give out Resource Sheet 28.1.

Q: Is this question the same as the one we have been working on?

Agree that it is the same question but that there is no 'Show your working' box.

Q: What should we do if there is no 'Show your working' box?

Emphasise that the children should draw on the diagram to add information given in the question and use any spaces on the paper to record their working out.

PLENARY

Show OHT 28.1 again, and ask children to look at Activity Sheet 28.1.

Remind the children of the different triangles they found and the way the letters were used to label the triangles.

Ask the children to work in pairs and decide:

Q: Which triangle has the largest perimeter?**Q: Which triangle has the smallest perimeter?**

Discuss children's answers and, on OHT 28.1, refer to the triangles, using the letters as labels.

Show OHT 28.2 with the six triangles.

Get the children to place the triangles in order of size of perimeter.

Discuss the children's responses and reasons. Cut out the pentagon on Resource Sheet 28.2. Use folding to show that the triangles in pictures 1 and 6 have the same perimeter.

Q: Which of these triangles are isosceles?

Create lines of symmetry by folding to establish that all the triangles are isosceles.

Remember:

- Isosceles triangles have two equal sides, two equal angles and one line of symmetry.
- Record any information in questions on the diagrams if it helps you.
- Write down your working out even if there is no 'Show your working' box.

LESSON 28 RELATED TEST QUESTION
2002 TEST A (NON-CALCULATOR PAPER)

11 Mr Singh buys paving slabs to go around his pond.

PAVING SLABS	
£1.95 each	Square slabs 50cm by 50cm
£3.50 each	Rectangular slabs 100cm by 50cm

He buys 4 rectangular slabs and 4 square slabs.
What is the total cost of the slabs he buys?

Show your working. You may get a mark.

£

Mr Singh says,
‘It would cost more to use square slabs all the way round.’

Explain why he is correct.

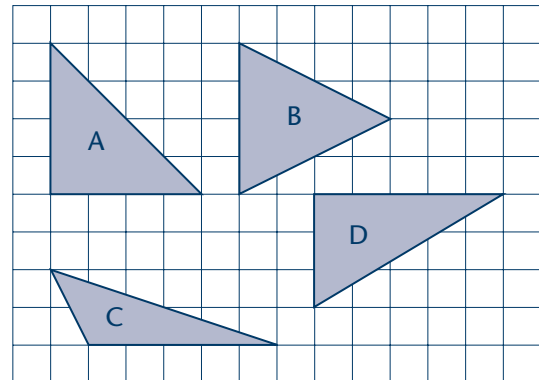
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LESSON 28 RELATED TEST QUESTION
2002 TEST B (CALCULATOR PAPER)

12 Here are four triangles drawn on a square grid.



Write the letter for each triangle in the correct region of the sorting diagram.

One has been done for you.

	has a right angle	has an obtuse angle	has 3 acute angles
is isoceles	A		
is not isoceles			

GUIDANCE FROM MARK SCHEME

Question	Requirement	Additional Guidance
11a	Award TWO marks for the correct answer of £21.80 If the answer is incorrect, award ONE mark for evidence of appropriate working, e.g. $3.50 \times 4 = 14.00$ $1.95 \times 4 = 7.80$ $14.00 + 7.80 =$ wrong answer	Accept £21.80p OR £21 80 Accept for ONE mark £2180p OR £2180 OR £21.8 as evidence of appropriate working. Calculation must be performed for the award of ONE mark
11b	An explanation which recognises that each square slab costs more than half a rectangular slab or equivalent, e.g. <ul style="list-style-type: none"> ■ ‘Half of £3.50 is £1.75, which is less than £1.95’; ■ ‘Two square slabs cost more than one rectangular slab’; ■ ‘Because 12 squares cost £23.40’; ■ ‘Because it would cost £1.60 more’. 	Do not accept vague or arbitrary explanations, e.g. <ul style="list-style-type: none"> ■ ‘Because he would need more slabs’; ■ ‘Because square slabs are cheaper than rectangular slabs’; ■ ‘Because it costs more’; ■ ‘He is right because the square slabs are £1.95 each and the rectangular slabs are £3.50 each’.

Question	Requirement	Additional Guidance
12	Award TWO marks for three letters in the correct regions of the sorting diagram, as shown:	Do not accept letters that are written in more than one region. Accept alternative indications such as lines drawn from the shapes to the appropriate regions of the sorting diagrams.

A		B
D	C	

Award **ONE** mark for two letters in the correct regions of the sorting diagram.

ANALYSIS OF CHILDREN'S ANSWERS

- Nearly 30 per cent of children working at level 3 gained both marks to part (a) of question 11; a further third were awarded 1 mark. As many level 3 children used a standard method for multiplication and addition as those who used an informal method. Informal methods were less common with level 4 or 5 children. None of the level 3 children was awarded the mark for part (b); only one-fifth of level 4 children gained the mark. The most common error was to say that using square slabs cost more without any comparison with other costs.
- Children working at level 3 were much less successful at answering this question correctly than children at level 4. Many children did not recognise that triangle B was isosceles, while 20 per cent of levels 3 and 4 children thought triangle C was isosceles. Only 5 per cent of level 3 children were awarded 2 marks; 15 per cent gained 1 mark.

IMPLICATIONS FOR PLANNING

- Children working at the level 3 to 4 borderline who can use informal methods confidently and accurately, should be encouraged to continue to use them.
- There should be planned activities where children are asked to justify a statement, first orally, then in writing. Children should be taught to recognise when an explanation is clear and why it offers a complete justification.
- Children should be presented with lines and shapes drawn onto a grid and taught how to determine whether two lines or the edges of shapes are the same length.
- There should be planned activities where children identify shapes in various orientations and within compound shapes.