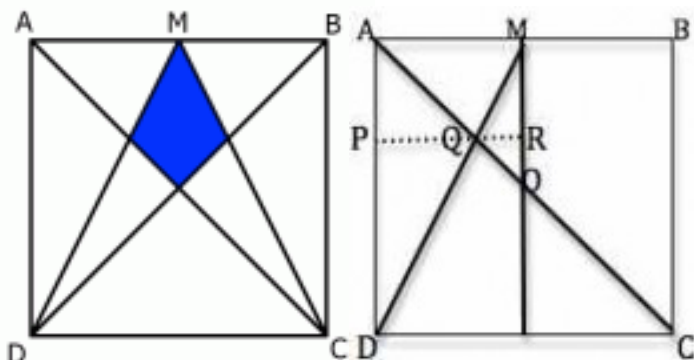


KITE IN A SQUARE

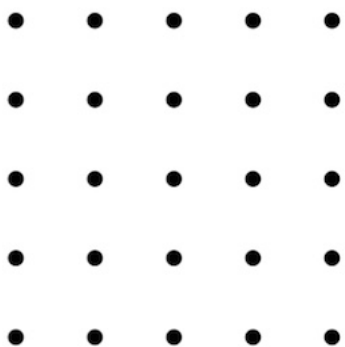


ABCD is a square with edge 1 unit.
 $AM=MB$ and O is the centre of the square.

Find the area of the kite.

Can you do this by more than one different method?

HELP

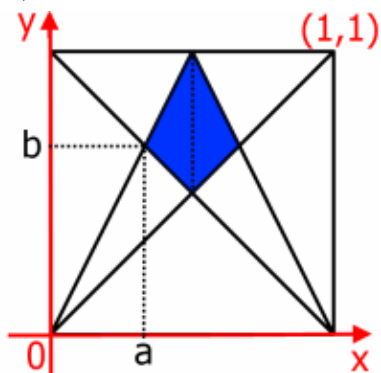


Start by drawing the square for yourself on dotty paper.

What do you notice about triangles ADQ and MQO ?

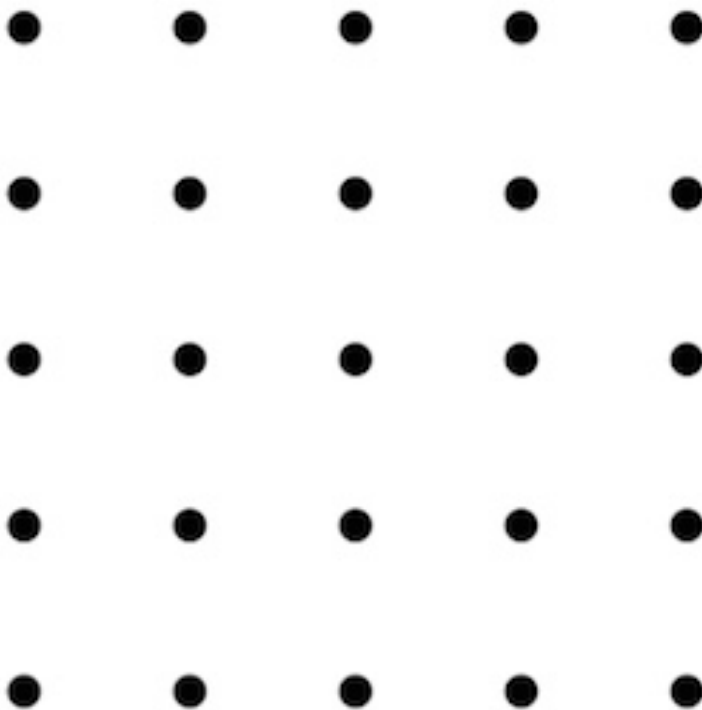
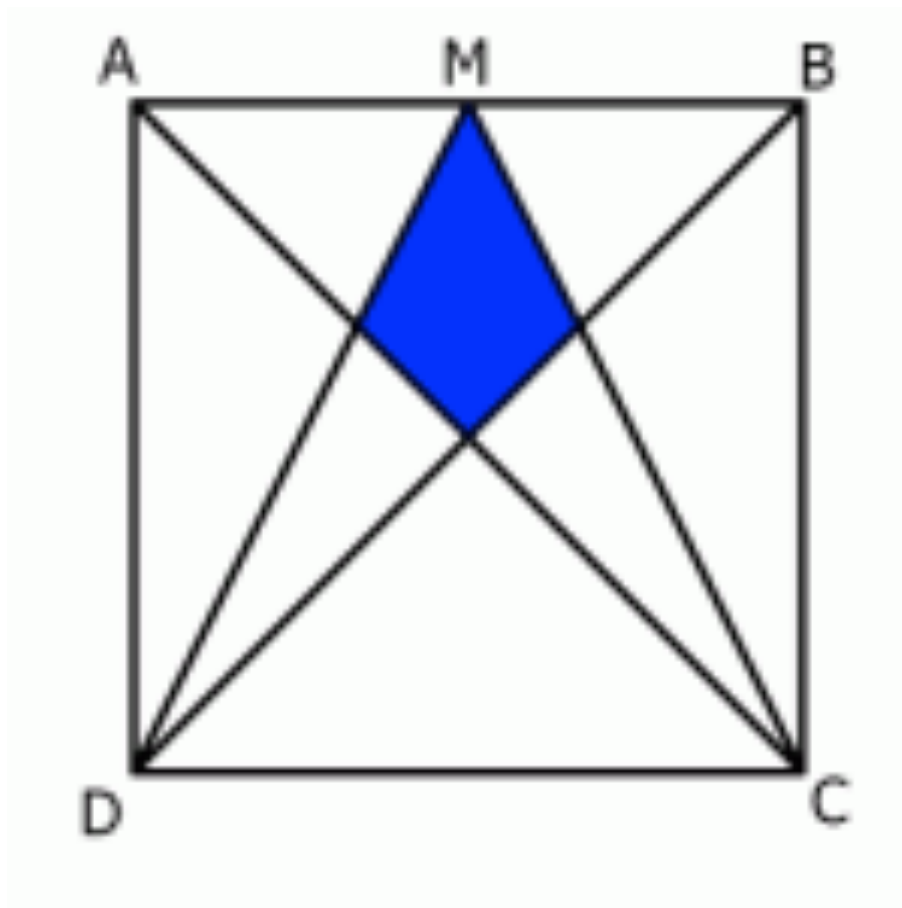
What can you find out about the lengths PQ and QR ?

NEXT



This diagram might suggest another method. Can you find the area of the kite by two different methods?

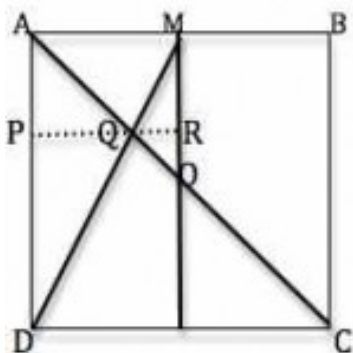
Can you find the areas of the other triangles in the diagram?



HOME LEARNING GUIDE

SOLUTION

METHOD 1: BY SIMILAR TRIANGLES

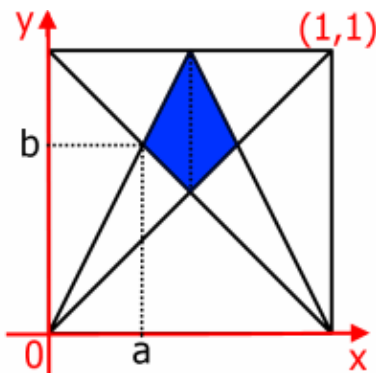


Triangles ADQ and QOM are similar because $\angle ADQ = \angle QMO$ (alternate angles $AD \parallel MO$) and $\angle DAQ = \angle QOM$ (alternate angles $AD \parallel MO$).

So $PQ = 2QR$, that is $PQ = \frac{1}{3}$ and $QR = \frac{1}{6}$.

Area $\triangle QOM = \frac{1}{2} \times \frac{1}{2} \times \frac{1}{6} = \frac{1}{24}$ and AREA of KITE = $\frac{1}{12}$.

METHOD 2 BY COORDINATES



The point (a, b) is the intersection of the lines $y = 2x$ and $y = 1 - x$ so $a = \frac{1}{3}$ and $b = \frac{2}{3}$.

The kite is made up of two congruent triangles. One triangle has vertices $(\frac{1}{2}, \frac{1}{2})$; $(\frac{1}{2}, 1)$, $(\frac{1}{3}, \frac{2}{3})$ perpendicular height $\frac{1}{6}$ and area $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{6} = \frac{1}{24}$

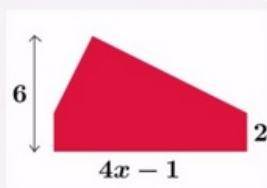
AREA of KITE = $\frac{1}{12}$.

Diagnostic Assessment This should take about 5–10 minutes.

1. Write the question on the board, say to the class:

“Put up 1 finger if you think the answer is A, 2 fingers for B, 3 fingers for C and 4 fingers for D”.

Which option gives an expression for the AREA of the shape.



A $24x - 6$

B $24x - 2$

C $16x - 2$

D $16x - 4$

2. Notice how the learners responded. Ask a learner who gave answer A to explain why he or she gave that answer and DO NOT say whether it is right or wrong but simply thank the learner for giving the answer.

3. It is important for learners to explain the reason for their answer as it helps them to clarify their own ideas and develop their communication skills.

4. Then do the same for answers B, C and D. Try to make sure that learners listen to these reasons and try to decide if their own answer was right or wrong.

5. Ask the class again to vote for the right answer by putting up 1, 2, 3 or 4 fingers. Notice if there is a

change and who gave right and wrong answers.

The concept of area is needed for the lesson to follow, so explain the right answer or give a remedial task.

The correct answer is **D**. Area rectangle + Area triangle

$$= 2(4x - 1) + \frac{1}{2} \times 4(4x - 1) = 4(4x - 1) = 16x - 4$$

A. This is the area of the ‘box’ enclosing the red shape.

B. and C. Students giving these answers seem to have multiplied the given dimensions randomly without any understanding of area.

<https://diagnosticquestions.com>

Why do this activity?

This activity is simpler than it looks and it gives learners the experience of using what they know about similar triangles to solve a problem involving area.

Learning objectives

In doing this activity students will have an opportunity to solve a geometric problem involving unknown sides and angles in triangles and quadrilaterals, using known properties of triangles and quadrilaterals, as well as properties of congruent and similar triangles.

Generic competences

In doing this activity students will have an opportunity to:

- think mathematically, reason logically and give explanations and proofs;
- visualize - develop the skill of interpreting and creating visual images;
- interpret and solve problems.

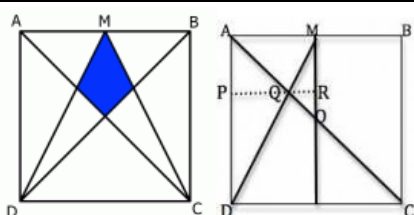
Suggestions for Home Learning

The following related activities could be used with a mixed age group of learners:

Young children: Could be given the picture (Page 2) and could talk about the shapes they see. And perhaps colour in the same colour the shapes that they think are the same.

Upper Primary: As above but these learners could also copy the diagram on page 2 on the dotted grid and talk about the symmetries they see. If you have one they could use a geoboard for this.

Lower Secondary: As above but, by Year 9 learners should be trying to find the area of the kite.



Years 9 and 10 You might guide these learners to use these two diagrams to find the area of the kite.

Start with the Diagnostic Quiz and find out if your learners can work out the area of a compound shape by splitting it into a rectangle and a triangle and finding those areas.

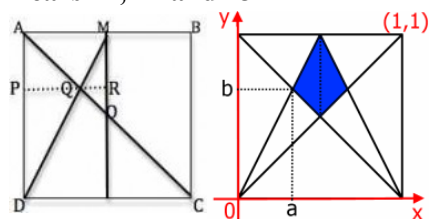
Show the first image from the problem and ask learners what they notice about it. Discuss the symmetries in the figure. Then say to the learners: "ABCD is a square with edge 1 unit. M is the midpoint of AB. Work out the area of the kite which is shaded in the diagram."

Give out the question on page 1. Give learners some time to have a go at the problem. If learners struggle to get started you might give them the HELP slip.

While they are working, see the methods they are trying. Use the key questions to guide their thinking. If they find the area by one method give them the NEXT slip from page 1.

Have a discussion about their solution getting learners to explain their work.

Years 11, 12 and 13 Older students could benefit from helping younger ones with the above.



Generally this age group should be able to work on their own but they can usually benefit from explaining their ideas to someone else. It might be confusing for them if you explain the maths to them in a different way to what they have heard from their teacher in school. These 2 diagrams give a hint about two different methods to solve the problem. Suggest they might work on a second method. Which method do they prefer?

Key questions

For Similar Figures method: • which angles are the same? • which triangles are similar? • which triangles are congruent? • can you find the lengths PQ and QR? • what lengths do we know?	For Coordinates method: • what are the equations of the lines? • where do they intersect?
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Follow-up ideas

Kissing Triangles <https://aiminghigh.aimssec.ac.za/years-9-11-kissing-triangles/>

Why the same <https://aiminghigh.aimssec.ac.za/years-11-12-why-the-same/>

Square Hole <https://aiminghigh.aimssec.ac.za/years-11-12-square-hole/>

Wedge on Wedge <https://aiminghigh.aimssec.ac.za/years-10-11-wedge-on-wedge/>

Note: The Grades or School Years specified on the AIMING HIGH Website correspond to Grades 4 to 12 in South Africa and the USA, to Years 4 to 12 in the UK and up to Secondary 5 in East Africa. New material will be added for Secondary 6. For resources for teaching A level mathematics see https://nrich.maths.org/12339 Note: The mathematics taught in Year 13 (UK) and Secondary 6 (East Africa) is beyond the school curriculum for Grade 12 SA.				
	Lower Primary or Foundation Phase Age 5 to 9	Upper Primary Age 9 to 11	Lower Secondary Age 11 to 14	Upper Secondary Age 15+
South Africa	Grades R and 1 to 3	Grades 4 to 6	Grades 7 to 9	Grades 10 to 12
USA	Kindergarten and G1 to 3	Grades 4 to 6	Grades 7 to 9	Grades 10 to 12
UK	Reception and Years 1 to 3	Years 4 to 6	Years 7 to 9	Years 10 to 13
East Africa	Nursery and Primary 1 to 3	Primary 4 to 6	Secondary 1 to 3	Secondary 4 to 6