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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

SUPERVISOR'S USE ONLY

Level 1 Mathematics and Statistics, 2014

91031 Apply geometric reasoning in solving problems

9.30 am Tuesday 18 November 2014

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Apply geometric reasoning in solving problems.	Apply geometric reasoning, using relational thinking, in solving problems.	Apply geometric reasoning, using extended abstract thinking, in solving problems.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Show ALL working.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

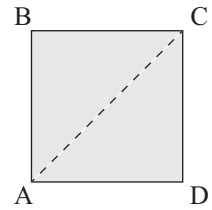
TOTAL

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QUESTION ONE

A wall has been tiled with square tiles.

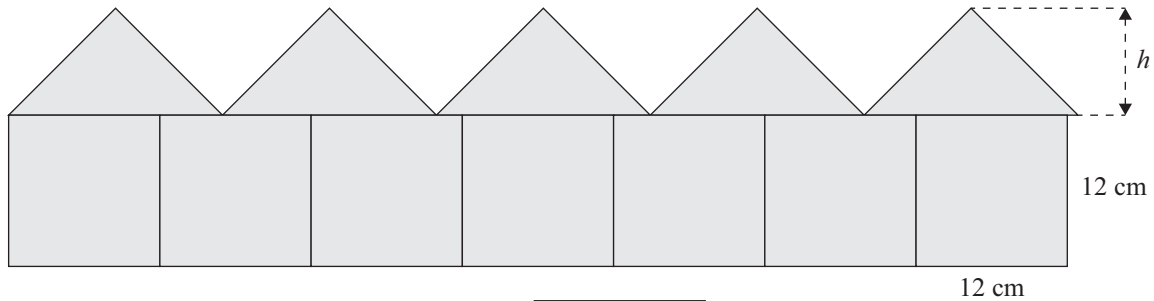
Each tile measures 12 cm by 12 cm. Some of the tiles have been cut diagonally as shown on the right:



- (a) (i) What is the length of the cut side, AC?

- (ii) Describe the triangle ABC using geometric terms.

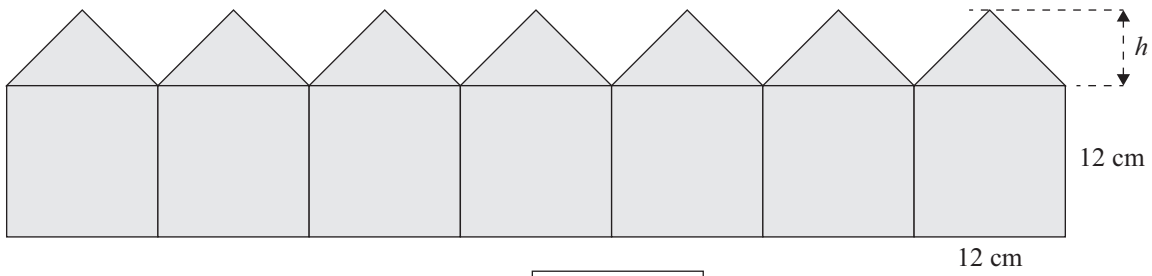
At the top of the wall, a border has been made from the tiles which have been cut in half, as shown below:



*Diagram is
NOT to scale*

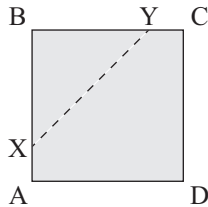
- (b) (i) How high is the border (distance h in the diagram above)?

(ii) Bob was looking at this border. He thought that it might look better if the border triangles ended neatly at the edge of the square tiles, as shown below (but not to scale):



*Diagram is
NOT to scale*

The triangles would be made by cutting tiles like this (so that XY is 12 cm):

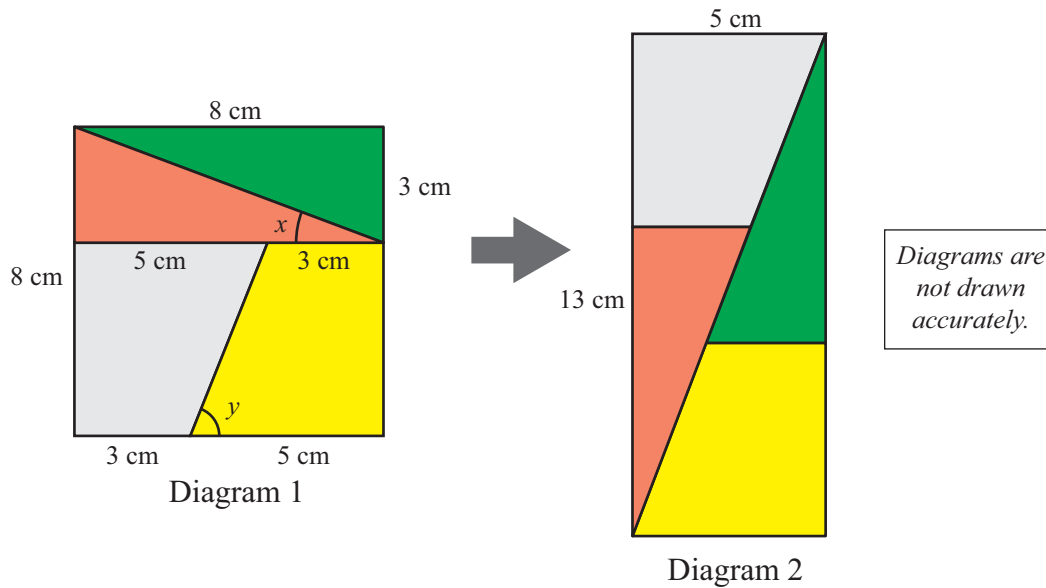


How high would this new border be (distance h in the top diagram)?

Explain your working clearly.

- (c) Bob has been reading about geometric puzzles that seem to be true, but are not actually true. This puzzle starts with a square tile, 8 cm by 8 cm. The area of this tile is 64 cm^2 (see Diagram 1, below).

The tile is then cut into 4 pieces and these pieces are rearranged as shown in Diagram 2.



This new shape seems to have an area of 65 cm^2 . Bob realises that the area cannot change.

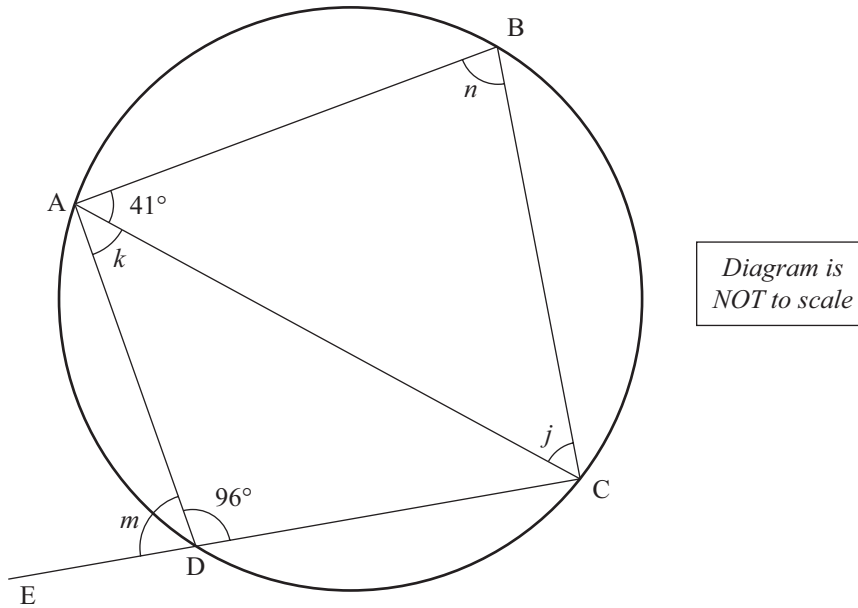
- (i) Calculate the size of angle x in Diagram 1.

- (ii) Calculate the size of angle y in Diagram 1.

- (iii) Explain why the area seems to have changed.

QUESTION TWO

- (a) ABCD is a cyclic quadrilateral and CE is a straight line.

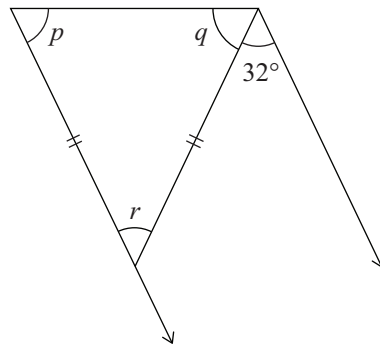


- (i) Calculate the size of angle m in the diagram above.
Justify your answer with clear geometric reasoning.

- (ii) Calculate the size of angle j in the diagram above.
Justify your answer with clear geometric reasoning.

- (b) (i) In the diagram below, find the size of angle p .

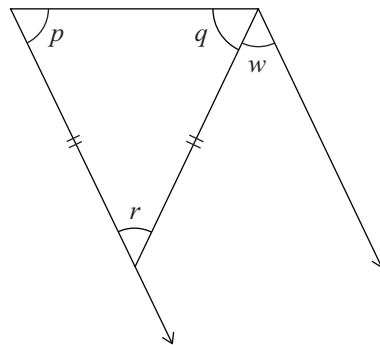
Justify your answer with clear geometric reasoning.



*Diagram is
NOT to scale*

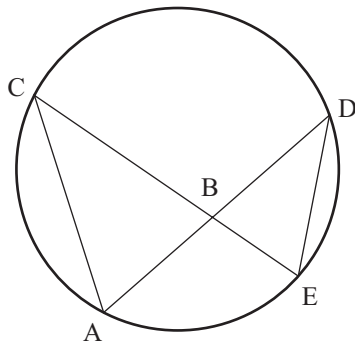
- (ii) In the diagram below, find an expression for angle p in terms of w only.

Justify your answer with clear geometric reasoning.



*Diagram is
NOT to scale*

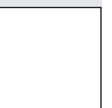
- (c) In the diagram below, A, C, D, and E lie on the circumference of a circle, and B is NOT the centre of the circle.



- (i) Use geometric reasoning to explain why triangles ABC and EBD are similar.

- (ii) Prove that $AB \times BD = BC \times BE$.

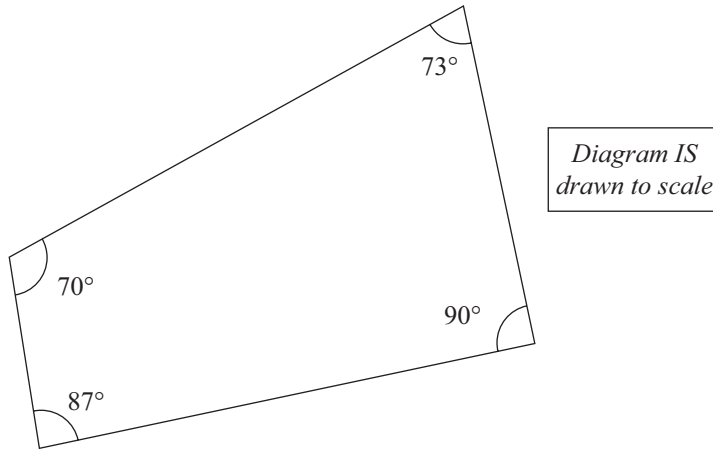
Justify your answer with clear geometric reasoning.



QUESTION THREE

Ahmed has been investigating quadrilaterals.

- (a) He uses his protractor to measure the angles in the quadrilateral below. He has made a mistake in measuring the angles. The diagram below is to scale.



- (i) There are two geometric reasons that show that Ahmed MUST have made a mistake.

Explain what these two reasons are.

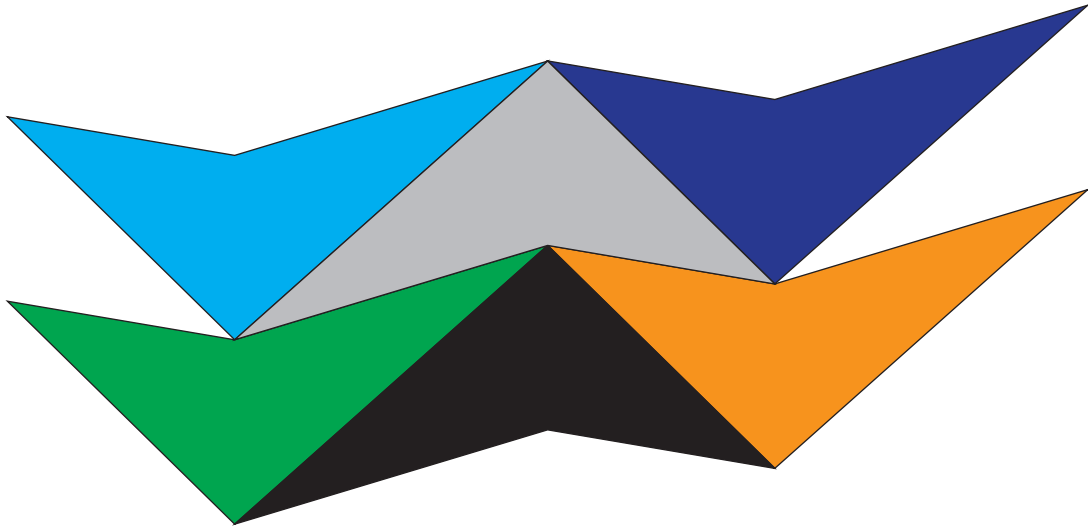
Reason 1: _____

Reason 2: _____

- (ii) Explain what mistake Ahmed might have made in using his protractor.

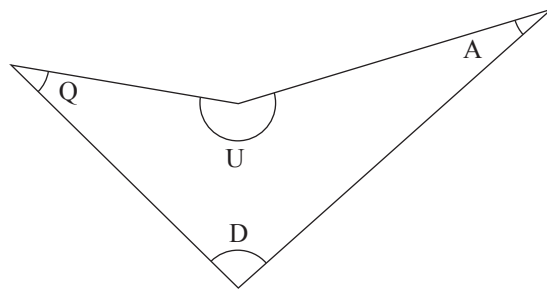
(b) Ahmed knows that any quadrilateral will tessellate. This means that it can be used to cover a surface leaving no gaps. An example is given below:

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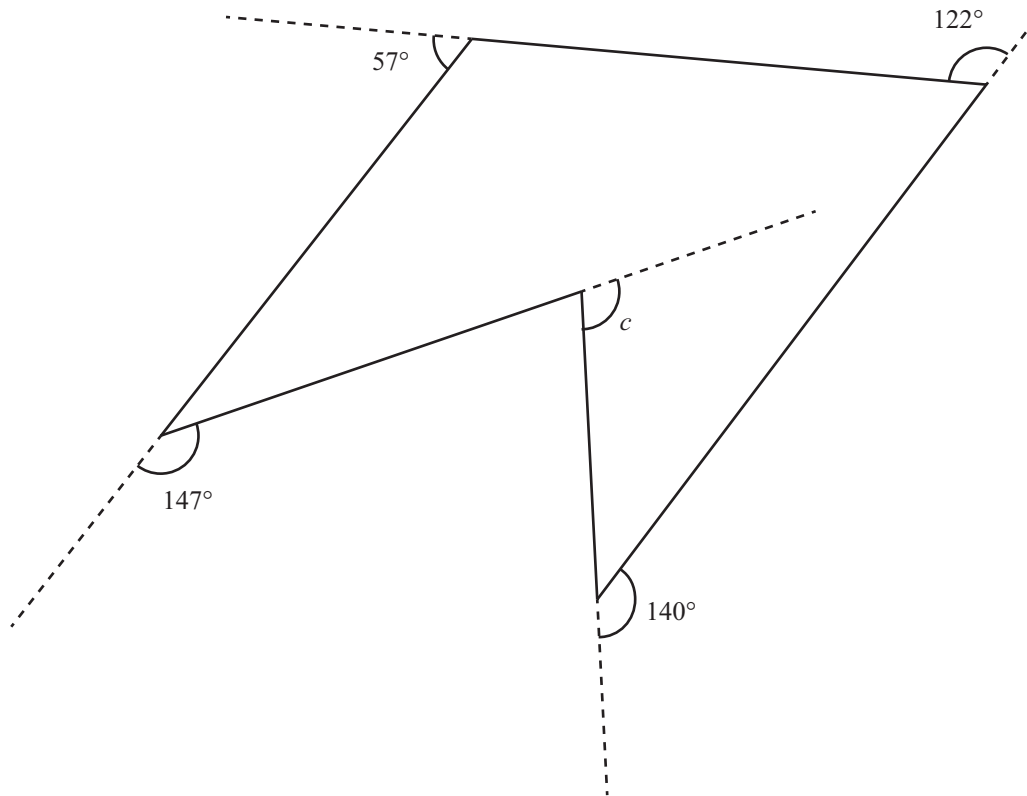


In this diagram, six copies of the same shape have been tessellated. The six shapes have been coloured differently so that you can see how the tessellation takes place.

Explain, using geometric reasoning, why it is true that any quadrilateral will tessellate. You may wish to refer to the labelled diagram below or to the tessellation above.



- (c) Ahmed draws a pentagon and draws the exterior angles (shown dotted).



Ahmed works out the size of angle c as shown below.

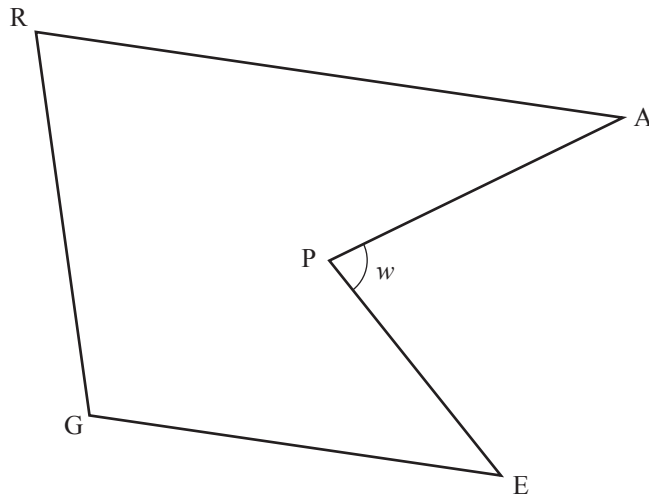
$$c = 360^\circ - 57^\circ - 147^\circ - 140^\circ - 122^\circ$$

$$c = -106^\circ$$

- (i) Give the geometric reason for his calculation.

- (ii) Explain the meaning of the negative measurement of the angle c , and state when this will occur.

- (d) In this pentagon, angle $EGR + \text{angle } GRA = 180^\circ$.



- (i) How does this prove that lines GE and RA are parallel?

- (ii) Prove that the angle APE (also labelled w above) is given by the equation:

$$\text{Angle } APE = \text{angle } PAR + \text{angle } PEG.$$

Explain your geometric reasoning clearly.

