1

91031

910310

SUPERVISOR'S USE ONLY

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Level 1 Mathematics and Statistics, 2019

91031 Apply geometric reasoning in solving problems

9.30 a.m. Wednesday 20 November 2019
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 room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–15 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

ASSESSOR'S USE ONLY

© New Zealand Qualifications Authority, 2019. All rights reserved.
No part of this publication may be reproduced by any means without the prior permission of the New Zealand Qualifications Authority.

VOYAGERS TO NEW ZEALAND

ASSESSOR'S USE ONLY

This year marks 250 years since the first meeting between Māori and the crew of Captain Cook's ship, the HMS *Endeavour*.

QUESTION ONE

Pacific voyagers settled in New Zealand many years before Captain Cook arrived. They travelled to New Zealand in double-hulled voyaging canoes, waka hourua, like the one pictured below.

Source: www.maoritelevision.com/news/sport/emerging-navigators-learn-ancient-art-way-finding

(a) The canoes had sails. One of the sails is shown in the diagram below.

BG, CF, and DE are all parallel to each other.

Angle EAD = 44º and angle ADE = 78º .

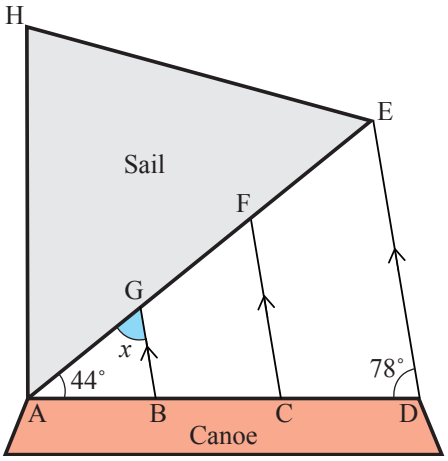


Diagram is NOT to scale

Calculate the size, x, of angle AGB.

Justify your answer with clear geometrical reasoning.

ASSESSOR'S USE ONLY

(b) The same sail is shown again below.

The edge of the canoe ABCD is horizontal.

The mast AKH is vertical.

AK = 2.8 metres. KH = 1.2 metres. Angle AKE = 90º .

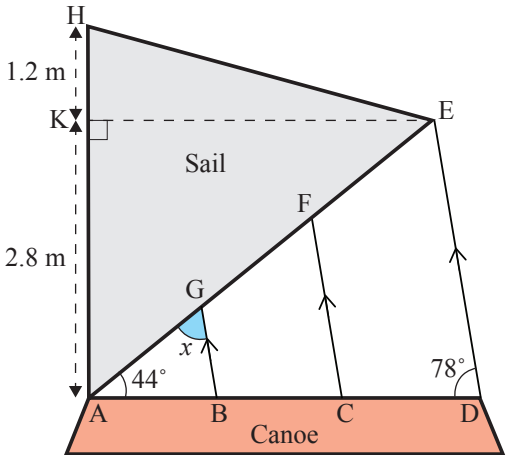


Diagram is NOT to scale

Calculate the area of the sail AHE (shaded grey in the diagram).

Show your working clearly.

ASSESSOR'S USE ONLY

(c) The canoe includes a pair of sails, which are both isosceles triangles, labelled P and Q below.
The angle z is exactly the same size in triangles P and Q.

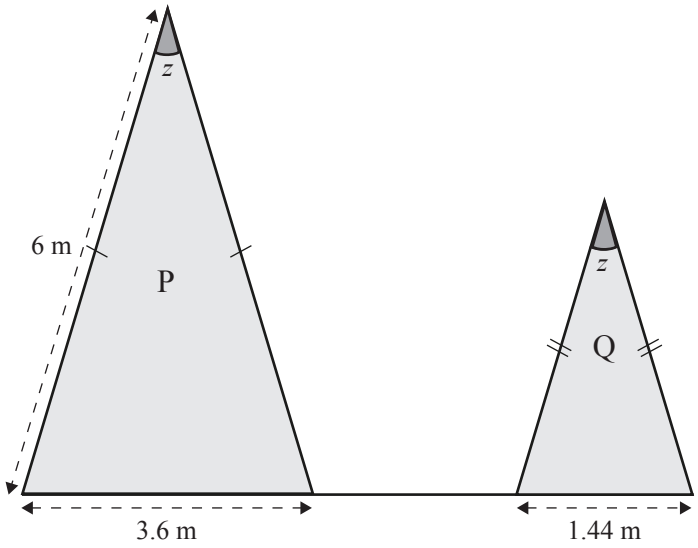


Diagram is NOT to scale

For the canoes to sail as fast as possible, the total area of both sails needs to be greater than 14 m².

Using the measurements shown in the diagram above, show whether or not the sails satisfy the size requirement.

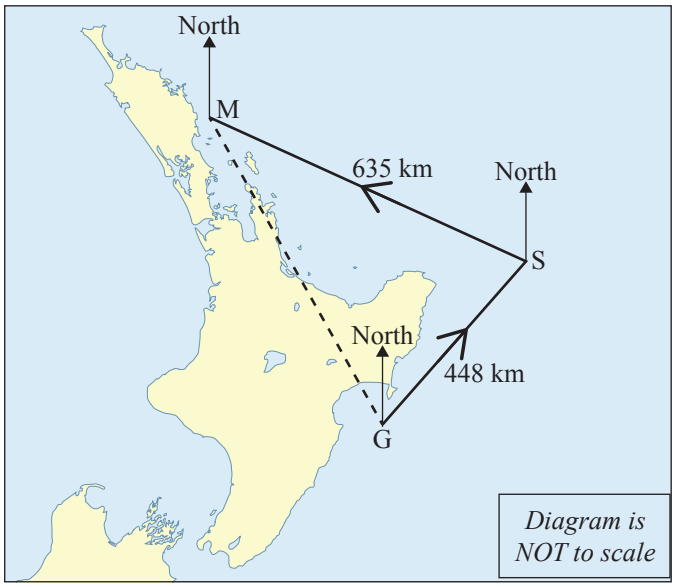
Justify your answer with clear geometrical reasoning and working.

ASSESSOR'S USE ONLY

(d) Captain Cook's ship, HMS *Endeavour*, sailed along the coastline via the route shown below on the map of the North Island, New Zealand.

The ship sailed from G to S on a bearing of 054º for a distance of 448 km.

It then changed direction, sailing from S to M on a bearing of 294º for a further distance of 635 km.



If Captain Cook was able to fly directly from G to M, find the bearing of M from G.

Show your working clearly.

Source (map, adapted): https://commons.wikimedia.org/wiki/File:Map_of_New_Zealand_(blank).svg. Public domain.

QUESTION TWO

ASSESSOR'S USE ONLY

(a) (i) Captain Cook sailed in a "tall ship" like the one shown in the picture below.

Source: www.telegraph.co.uk/news/2018/09/19/captain-cooks-missing-hms-endeavour-discovered-us-coast/

Part of the sail rigging is shown in the diagram below.

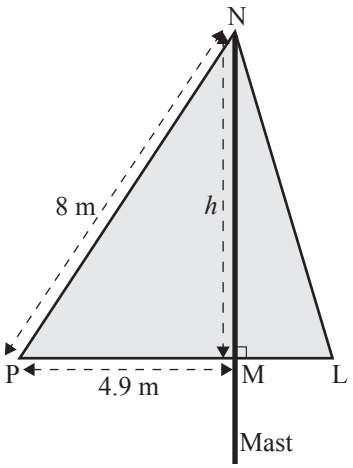


Diagram is NOT to scale

Show that the height of the sail, h, from M to N, is 6.32 metres.

Show your working clearly.

ASSESSOR'S USE ONLY

(ii) In light winds, the same section of sail expands, as shown below.

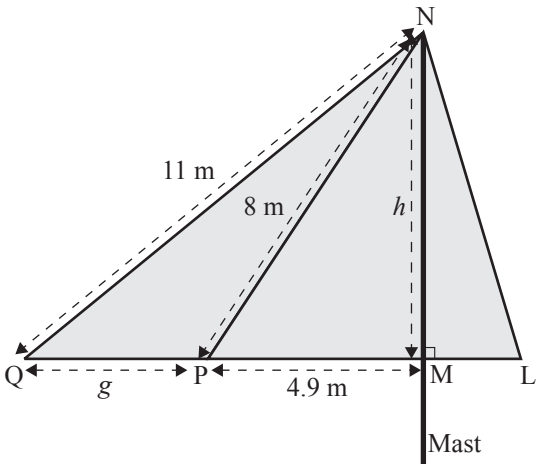


Diagram is NOT to scale

Calculate the length of the cross-beam, g, from P to Q.

Show your working clearly.

(iii) An extra support structure is necessary for heavy winds.

The straight support beam will attach from M to a point Y, somewhere along PN so that the angle between the lines MY and PN will be 90º.

Calculate the **perimeter** of the triangle PYM.

Show your working clearly.

ASSESSOR'S USE ONLY

(b) (i) Point C is the centre of the circle.
The straight line, SAT, is the tangent to the circle at the point A.

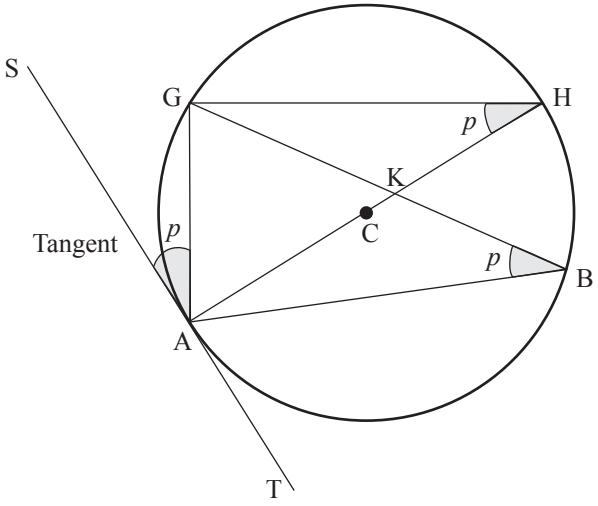


Diagram is NOT to scale

Prove that the sizes, p, of the angles SAG, AHG, and ABG are all equal to each other.
Justify your answer with clear geometrical reasoning.

ASSESSOR'S USE ONLY

(ii) In the diagram below, straight line SRT is the tangent to the circle at the point R.
The triangle UVR is isosceles, with UV = RV.
Angle UVR = 38º.

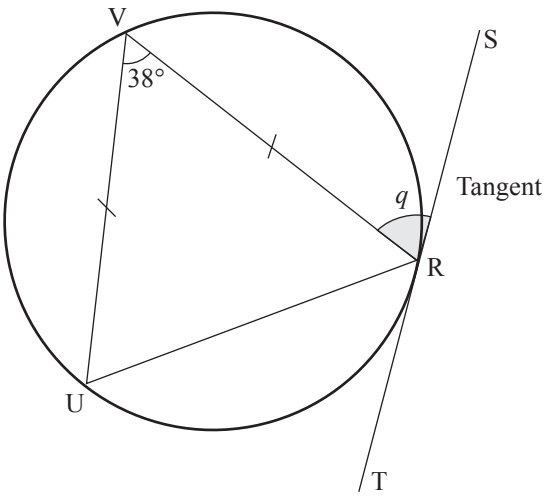


Diagram is NOT to scale

Calculate the size, q, of angle VRS.
Justify your answer with clear geometrical reasoning.

QUESTION THREE

ASSESSOR'S USE ONLY

(a) Straight lines DEF and TMB are parallel to each other.

Lines EM and EB are of equal length.

Angle FEB = 58º

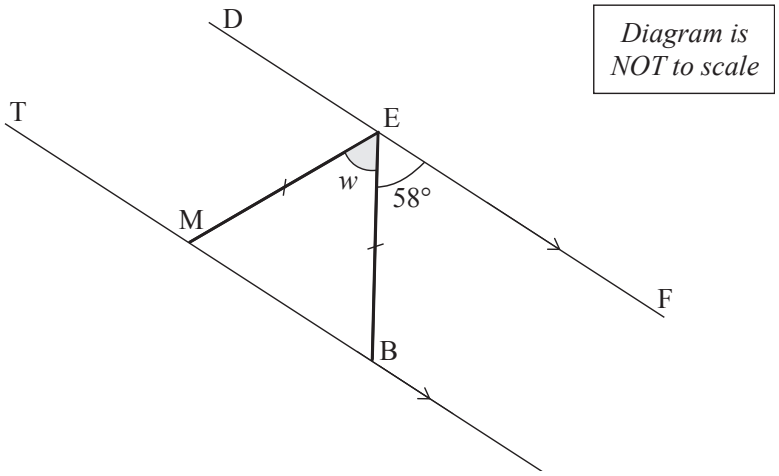


Diagram is NOT to scale

Calculate the size, *w*, of angle MEB.

Justify your answer with clear geometrical reasoning.

ASSESSOR'S USE ONLY

(b) C is the centre of the circle.

The radius of the circle is 28 mm.

Straight lines LMT and LNS are tangents to the circle at points M and N, respectively.

Angle MLN = 72º .

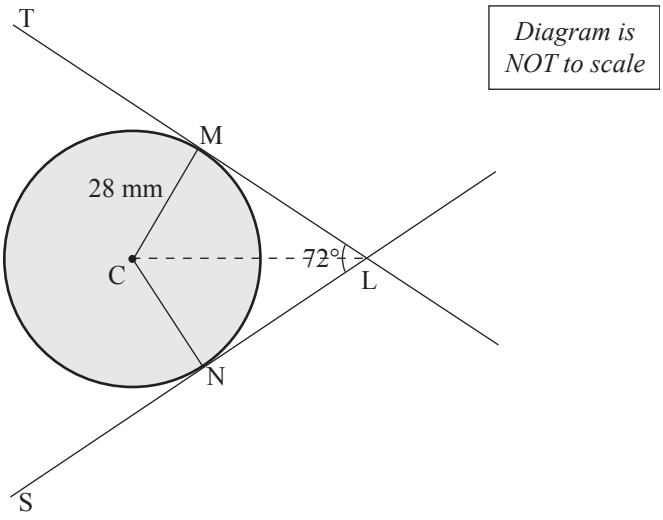


Diagram is NOT to scale

Calculate the length LC.

Justify your answer with clear geometrical reasoning.

ASSESSOR'S USE ONLY

(c) The points A, B, D, and E all lie on the circumference of a circle, with centre C.

Angle BDE = x.

AE = AB.

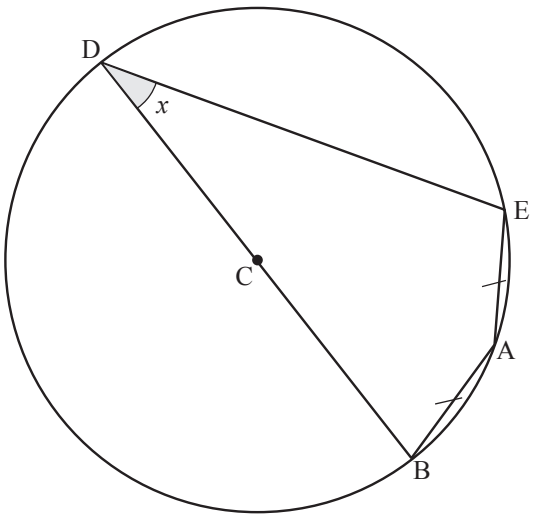


Diagram is NOT to scale

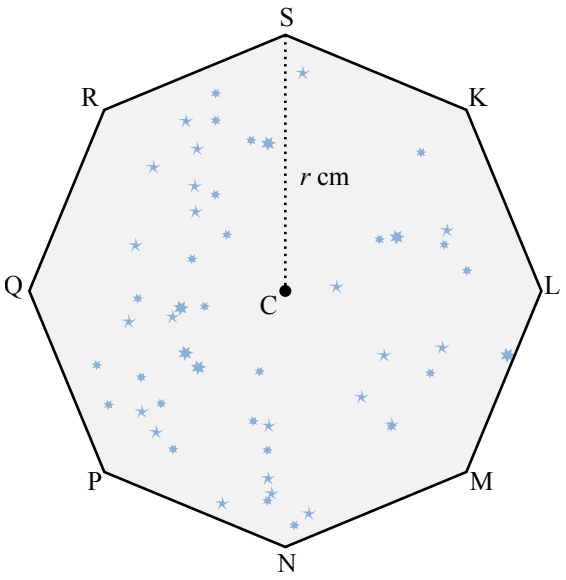
Find an expression for angle DBA, in terms of x.

Justify your answer with clear geometrical reasoning.

ASSESSOR'S USE ONLY

(d) Explorers in the 18th Century used the stars to help them navigate the oceans. They used a chart similar to one shown below, which shows a regular octagon.

The distance from the centre, C, of the octagon to each vertex is r cm.



Find an expression for the area of the octagon, in terms of r.

Show your working clearly.

Source (stars, adapted): https://en.wikipedia.org/wiki/File:Navigational-stars-below-30-degrees-south.svg. Public domain.

Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER

ASSESSOR'S USE ONLY

Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER

ASSESSOR'S USE ONLY

91031