91031M

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1

SUPERVISOR'S USE ONLY

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

Te Pāngarau me te Tauanga, Kaupae 1, 2019

91031M Te whakahāngai whakaaro āhuahanga whaitake hei whakaoti rapanga

9.30 i te ata Rāapa 20 Whiringa-ā-rangi 2019
Whiwhinga: Whā

Paetae	Kaiaka	Kairangi
Te whakahāngai whakaaro āhuahanga whaitake hei whakaoti rapanga.	Te whakahāngai whakaaro āhuahanga whaitake mā te whakaaro whaipānga hei whakaoti rapanga.	Te whakahāngai whakaaro āhuahanga whaitake mā te whakaaro waitara hōhonu hei whakaoti rapanga.

Tirohia mēnā e rite ana te Tau Ākonga ā-Motu (NSN) kei runga i tō puka whakauru ki te tau kei runga i tēnei whārangi.

Me whakamātau koe i ngā tūmahi KATOA kei roto i tēnei pukapuka.

Whakaaturia ngā mahinga KATOA.

Mēnā ka hiahia whārangi atu anō mō ō tuhinga, whakamahia te wāhi wātea kei muri o tēnei pukapuka.

Tirohia mēnā e tika ana te raupapatanga o ngā whārangi 2–27 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

ME HOATU RAWA KOE I TĒNEI PUKAPUKA KI TE KAIWHAKAHAERE Ā TE MUTUNGA O TE WHAKAMĀTAUTAU.

TAPEKE

MĀ TE KAIMĀKA ANAKE

NGĀ RERENGA KI AOTEAROA

MĀ TE KAIMĀKA ANAKE

Ko tēnei tau te tau 250 mai i te tūtakitanga tuatahi o te Māori me ngā kaumoana o te kaipuke o Kāpene Kuki, te HMS *Endeavour*.

TŪMAHI TUATAHI

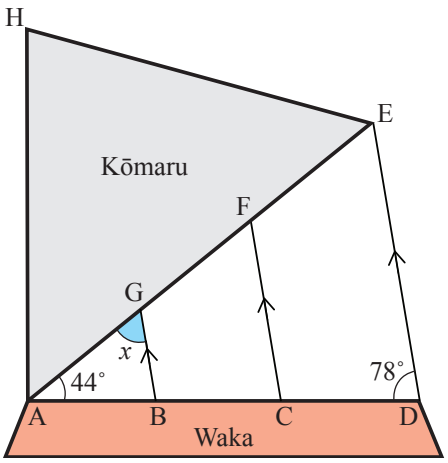
I tau mai ngā kaumoana o Te Moananui-a-Kiwa ki Aotearoa i ngā rau tau i mua noa atu i te taenga mai o Kāpene Kuki ki konei. I haere mai rātou ki Aotearoa mā runga i ngā waka hourua, pērā i tērā i roto i te pikitia i raro.

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

(a) He kōmaru ō ngā waka. E whakaaturia ana tētahi o ngā kōmaru i te hoahoa ki raro.

He whakarara a BG, CF, me DE tētahi ki tētahi.

Ko te koki EAD = 44º me te koki ADE = 78º .



KĀORE i tuhi ā-āwhatatia tēnei hoahoa

Tātaihia te rahi, x, o te koki AGB.

Whakamahia te whakaaro āhuahanga mārama hei parahau i tāu tuhinga.

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 .

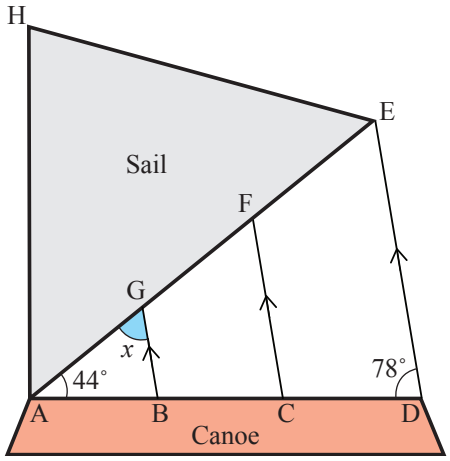


Diagram is NOT to scale

Calculate the size, x, of angle AGB.

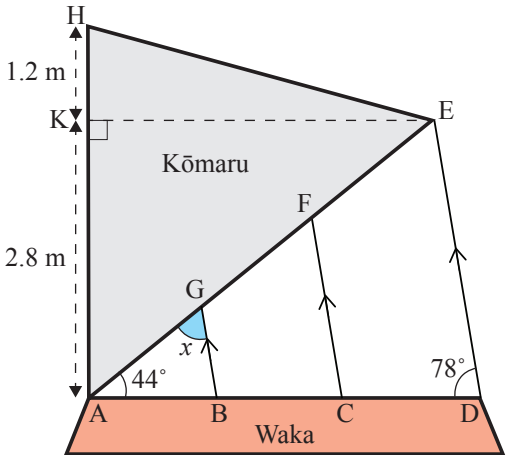
Justify your answer with clear geometrical reasoning.

(b) E whakaaturia ana taua kōmaru anō i raro nei.

Ko te tapa o te waka ABCD he huapae.

Ko te tūtira AKH he poutū.

AK = 2.8 mita. KH = 1.2 mita. Koki AKE = 90º .



KĀORE i tuhi ā-āwhatatia tēnei hoahoa

Tātaihia te horahanga o te kōmaru AHE (kua kiwikiwitia i roto i te hoahoa).

Āta whakaaturia ō mahinga.

MĀ TE KAIMĀKA ANAKE

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 .

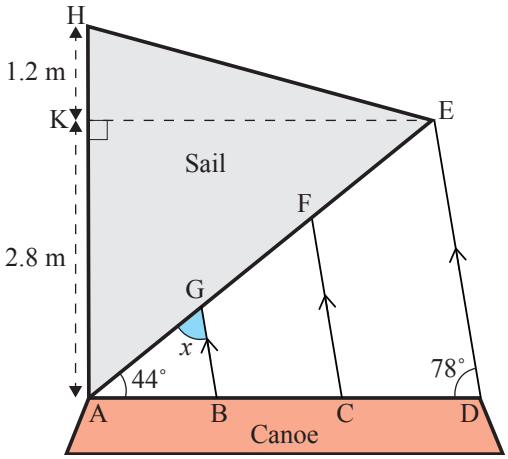


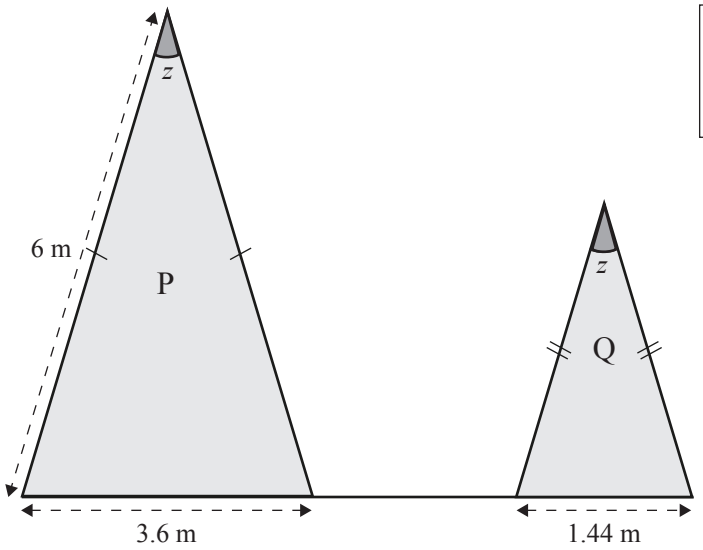
Diagram is NOT to scale

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

Show your working clearly.

(c) E rua ngā kōmaru o te waka, he tapatoru waerite ngā mea e rua, kua tapaina ko P me Q i raro nei.

He ōrite pū te koki z i roto i ngā tapatoru, P me Q.



KĀORE i tuhi ā-āwhatatia tēnei hoahoa

Kia tere rawa ai te whakatere o ngā waka, me nui ake te horahanga tapeke o ngā kōmaru e rua i te 14 m².

Mā te whakamahi i ngā inenga e whakaaturia ana i roto i te hoahoa i runga ake, me whakaatu mēnā kei te ū ngā kōmaru ki te rahinga e hiahiatia ana, kāore rānei.

Whakamahia te whakaaro āhuahanga mārama hei parahau i tō tuhinga.

MĀ TE KAIMĀKA ANAKE

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.

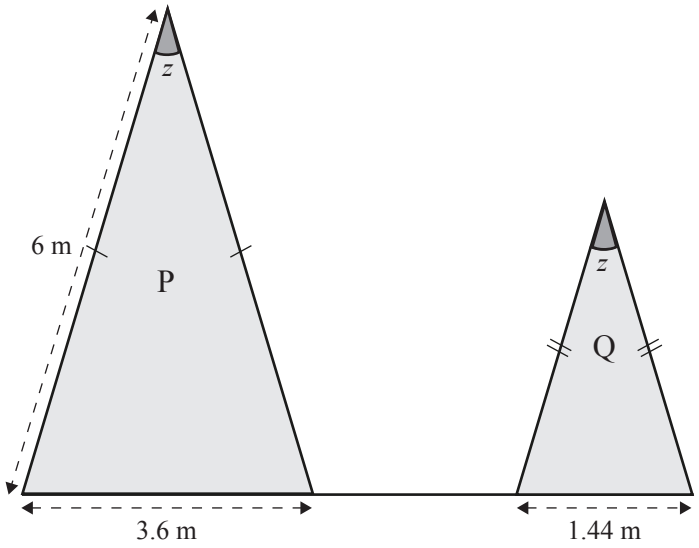


Diagram is NOT to scale

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

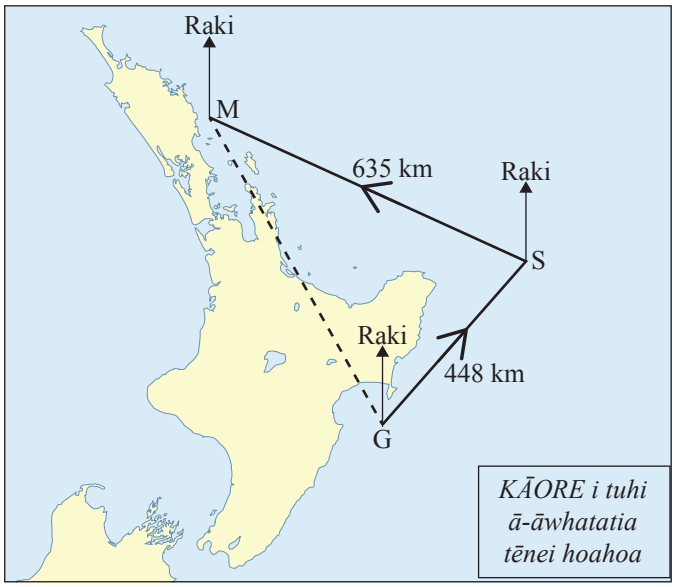
Using the measurements shown in the diagram above, show whether or not the sails satisfy the size requirement.

Justify your answer with clear geometrical reasoning and working.

(d) I tere te kaipuke o Kāpene Kuki, te HMS *Endeavour*, mā te takutai ki te ara e whakaaturia ana ki raro i te mahere whenua o Te Ika-a-Māui, Aotearoa.

I tere te kaipuke mai i G ki S i te ahunga o te 054º mō te tawhiti o te 448 km.

Kātahi ka huri te ahunga, ka tere mai i S ki M i te ahunga o te 294º mō te 635 km te tawhiti atu anō.



Mēnā ka taea e Kāpene Kuki kia tōtika te rere arorangi mai i G ki M, kimihia mai te ahunga o M mai i G.

Āta whakaaturia ō mahinga.

MĀ TE KAIMĀKA ANAKE

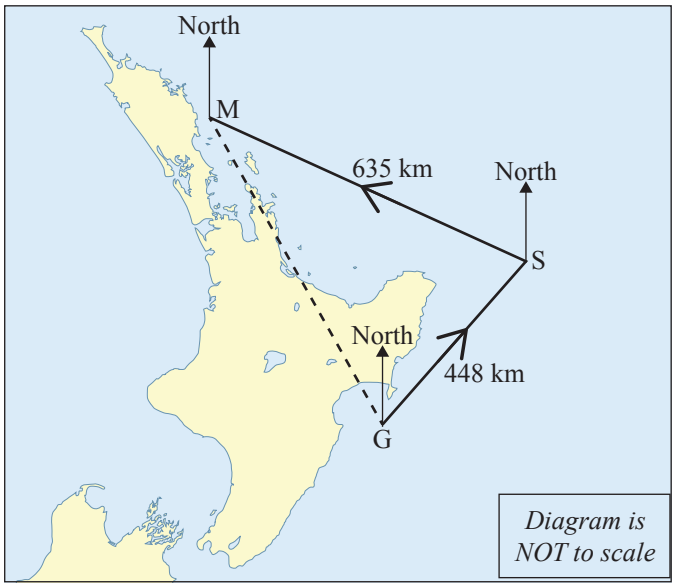
Mātāpuna (mahere, he mea urutau): https://commons.wikimedia.org/wiki/File:Map_of_New_Zealand_(blank).svg. Tuhinga tūmatanui.

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.

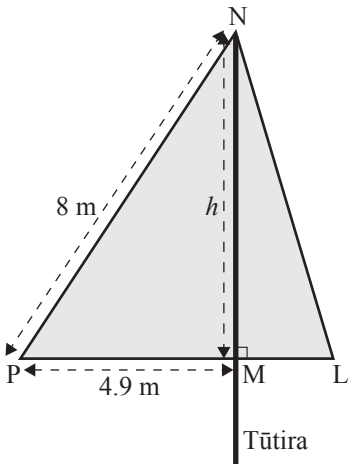
TŪMAHI TUARUA

MĀ TE KAIMĀKA ANAKE

(a) (i) I whakatere a Kāpene Kuki i roto i tētahi "Kaipuke Tāroa" pērā i te kaipuke e whakaaturia ana i raro.

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

E whakaaturia ana tētahi wāhanga o te pūnaha here kōmaru i te hoahoa i raro.



KĀORE i tuhi ā-āwhatatia tēnei hoahoa

Me whakaatu ko te teitei o te kōmaru, *h*, mai i M ki N, he 6.32 mita.

Āta whakaaturia ō mahinga.

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.

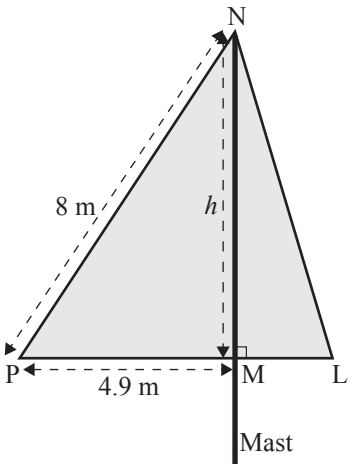
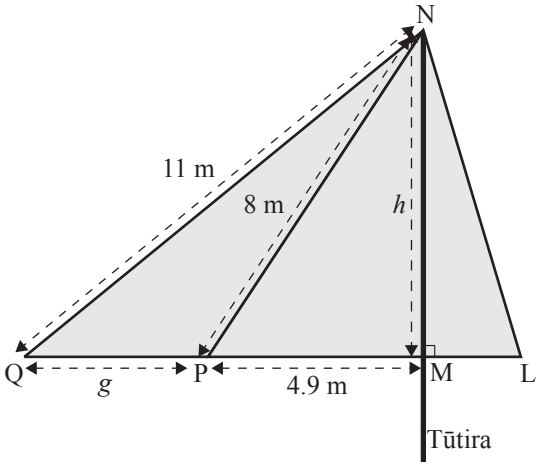


Diagram is NOT to scale

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

Show your working clearly.

(ii) I ngā hau māmā, ka roha taua wāhanga anō o te kōmaru, e whakaaturia ana i raro.



KĀORE i tuhi ā-āwhatatia tēnei hoahoa

Tātaihia te roa o te tāhū, *g*, mai i P ki Q.

Āta whakaaturia ō mahinga.

(iii) E hiahiatia ana he hanganga tautoko atu anō mō ngā hau pūkeri.

Ka mau te tāhū torotika mai i M ki tētahi pūwāhi Y, i tētahi wāhi i PN kia noho ai te koki i waenga i ngā rārangi MY me te PN he 90º.

Tātaihia te **paenga** o te tapatoru PYM.

Āta whakaaturia ō mahinga.

ASSESSOR'S USE ONLY

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

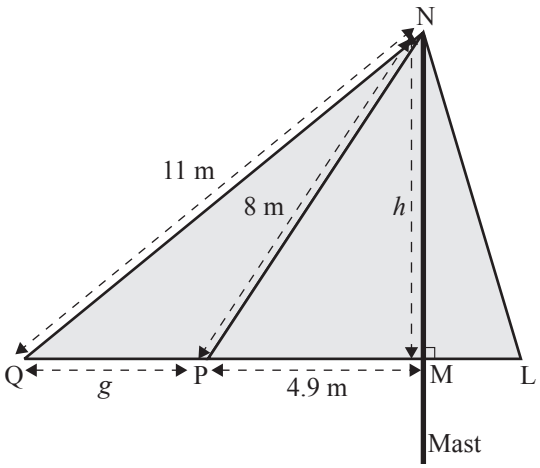


Diagram is NOT to scale

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

Show your working clearly.

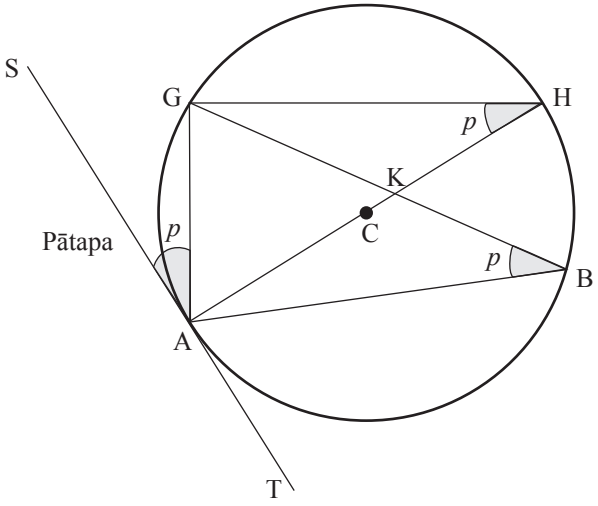
(iii) An extra support structure is necessary for heavy winds.

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.

(b) (i) Ko te pūwāhi C kei te pū o te porowhita.
Ko te rārangi torotika, SAT, ko te pātapa ki te porowhita i te pūwāhi A.



KĀORE i tuhi ā-āwhatatia tēnei hoahoa

Hāponotia ko ngā rahinga, p, o ngā koki SAG, AHG, me ABG he ōrite katoa tētahi ki tētahi.
Whakamahia te whakaaro āhuahanga mārama hei parahau i tāu tuhinga.

MĀ TE KAIMĀKA ANAKE

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.

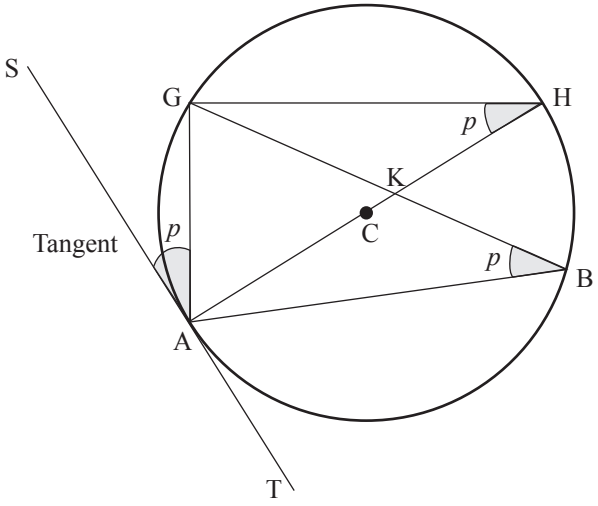
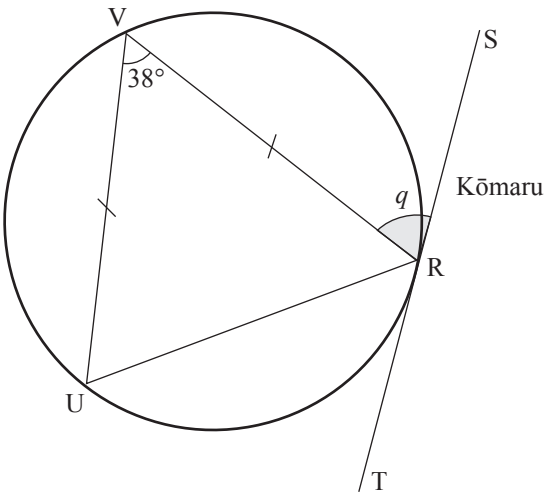


Diagram is NOT to scale

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.

(ii) Ki te hoahoa i raro, ko te rārangi torotika SRT te pātapa ki te porowhita i te pūwāhi R.
Ko te tapatoru UVR he waerite, ā, UV = RV.
Koki UVR = 38º .



KĀORE i tuhi ā-āwhatatia tēnei hoahoa

MĀ TE KAIMĀKA ANAKE

Tātaihia te rahi, *q*, o te koki VRS.
Whakamahia te whakaaro āhuahanga mārama hei parahau i tāu tuhinga.

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.

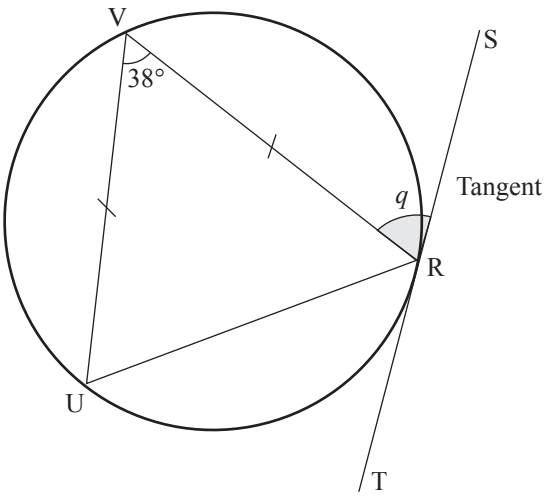


Diagram is NOT to scale

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

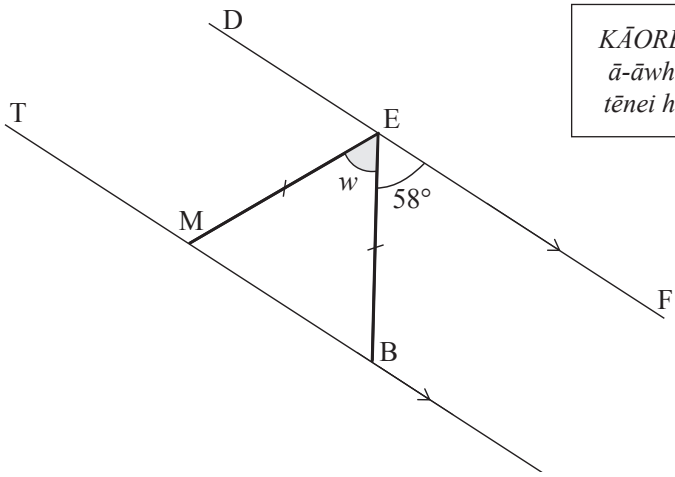
TŪMAHI TUATORU

MĀ TE KAIMĀKA ANAKE

(a) Ko ngā rārangi torotika DEF me TMB he whakarara tētahi ki tētahi.

Ko ngā rārangi EM me EB he ōrite te roa.

Koki FEB = 58º .



KĀORE i tuhi ā-āwhatatia tēnei hoahoa

Tātaihia te rahi, *w*, o te koki MEB.

Whakamahia te whakaaro āhuahanga mārama hei parahau i tāu tuhinga.

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

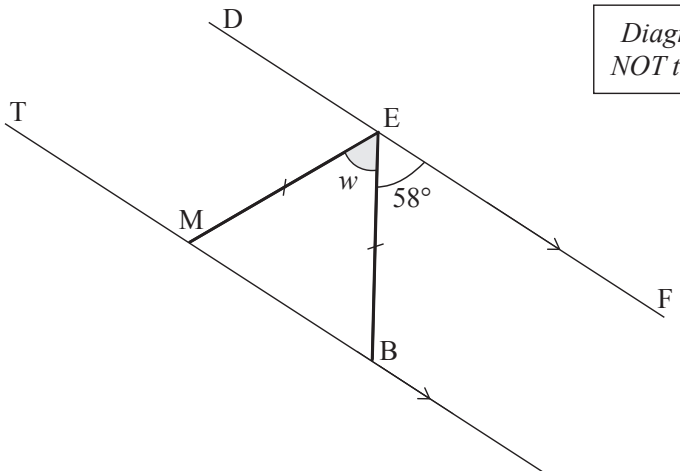


Diagram is NOT to scale

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

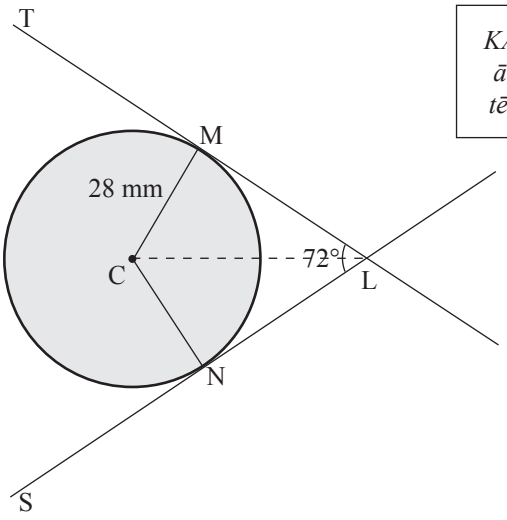
Justify your answer with clear geometrical reasoning.

(b) Ko C te pū o te porowhita.

He 28 mm te pūtoro o te porowhita.

He pātapa ngā rārangi torotika LMT me LNS ki te porowhita i ngā pūwāhi M me N.

Koki MLN = 72º .



KĀORE i tuhi ā-āwhatatia tēnei hoahoa

Tātaihia te roanga LC.

Whakamahia te whakaaro āhuahanga mārama hei parahau i tāu tuhinga.

MĀ TE KAIMĀKA ANAKE

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 .

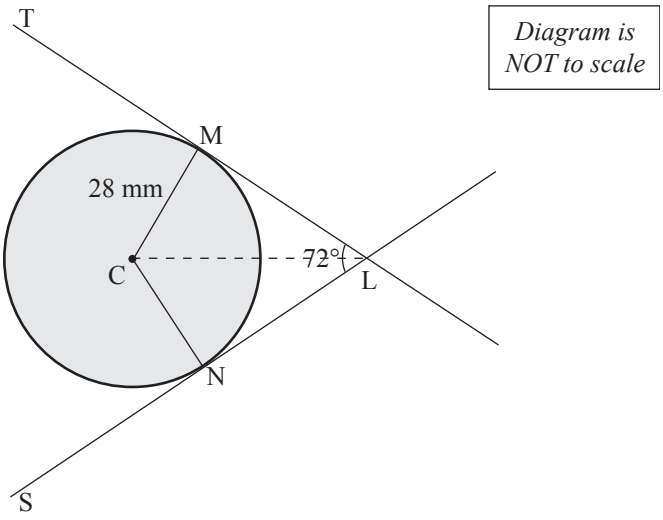


Diagram is NOT to scale

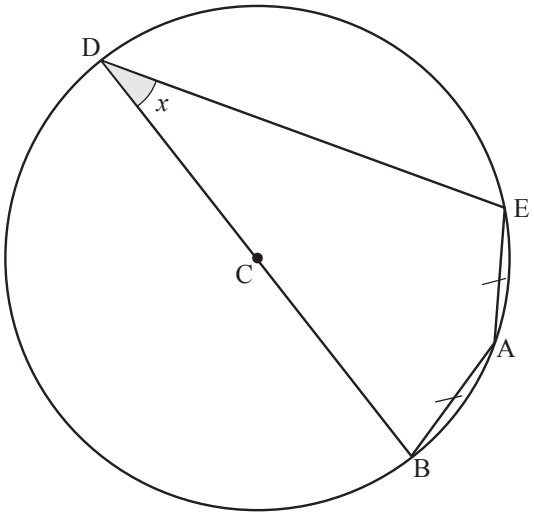
Calculate the length LC.

Justify your answer with clear geometrical reasoning.

(c) E takoto ana ngā pūwāhi A, B, D, me E ki te paenga o tētahi porowhita, ā, ko C te pū.

Koki BDE = x.

AE = AB.



KĀORE i tuhi ā-āwhatatia tēnei hoahoa

Kimihia he kīanga mō te koki DBA, e pā ana ki a x.

Whakamahia te whakaaro āhuahanga mārama hei parahau i tāu tuhinga.

MĀ TE KAIMĀKA ANAKE

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.

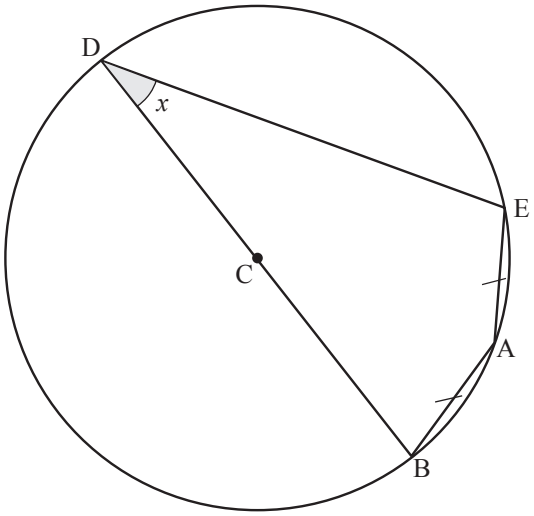


Diagram is NOT to scale

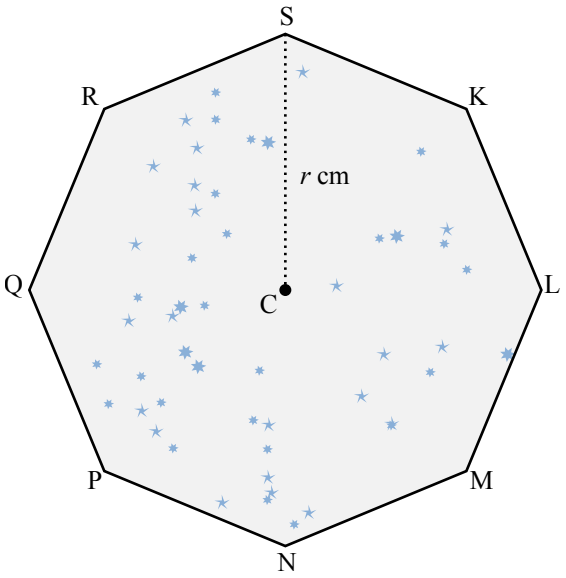
Find an expression for angle DBA, in terms of x.

Justify your answer with clear geometrical reasoning.

MĀ TE KAIMĀKA ANAKE

(d) I whakamahia e ngā kaihōpara o te rau tau 1700-1799 ngā whetū hei āwhina i a rātou ki te whakatere haere i ngā moana. I whakamahia e rātou tētahi mahere pērā i te mahere e whakaaturia ana i raro, e whakaatu ana i tētahi tapawaru rite.

Ko te tawhiti mai i te pū, C, o te tapawaru ki ia akitu he *r* cm.



Kimihia he kīanga mō te horahanga o te tapawaru, e pā ana ki *r*.

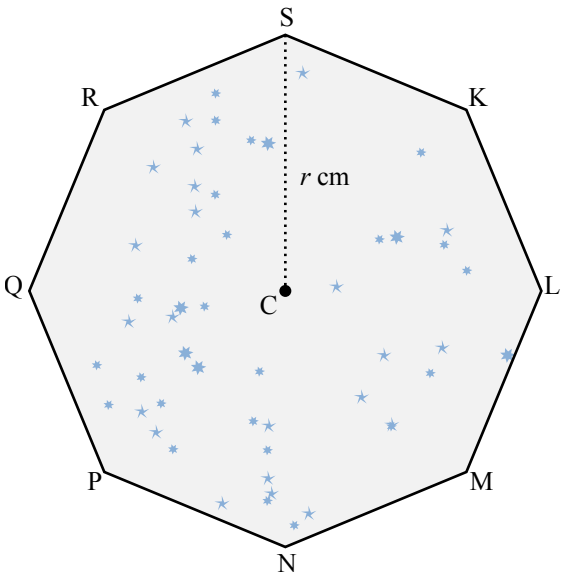
Āta whakaaturia ō mahinga.

Mātāpuna (ngā whetū, he mea urutau): https://en.wikipedia.org/wiki/File:Navigational-stars-below-30-degrees-south.svg. Tuhinga tūmatanui.

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.

He whārangi anō ki te hiahiatia.
Tuhia te (ngā) tau tūmahi mēnā e tika ana.

TAU TŪMAHI

MĀ TE KAIMĀKA ANAKE

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

English translation of the wording on the front cover

COMMON ASSESSMENT TASK

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 2–27 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.