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91031M



910315



NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

SUPERVISOR'S USE ONLY

Tohua tēnei pouaka
mēnā kāore he tuhituhi i
roto i tēnei pukapuka

Te Pāngarau me te Tauanga, Kaupae 1, 2020

91031M Te whakahāngai whakaaro āhuahanga whaitake hei whakaoti rapanga

9.30 i te ata Rāmere 20 Whiringa-ā-rangi 2020
Ngā 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 KATOAA kei roto i tēnei pukapuka.

Tuhia ō mahinga KATOAA.

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 2-31 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

TE ĀHUAHANGA O NGĀ TUKUTUKU PŪNGĀWEREWERE

Ka hangaia e ngā pūngāwerewere ngā tukutuku mā ngā hoahoa āhuahanga tino āmiki, ā, ka whakamātau te tangata ki te tārua. E whakatauirā ana ngā hoahoa o tēnei tauira aromatawai i ngā wāhanga o ngā tukutuku rerekē.



<https://pixabay.com/photos/spider-web-dew-pattern-insect-617754/>

TŪMAHI TUATAHI

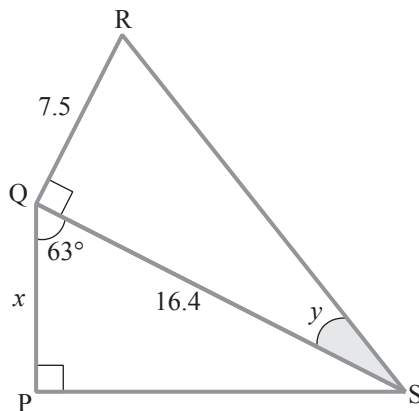
- (a) Kei te wāhanga o te tukutuku e whakaaturia ana i raro ko ngā tapatoru hāngai e rua e hono ana.

$$\text{Koki } PQS = 63^\circ$$

$$QS = 16.4 \text{ cm}$$

$$\text{Koki } RQS = \text{Koki } QPS = 90^\circ$$

$$QR = 7.5 \text{ cm}$$



*KĀORE i tuhi
ā-āwhatatia
tēnei hoahoa*

- (i) Tātaitia te roa, x , mai i P ki Q.

Āta whakaaturia ngā mahinga katoa.

THE GEOMETRY OF SPIDER WEBS

ASSESSOR'S
USE ONLY

Spiders create their webs with amazingly detailed geometrical designs, which humans often try to copy. The diagrams in this assessment model parts of different spider webs.



<https://pixabay.com/photos/spider-web-dew-pattern-insect-617754/>

QUESTION ONE

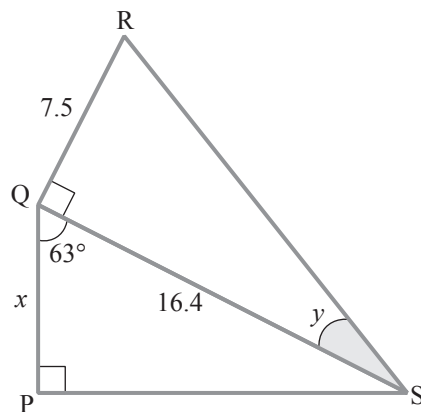
- (a) The section of one spider web shown below has two connecting right-angled triangles.

$$\text{Angle PQS} = 63^\circ$$

$$\text{QS} = 16.4 \text{ cm}$$

$$\text{Angle RQS} = \text{Angle QPS} = 90^\circ$$

$$\text{QR} = 7.5 \text{ cm}$$



*Diagram is
NOT to scale*

- (i) Calculate the length, x , from P to Q.

Show your working clearly.

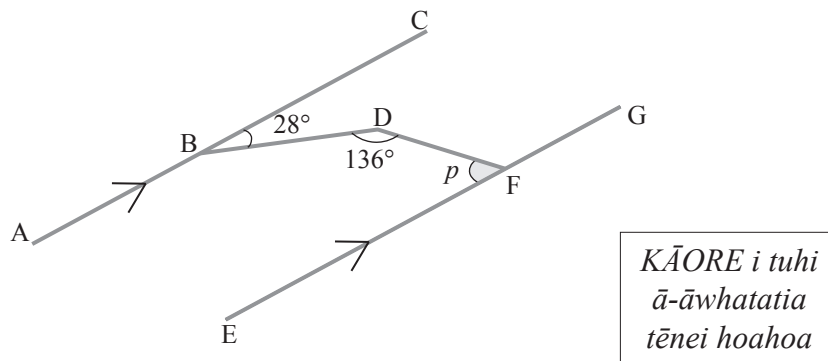
(ii) Tātaihia te rahi, y , o te koki QSR.

Āta whakaaturia ngā mahinga katoa.

(b) E whakaaturia ana ētahi o ngā aho mai i tētahi tukutuku kē.

Ko ngā rārangi torotika ABC me EFG he whakarara tētahi ki tētahi.

Koki $CBD = 28^\circ$ Koki $BDF = 136^\circ$



Tātaitia te rahi, p , o te koki DFE.

Whakamahia te whakaaro āhuahanga mārama hei parahau i tāu tuhinga.

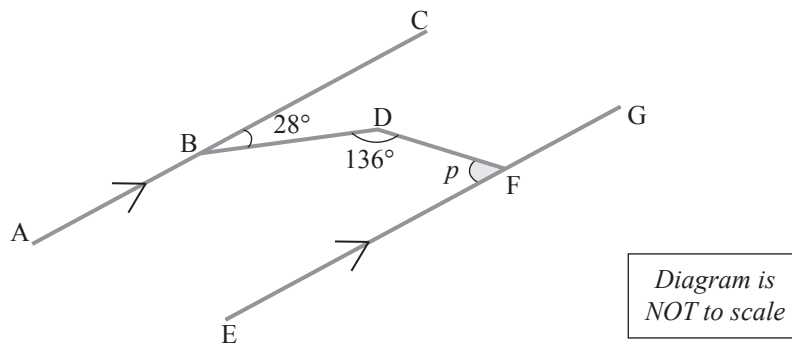
- (ii) Calculate the size, y , of angle QSR.

Show your working clearly.

- (b) Some of the strands from a different spider web are shown below.

Straight lines ABC and EFG are parallel to each other.

Angle CBD = 28° Angle BDF = 136°

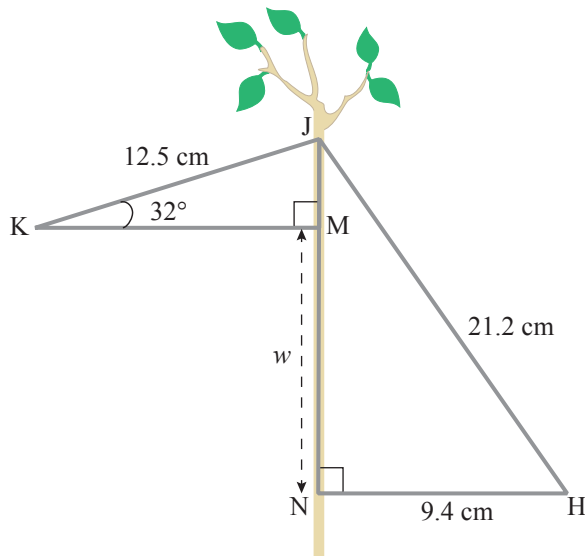


Calculate the size, p , of angle DFE.

Justify your answer with clear geometrical reasoning.

(c) Whakamahia ai e ngā pūngāwerewere ngā rākau hei tautoko i ngā tukutuku.

Koki JKM = 32° KJ = 12.5 cm JH = 21.2 cm NH = 9.4 cm

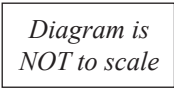
$$\text{Koki KMJ} = \text{Koki JNH} = 90^\circ$$


*KĀORE i tuhi
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tēnei hoahoa*

Tātaitia te roa, w , mai i M ki N.

Āta whakaaturia ngā mahinga katoa.

- (c) Spiders often use trees to support their webs.
 Angle JKM = 32° KJ = 12.5 cm JH = 21.2 cm NH = 9.4 cm
 Angle KMJ = Angle JNH = 90°



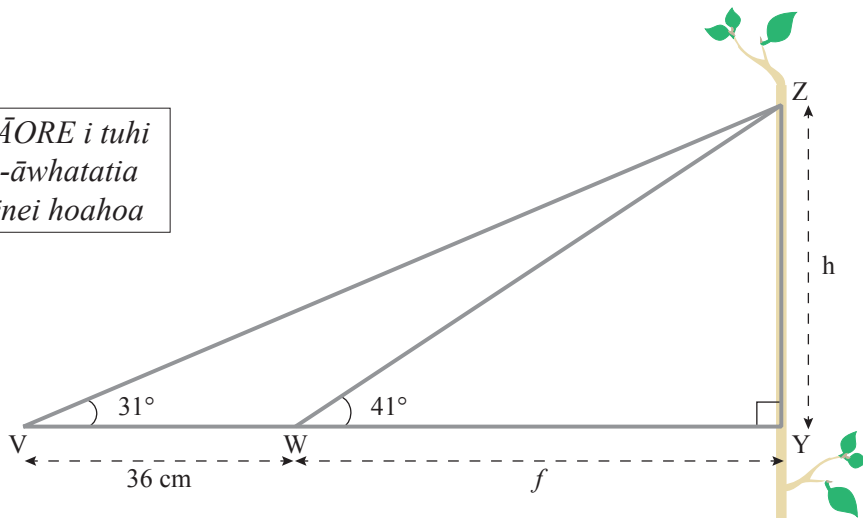
Show your working clearly.

(d) E hono tahi ana ngā aho tukutuku kia kaha ake ai.

$$\text{Koki ZVY} = 31^\circ \qquad \text{Koki VYZ} = 90^\circ$$

Koki ZWY = 41° VW = 36 cm

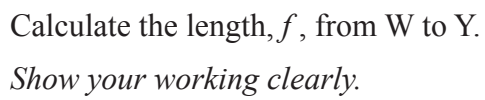
*KĀORE i tuhi
ā-āwhatatia
tēnei hoahoa*



Tātaitia te roa, f , mai i W ki Y .

Āta whakaaturia ngā mahinga katoa.

- Angle ZVY = 31° Angle VYZ = 90°
Angle ZWY = 41° VW = 36 cm



TŪMAHI TUARUA

I ētahi wā ka puta he puare ki ētahi tukutuku.

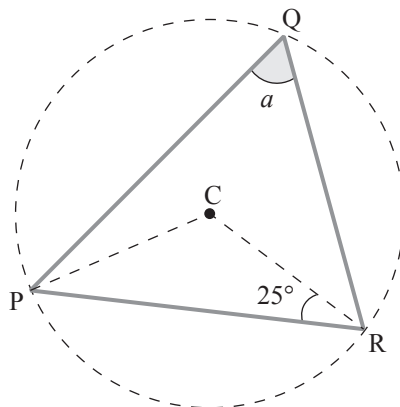


<https://www.patternpictures.com/part-of-a-spider-web-close-up-on-green-backdrop/>

- (a) Kei raro ko tētahi tukutuku he puare kei roto.

E takoto ana ngā pūwāhi P, Q, me R ki te paenga o tētahi porowhita, ā, ko C te pū.

Koki $\angle PRC = 25^\circ$



*KĀORE i tuhi
ā-āwhatatia
tēnei hoahoa*

Tātaitia te rahi, a , o te koki PQR.

Parahautia tō tuhinga.

QUESTION TWO

Sometimes holes can appear in a spider web.

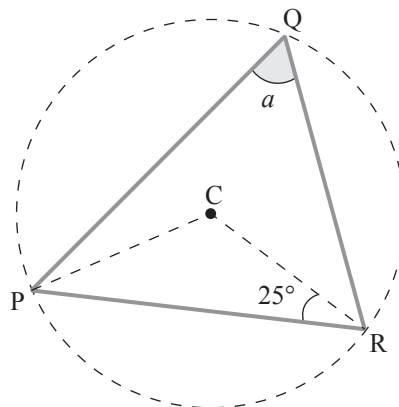


<https://www.patternpictures.com/part-of-a-spider-web-close-up-on-green-backdrop/>

- (a) Below is part of a spider web with a hole in it.

Points P, Q, and R all lie on the circumference of a circle, with centre C.

Angle $PRC = 25^\circ$

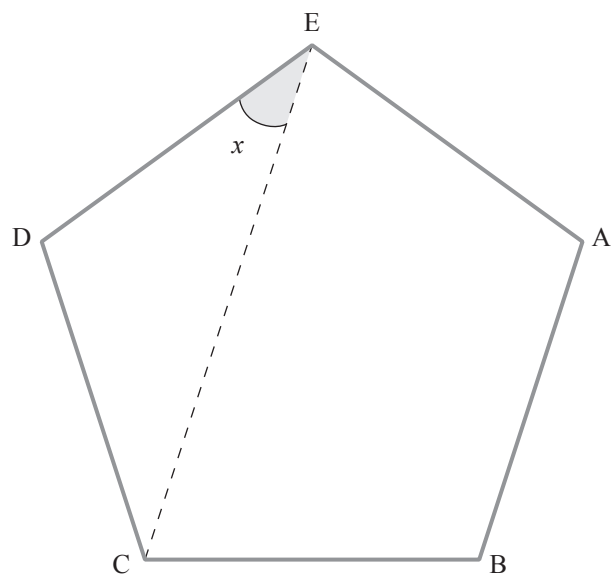


*Diagram is
NOT to scale*

Calculate the size, a , of angle PQR.

Justify your answer.

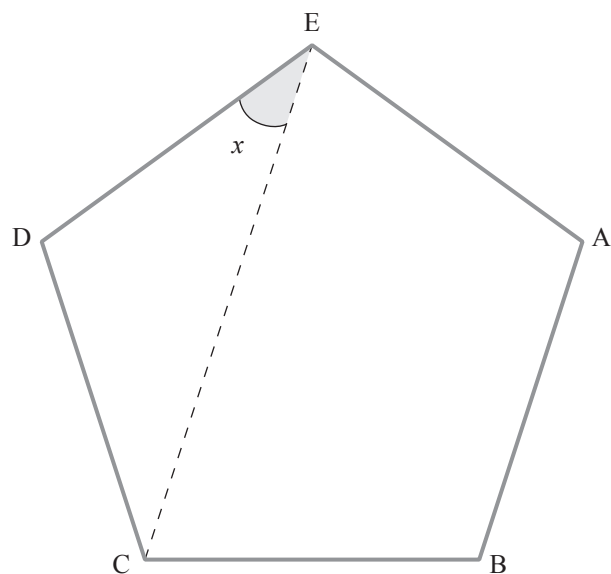
(b) He taparima rite te hanga o te tukutuku.



Tātaihia te rahi, x , o te koki CED.

Parahautia tō tuhinga.

- (b) The spider web below forms a regular pentagon.



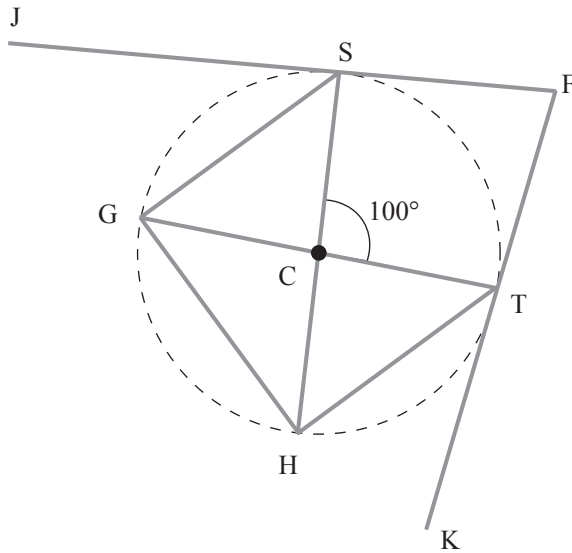
Calculate the size, x , of angle CED.

Justify your answer.

(c) I roto i tēnei tukutuku, e takoto ana ngā pūwāhi G, H, T, me S ki te paenga o tētahi porowhita, ā, ko C te pū.

Ko ngā rārangi torotika FSJ me FTK ngā pātapa ki te porohita kei ngā pūwāhi S me T.

Koki SCT = 100°



*KĀORE i tuhi
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tēnei hoahoa*

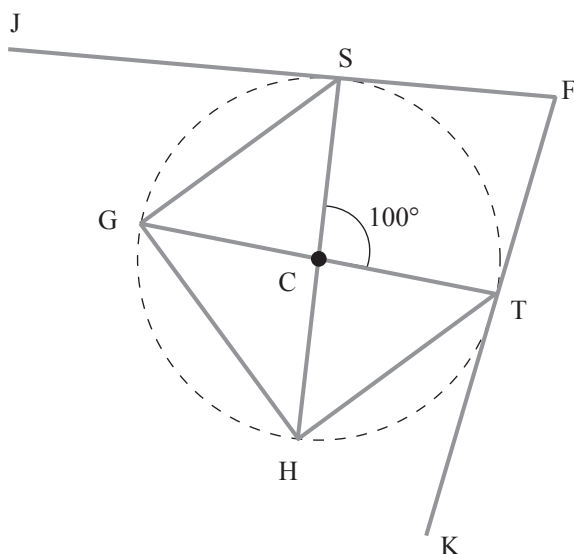
Whiriwhiria mēnā e whakarara ana te rārangi FSJ ki te rārangi GCT.

Whakamahia te whakaaro āhuahanga mārama hei parahau i tāu tuhinga.

(c) In this spider web, points G, H, T, and S all lie on the circumference of a circle, with centre C.

The straight lines FSJ and FTK are both tangents to the circle at the points S and T.

Angle SCT = 100°



*Diagram is
NOT to scale*

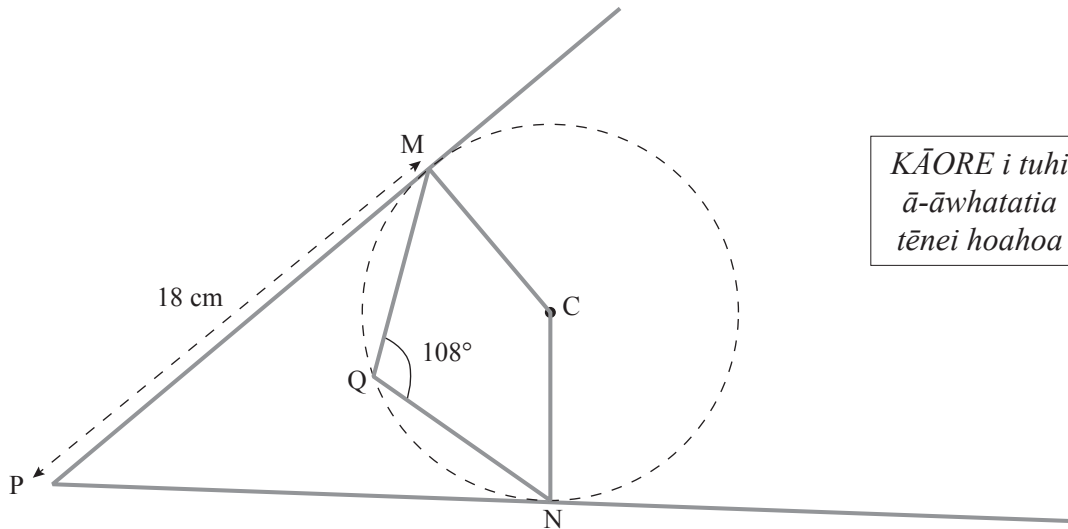
Determine whether the line FSJ is parallel to the line GCT.

Justify your answer with clear geometrical reasoning.

- (d) I tēnei tukutuku, e takoto ana ngā pūwāhi M, Q, me N ki te paenga o tētahi porowhita, ā, ko C te pū.

Ko ngā rārangi torotika PM me PN ngā pātapa ki te porohita kei ngā pūwāhi M me N.

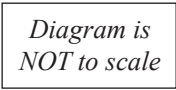
Koki $\angle MQN = 108^\circ$

$$PM = 18 \text{ cm}$$


Tātaitia te pūtoro o te porowhita.

Whakamahia te whakaaro āhuahanga mārama hei parahau i tāu tuhinga.

- ASSESSOR'S
-
- USE ONLY



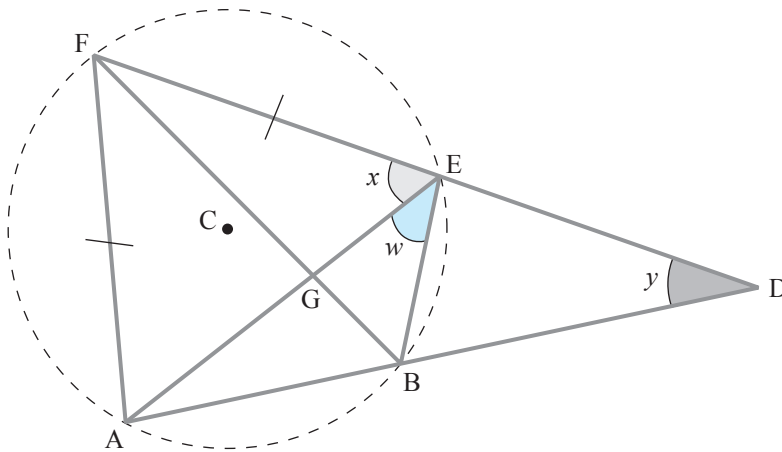
Justify your answer with clear geometrical reasoning.

- (e) I tēnei tukutuku, e takoto ana ngā pūwāhi A, B, E, me F ki te paenga o tētahi porowhita, ā, ko C te pū.

Ko ngā rārangi FE me FA he ōrite te roa.

$$\text{Koki AEF} = x$$

Koki ADF = y



*KĀORE i tuhi
ā-āwhatatia
tēnei hoahoa*

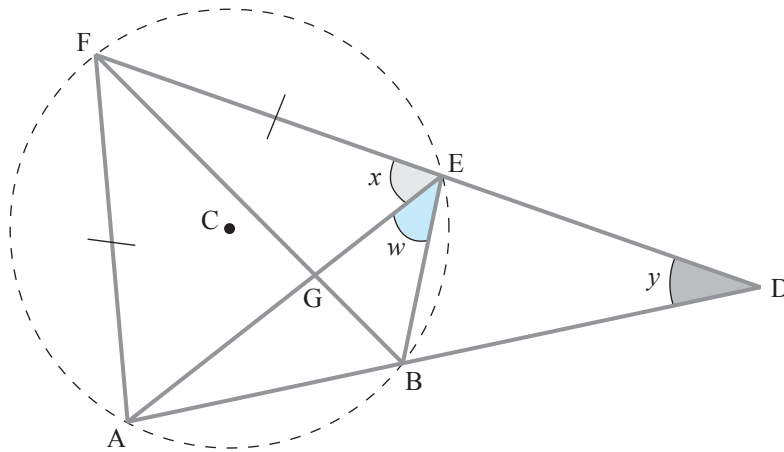
Tātaitia te rahi, w , o te koki AEB, e ai ki x me y .

Whakamahia te whakaaro āhuahanga mārama hei parahau i tāu tuhinga.

(e) In this spider web, points A, B, E, and F all lie on the circumference of a circle, with centre C. Lines FE and FA are of equal length.

Angle AEF = x

Angle ADF = y



Find the size, w , of angle AEB, in terms of x and y .

Justify your answer with clear geometrical reasoning.

TŪMAHI TUATORU

Ka tiro tiro tēnei tūmahi ki ētahi atu tukutuku.

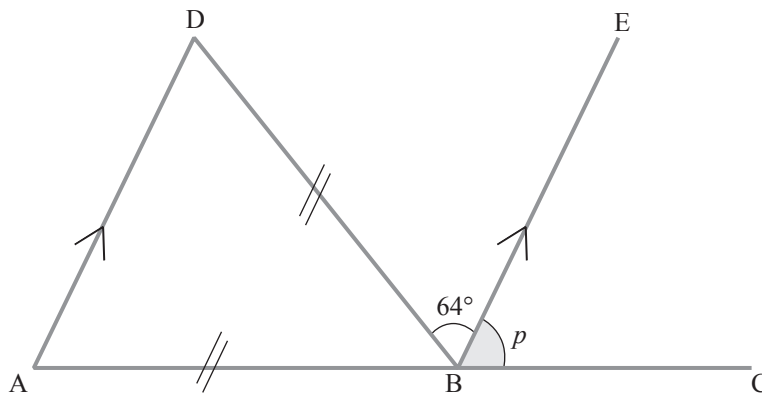


<https://pixabay.com/photos/cobweb-dewdrop-web-insect-case-921039/>

(a) I tēnei tukutuku, he rārangi torotika a ABC.

Ko ngā rārangi AD me BE he whakarara tētahi ki tētahi me $DB = AB$.

Koki $DBE = 64^\circ$



*KĀORE i tuhi
ā-āwhatatia
tēnei hoahoa*

Tātaitia te rahi, p , o te koki EBC.

Parahautia tō tuhinga.

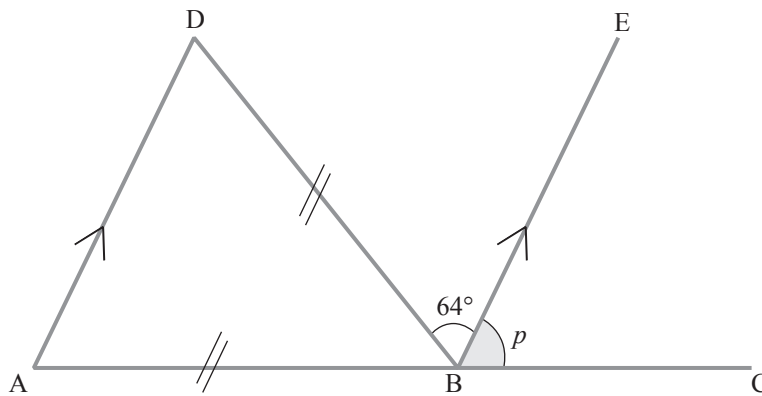
QUESTION THREE

This question looks at more spider webs.



<https://pixabay.com/photos/cobweb-dewdrop-web-insect-case-921039/>

- (a) In this spider web, ABC is a straight line.
 Lines AD and BE are parallel to each other and $DB = AB$.
 Angle $DBE = 64^\circ$



*Diagram is
NOT to scale*

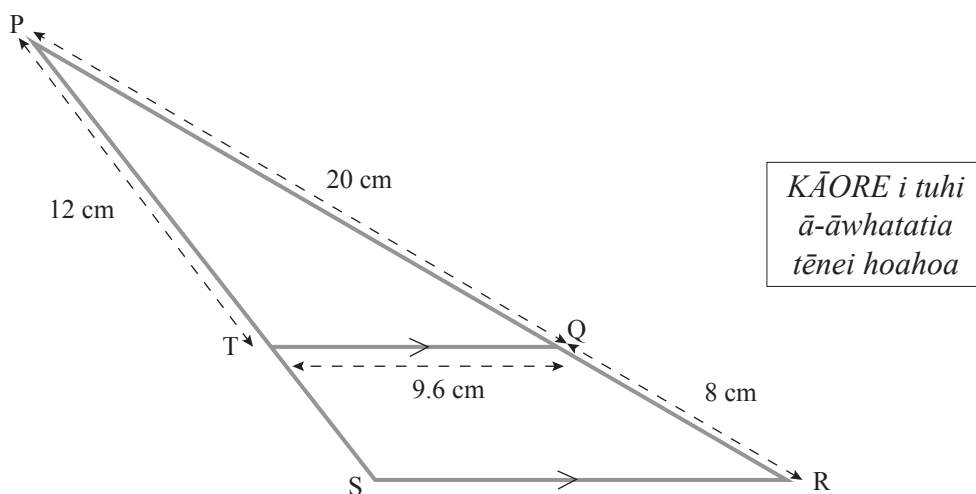
Calculate the size, p , of angle EBC .

Justify your answer.

- (b) I tēnei tukutuku tapatoru, ko ngā rārangi TQ me SR he whakarara tētahi ki tētahi.

$$PQ = 20 \text{ cm} \qquad QR = 8 \text{ cm}$$

$$PT = 12 \text{ cm} \qquad TQ = 9.6 \text{ cm}$$



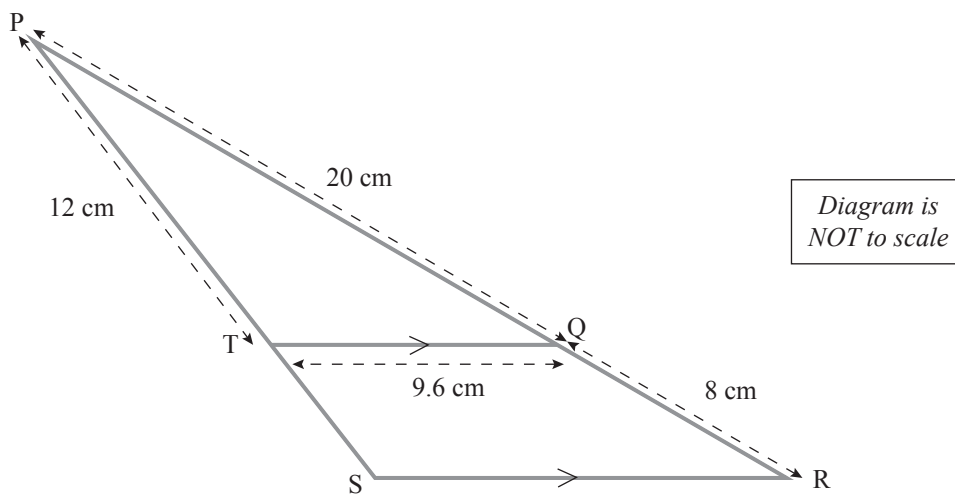
Tātaitia te paenga o te taparara **QRST**.

Āta whakaaturia ngā mahinga katoa.

(b) In this triangular spider web, lines TQ and SR are parallel to each other.

PQ = 20 cm QR = 8 cm

$$PT = 12 \text{ cm} \qquad TQ = 9.6 \text{ cm}$$



Calculate the perimeter of the trapezium **QRST**.

Show your working clearly.

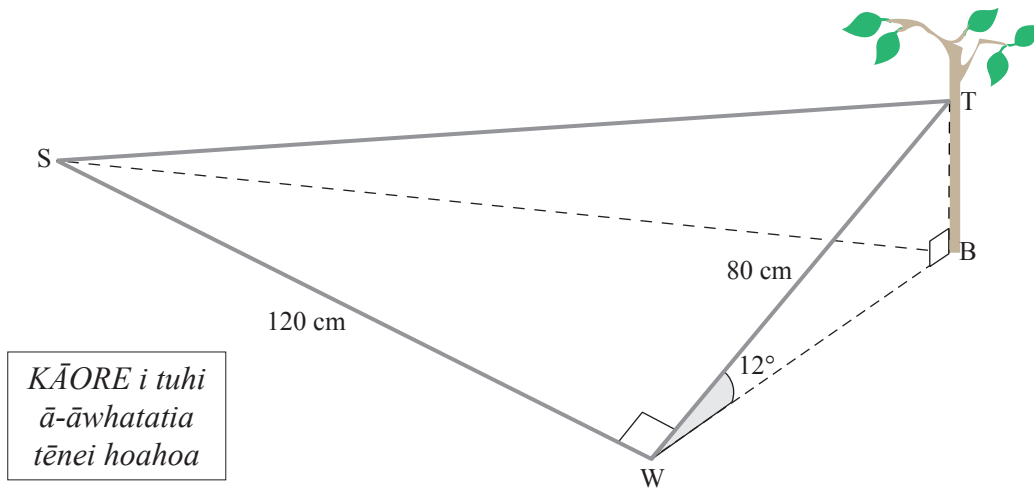
- (c) Ka hangaia e tētahi pūngāwerewere tētahi tukutuku nui mā te whakatika i tana tukutuku i waenga i tētahi rākau poutū i te pūwāhi T me ngā pūwāhi e rua kei te papa i W me S.
- Ko Pūwāhi B kei te pūtaka o te rākau, kei raro i T. Kei te taumata huapae (papa) ōrite ngā pūwāhi B, W me S.

$$\text{Koki SWT} = \text{Koki WBT} = 90^\circ$$

$$\text{SW} = 120 \text{ cm}$$

$$\text{Koki TWB} = 12^\circ$$

$$\text{WT} = 80 \text{ cm}$$



- (i) Me whakaatu ko te teitei o te tukutuku, BT, he 16.63 cm.

Āta whakaaturia ō mahinga katoa.

- (ii) Tātaitia te koki o te rewatanga o T i runga ake o S, koki TSB.

Āta whakaaturia ngā mahinga katoa.

- (c) One spider makes a large spider web by fixing its web between a vertical tree at point T and two points on the ground at W and S.

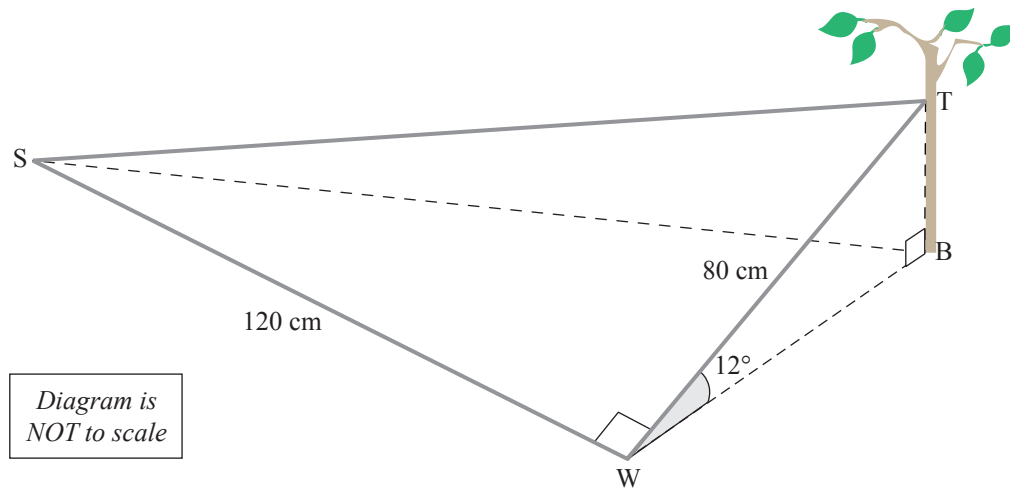
Point B is at the base of the tree, below T. Points B, W, and S are all on the same horizontal level (ground level).

$$\text{Angle } SWT = \text{Angle } WBT = 90^\circ$$

$$SW = 120 \text{ cm}$$

$$\text{Angle } TWB = 12^\circ$$

$$WT = 80 \text{ cm}$$



- (i) Show that the height of the spider web, BT, is 16.63 cm.

Show your working clearly.

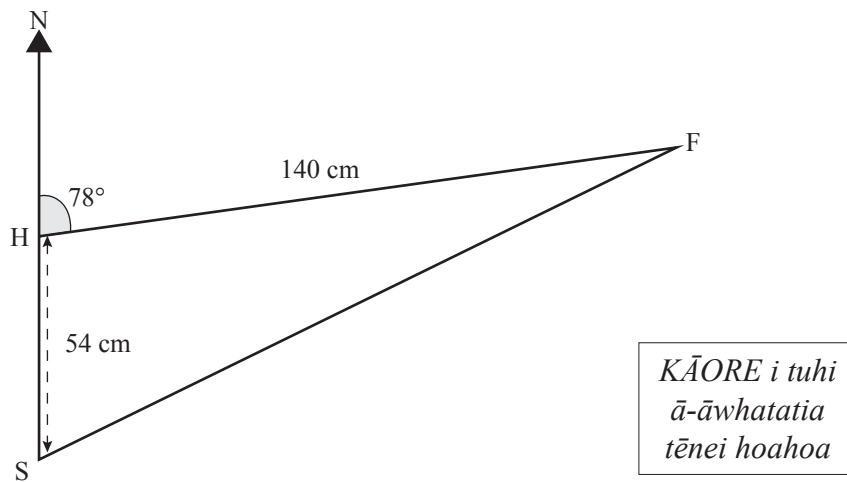
- (ii) Find the angle of elevation of T above S, angle TSB.

Show your working clearly.

MĀ TE
KAIMĀKA
ANAKE

- (d) Kei te neke haere tētahi pūngāwerewere i te papa. Ka tīmata te pūngāwerewere i pūwāhi S ka ahu whakateraki kia 54 cm te tawhiti, kia tae atu ki pūwāhi H. Kātahi ka huri te aro o te pūngāwerewere ka ahu atu ki te pūwāhi F, ā, he 140 cm te tawhiti, ā, he 078° te ahu.

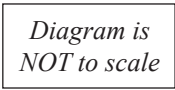
$$\text{SH} = 54 \text{ cm} \qquad \text{HF} = 140 \text{ cm}$$



Whiriwhiria te tawhiti torotika me te ahu o S mai i F.

Āta whakaaturia ngā mahinga katoa.

- $$SH = 54 \text{ cm} \qquad HF = 140 \text{ cm}$$



Show your working clearly.

**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.

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QUESTION
NUMBER

English translation of the wording on the front cover

Level 1 Mathematics and Statistics 2020

91031 Apply geometric reasoning in solving problems

9.30 a.m. Friday 20 November 2020
Credits: Four

91031M

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 2–31 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.