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91031M



910315



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Tohua tēnei pouaka mēnā  
KĀORE koe i tuhituhi i  
roto i tēnei pukapuka

# Te Pāngarau me te Tauanga, Kaupae 1, 2021

## 91031M Te whakahāngai whakaaro āhuahanga whaitake hei whakaoti rapanga

Ngā whiwhinga: Whā

Paetae	Kaiaka	Kairangi
Te whakahāngai whakaaro āhuahanga whaitake hei whakaoti rapanga.	Te whakahāngai whakaaro āhuahanga whaitake mā te whakaaro tūhonohono hei whakaoti rapanga.	Te whakahāngai whakaaro āhuahanga whaitake mā te whakaaro waitara 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 2–27 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

Kaua e tuhi ki roto i tētahi wāhi kauruku whakahāngai (///). Ka tapahia pea tēnei wāhi ina mākahia te pukapuka.

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

## TOI AHO NĒRA

Ka taea te hanga toi aho mā te herehere i ngā aho ki ngā nēra hei hanga i ngā tauira. Kei roto i tēnei aromatawai ko ngā hoahoa e whakaatu ana i ētahi o ēnei tauira, mā te whakamahi i ngā nahanahatanga rerekē o ngā nēra.



Mātāpuna: <https://www.doodlecraftblog.com/2017/08/easy-string-art-tutorial-heart-diamond.html>

### TŪMAHI TUATAHI

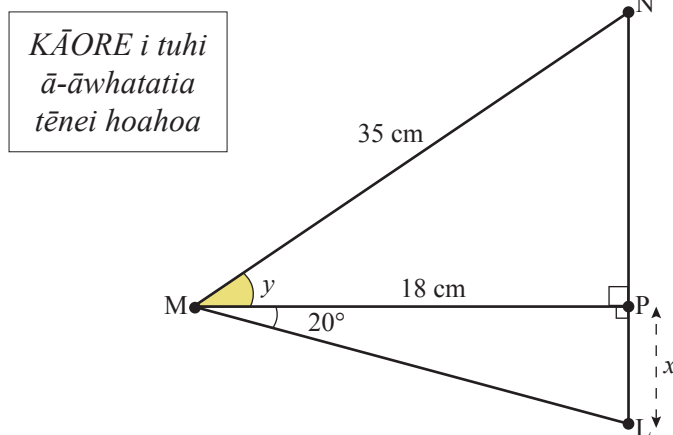
- (a) Kei te tauira i raro ko ngā tapatoru hāngai e rua kua tūhonoa.  
Ka raua ngā nēra ki ngā pūwāhi L, M, N me P, me te kukume i te aho i waenga i ēnei nēra.

$$\text{Koki LMP} = 20^\circ$$

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

$$\text{Koki LPM} = \text{Koki NPM} = 90^\circ$$

$$\text{MN} = 35 \text{ cm}$$



- (i) Tātaihia te roa,  $x$ , mai i L ki P. Āta whakaaturia ō mahinga katoa.

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- (ii) Tātaihia te rahi,  $y$ , o te koki PMN. Āta whakaaturia ō mahinga katoa.

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## NAIL-STRING ART

String art can be made by tying pieces of string around nails to create patterns. This assessment contains diagrams that show some of these patterns, using different arrangements of nails.



Source: <https://www.doodlecraftblog.com/2017/08/easy-string-art-tutorial-heart-diamond.html>

### QUESTION ONE

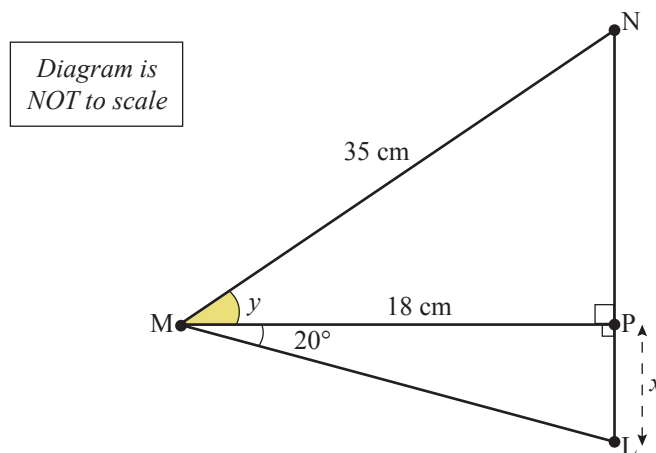
- (a) The pattern below has two connecting right-angled triangles.  
Nails are put at the points L, M, N, and P, with the string pulled between these nails.

$$\text{Angle LMP} = 20^\circ$$

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

$$\text{Angle LPM} = \text{Angle NPM} = 90^\circ$$

$$\text{MN} = 35 \text{ cm}$$



- (i) Calculate the length,  $x$ , from L to P. *Show your working clearly.*

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- (ii) Calculate the size,  $y$ , of angle PMN. *Show your working clearly.*

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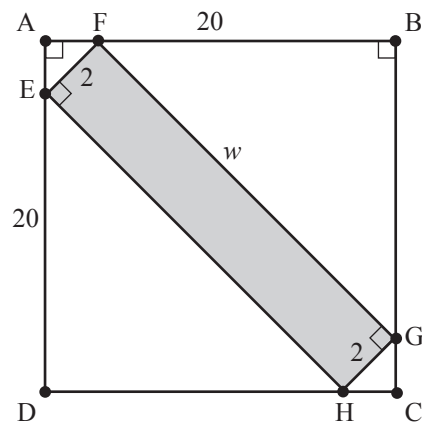
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- (b) Kei te tauira i raro ko ngā nēra kei ngā kokonga o tētahi tapawhā rite, ABCD, me ngā taha o te roa 20 cm.

Ko ngā nēra E, F, G me H he tapawhā hāngai me ngā kokonga e takoto hangarite ana ki ngā taha o te tapawhā. Roa EF = Roa GH = 2 cm



*KĀORE i tuhi  
ā-āwhatatia  
tēnei hoahoa*

- (i) Hāponotia ko te roa  $AF = 1.4142$  cm. *Āta whakaaturia ō mahinga katoa.*

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- (ii) Tātaihia te roa,  $w$ , mai i F ki G. *Āta whakaaturia ō mahinga katoa.*

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- (b) The pattern below has nails at the corners of a square, ABCD, with sides of length 20 cm. The nails E, F, G, and H form a rectangle with its corners lying symmetrically on the edges of the square. Length EF = Length GH = 2 cm

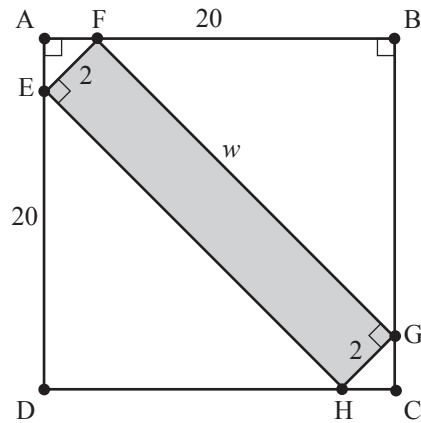


Diagram is  
NOT to scale

- (i) Prove that the length  $AF = 1.4142$  cm. *Show your working clearly.*

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- (ii) Calculate the length,  $w$ , from F to G. *Show your working clearly.*

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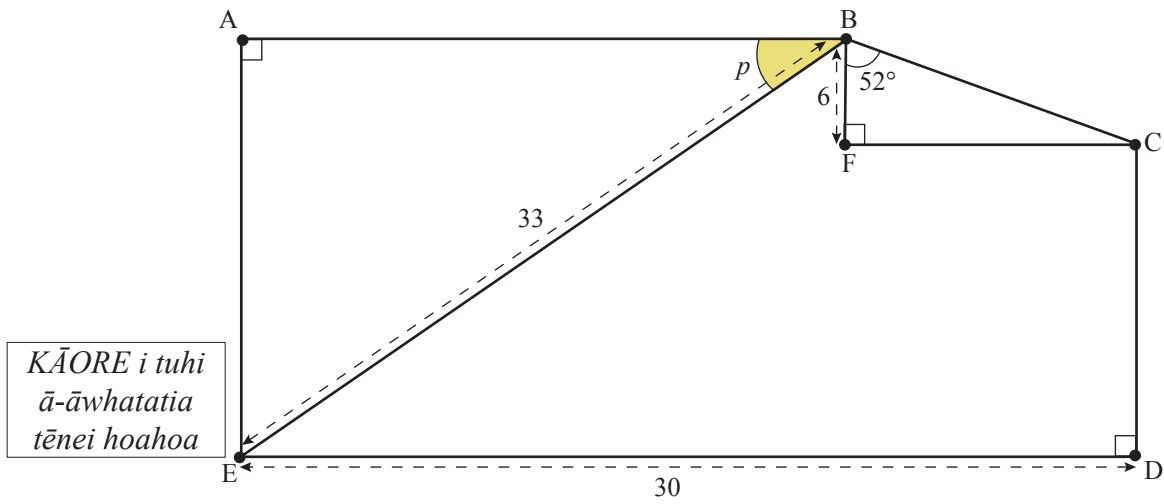
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(c) E whakaaturia ana i raro ko tētahi tauira nēra, ABCDEF.

Koki CBF = 52°

$$\text{Koki BAE} = \text{Koki BFC} = \text{Koki CDE} = 90^\circ$$
$$\text{BF} = 6 \text{ cm}$$
$$DE = 30 \text{ cm}$$
$$BE = 33 \text{ cm}$$


Tātaihia te rahi,  $p$ , o te koki ABE.

*Āta whakaaturia ō mahinga katoa.*

- (c) A pattern of nails, ABCDEF, is shown below.

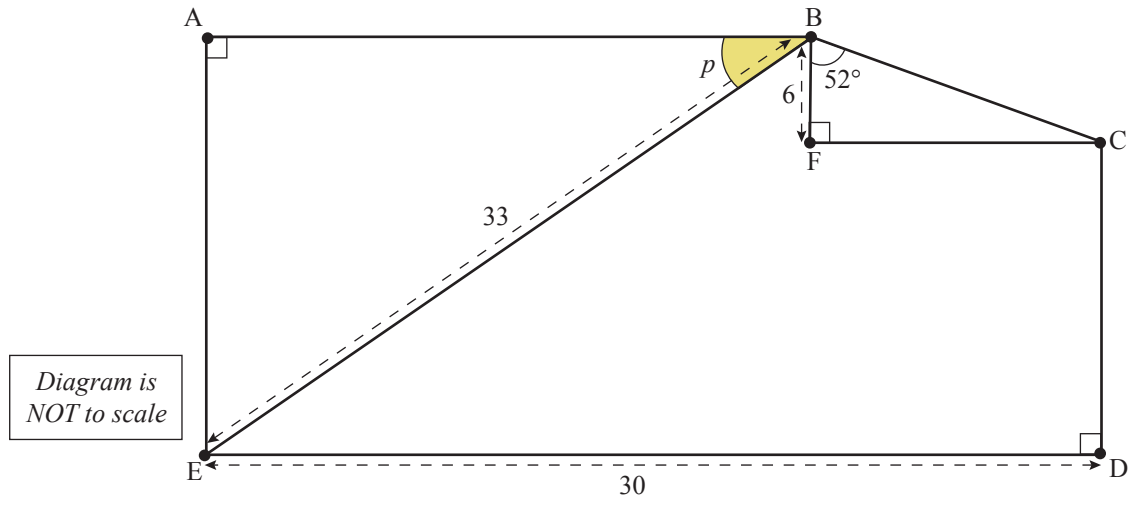
Angle CBF =  $52^\circ$

$$\text{Angle BAE} = \text{Angle BFC} = \text{Angle CDE} = 90^\circ$$

$$BF = 6 \text{ cm}$$

$$DE = 30 \text{ cm}$$

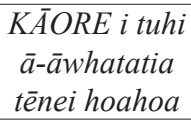
$$BE = 33 \text{ cm}$$



Calculate the size,  $p$ , of angle ABE.

*Show your working clearly.*

- Koki AGD =  $65^{\circ}$



*Āta whakaaturia ō mahinga katoa.*



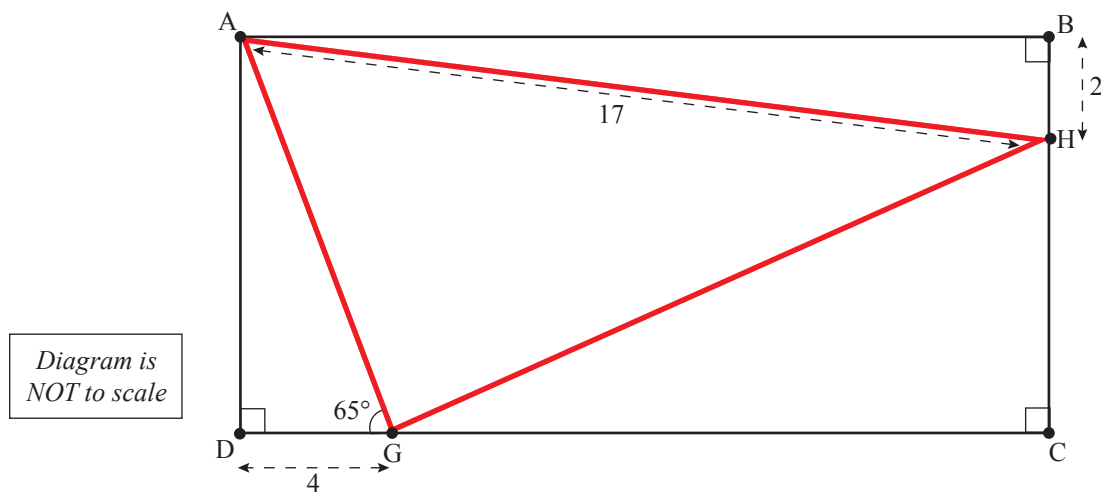
- (d) David wants to make the red triangle, AGH, shown below inside rectangle ABCD.

$$AH = 17 \text{ cm}$$

BH = 2 cm

DG = 4 cm

Angle AGD =  $65^\circ$



Find the total length of the red string David will need to connect the three nails placed at A, G, and H.  
*Show your working clearly.*

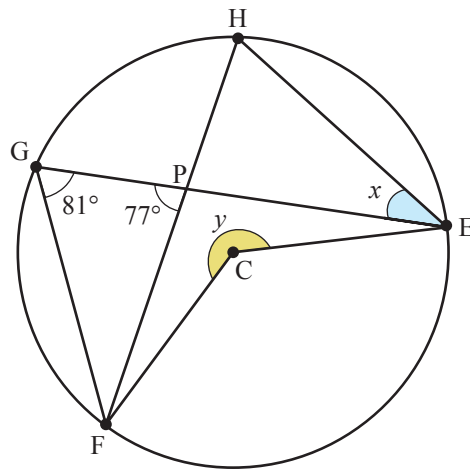
## TŪMAHI TUARUA

Ka taea anō ngā tauira kia porohitahita.



Mātāpuna: <https://babbledabbledo.com/math-art-idea-explore-geometry-string-art/>

- (a) E takoto ana ngā nēra E, F, G me H ki te paenga o tētahi porohita, ā, ko C te pū.  
Koki  $FGE = 81^\circ$       Koki  $GPF = 77^\circ$



*KĀORE i tuhi  
ā-āwhatatia  
tēnei hoahoa*

- (i) Whiriwhiria te rahi,  $x$ , o te koki HEG. *Parahautia tō whakautu.*

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- (ii) Tātaihia te rahi,  $y$ , o te koki rāwaho ECF. *Parahautia tō whakautu.*

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## QUESTION TWO

Patterns can also be circular.



Source: <https://babbledabbledo.com/math-art-idea-explore-geometry-string-art/>

- (a) Nails E, F, G, and H all lie on the circumference of a circle, with centre C.  
 Angle FGE =  $81^\circ$       Angle GPF =  $77^\circ$

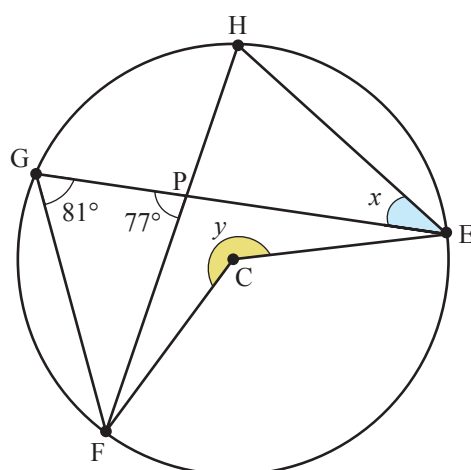


Diagram is  
NOT to scale

- (i) Find the size,  $x$ , of angle HEG. *Justify your answer.*

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- (ii) Find the size,  $y$ , of reflex angle ECF. *Justify your answer.*

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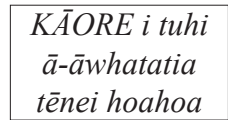
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- He torotika ngā rārangi PVW me QCW. Koki QPV = 40°

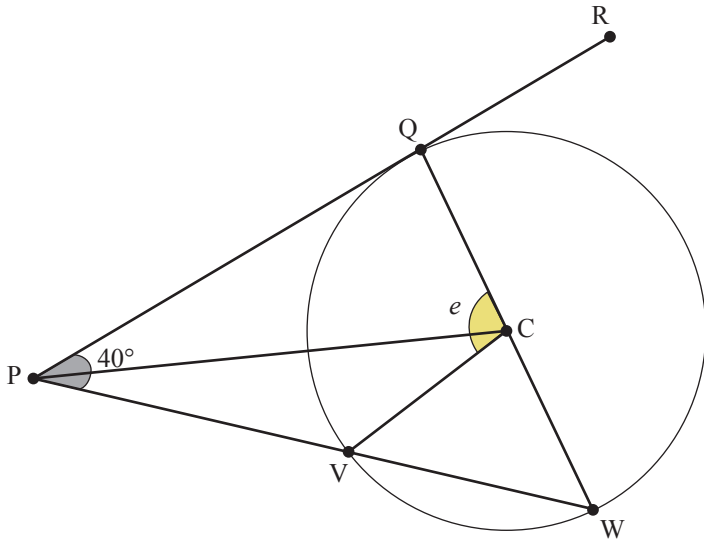


*Whakamahia te whakaaro āhuahanga mārama hei parahau i tāu tuhinga.*

- (b) Nails Q, V, and W all lie on the circumference of a circle, with centre C. Other nails form a straight line PQR which is a tangent to the circle at point Q.

The lines PVW and QCW are straight.

Angle QPV =  $40^\circ$



*Diagram is NOT to scale*

Find the size,  $e$ , of angle QCV.

*Justify your answer with clear geometric reasoning.*

- $$LQ = MQ$$



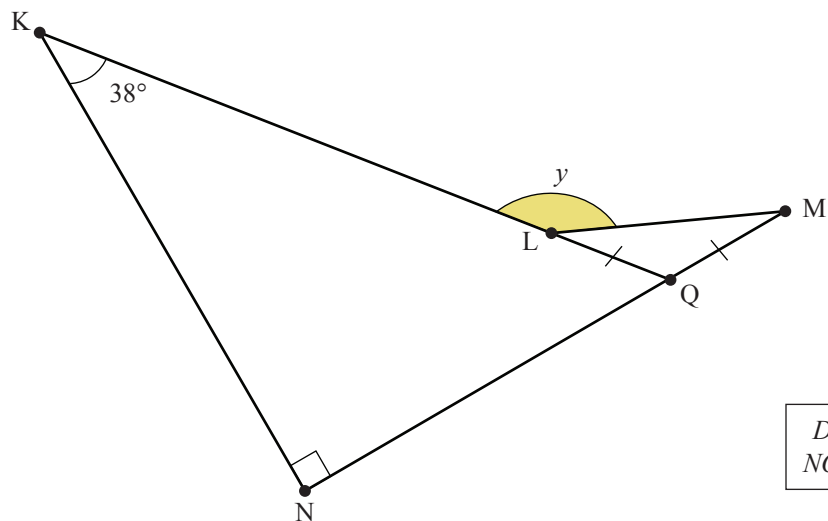
- (c) The pattern below has nails at points K, L, M, Q, and N.

Lines KLQ and MQN are straight.

$$\text{Angle NKQ} = 38^\circ$$

Angle KNM =  $90^\circ$

$$LQ = MQ$$



*Diagram is  
NOT to scale*

Find the size,  $y$ , of the obtuse angle KLM.

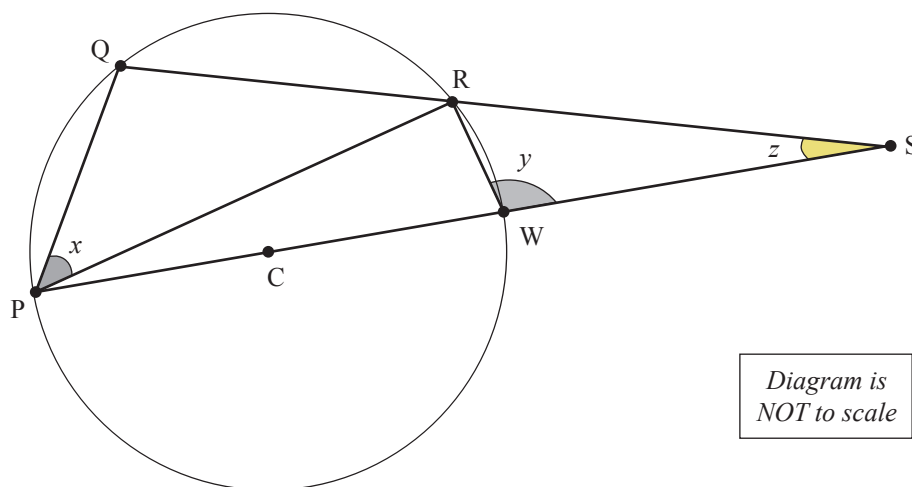
*Justify your answer with clear geometric reasoning.*

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- Kāore i tuhi  
ā-āwhatatia  
tēnei hoahoa*

*Whakamahia te whakaaro āhuahanga mārama hei parahau i tāu tuhinga.*



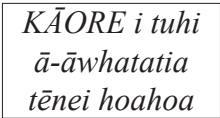
- (d) Nails P, Q, R, and W all lie on the circumference of a circle, centre C.  
Lines QRS and PWS are both straight.



Find the size,  $z$ , of angle RSW, in terms of  $x$  and  $y$ .

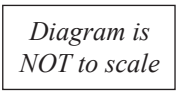
*Justify your answer with clear geometric reasoning.*

(a) Kei te tauira i raro ko ngā nēra V, W, X me Y. He whakarara ngā rārangi VW me YX tētahi ki tētahi. Koki  $WXY = 90^\circ$        $XY = 33 \text{ cm}$        $WY = 85 \text{ cm}$



*Āta whakaaturia ō mahinga katoa.*

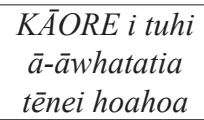
Angle WXY =  $90^\circ$       XY = 33 cm      WY = 85 cm



*Show your working clearly.*

- $$\text{Koki PTQ} = \text{Koki PSR} = 90^\circ$$

$$RS = 10.26 \text{ cm}$$

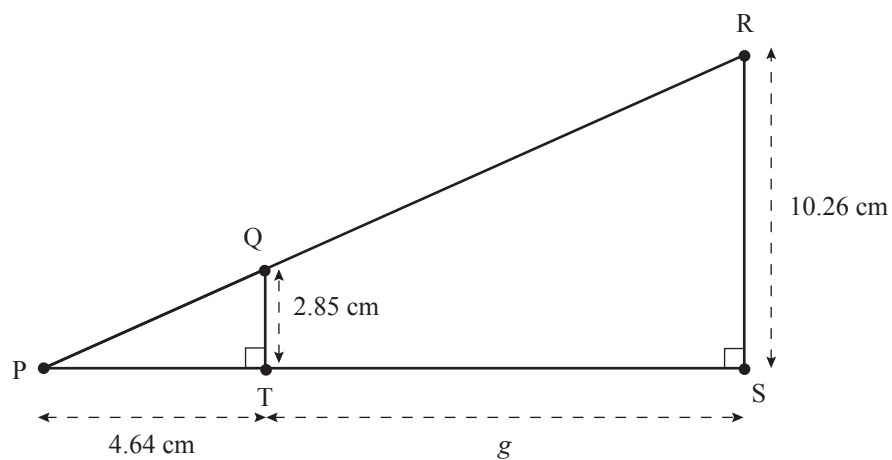


*Āta whakaaturia ngā mahinga katoa.*

- (b) In the pattern below, the lines PTS and PQR are straight.

$$\text{Angle PTQ} = \text{Angle PSR} = 90^\circ$$

PT = 4.64 cm

$$QT = 2.85 \text{ cm}$$
$$RS = 10.26 \text{ cm}$$


*Diagram is  
NOT to scale*

Calculate the length,  $g$ , from T to S.

*Show your working clearly.*



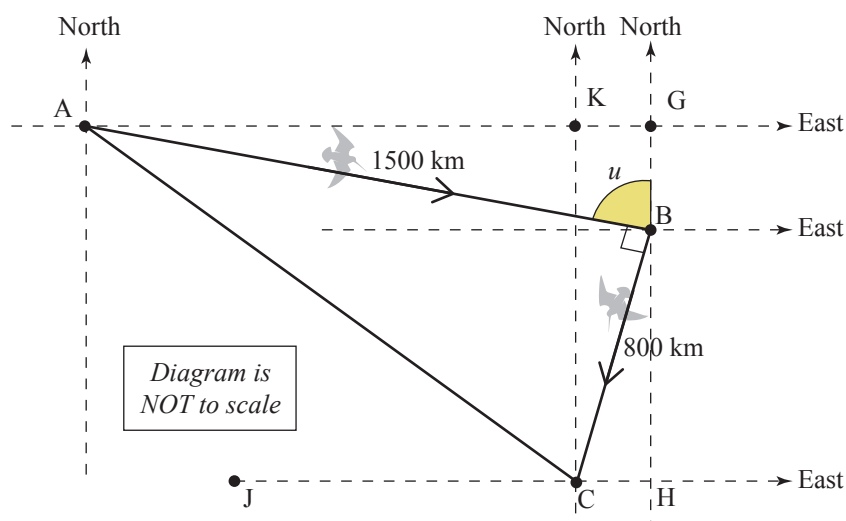
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Source: <http://nzbirdsonline.org.nz/species/bar-tailed-godwit>

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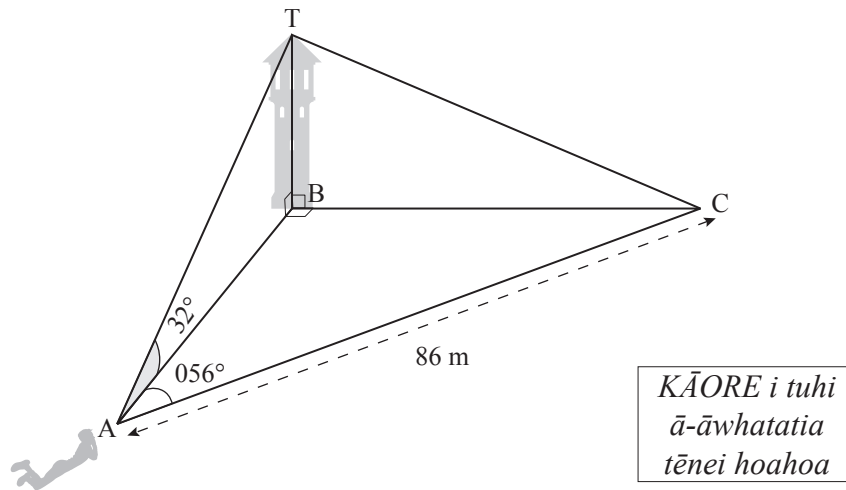
- (d) Ki te hoahoa i raro, e whakaatu ana a A i tētahi pūwāhi e rere whakatetonga o te pūtaka o tētahi pourewa poutū BT.

Ko te pūwāhi C kei te taha rāwhiti o B. Ko ngā pūwāhi  $\bar{A}$ , B me C kei te papa huapae.

I te pūwāhi A, ka inea e Kenny te koki rewa i runga ake o te pourewa, T, kia  $32^\circ$ .

Ko te pūwāhi C kei te ahunga  $056^\circ$  mai i A.

Ko te tawhiti AC he 86 mita.



- (i) Me whakaatu ko te teitei, BT, o te pourewa he 30.05 mita. *Āta whakaaturia ō mahinga katoa.*

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- (ii) Tātaihia te koki rewa mai i C ki T. *Āta whakaaturia ō mahinga katoa.*

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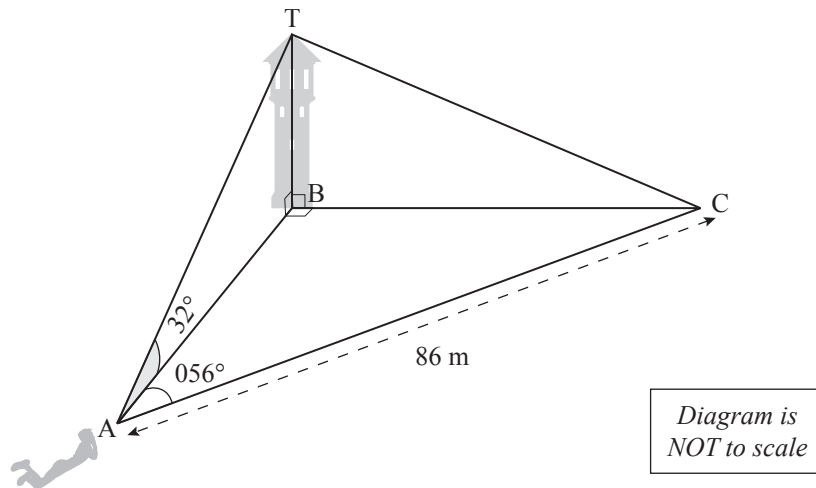
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- (d) In the diagram drawn below, A represents a point due south of the base of a vertical tower BT. The point C is due east of B. The points A, B, and C are all on horizontal ground. Kenny, lying at the point A, measured the angle of elevation of the top of the tower, T, to be  $32^\circ$ . The point C is on a bearing of  $056^\circ$  from A. The distance AC is 86 metres.



- (i) Show that the height, BT, of the tower is 30.05 metres. *Show your working clearly.*

- (ii) Calculate the angle of elevation from C to T. *Show your working clearly.*

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

TAU TŪMAHI

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

QUESTION  
NUMBER

*English translation of the wording on the front cover*

## Level 1 Mathematics and Statistics 2021

### 91031M Apply geometric reasoning in solving problems

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 2–27 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (). This area may be cut off when the booklet is marked.

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