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Level 1 Mathematics and Statistics 2021

91031 Apply geometric reasoning in solving problems

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.

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.

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.

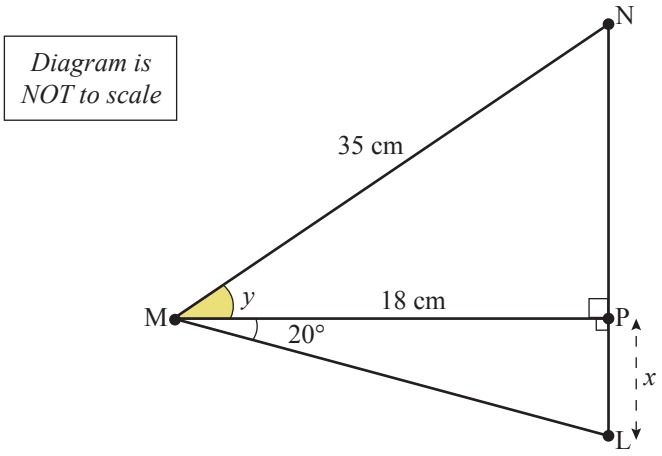
Source: https://www.doodlecraftblog.com/2017/08/easy-string-art-tutorial-heart-diamond.html

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.

Angle LMP = 20° PM = 18 cm

Angle LPM = Angle NPM = 90° MN = 35 cm



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

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

(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

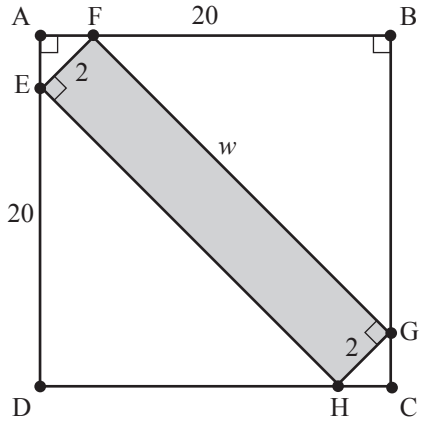


Diagram is NOT to scale

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

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

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

Angle CBF = 52° Angle BAE = Angle BFC = Angle CDE = 90°

BF = 6 cm DE = 30 cm BE = 33 cm

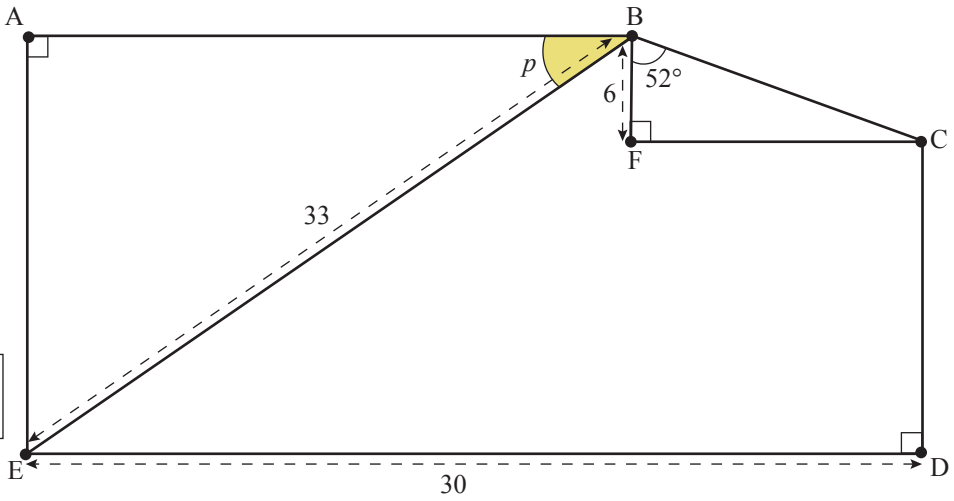


Diagram is NOT to scale

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

Show your working clearly.

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

AH = 17 cm BH = 2 cm DG = 4 cm

Angle AGD = 65°

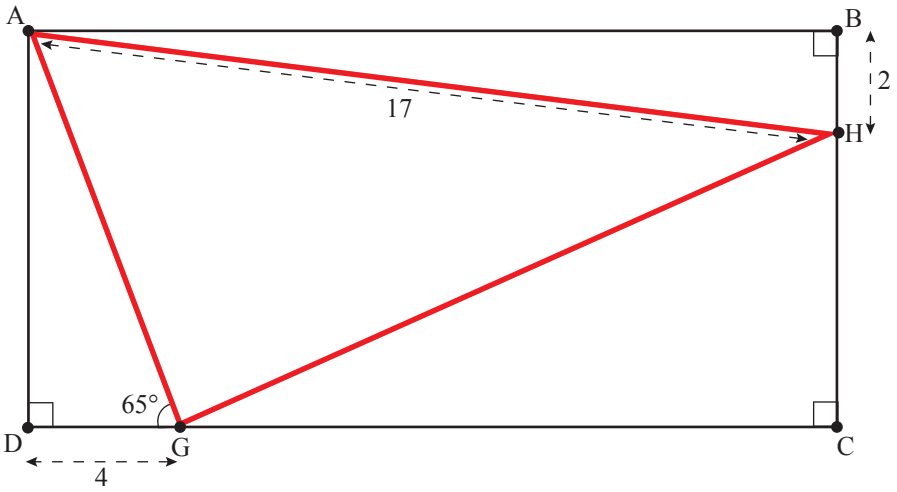


Diagram is NOT to scale

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.

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° Angle GPF = 77°

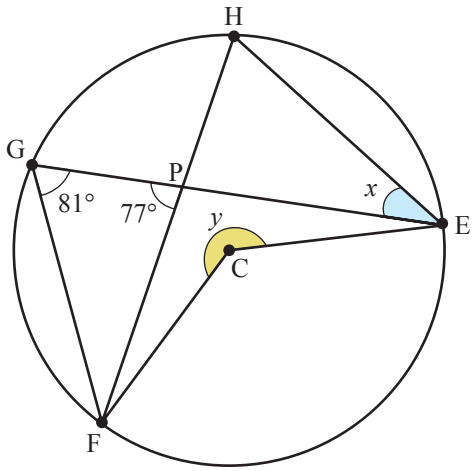


Diagram is NOT to scale

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

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

(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°

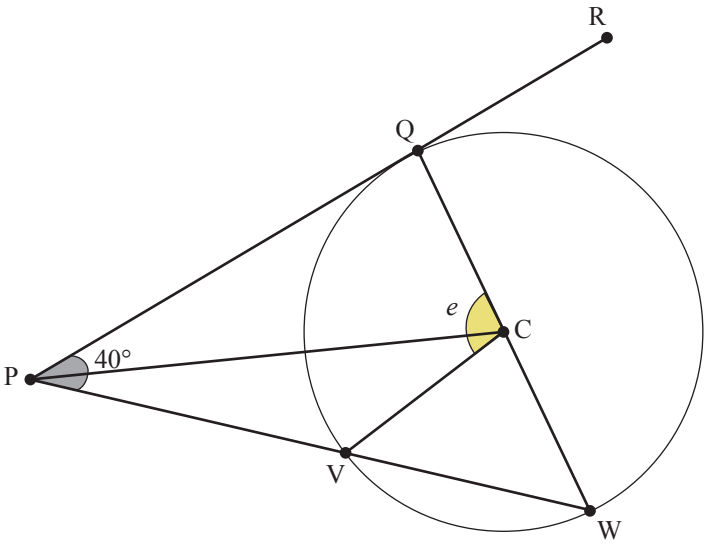


Diagram is NOT to scale

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

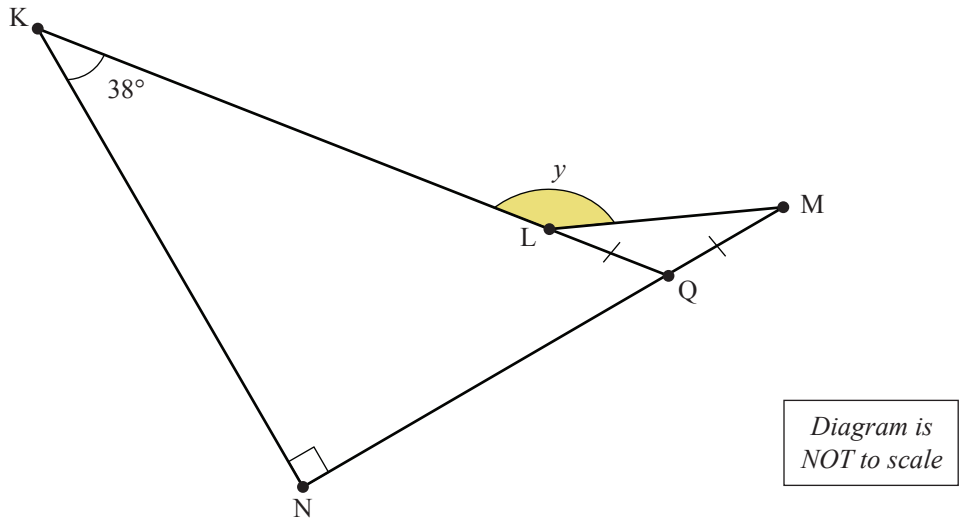
Justify your answer with clear geometric reasoning.

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

Lines KLQ and MQN are straight.

Angle NKQ = 38° Angle KNM = 90°

LQ = MQ



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

Justify your answer with clear geometric reasoning.

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

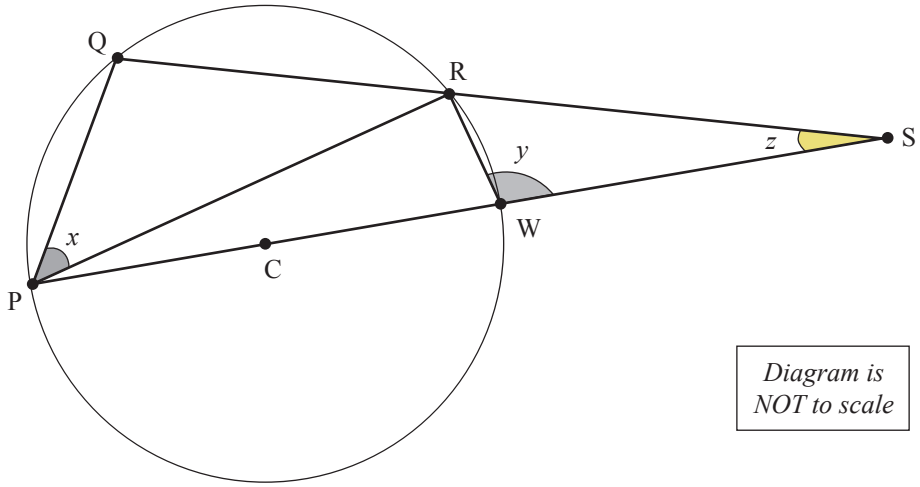


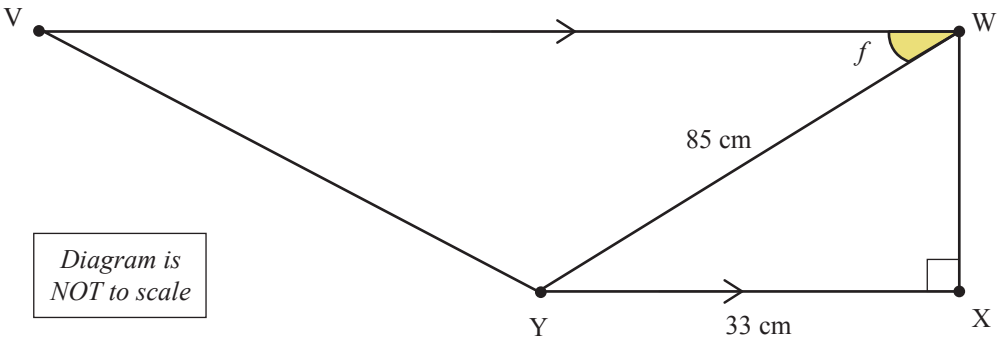
Diagram is NOT to scale

Find the size, z, of angle RSW, in terms of x and y.
Justify your answer with clear geometric reasoning.

QUESTION THREE

(a) The pattern below has nails at V, W, X, and Y. Lines VW and YX are parallel to each other.

Angle WXY = 90° XY = 33 cm WY = 85 cm



Calculate the size, *f*, of angle VWY.

Show your working clearly.

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

Angle PTQ = Angle PSR = 90°

PT = 4.64 cm QT = 2.85 cm RS = 10.26 cm

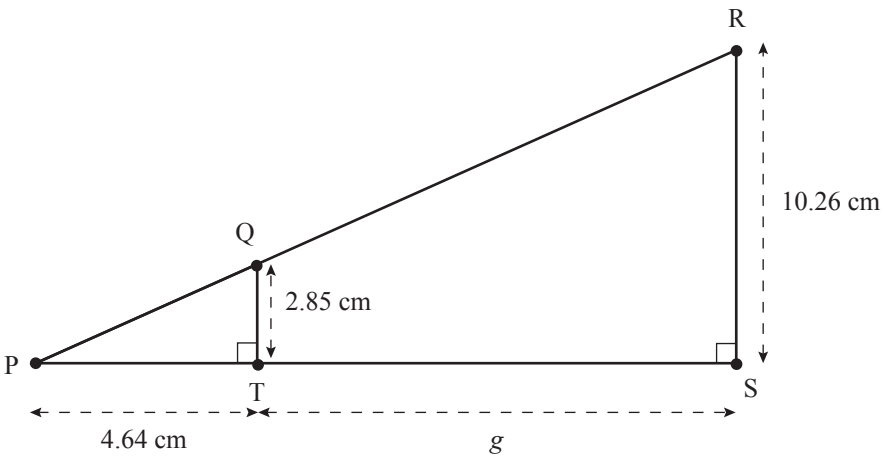


Diagram is NOT to scale

Calculate the length, g, from T to S.

Show your working clearly.

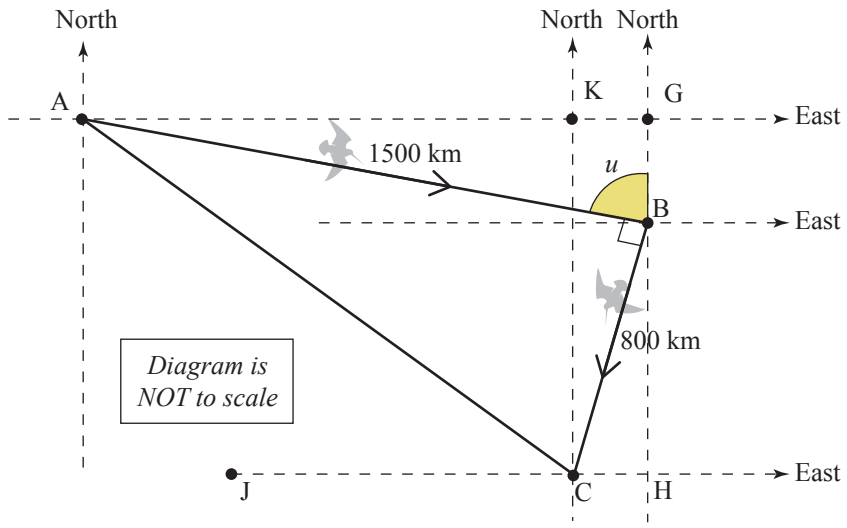
(c) The bar-tailed godwit (kuaka) flies long distances.

The diagram below shows how one particular godwit has been tracked from point A to point B and then on to point C.

The godwit flies from A to B, a distance of 1500 km, on a bearing of 128°.

It then turns through 90°, flying a further 800 km to reach point C.
Angle ABC = 90°

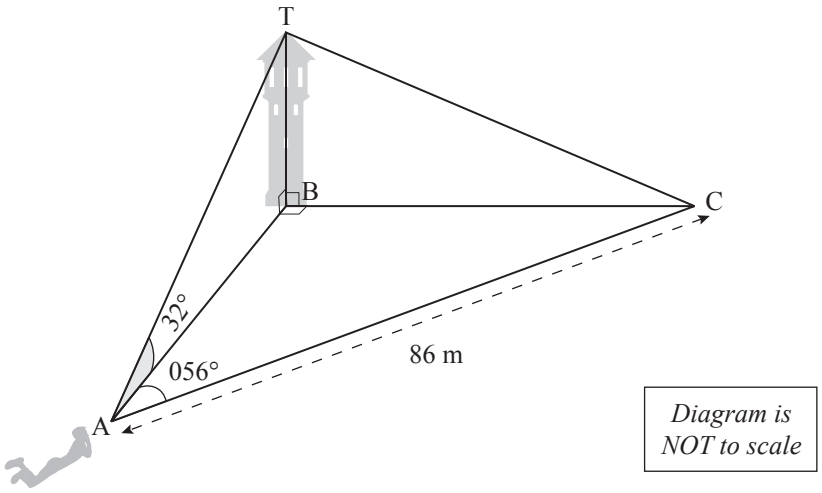
Source: http://nzbirdsonline.org.nz/species/bar-tailed-godwit



(i) Show that the size, u, of angle ABG is 52°. *Justify your working.*

(ii) Find the bearing of A from C. *Show your working clearly.*

(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°.
The point C is on a bearing of 056° 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.*

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

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