WORKSHEET - General 2 Mathematics

Topic Areas:

Measurement

MM5 – Apps of Trigonometry

- Harder applications (2 triangle questions)
- Bearings/Sine Cosine Rules

Teacher: PETER HARGRAVES

Source: HSC exam questions

Exam Equivalent Time: 87 minutes

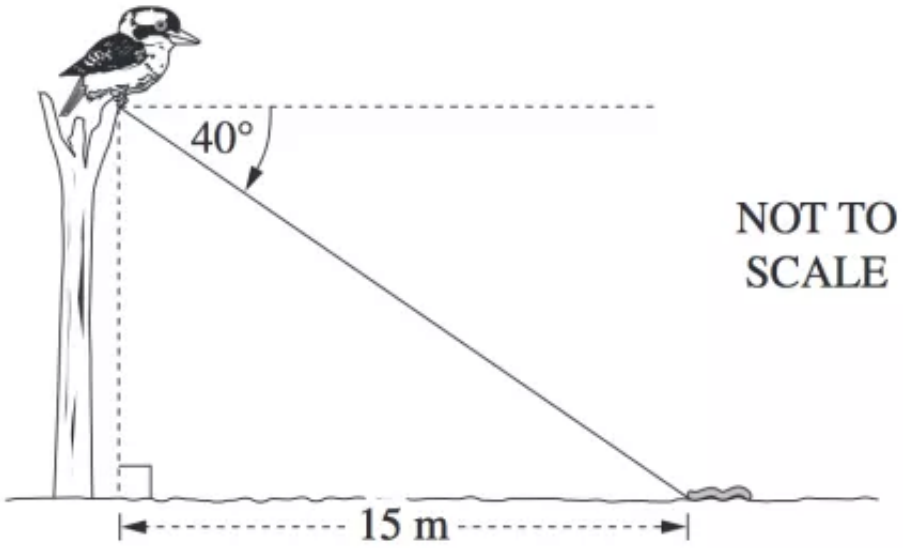
Worked Solutions: Included

Note: Each question has designated marks. Use this information as both a guide to the question's difficulty and as a timing indicator, whereby each mark should equate to 1.5 minutes of working (examination) time.

Questions

1. Measurement, 2UG 2011 HSC 4 MC

The angle of depression from a kookaburra's feet to a worm on the ground is 40°. The worm is 15 metres from a point on the ground directly below the kookaburra's feet.



How high above the ground are the kookaburra's feet, correct to the nearest metre?

(A) 10 m

(B) 11 m

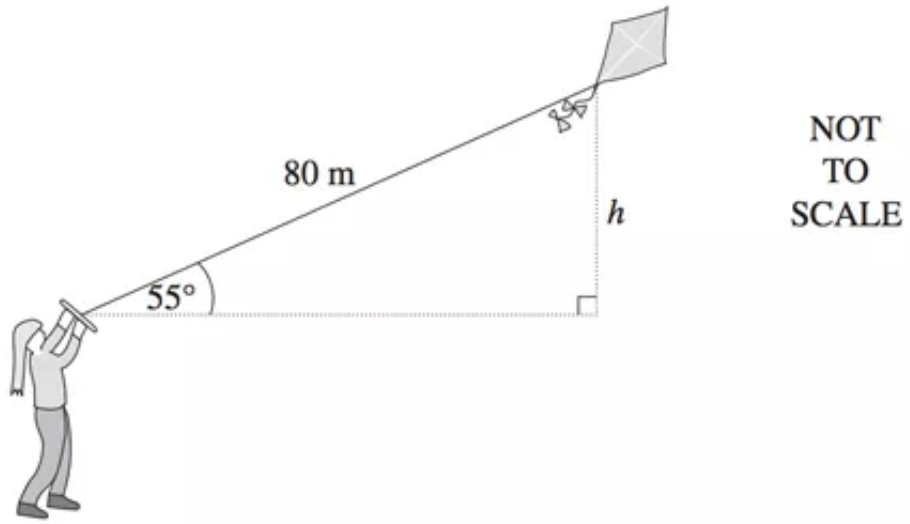
(C) 13 m

(D) 18 m

2. Measurement, 2UG 2008 HSC 14 MC

Danni is flying a kite that is attached to a string of length 80 metres. The string makes an angle of 55° with the horizontal.

How high, to the nearest metre, is the kite above Danni's hand?



(A) 46 m

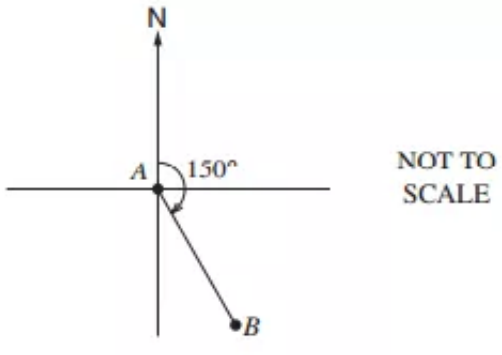
(B) 66 m

(C) 98 m

(D) 114 m

3. Measurement, 2UG 2010 HSC 10 MC

A plane flies on a bearing of 150° from A to B.



What is the bearing of A from B?

(A) 30°

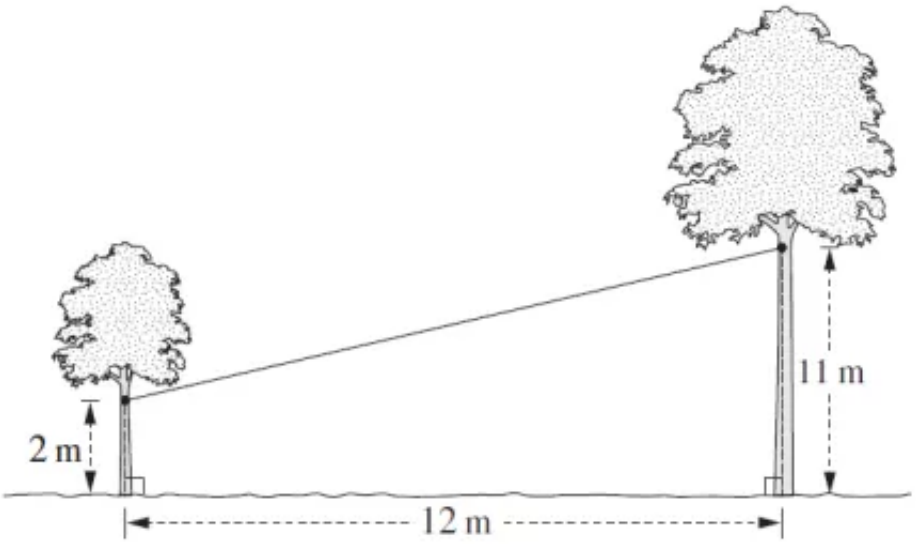
(B) 150°

(C) 210°

(D) 330°

4. Measurement, 2UG 2011 HSC 9 MC

Two trees on level ground, 12 metres apart, are joined by a cable. It is attached 2 metres above the ground to one tree and 11 metres above the ground to the other.



NOT TO SCALE

What is the length of the cable between the two trees, correct to the nearest metre?

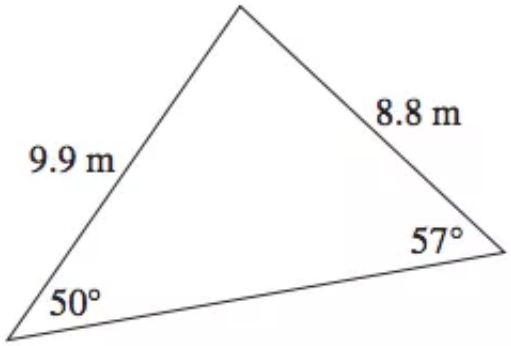
(A) 9 m

(B) 12 m

(C) 15 m

(D) 16 m

5. Measurement, 2UG 2012 HSC 10 MC



NOT TO SCALE

What is the area of this triangle, to the nearest square metre?

(A) $33\ \text{m}^2$

(B) $37\ \text{m}^2$

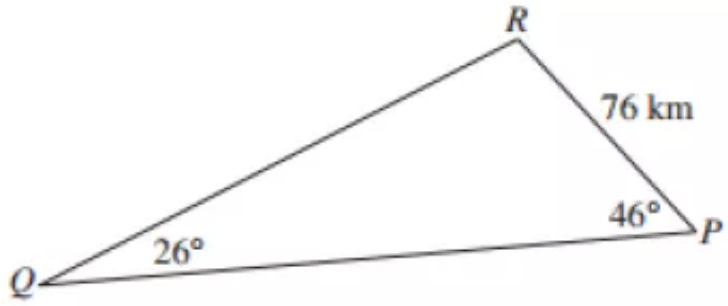
(C) $42\ \text{m}^2$

(D) $44\ \text{m}^2$

6. Measurement, 2UG 2010 HSC 9 MC

Three towns P, Q and R are marked on the diagram.

The distance from R to P is $76\ \text{km}$. $\angle RQP = 26^\circ$ and $\angle RPQ = 46^\circ$



NOT TO SCALE

What is the distance from P to Q to the nearest kilometre?

(A) $100\ \text{km}$

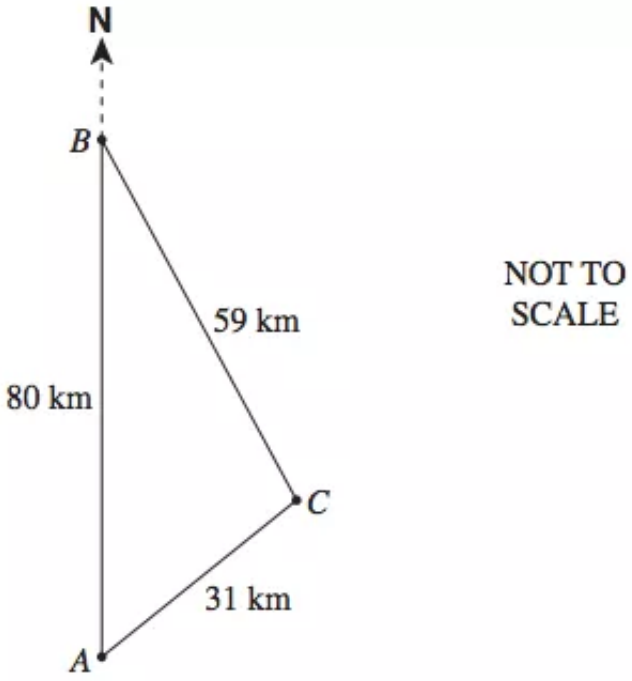
(B) $125\ \text{km}$

(C) $165\ \text{km}$

(D) $182\ \text{km}$

7. Measurement, 2UG 2012 HSC 20 MC

Town B is $80\ \text{km}$ due north of Town A and $59\ \text{km}$ from Town C.
Town A is $31\ \text{km}$ from Town C.



What is the bearing of Town C from Town B?

(A) 019°

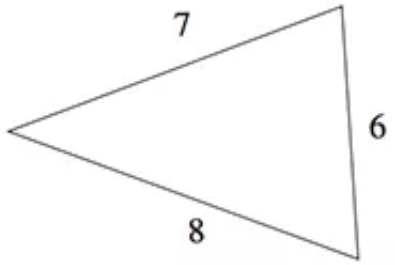
(B) 122°

(C) 161°

(D) 341°

8. Measurement, 2UG 2008 HSC 5 MC

What is the size of the smallest angle in this triangle?



NOT TO SCALE

(A) 29°

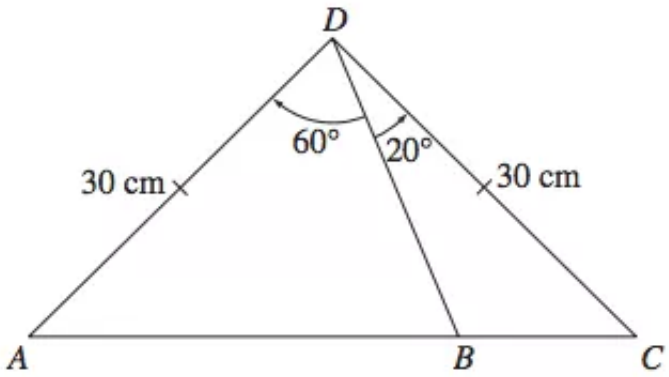
(B) 47°

(C) 58°

(D) 76°

9. Measurement, 2UG 2009 HSC 22 MC

In the diagram, AD and DC are equal to 30 cm.



NOT TO SCALE

What is the length of AB to the nearest centimetre?

(A) 28 cm

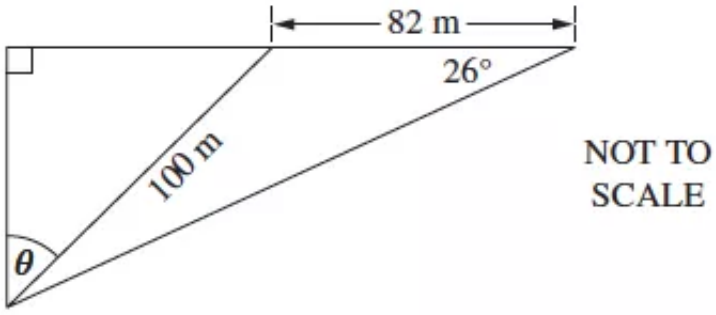
(B) 31 cm

(C) 34 cm

(D) 39 cm

10. Measurement, 2UG 2013 HSC 24 MC

What is the value of θ, to the nearest degree?



(A) 21°

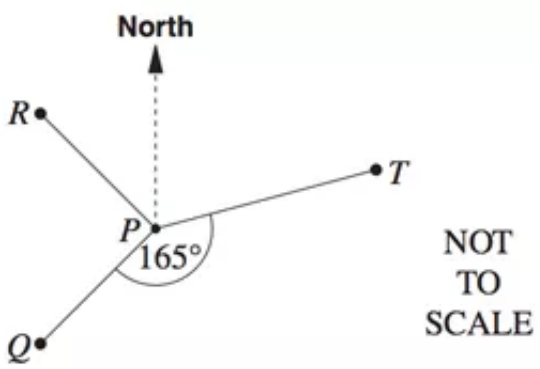
(B) 32°

(C) 43°

(D) 55°

11. Measurement, 2UG 2008 HSC 17 MC

The diagram shows the position of Q, R and T relative to P.



In the diagram,

$$Q \text{ is } SW \text{ of } P$$
$$R \text{ is } NW \text{ of } P$$
$$\angle QPT \text{ is } 165^\circ$$

What is the bearing of T from P?

(A) 060°

(B) 075°

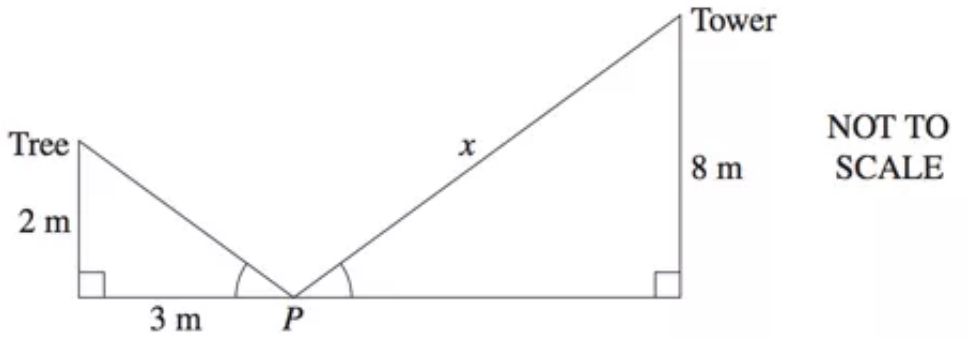
(C) 105°

(D) 120°

12. Measurement, 2UG 2008 HSC 20 MC

A point P lies between a tree, 2 metres high, and a tower, 8 metres high. P is 3 metres away from the base of the tree.

From P, the angles of elevation to the top of the tree and to the top of the tower are equal.



What is the distance, x, from P to the top of the tower?

(A) 9 m

(B) 9.61 m

(C) 12.04 m

(D) 14.42 m

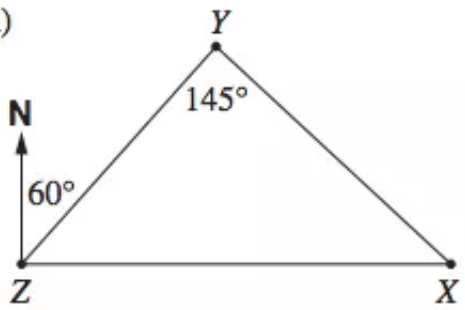
13. Measurement, 2UG 2014 HSC 23 MC

The following information is given about the locations of three towns X, Y and Z:

- X is due east of Z
- X is on a bearing of 145° from Y
- Y is on a bearing of 060° from Z.

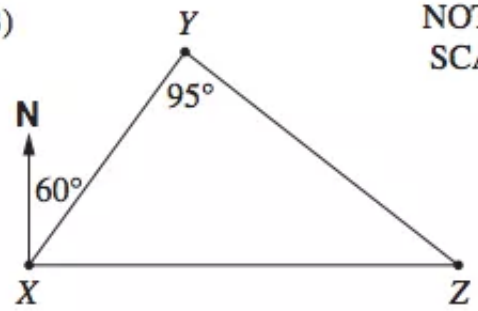
Which diagram best represents this information?

(A)

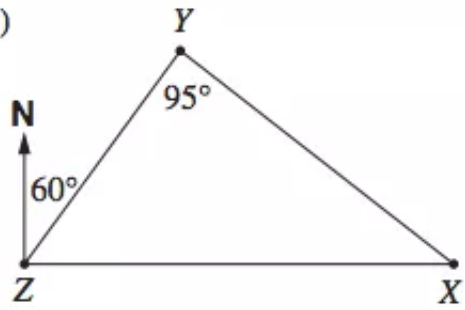


(B)

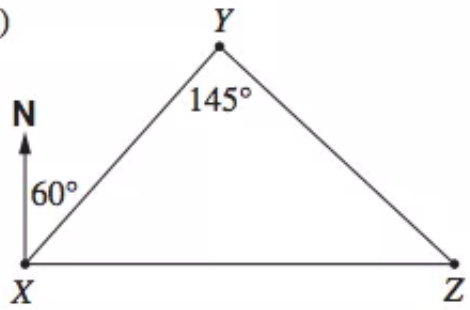
NOT TO SCALE



(C)

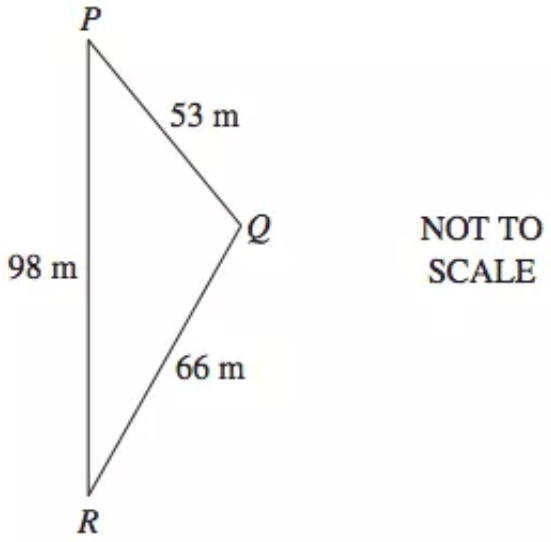


(D)



14. Measurement, 2UG 2013 HSC 26a

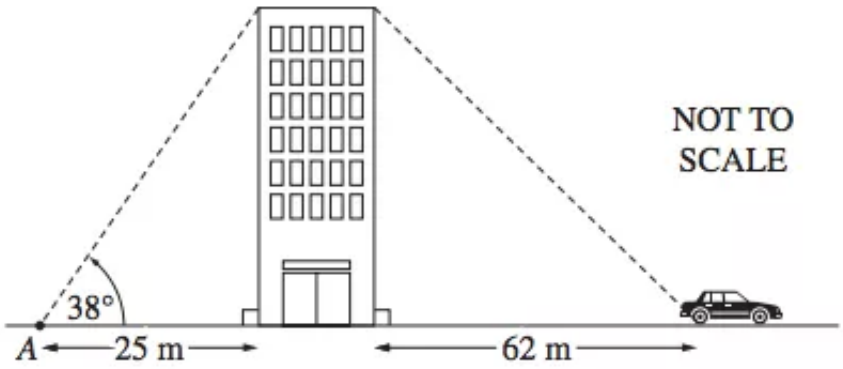
Triangle PQR is shown.



Find the size of angle Q, to the nearest degree. ***(2 marks)***

15. Measurement, 2UG 2009 HSC 23a

The point A is 25 m from the base of a building. The angle of elevation from A to the top of the building is 38°.



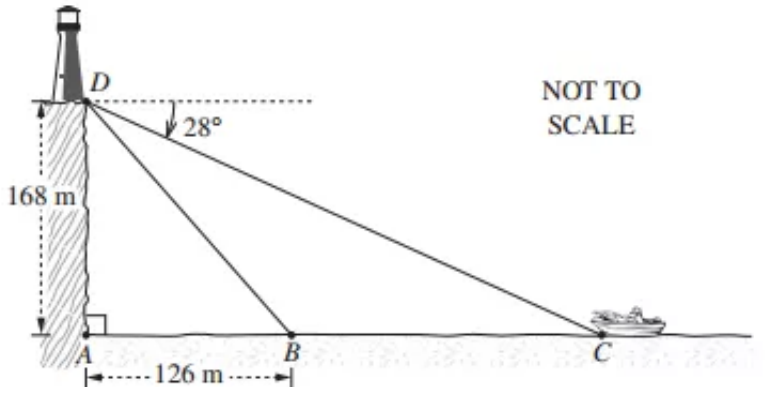
(i) Show that the height of the building is approximately 19.5 m. ***(1 mark)***

(ii) A car is parked 62 m from the base of the building.

What is the angle of depression from the top of the building to the car?
Give your answer to the nearest degree. ***(2 marks)***

16. Measurement, 2UG 2010 HSC 24d

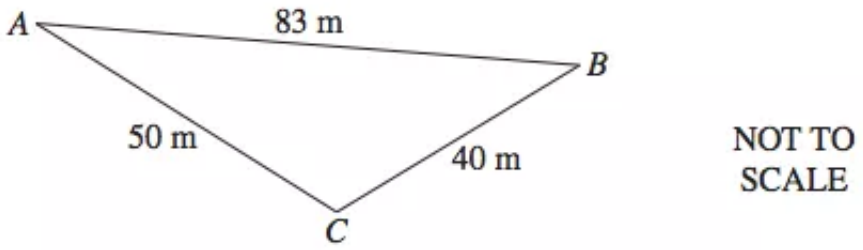
The base of a lighthouse, D, is at the top of a cliff 168 metres above sea level. The angle of depression from D to a boat at C is 28°. The boat heads towards the base of the cliff, A, and stops at B. The distance AB is 126 metres.



(i) What is the angle of depression from D to B, correct to the nearest degree? ***(3 marks)***

(ii) How far did the boat travel from C to B, correct to the nearest metre? ***(2 marks)***

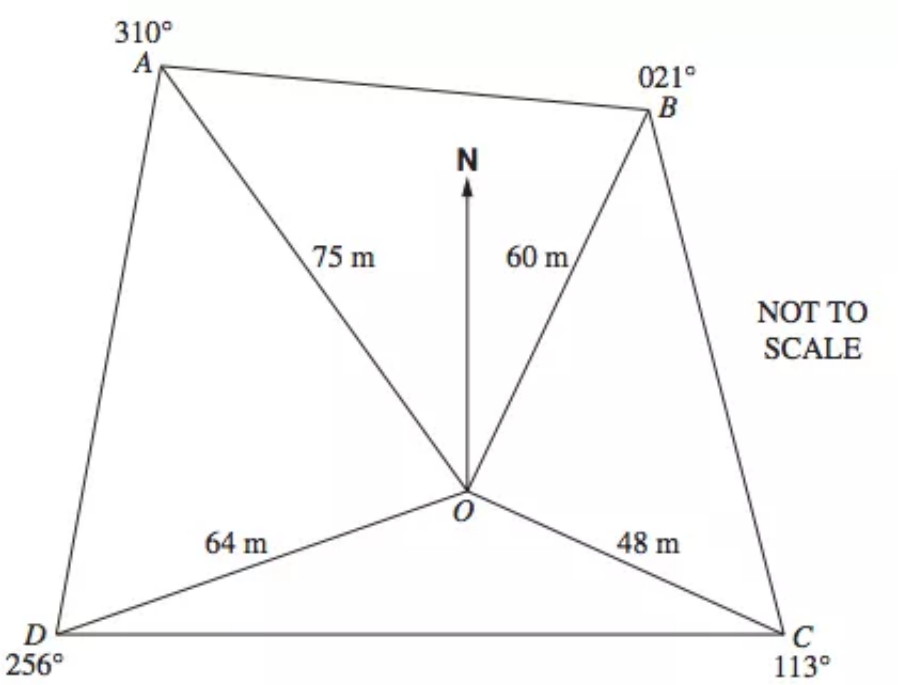
17. Measurement, 2UG 2010 HSC 26d



Find the area of triangle ABC, correct to the nearest square metre. ***(3 marks)***

18. Measurement, 2UG 2013 HSC 28a

A compass radial survey of the field $ABCD$ has been conducted from O.

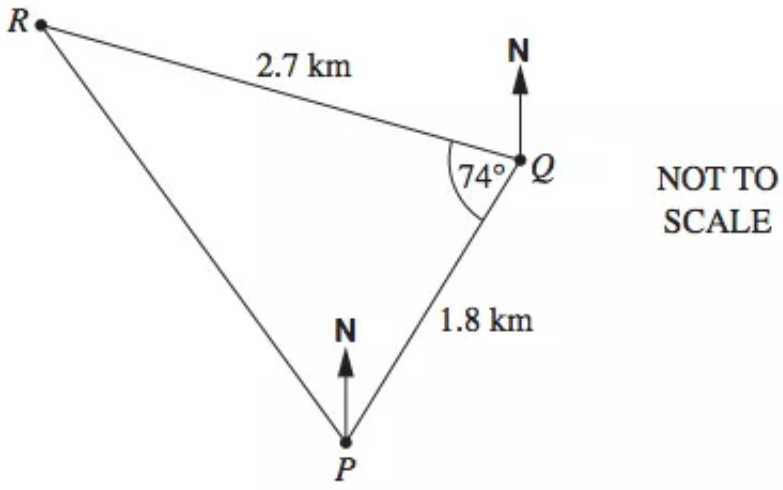


Find the area of the section ABO, to the nearest square metre. ***(2 marks)***

19. Measurement, 2UG 2009 HSC 27b

A yacht race follows the triangular course shown in the diagram. The course from P to Q is $1.8\ \text{km}$ on a true bearing of 058°.

At Q the course changes direction. The course from Q to R is $2.7\ \text{km}$ and $\angle PQR = 74^\circ$.



(i) What is the bearing of R from Q? ***(1 mark)***

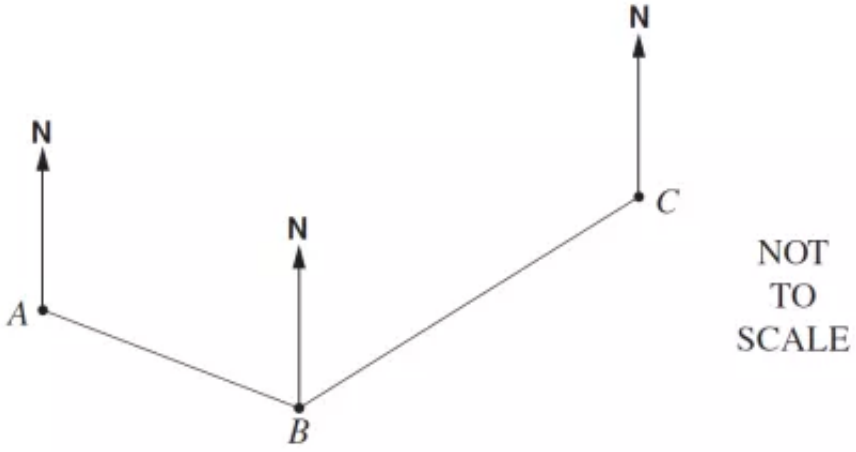
(ii) What is the distance from R to P? ***(2 marks)***

(iii) The area inside this triangular course is set as a 'no-go' zone for other boats while the race is on.

What is the area of this 'no-go' zone? ***(1 mark)***

20. Measurement, 2UG 2011 HSC 24c

A ship sails $6\ \text{km}$ from A to B on a bearing of 121°. It then sails $9\ \text{km}$ to C. The size of angle ABC is 114°.



Copy the diagram into your writing booklet and show all the information on it.

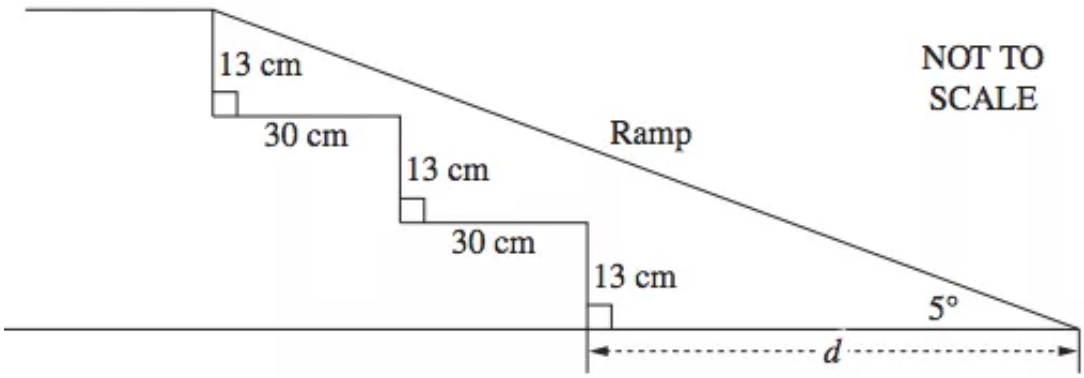
(i) What is the bearing of C from B? ***(1 mark)***

(ii) Find the distance AC. Give your answer correct to the nearest kilometre. ***(2 marks)***

(iii) What is the bearing of A from C? Give your answer correct to the nearest degree. ***(3 marks)***

21. Measurement, 2UG 2012 HSC 27d

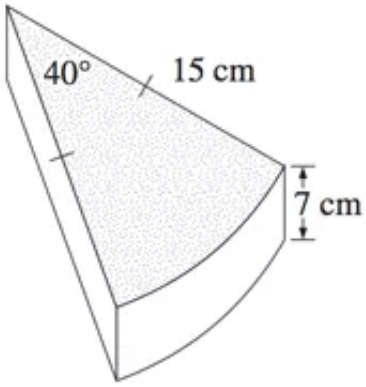
A disability ramp is to be constructed to replace steps, as shown in the diagram.
The angle of inclination for the ramp is to be 5°.



Calculate the extra distance, d, that the ramp will extend beyond the bottom step.
Give your answer to the nearest centimetre. ***(3 marks)***

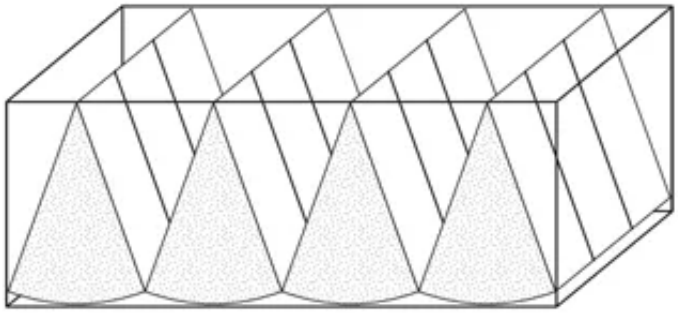
22. Measurement, 2UG 2008 HSC 25c

Pieces of cheese are cut from cylindrical blocks with dimensions as shown.



NOT TO SCALE

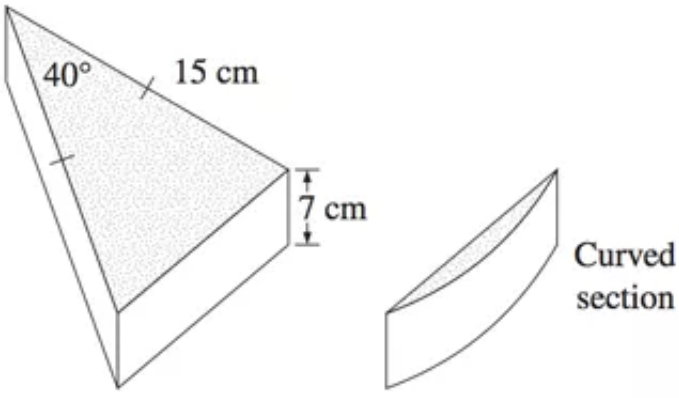
Twelve pieces are packed in a rectangular box. There are three rows with four pieces of cheese in each row. The curved surface is face down with the pieces touching as shown.



NOT TO SCALE

(i) What are the dimensions of the rectangular box? ***(4 marks)***

To save packing space, the curved section is removed.

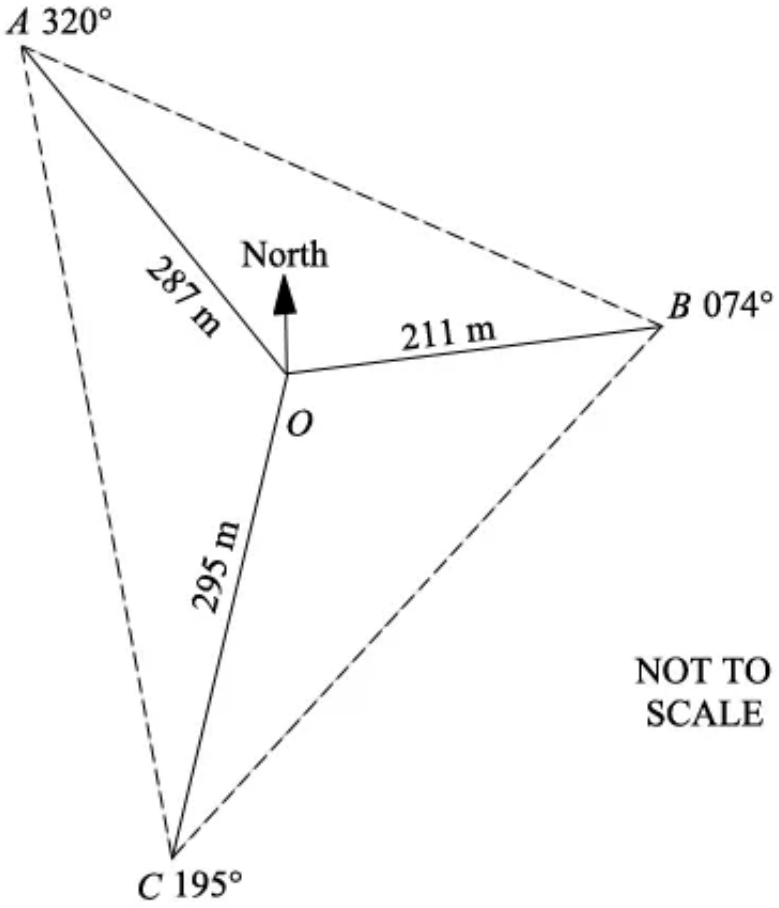


NOT TO SCALE

(ii) What is the volume of the remaining triangular prism of cheese? Answer to the nearest cubic centimetre. ***(2 marks)***

23. Measurement, 2UG 2014 HSC 28b

A radial compass survey of a sports centre is shown in the diagram.



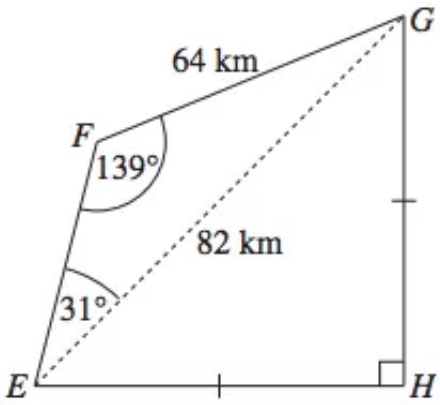
(i) Show that the size of angle AOB is 114°. ***(1 mark)***

(ii) Calculate the length of the boundary AB, to the nearest metre. ***(2 marks)***

(iii) Find the area of triangle AOB in hectares, correct to two significant figures. ***(3 marks)***

24. Measurement, 2UG 2012 HSC 29c

Raj cycles around a course. The course starts at E, passes through F, G and H and finishes at E. The distances EH and GH are equal.



NOT TO SCALE

(i) What is the length of EF, to the nearest kilometre? ***(2 marks)***

(ii) What is the total distance that Raj cycles, to the nearest kilometre? ***(3 marks)***

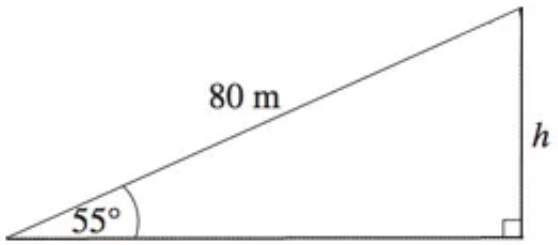
Worked Solutions

1. Measurement, 2UG 2011 HSC 4 MC

$$\begin{aligned}
\angle \text{Elevation (worm)} &= 40^\circ \quad \text{(alternate angles)} \\
\tan 40^\circ &= \frac{h}{15} \\
h &= 15 \times \tan 40^\circ \\
&= 12.58... \text{ m}
\end{aligned}$$

$\Rightarrow C$

2. Measurement, 2UG 2008 HSC 14 MC

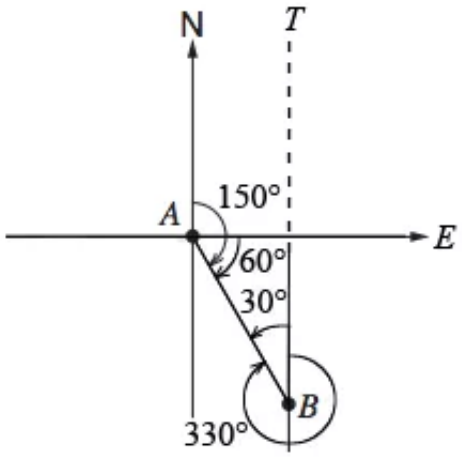


$$\begin{aligned}
\sin 55^\circ &= \frac{h}{80} \\
h &= 80 \times \sin 55^\circ \\
&= 65.532... \text{ m}
\end{aligned}$$

$\Rightarrow B$

3. Measurement, 2UG 2010 HSC 10 MC

♦♦ *Mean mark 34%*



$\angle TBA = 30^\circ \quad (180^\circ \text{ in } \Delta)$

$\therefore$ Bearing of A from B

$= 360 - 30$

$= 330^\circ$

$\Rightarrow \ D$

4. Measurement, 2UG 2011 HSC 9 MC

Using Pythagoras

$c^2 = 12^2 + 9^2$

$= 144 + 81$

$= 225$

$\therefore c = 15, \ c > 0$

$\Rightarrow C$

5. Measurement, 2UG 2012 HSC 10 MC

Let unknown angle $= \angle C$

$$\angle C = 180 - (50 + 57) \quad (180^\circ \text{ in } \Delta)$$
$$= 73^\circ$$

Using $A = \frac{1}{2}ab\sin C$

$$\therefore A = \frac{1}{2} \times 9.9 \times 8.8 \times \sin 73^\circ$$
$$= 41.656 \text{ m}^2$$

$\Rightarrow C$

6. Measurement, 2UG 2010 HSC 9 MC

$$\angle QRP = 180 - (26 + 46) \ (180^\circ \text{ in } \Delta)$$
$$= 108^\circ$$

Using sine rule

$$\frac{PQ}{\sin 108^\circ} = \frac{76}{\sin 26^\circ}$$
$$PQ = \frac{76 \times \sin 108^\circ}{\sin 26^\circ}$$
$$= 164.88 \text{ km}$$

$\Rightarrow C$

7. Measurement, 2UG 2012 HSC 20 MC

♦ *Mean mark 49%*

Using the cosine rule

$$\cos \angle B = \frac{a^2 + c^2 - b^2}{2ac}$$
$$= \frac{59^2 + 80^2 - 31^2}{2 \times 59 \times 80}$$
$$= 0.9449...$$
$$\angle B = 19^\circ \text{ (nearest degree)}$$

$\therefore$ Bearing of Town C from B $= 180 - 19 = 161^\circ$

$\Rightarrow C$

8. Measurement, 2UG 2008 HSC 5 MC

Smallest angle is opposite smallest side.

$$\text{Using } \cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$$\cos A = \frac{7^2 + 8^2 - 6^2}{2 \times 7 \times 8}$$

$$= 0.6875$$

$$\therefore\ A = 46.567...^\circ$$

$$\Rightarrow\ B$$

9. Measurement, 2UG 2009 HSC 22 MC

♦♦ Mean mark of 35%

ΔADC is isosceles

$$\angle DAB = \angle DCA = x^\circ$$

$$\Rightarrow 2x + 80^\circ = 180^\circ \quad (180^\circ \text{ in } \Delta ADC)$$

$$2x = 100^\circ$$

$$x = 50^\circ$$

$$\angle DBA = 180\ - (50 + 60) \quad (180^\circ \text{ in } \Delta ADB)$$

$$= 70^\circ$$

Using sine rule

$$\frac{AB}{\sin 60} = \frac{30}{\sin 70}$$

$$AB = \frac{30 \times \sin 60}{\sin 70}$$

$$= 27.648... \text{ cm}$$

$$\Rightarrow\ A$$

10. Measurement, 2UG 2013 HSC 24 MC

$$\text{Using } \frac{a}{\sin A} = \frac{b}{\sin B}$$

$$\frac{82}{\sin A} = \frac{100}{\sin 26}$$

$$\sin A = \frac{82 \times \sin 26}{100} = 0.35946...$$

$$\angle A = 21^\circ \quad \text{(nearest degree)}$$

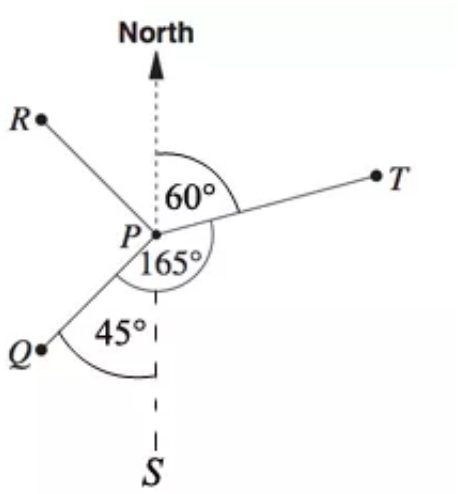
Since 180° in Δ

$$90 + 26 + (\theta + 21) = 180$$

$$\theta = 43^\circ$$

$\Rightarrow C$

11. Measurement, 2UG 2008 HSC 17 MC



$\angle QPS = 45^\circ \quad (Q \text{ is south west of } P)$

$\angle TPS = 165 - 45 = 120^\circ$

$\therefore \angle NPT = 60^\circ \quad (180^\circ \text{ in straight line})$

$\Rightarrow A$

12. Measurement, 2UG 2008 HSC 20 MC

Triangles are similar $(2 \angle \text{s same})$

In smaller triangle

$$\begin{aligned} h^2 &= 2^2 + 3^2 \\ &= 13 \\ h &= \sqrt{13} \\ \frac{x}{8} &= \frac{\sqrt{13}}{2} \quad (\text{sides of similar } \Delta\text{s same ratio}) \\ x &= \frac{8\sqrt{13}}{2} \\ &= 14.422... \end{aligned}$$

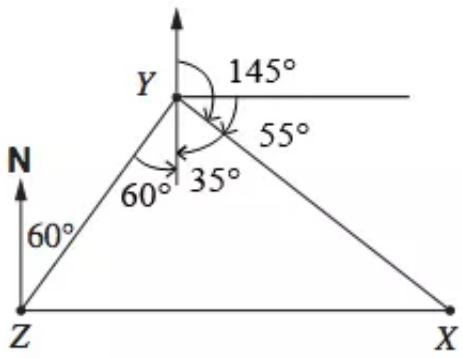
$\Rightarrow D$

13. Measurement, 2UG 2014 HSC 23 MC

♦ *Mean mark 38%*
COMMENT: Drawing a parallel North/South line through Y makes this question ***much simpler*** to solve.

Since X is due east of Z

$\Rightarrow$ Cannot be B or D



The diagram shows we can find

$$\angle ZYX = 60 + 35^\circ = 95^\circ$$

Using alternate angles (60°) and

the 145° bearing of X from Y

$\Rightarrow C$

14. Measurement, 2UG 2013 HSC 26a

♦ *Mean mark 47%*

Using cosine rule

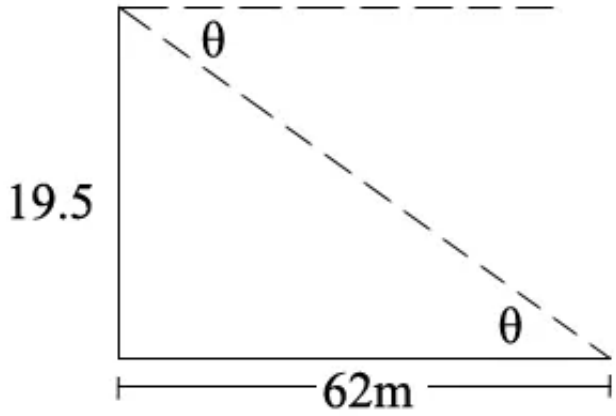
$$\begin{aligned}
\cos\angle Q &= \frac{a^2+b^2-c^2}{2ab} \\
&= \frac{53^2+66^2-98^2}{2\times 53\times 66} \\
&= -0.3486... \\
\therefore \angle Q &= 110.4034... \\
&= 110^\circ \quad \text{(nearest degree)}
\end{aligned}$$

15. Measurement, 2UG 2009 HSC 23a

(i) Need to prove height (h) ≈ 19.5 m

$$\begin{aligned}\tan 38^\circ &= \frac{h}{25} \\ h &= 25 \times \tan 38^\circ \\ &= 19.5321... \\ &\approx 19.5 \text{ m} \quad \text{... as required.}\end{aligned}$$

(ii)



Let $\angle$ Elevation (from car) $= \theta$

$$\begin{aligned}\tan\theta &= \frac{h}{62} \\ &= \frac{19.5}{62} \\ &= 0.3145... \\ \theta &= 17.459...^\circ \\ &= 17^\circ \quad \text{(nearest degree)}\end{aligned}$$

$\therefore \angle$ Depression to car $= 17^\circ$ (alternate to θ)

♦♦ *Mean mark 33%*
MARKER'S COMMENT:
Students who didn't round to the nearest degree lost a mark here.

16. Measurement, 2UG 2010 HSC 24d

(i) $\tan\angle ADB = \dfrac{126}{168}$

$\angle ADB = 36.8698...$

$= 36.9^\circ \quad (\text{to 1 d.p})$

$\angle\text{Depression } D \text{ to } B = 90 - 36.9$

$= 53.1$

$= 53^\circ \text{ (nearest degree)}$

♦♦ *Mean mark 31%*

(ii) Need to find CB

$\angle ADC + 28 = 90$

$\angle ADC = 62^\circ$

$\tan 62^\circ = \dfrac{AC}{168}$

$AC = 168 \times \tan 62^\circ$

$= 315.962...$

$CB = AC - AB$

$= 315.962... - 126$

$= 189.962...$

$= 190 \text{ m (nearest m)}$

♦♦ *Mean mark 31%*

MARKER'S COMMENT: This question can be solved simply and efficiently by using right-angled trigonometry. Many students used non-right angled trig, adding to the calculations and the difficulty.

17. Measurement, 2UG 2010 HSC 26d

$$\begin{aligned}\cos\angle C &= \frac{AC^2 + CB^2 - AB^2}{2 \times AC \times CB} \\ &= \frac{50^2 + 40^2 - 83^2}{2 \times 50 \times 40} \\ &= -0.69725... \\ \angle C &= 134.2067...^\circ\end{aligned}$$

$$\text{Using Area} = \frac{1}{2}ab\sin C$$

$$\begin{aligned}\text{Area } \Delta ABC &= \frac{1}{2} \times 50 \times 40 \times \sin 134.2067...^\circ \\ &= 716.828... \\ &= 717 \text{ m}^2 \quad (\text{nearest m}^2)\end{aligned}$$

♦♦ *Mean mark 32%.*
TIP: The allocation of 3 marks to this question should flag the need for more than 1 step. In this case, find an angle and only then can you calculate the area.

18. Measurement, 2UG 2013 HSC 28a

$$\begin{aligned}\angle AOB &= 21^\circ + (360 - 310) \\ &= 71^\circ\end{aligned}$$

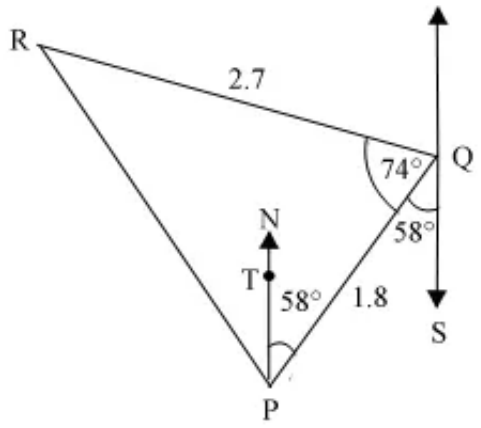
$$\text{Using Area} = \frac{1}{2}ab\sin C$$

$$\begin{aligned}\text{Area} &= \frac{1}{2} \times 60 \times 75 \times \sin 71^\circ \\ &= 2127.4167... \\ &= 2127 \text{ m}^2 \quad (\text{nearest m}^2)\end{aligned}$$

♦ *Mean mark 50%*

19. Measurement, 2UG 2009 HSC 27b

(i)



$\angle PQS = 58^\circ \quad (\text{alternate to } \angle TPQ)$

Bearing of R from Q

$= 180^\circ + 58^\circ + 74^\circ$

$= 312^\circ$

♦♦♦ *Mean mark 18%.*
TIP: Draw North-South parallel lines through relevant points to help calculate angles as shown in the Worked Solutions.

(ii) Using cosine rule

$RP^2 = RQ^2 + PQ^2 - 2 \times RQ \times PQ \times \cos \angle RQP$

$= 2.7^2 + 1.8^2 - 2 \times 2.7 \times 1.8 \times \cos 74^\circ$

$= 7.29 + 3.24 - 2.679...$

$= 7.851...$

$\therefore RP = \sqrt{7.851...}$

$= 2.8019...$

$\approx 2.8 \text{ km (1 d.p.)}$

♦ *Mean mark 36%*

(iii) Using $A = \frac{1}{2}ab\sin C$

$A = \frac{1}{2} \times 2.7 \times 1.8 \times \sin 74^\circ$

$= 2.3358...$

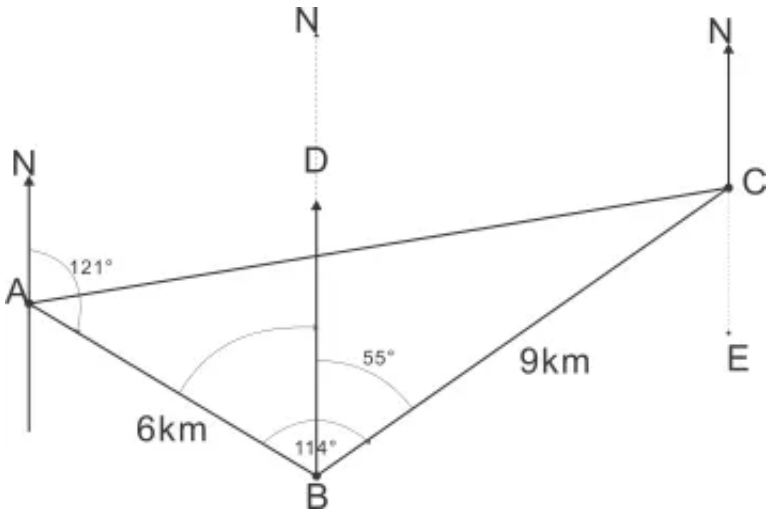
$= 2.3 \text{ km}^2$

$\therefore$ No-go zone is 2.3 km^2

♦ *Mean mark 44%*

20. Measurement, 2UG 2011 HSC 24c

(i)



♦♦ *Mean mark 24%*
TIP: This deserves repeating again: ***Draw North-South parallel lines through major points to make the angle calculations easier***.

Let point D be due North of point B

$$\begin{aligned}\angle ABD &= 180 - 121 \text{ (cointerior with } \angle A) \\ &= 59^\circ \\ \angle DBC &= 114 - 59 \\ &= 55^\circ\end{aligned}$$

$\therefore$ Bearing of C from B is 055°

(ii) Using cosine rule

♦ *Mean mark 39%*

$$\begin{aligned}AC^2 &= AB^2 + BC^2 - 2 \times AB \times BC \times \cos\angle ABC \\ &= 6^2 + 9^2 - 2 \times 6 \times 9 \times \cos 114^\circ \\ &= 160.9275... \\ \therefore AC &= 12.685... \quad (\text{Noting } AC > 0) \\ &= 13 \text{ km (nearest km)}\end{aligned}$$

(iii) Need to find $\angle ACB$ (see diagram)

$$\begin{aligned}\cos\angle ACB &= \frac{AC^2 + BC^2 - AB^2}{2 \times AC \times BC} \\ &= \frac{(12.685...)^2 + 9^2 - 6^2}{2 \times (12.685..) \times 9} \\ &= 0.9018... \\ \angle ACB &= 25.6^\circ \text{ (to 1 d.p.)}\end{aligned}$$

♦♦♦ *Mean mark 15%*
MARKER'S COMMENT: The best responses clearly showed what steps were taken with working on the diagram. Note that all North/South lines are parallel.

From diagram

$\angle BCE = 55^\circ$ (alternate to $\angle DBC$)

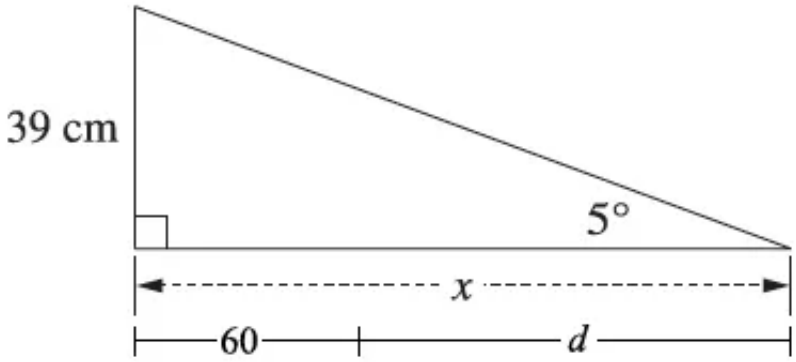
$\therefore$ Bearing of A from C

$= 180 + 55 + 25.6$

$= 260.6$

$= 261^\circ$ (nearest degree)

21. Measurement, 2UG 2012 HSC 27d



Let the horizontal part of the ramp $= x$ cm

$$\tan 5^\circ = \frac{39}{x}$$

$$x = \frac{39}{\tan 5^\circ}$$

$$= 445.772...$$

Since $x = 60 + d$

$$d = 445.772 - 60$$

$$= 385.772 \text{ cm}$$

$$= 386 \text{ cm} \quad \text{(nearest cm)}$$

♦♦ *Mean mark 35%*
MARKER'S COMMENT: The better responses used a diagram of a simplified version of the ramp as per the Worked Solution.

22. Measurement, 2UG 2008 HSC 25c

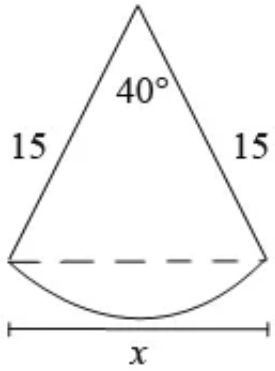
(i) Box height $= 15$ cm

(radius of the arc)

Box width $= 3 \times 7$

$= 21$ cm

Box length $= 4x$



Using cosine rule

$$\begin{aligned} c^2 &= a^2 + b^2 - 2ab\cos C \\ \Rightarrow x^2 &= 15^2 + 15^2 - 2 \times 15 \times 15 \times \cos 40^\circ \\ &= 450 - 344.7199... \\ &= 105.2800... \\ x &= 10.2606... \\ \Rightarrow \text{ Box length} &= 4 \times 10.2606... \\ &= 41.04... \end{aligned}$$

$\therefore$ Dimensions are $41 \text{ cm} \times 21 \text{ cm} \times 15 \text{ cm}$

(ii) Volume $= Ah$

$h = 7$ cm

Need to find A

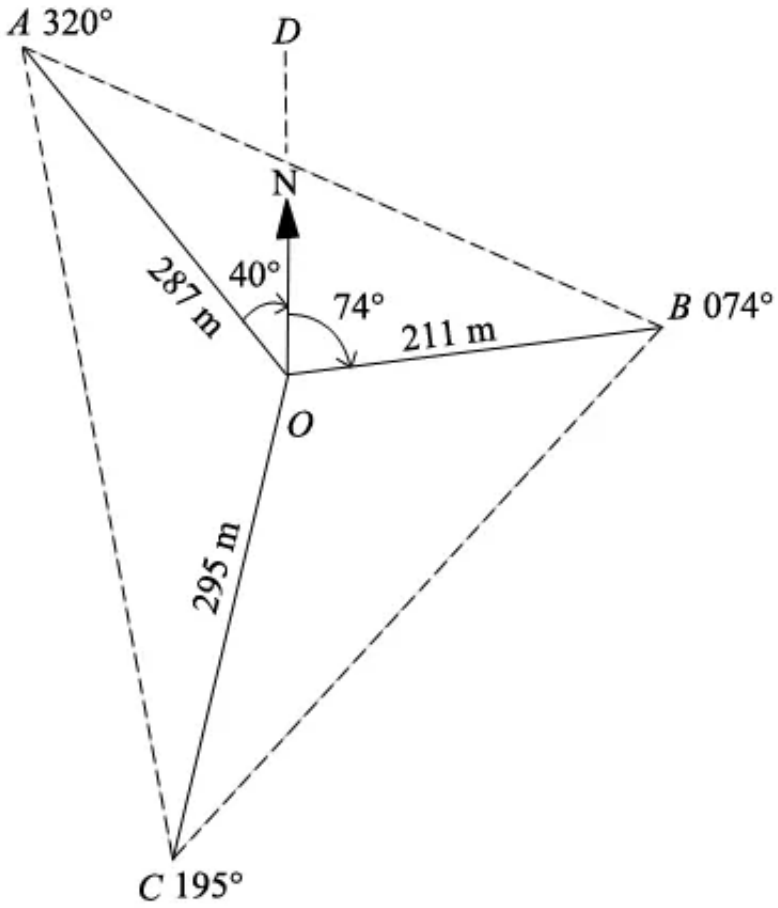
$$\text{Using } A = \frac{1}{2}ab\sin C$$

$$\begin{aligned} \Rightarrow A &= \frac{1}{2} \times 15 \times 15 \times \sin 40^\circ \\ &= 72.3136... \end{aligned}$$

$$\begin{aligned} \therefore V &= 72.3136... \times 7 \\ &= 506.195... \\ &= 506 \text{ cm}^3 \text{ (nearest whole)} \end{aligned}$$

23. Measurement, 2UG 2014 HSC 28b

(i)



Let D be directly north of O

$\angle AOD = 360 - 320 = 40^\circ$

$\therefore\ \angle AOB = 40 + 74 = 114^\circ$ ... as required

(ii) Using cosine rule

$$\begin{aligned} AB^2 &= AO^2 + BO^2 - 2 \times AO \times BO \times \cos\angle AOB \\ &= 287^2 + 211^2 - 2 \times 287 \times 211 \times \cos 114^\circ \\ &= 126\,890 - 121\,114(-0.4067...) \\ &= 176\,151.50... \\ AB &= 419.704... \\ &= 420 \text{ m (nearest m)} \end{aligned}$$

♦ *Mean marks of 42% and 41% for parts (ii) and (iii) respectively.*

(iii) Using $A = \frac{1}{2}ab\sin C$

$$\begin{aligned} \text{Area } \Delta AOB &= \frac{1}{2} \times 287 \times 211 \times \sin 114^\circ \\ &= 27\,660.786... \text{ m}^2 \end{aligned}$$

$$= 27.660... \text{ ha} \quad (1 \text{ ha} = 10{,}000 \text{ m}^2)$$
$$= 28 \text{ ha (2 sig figures)}$$

24. Measurement, 2UG 2012 HSC 29c

(i) Need to find EF

$$\angle FGE = 180 - (139 + 31) \quad (180^\circ \text{ in } \Delta)$$
$$= 180 - 170$$
$$= 10^\circ$$

♦ *Mean mark 48%.*

Using sine rule

$$\frac{EF}{\sin 10^\circ} = \frac{82}{\sin 139^\circ}$$
$$EF = \frac{82 \times \sin 10^\circ}{\sin 139^\circ}$$
$$= 21.70406..$$
$$= 22 \text{ km (nearest km)}$$

(ii) Let d = total distance cycled

Need to find EH

Since ΔEGH is isosceles, and $\angle EHG = 90^\circ$

$\angle GEH = \angle HGE = 45^\circ$ (equal angles opp. equal sides)

$$\Rightarrow \sin 45^\circ = \frac{GH}{82}$$
$$GH = 82 \times \sin 45^\circ$$
$$= 57.983...$$

♦ *Mean mark 37%.*
MARKER'S COMMENT: Students could also have used Pythagoras or the Sine rule to calculate GH.

$$d = EF + FG + GH + EH$$
$$= 21.704... + 64 + 57.983 + 57.983$$
$$= 201.66..$$
$$= 202 \text{ km (nearest km)}$$