N4 RELATIONSHIPS 1.3

This resource is to support pupils in passing the appropriate National 4 Assessment Standard. The questions and marking schemes used are from SQA past papers and as such test the topics in their entirety from grade A to C and *may* include other areas from the course. In addition the questions from **Paper 1** (P1) should be completed **without** the use of a calculator and questions from **Paper 2** (P2) permit the use of a calculator.

Each Assessment Standard is used to ensure pupils have the minimum competency on the specified sub-skills for the National 4 course. As such each Assessment Standard will test grade C work on that specific topic.

This resource is divided into two sections:

- Section A has an example on each sub skill for the relevant Assessment Standard and the marking scheme for these questions
- Section B has extra practice questions on this Assessment Standard and the marking scheme for these questions

Unit Assessment Standard	Sub skills	Section A – Question Number
Relationships 1.3 Applying trigonometric skills to right-angled triangles	The sub-skills are:	
	calculating a side in a right-angled triangle	Q1
	calculating an angle in a right-angled triangle	Q2

FORMULAE LIST

Circumference of a circle: $C = \pi d$

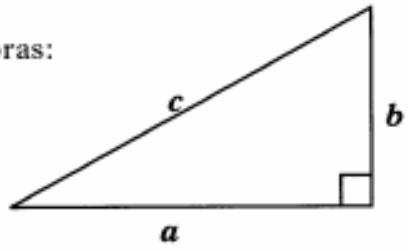
Area of a circle: $A = \pi r^2$

Curved surface area of a cylinder: $A = 2\pi rh$

Volume of a cylinder: $V = \pi r^2 h$

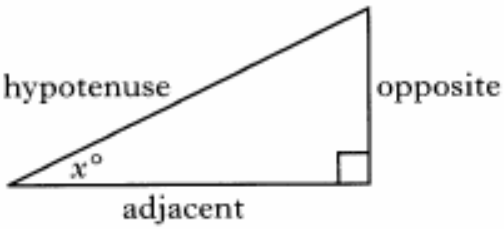
Volume of a triangular prism: $V = Ah$

Theorem of Pythagoras:



$$a^2 + b^2 = c^2$$

Trigonometric ratios in a right angled triangle:

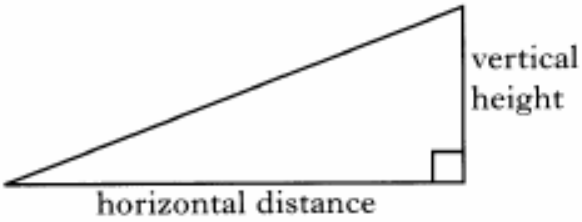


$$\tan x^\circ = \frac{\text{opposite}}{\text{adjacent}}$$

$$\sin x^\circ = \frac{\text{opposite}}{\text{hypotenuse}}$$

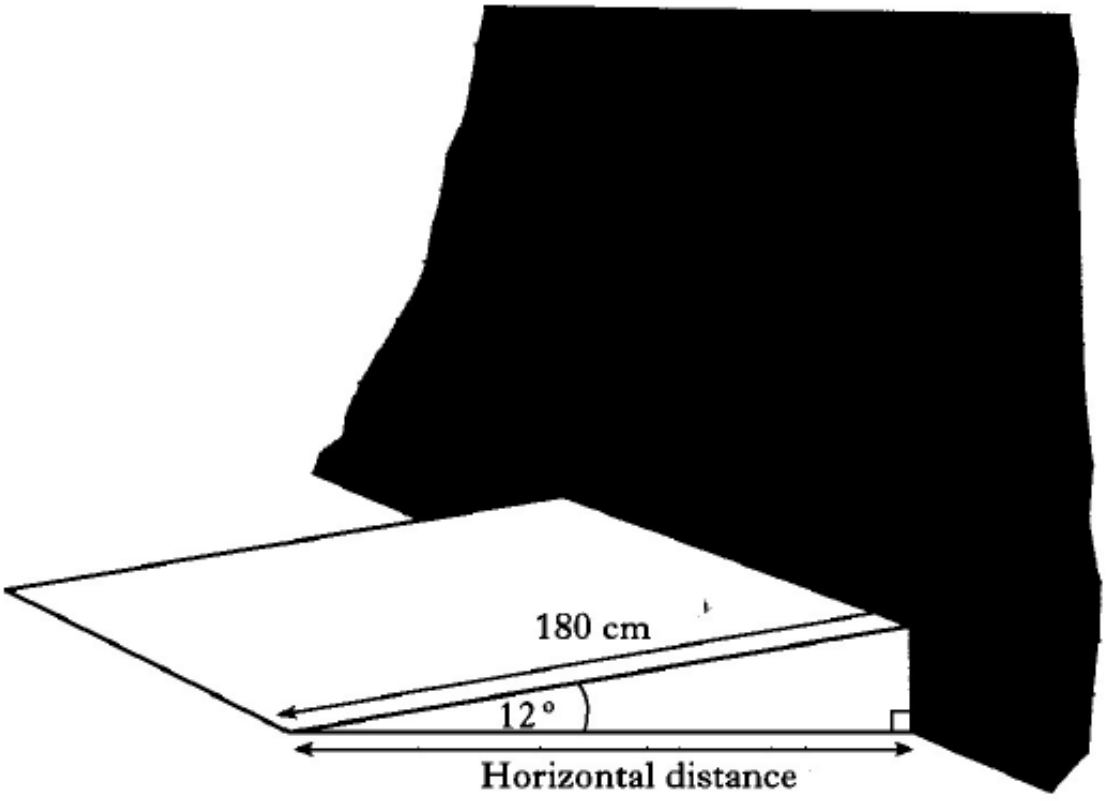
$$\cos x^\circ = \frac{\text{adjacent}}{\text{hypotenuse}}$$

Gradient:



$$\text{Gradient} = \frac{\text{vertical height}}{\text{horizontal distance}}$$

Section A

Q		Marks
Q1 P2	**4.** The entrance to a building is by a ramp as shown in the diagram below. The length of the ramp is 180 centimetres. The angle between the ramp and the ground is 12°.  Calculate the horizontal distance. Round your answer to one decimal place. **Do not use a scale drawing.**	**4**

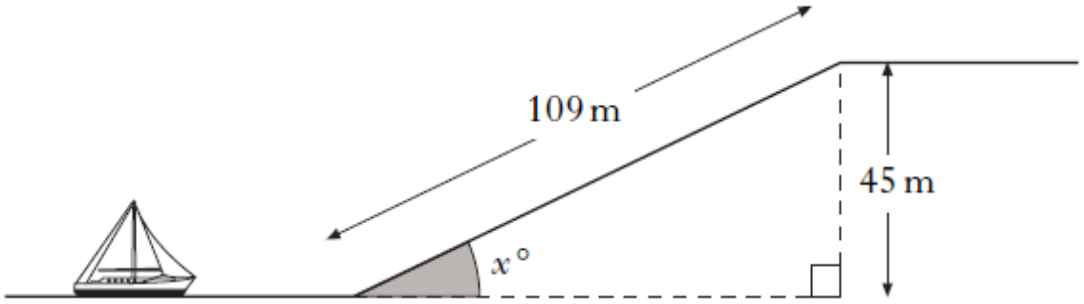
Q2 P2

12. A boat elevator is used to take a boat from the lower canal to the upper canal.

The boat elevator is in the shape of a triangle.

The length of the hypotenuse is 109 metres.

The height of the triangle is 45 metres.



Calculate the size of the shaded angle $x°$.

3

Section A

MARKING SCHEME

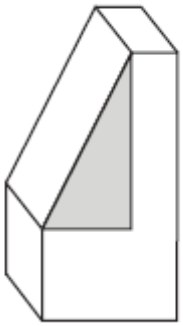
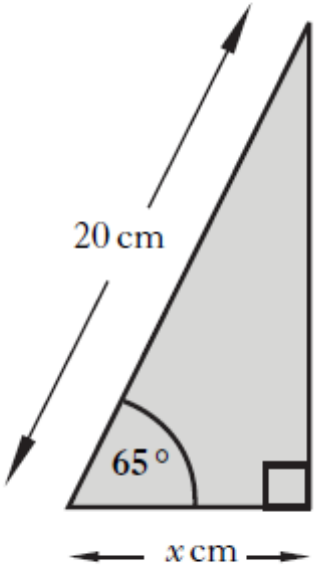
Section A - Marking Scheme

Q		Marks
Q1	**4** **Ans: 176 · 1 (cm)** $\bullet^1$ Valid trig ratio — $\bullet^1$ $\cos 12° = d/180$ $\bullet^2$ Correct rearranging — $\bullet^2$ $d = 180 \times \cos 12°$ $\bullet^3$ Correct calculation involving trig ratio — $\bullet^3$ $d = 176 \cdot 06657 \ldots$ $\bullet^4$ Correct rounding — $\bullet^4$ $d = 176 \cdot 1$ (cm) **Notes:** (i) Final mark is for correct rounding following a calculation (ii) Credit should be given where a more laborious method is used (iii) **Final answers** / **with working** / **without working** 176·1 / 4/4 / 3/4 151·9 [RAD] / 4/4 / 3/4 176·8 [GRAD] / 4/4 / 3/4 37·4 (180 × sin 12) / 3/4 / 0/4 38·3 (180 × tan 12) / 3/4 / 0/4	**4**
Q2	**12** **Ans: 24.4(°)** $\bullet^1$ Valid trig ratio — $\bullet^1$ $\sin x = 45/109$ $\bullet^2$ Correct value for $\sin x$ or equivalent — $\bullet^2$ $\sin x = 0.413$ or $x = \sin^{-1}\left(45/109\right)$ $\bullet^3$ Correct angle — $\bullet^3$ $x = 24.4(°)$ **Note:** **Final Answers** / **with working** / **without working** 24.4 / 3/3 / 2/3 0·425 [RAD] / 3/3 / 2/3 27·1 [GRAD] / 3/3 / 2/3	**3**

Section B

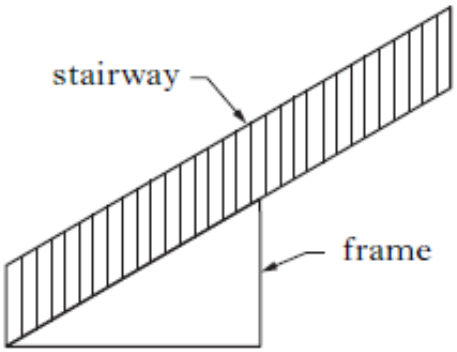
Section B – Paper 1 – No questions

Section B – Paper 2 – Questions

Q		Marks
1	**11.** The shaded part of a garden light is triangular.   • the triangle is right angled • the sloping edge is 20 centimetres long • the angle between the base and the sloping edge is 65°. Calculate the value of x.	3

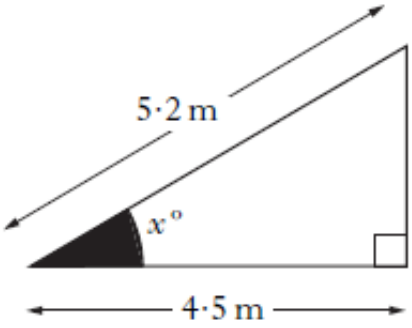
2

10. Ahmed is making a frame to strengthen a stairway in a shopping centre.



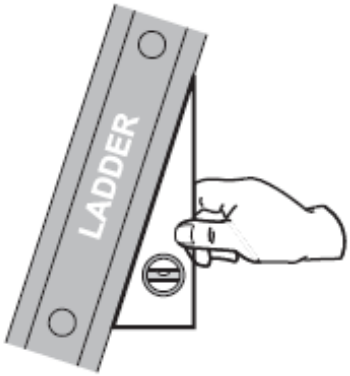
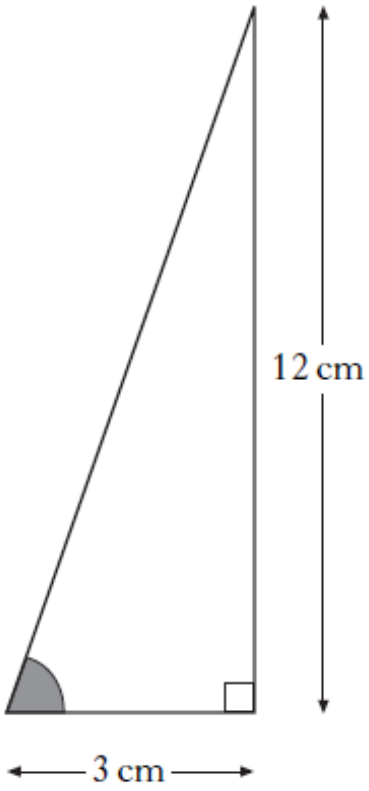
He needs to know the angle the stairway makes with the floor, as shown in the diagram below.

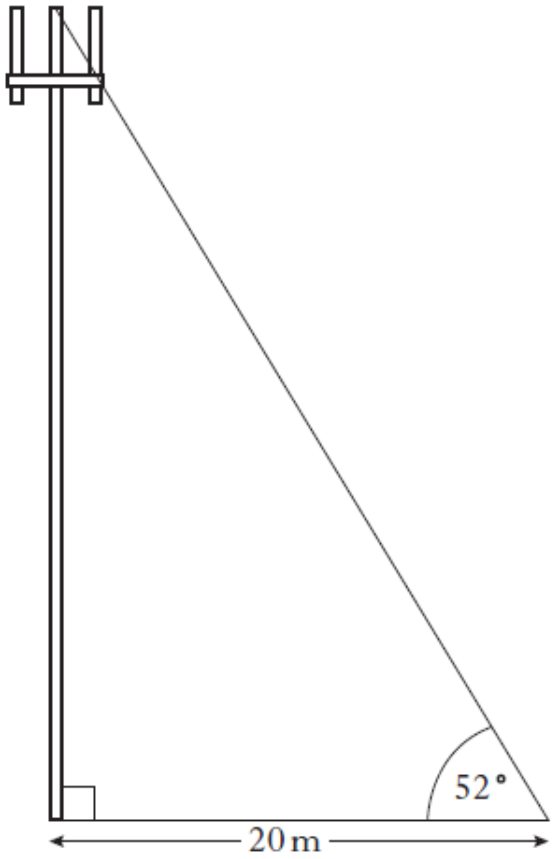
The hypotenuse of the frame is 5·2 m and the horizontal distance is 4·5 m.



Calculate the size of the shaded angle $x°$.

3

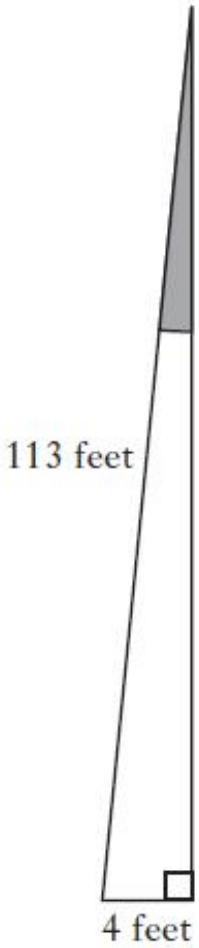
3	9. Larry has invented a device for checking that ladders are positioned at the correct angle. His design for the device is given below. Calculate the size of the shaded angle.  	**3**

4	**13.** A surveyor has to calculate the height of a mobile phone mast. From a point 20 metres from the base of the mast, the angle of elevation to the top is 52 °. Calculate the height of the mobile phone mast. Round your answer to 1 decimal place. **Do not use a scale drawing.**  	**3**

5

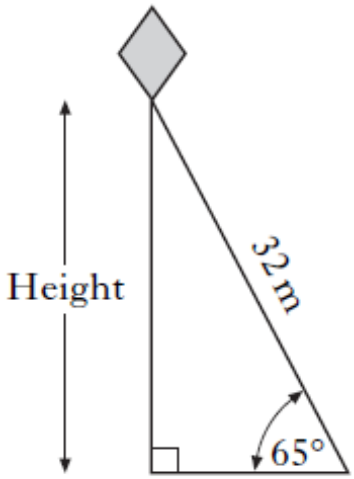
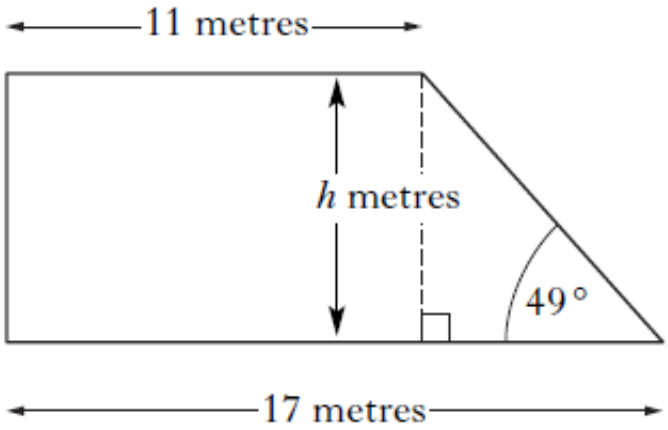
12. Belfast has a leaning clock tower.

The leaning of the clock tower is shown in the diagram below.



Calculate the size of the shaded angle.

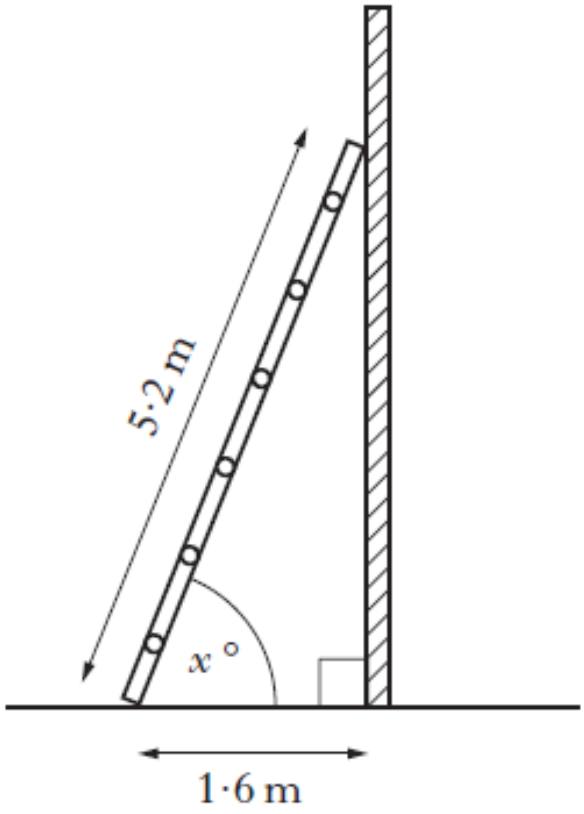
3

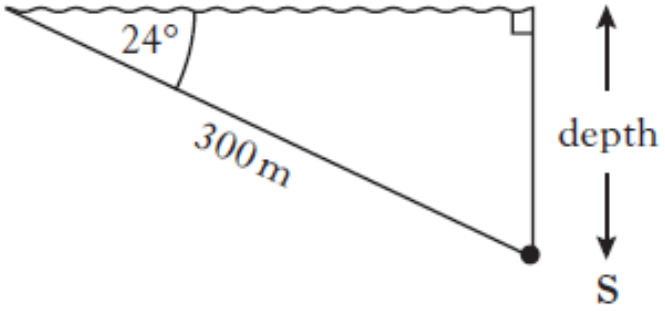
6	13. Kate is flying a kite. She lets out 32 metres of string, pulled tight, at 65° to the ground.  Calculate the height of the kite as shown in the diagram. **Do not use a scale drawing.**	3
7	12. Calculate the height, h metres, of the trapezium shown below. **Do not use a scale drawing.**  	4

8

8. A ladder which is 5·2 metres long is placed against a wall.
The foot of the ladder is 1·6 metres from the wall.
The size of the angle between the ladder and the ground is x °.
Calculate x.
Do not use a scale drawing.

3



9	9. A submarine, **S**, dives for 300 metres at an angle of 24° to the surface. Calculate the depth of the submarine as shown in the diagram. **Do not use a scale drawing.**  	**3**

Section B

MARKING SCHEME

Section B – Paper 1 – No Marking Scheme

<table>
<tr><th>Q</th><th></th><th>Marks</th></tr>
<tr><td>1</td><td>
11
Ans: 8·45
•1 for a valid trig ratio — •1 Cos 65° = x/20
•2 correct rearranging — •2 x = 20 × Cos 65°
•3 correct trig calculation — •3 x = 8·45
</td><td>3</td></tr>
<tr><td>2</td><td>
10
Ans: 30·1(°)
•1 valid trig ratio — •1 Cos x = 4·5/5·2
•2 correct value for Cosx or equivalent — •2 Cos x = 0·865 or x = Cos⁻¹(4·5/5·2)
•3 correct angle — •3 30·1(°)
3
NOTE:
(i) Final answers: 30·1 — with working: 3/3 — without working: 0/3 (measures 30° on diag)
0·52 [RAD] — 3/3 — 0/3
33·4 [GRAD] — 3/3 — 0/3
</td><td>3</td></tr>
</table>

3			3

9	**Ans: $x = 75{\cdot}96...(°)$**		
	$\bullet^1$ valid trig ratio	$\bullet^1$ $\tan x° = 12/3$	
	$\bullet^2$ correct value for $\tan x°$ or equivalent	$\bullet^2$ $\tan^{-1}(12/3)$ or $\tan x° = 4$	
	$\bullet^3$ correct angle	$\bullet^3$ $x = 75{\cdot}96...(°)$	**3K**

NOTES:

(i)

Final answers	**with working**	**without working**
75·96...°	3/3	1/3
76°	3/3	1/3
1·33 [RAD]	3/3	1/3
84·4 [GRAD]	3/3	1/3
14°	2/3	0/3

(ii) Where final answer comes from $\sin x° = 3/12$ or $\cos x° = 3/12$ the maximum mark available is 1/3

(iii) Credit should be given where a more laborious method is used.

(iv) Ignore incorrect rounding

4					**3**
	13	**Ans:**	**25·6 (m)**		
		•[1]	correct trig statement	•[1]	Tan 52° = h/20
		•[2]	rearrange formula	•[2]	h = 20 × Tan 52°
		•[3]	correct calculation	•[3]	h = 25·598...
		•[4]	correct rounding	•[4]	h = 25·6 (m)

NOTE:

(i)	**Final Answers**	**With Working**	**Without Working**
	25·6	4/4	3/4
	(-)121·1 [RAD]	4/4	3/4
	21·3 [GRAD]	4/4	3/4
	15·8 (20 × Sin 52°)	3/4	0/4
	12·3 (20 × Cos 52°)	3/4	0/4

5								**3**
12			**Ans: 2·02 (°)**		**3**			
			•[1]	valid trig ratio		•[1]	$\sin x° = 4/113$	
			•[2]	correct value for $\sin x°$		•[2]	$\sin x° = 0·035\ldots$	
			•[3]	correct angle		•[3]	$x° = 2·02°$	
					(KU)			

Notes:

(i)

Final Answers	with working	without working
2(·02)	3/3	0/3
0·035 [RAD]	3/3	0/3
2·25 [GRAD]	3/3	0/3

(ii) Where the final answer comes from $\cos x° = 4/113$ leading to 88° or $\tan x° = 4/113$ leading to 2·027 … the maximum mark available is 1/3

(iii) candidates who use tan can also obtain a final answer of 2(·027) – award 1/3

(iv) credit should be given where a more laborious method is used

(v) ignore incorrect rounding

6						**3**
13			**Ans: 29 m**	**3**		
			•[1] use correct sine ratio: $\sin 65° = {}^{h}/_{32}$		1. Correct answer without working award 2/3	
			•[2] know how to solve equation: $h = 32 \times \sin 65°$		2. Do not penalise inadvertent use of radians or grads 26(·458…) (radians used) award 3/3 27(·284…) (grads used) award 3/3	
			•[3] carry out trig. calculation: 29 (·0018….)		3. Disregard premature rounding or truncation eg $32 \times \sin 65° = 32 \times 0{\cdot}9 = 28{\cdot}8$ award 3/3	
					4. Where an incorrect trig ratio is used, working should be followed through with the possibility of awarding 2/3. [Disregard premature rounding or truncation] (a) $32 \times \cos 65° = 13{\cdot}5(23\ldots)$ award 2/3 ×✓✓ (b) $32 \times \cos 65° = 32 \times 0{\cdot}4 = 12{\cdot}8$ award 2/3 ×✓✓ (c) $32 \times \tan 65° = 68{\cdot}6(24\ldots)$ award 2/3 ×✓✓ (d) $32 \times \tan 65° = 32 \times 2{\cdot}1 = 67{\cdot}2$ award 2/3 ×✓✓	

7						**4**
	12		**Ans: 6·9 m (or 7m)** •[1] find base of triangle: $17 - 11 = 6$ •[2] use correct tan ratio: $\tan 49° = {}^{h}/_{6}$ •[3] know how to solve equation: $h = 6 \times \tan 49°$ •[4] carry out trig. calculation: 6·9(0….)	**4**	1. Correct answer without working award 3/4 **Be aware** $\tan 49 = {}^{h}/_{6}$ $\tan^{-1}(6/49) = 6.9(8…)$ ✓✓×✓ 2. Do not penalise inadvertent use of radians or grads -19(·0…) (radians used) award 4/4 5(·184…) (grads used) award 4/4 3. Where an incorrect trig ratio is used, working should be followed through with the possibility of awarding 3/4. (a) $6 \times \cos 49° = 3·9(36…)$ award 3/4 ✓×✓✓ (b) $6 \times \sin 49° = 4·5(28…)$ award 3/4✓×✓✓ 4. In awarding the 4th mark, the trig. ratio should not be rounded to any less than 2 decimal places eg (a) $6 \times \tan 49° = 6 \times 1·15 = 6·9$ award 4/4 (b) $6 \times \tan 49° = 6 \times 1·2 = 7·2$ award 3/4 ✓✓✓×	

8 **3**

8

Ans: 72°

- •1 use correct cosine ratio: $\cos x° = {}^{1\cdot6}/_{5\cdot2}$
- •2 know how to find x: $\cos^{-1}({}^{1\cdot6}/_{5\cdot2})$ or $\cos^{-1}0\cdot307\ldots$
- •3 carry out inverse trig. calculation: 72(·07….)

3

1. Correct answer without working award 2/3
2. Do not penalise inadvertent use of radians or grads
   1·3 or 1·2(5…) (radians used) award 3/3
   80·1 or 80·08(…) (grads used) award 3/3
3. Where an incorrect trig ratio is used, working should be followed through with the possibility of awarding 2/3.
   (a) $\sin^{-1}({}^{1\cdot6}/_{5\cdot2})$ = 18 or 17·9(…) award 2/3 ×✓✓
   (b) $\tan^{-1}({}^{1\cdot6}/_{5\cdot2})$ = 17·1(0…) award 2/3×✓✓
   (c) $\tan^{-1}({}^{5\cdot2}/_{1\cdot6})$ = 73 or 72·9 or 72·8(9…) award 2/3×✓✓
4. In awarding the 3rd mark, ${}^{1\cdot6}/_{5\cdot2}$ should not be rounded or truncated to any less than two decimal places
   (a) $\cos^{-1}0\cdot31$ = 72 or 71·9(…) award 3/3
   (b) $\cos^{-1}0\cdot3(0)$ = 73 or 72·5(…) award 2/3✓✓×
5. Do **not** award 3rd mark if there is invalid subsequent working
   e.g. $\cos^{-1}({}^{1\cdot6}/_{5\cdot2}) = 72 \rightarrow \sqrt{72} = 8\cdot485\ldots$ award 2/3✓✓×

Section B – Paper 2 – Marking Scheme

9									**3**
9			**Ans: 122m**			3			
			• [1] use correct sin ratio: $\sin 24° = {}^{d}/_{300}$				1. Correct answer without working award 3/3		
			• [2] know how to solve equation: $d = 300 \times \sin 24°$				2. Do not penalise inadvertent use of radians or grads −272, 271(·67 …) (radians used) award 3/3 110(·4…) (grads used) award 3/3		
			• [3] carry out trig. calculation: 122(·02….)				3. Where an incorrect trig ratio is used, working should be followed through with the possibility of awarding 2/3. (a) 274(·06…) [300 × cos 24°] award 2/3 ×✓✓ (b) 134, 133(·568…) [300 × tan 24°] award 2/3 ×✓✓		
							4. In awarding the 3rd mark, the trig. ratio should not be rounded to any less than 2 decimal places, eg (a) 300 × sin 24° = 300 × 0·41 = 123 award 3/3 (b) 300 × sin 24° = 300 × 0·4(0) = 120 award 2/3 ✓✓×		
							5. Do **not** award the 3rd mark if there is invalid subsequent working e.g. 300sin 24° = 122 → √122 = 11(·…) award 2/3 ✓✓×		