REVISE
.wales

F3.05 — Right-angled trigonometry (SOH CAH TOA)

Mark schemes for the F3.05 question pack

Spec 1.5.6, 3.7.3, 3.7.4 — Unit 3

SOLUTIONS · 2025 SPECIFICATION

Mark schemes for the 26 questions in the corresponding revise.wales question pack (85 marks total). Sources: legacy WJEC GCSE papers, WJEC SAM, and custom-authored mark schemes.

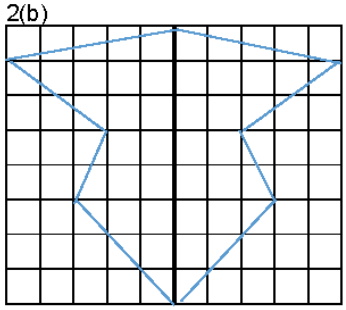
16.	$\frac{QR}{18} = \tan 24(°)$ $QR = 18 \times \tan 24(°)$ $= 8(\cdot 01..)(cm)$		M1 m1 A1	OR $\frac{QR}{\sin 24} = \frac{18}{\sin 66}$ $QR = \frac{18 \times \sin 24}{\sin 66}$ C.A.O.

		equations shown.
19.(a) Tan ACB = $\frac{6{\cdot}5}{10{\cdot}4}$ (ACB =) $\tan^{-1}$ 0·625 or $\tan^{-1}$ (6·5 / 10·4) (x) = 32(°)	M1 A1 A1	M1 for equivalent complete method. C.A.O. (Implies previous A1.) Accept an answer that rounds to 32(°)
Alternative method. ***Correct** use of 'two-step' method.* *(x) = 32(°)*	M2 A1	*A partial trigonometric method is M0.* *Accept an answer that rounds to 32(°)*
19.(b) (DE =) 9·4 × sin[22 + 32](°) = 7·6(…)(cm) ISW	M2 A1	FT 22° + 'their 32°'. M0 for using sin22° or sin 'their 32°' alone. M1 for $\frac{DE}{9{\cdot}4}$ = sin54(°) If no marks awarded SC1 for a correct answer (1dp) using their clearly stated or shown angle (D)C(E), but not 22° or 'their 32°'.
Alternative method. ***Correct** use of 'two-step' method.* *(DE) = 7·6(…)(cm) ISW*	M2 A1	*A partial trigonometric method is M0.*

18.(a) Tan x = $\frac{6\cdot4}{8\cdot2}$ (x =) $\tan^{-1}$ 0·78(0..) or $\tan^{-1}\frac{6\cdot4}{8\cdot2}$ = 38(°) OR 37·9(...°)	M1 A1 A1	 Implies previous A1.
Alternative method. ***Correct** use of 'two-step' method.* *(x) = 38(°)*	M2 A1	*A partial trigonometric method is M0.* *Accept an answer that rounds to 38(°)*
18.(b) (PAQ = 90 – 38 =) 52(°) AQ = $\frac{7\cdot9}{\sin52(°)}$ (AQ) = 10(cm) OR 10·0(…cm)	B1 M2 A1	FT 90° − 'their 38°'. May be seen on the diagram. FT 'their clearly defined PAQ' BUT not if PAQ = 'their x'. M1 for sin52(°) = $\frac{7\cdot9}{AQ}$
Alternative method. PQA =*38(°)* AQ = $\frac{7\cdot9}{\cos38(°)}$ (AQ) = 10(cm) OR 10·0(…cm)	B1 M2 A1	FT 'their 38°'. May be seen on the diagram. FT 'their clearly defined PQA' M1 for cos 38(°) = $\frac{7\cdot9}{AQ}$
Alternative method. *(PAQ = 90 – 38 =) 52(°)* ***Correct** use of 'two-step' method.* *(AQ) = 10(cm)*	*B1* *M2* *A1*	*FT 90° − 'their 38°'.* *A partial trigonometric method is M0.* *FT 'their clearly defined PAQ'* *BUT not if PAQ = 'their x'.* *Accept an answer that rounds to 10(cm)*

WJEC GCSE MATHEMATICS

SUMMER 2019 MARK SCHEME

GCSE MATHEMATICS Unit 1 Foundation Tier	Mark	Comments
1(a) 4523	B1	
1(b) 168	B1	
1(c) 1, 3, 9, 27	B2	B1 for 2 correct and 0 wrong OR B1 for 3 correct and 0 or 1 wrong OR B1 for 4 correct and 1 wrong
2(a) Evidence of counting squares 32 – 42 inclusive 160 – 210 (cm^2)	M1 A1 B1	 FT 'their number of squares' × 5 evaluated correctly Award 3 marks for an unsupported answer between 160 and 210 inclusive. Mark final answer
Accuracy in writing	W1	For W1, candidates will be expected to: • show all their working • make few, if any, errors in spelling, punctuation and grammar • use correct mathematical form in their working • use appropriate terminology, units, etc
2(b) 	B1	
3(a) an even chance	B1	
3(b) impossible	B1	
4(a) Correctly drawn tangent	B1	
4(b) Correctly drawn radius	B1	

10. Intent to square at least two of the three values.	S1	(*Note:* $12{\cdot}8^2 = 163{\cdot}84$, $22{\cdot}7^2 = 515{\cdot}29$ and $25{\cdot}6^2 = 655{\cdot}36$)
Comparing $(25{\cdot}6)^2$ with $(12{\cdot}8)^2 + (22{\cdot}7)^2$ or Any intent to compare any other relevant values. (e.g. $(25{\cdot}6)^2 - (22{\cdot}7)^2$ with $(12{\cdot}8)^2$ or $\sqrt{[(12{\cdot}8)^2 + (22{\cdot}7)^2]}$ (with 25·6))	M1	The comparison attempted must show <u>both</u> intended calculations e.g. $(25{\cdot}6)^2$ AND $(12{\cdot}8)^2 + (22{\cdot}7)^2$ unless intention is to compare with a given side e.g. $\sqrt{[(12{\cdot}8)^2 + (22{\cdot}7)^2]}$ with 25·6
Correct evaluation of value(s) to be compared. (e.g 'sight of 655·36 WITH 679·13' or 'sight of 140·07 WITH 163·84' or 'sight of 26·06 (WITH 25·6)')	A1	C.A.O. but allow evaluated answers to be given to the nearest whole number. e.g. 655 WITH 679.
Statement that it is NOT possible	A1	Allow FT if M1 awarded. *If all marks gained ISW.*
10. <u>Alternative method 1</u> *Intent to use two right-angled trig ratios **using 2 <u>different pairs</u> of given sides***	S1	*i.e. In order to find the value of either the same angle OR two different angles, whilst sufficient to show that it isn't a right-angled triangle.*
*Correct right-angled trig ratio used **twice**, **using 2 <u>different</u> given sides**, in order to compare* • *the values of the same angle or* • *the sum of the two angles with 90°.*	M1	
Correct evaluation of value(s) to be compared. e.g. sight of any two of 30(°), 27.5…(°) and 29.4…(°) OR sight of 30(°) and 60.58…(°) (and the sum to be compared with 90°)	A1	*CAO* **Ratio** / **Opp** / **Adj** / **Hyp** / **Angle** Sin / 12.8 / / 25.6 / 30(°) Cos / / 22.7 / 25.6 / 27.5…(°) Tan / 12.8 / 22.7 / / 29.4…(°) Sin / 22.7 / / 25.6 / 62.46…(°) Cos / / 12.8 / 25.6 / 60(°) Tan / 22.7 / 12.8 / / 60.58…(°)
Statement that it is NOT possible	A1	*If comparing the sum of two angles (with 90°), the sum must be shown. Allow FT if M1 awarded. If all marks gained ISW.*
10. <u>Alternative method 2</u> (using the cosine rule)		*<u>NOTE</u> The cosine rule is not on the intermediate tier specification, but as it is a common question, it may be seen by Higher tier candidates.*
(cos A =) $(12.8^2 + 22.7^2 - 25.6^2) / (2\times12.8\times22.7)$ (= 2377/58112 or 0·0409..)	*M2*	*M1 for $25.6^2 = 12.8^2 + 22.7^2 - 2\times12.8\times22.7\times\cos A$*
(A =) 87(.6557…°)	*A1*	
Statement that it is NOT possible	*A1*	*If all marks gained ISW.*

			If all marks gained ISW.
11.(a)	$A \cap B$	B1	
11.(b)	B'	B1	
12 Four numbers with a range of 10. Four numbers with a total of 36. Four numbers with a median of 8. Possible answers for all three marks are 5,5,11,15 or 5,6,10,15 or 5,7,9,15 or 5,8,8,15		 B1 B1 B1	B0 if all four original numbers used.

	= 66(·%)	A1	An answer of 66(·%) gains B1M1A1.
14.	MN = 13·5 × cos 27	M2	M1 for cos 27 = $\frac{MN}{13·5}$
	= 12(·0…) (cm) ISW	A1	*A correct and complete method (e.g. using two trigonometric relationships.)* M2 *MN = 12(·0…)(cm) ISW* A1

10.(a) $\frac{1}{6} \times \frac{1}{4}$ or equivalent $= \frac{1}{24}$ ISW	M1 A1	Accept 0·0416... or 0·0417 or 0·042 for M1A1 M1A0 for '1 in 24', '1:24'.
10.(b) $\frac{1}{5} + \frac{1}{10}$ or equivalent. $= \frac{3}{10}$ or equivalent. ISW	M1 A1	
11. $(AC^2 =)\ 10{\cdot}8^2 + 14{\cdot}4^2$ $AC^2 = 324$ or $(AC =)\ \sqrt{324}$ $(AC =)$ 18(cm) (Area ACD =) $\frac{24 \times 18}{2}$ $= 216\ (cm^2)$	M1 A1 A1 M1 A1	Accept equivalent of using cos rule (as cos 90 = 0). F.T. $\sqrt{}$'their 324' provided M1 gained. Final answer of AC = 324 is M1A0A0. *Alternative method to find AC* *A correct and complete method (using two trigonometric relationships)* *M2* *AC = 18(cm)* *A1* FT 'their stated AC'. (May be shown on the diagram) Accept equivalent of using ½ × 24 × 18 × sin 90 (as sin 90 = 1).
12. One correct evaluation $7{\cdot}2 \le x \le 7{\cdot}3$ 2 correct evaluations $7{\cdot}275 \le x \le 7{\cdot}295$, one < 0, one > 0. 2 correct evaluations $7{\cdot}275 \le x \le 7{\cdot}285$, one < 0, one > 0. $x = 7{\cdot}28$	 B1 B1 M1 A1	*Correct evaluation regarded as enough to identify if negative or positive. If evaluations not seen accept 'too high' or 'too low'.* *Look out for equating* $x^3 - 5x = 350$ x $x^3 - 5x - 350$ 7·2 −12·75(2) 7·21 −11(·2..) 7·22 − 9(·7...) 7·23 − 8(·2...) 7·24 − 6(·6...) 7·25 −5(·1...) 7·26 − 3(·6...) 7·275 −1(·3....) 7·27 − 2(·1...) 7·284 0(·04..) **7·28** **−0·5(7..)** **7·285** **0·1(9..)** **7·29** **0·9(7..)** 7·295 1(·7....) 7·3 2·5(17)
13.(a) an expression	B1	
13.(b) an equation	B1	
14. (Mid-points) 2·5, (7·5), 12·5 and 17·5. $8 \times 2{\cdot}5 + (0 \times 7{\cdot}5) + 7 \times 12{\cdot}5 + 5 \times 17{\cdot}5$ (20 + 0 + 87·5 + 87·5 = 195) ÷ 20 = 9.75	B1 M1 m1 A1	Allow for sight of mid-points. F.T. 'their mid-points' including bounds, provided they fall within the classes (including lower and upper bounds and used consistently). C.A.O.
15. $(x =)\ \frac{360}{15}$ or $180 - \frac{(15-2) \times 180}{15}$ or equivalent = 24(°) (BR =) 8 × cos 24 or 8 × sin (90 – 24) = 7·3(0...)(cm) or 7·31(cm)	M1 A1 M2 A1	May be seen in parts. FT 'their stated value for x' (x < 90°) M1 for $\frac{BR}{8} = \cos 24$ or $\frac{BR}{8} = \sin(90 - 24)$ Accept equivalent of using sin rule (as sin 90 = 1). *Alternative method to find BR* *A correct and complete method (using two trigonometric relationships and possibly Pythagoras's theorem)* *M2* *BR = 7·3(0...)(cm) or 7·31(cm)* *A1*

10.(a) $\frac{1}{6} \times \frac{1}{4}$ or equivalent	M1	
$= \frac{1}{24}$ ISW	A1	Accept 0·0416... or 0·0417 or 0·042 for M1A1 M1A0 for '1 in 24', '1:24'.
10.(b) $\frac{1}{5} + \frac{1}{10}$ or equivalent.	M1	
$= \frac{3}{10}$ or equivalent. ISW	A1	
11. $(AC^2 =)\ 10{\cdot}8^2 + 14{\cdot}4^2$	M1	Accept equivalent of using cos rule (as cos 90 = 0).
$AC^2 = 324$ or $(AC =) \sqrt{324}$	A1	
$(AC =)$ 18(cm)	A1	F.T. √'their 324' provided M1 gained. Final answer of AC = 324 is M1A0A0. *Alternative method to find AC* *A correct and complete method (using two trigonometric relationships)* *M2* *AC = 18(cm)* *A1*
(Area ACD =) $\frac{24 \times 18}{2}$	M1	FT 'their stated AC'. (May be shown on the diagram) Accept equivalent of using ½ × 24 × 18 × sin 90 (as sin 90 = 1).
$= 216\ (cm^2)$	A1	
12.		*Correct evaluation regarded as enough to identify if negative or positive. If evaluations not seen accept 'too high' or 'too low'.* *Look out for equating $x^3 - 5x = 350$*
One correct evaluation $7{\cdot}2 \le x \le 7{\cdot}3$	B1	
2 correct evaluations $7{\cdot}275 \le x \le 7{\cdot}295$, one < 0, one > 0.	B1	
2 correct evaluations $7{\cdot}275 \le x \le 7{\cdot}285$, one < 0, one > 0.	M1	
$x = 7{\cdot}28$	A1	

x	$x^3 - 5x - 350$		
7·2	−12·75(2)		
7·21	−11(·2..)		
7·22	− 9(·7...)		
7·23	− 8(·2...)		
7·24	− 6(·6...)		
7·25	−5(·1...)		
7·26	− 3(·6...)	7·275	−1(·3....)
7·27	− 2(·1...)	7·284	0(·04..)
7·28	**−0·5(7..)**	**7·285**	**0·1(9..)**
7·29	**0·9(7..)**	7·295	1(·7....)
7·3	2·5(17)		

13.(a) an expression	B1	
13.(b) an equation	B1	
14. (Mid-points) 2·5, (7·5), 12·5 and 17·5.	B1	Allow for sight of mid-points.
$8 \times 2{\cdot}5 + (0 \times 7{\cdot}5) + 7 \times 12{\cdot}5 + 5 \times 17{\cdot}5$ $(20 + 0 + 87{\cdot}5 + 87{\cdot}5 = 195)$	M1	F.T. 'their mid-points' including bounds, provided they fall within the classes (including lower and upper bounds and used consistently).
$\div 20$	m1	
$= 9.75$	A1	C.A.O.
15. $(x =) \frac{360}{15}$ or $180 - \frac{(15-2) \times 180}{15}$ or equivalent	M1	May be seen in parts.
$= 24(°)$	A1	
(BR =) $8 \times \cos 24$ or $8 \times \sin (90 - 24)$	M2	FT 'their stated value for x' (x < 90°) M1 for $\frac{BR}{8} = \cos 24$ or $\frac{BR}{8} = \sin (90 - 24)$ Accept equivalent of using sin rule (as sin 90 = 1).
= 7·3(0...)(cm) or 7·31(cm)	A1	*Alternative method to find BR* *A correct and complete method (using two trigonometric relationships and possibly Pythagoras's theorem)* *M2* *BR = 7·3(0...)(cm) or 7·31(cm)* *A1*

16. $2{\cdot}656 \times 10^6$	B2	B1 for a correct value but not in standard form. Mark final answer. B1 for sight of 2 656 000. SC1 for $2{\cdot}66 \times 10^6$ or $2{\cdot}7 \times 10^6$ or $2{\cdot}6 \times 10^6$ or $2{\cdot}65 \times 10^6$
17. Sight of 24·5 AND 15·5 OR Sight of 23·5 AND 14·5	B1	Sight of (Greatest =) 80 OR (Least =) 76 implies B1
2(24·5 + 15·5) – 2(23·5 + 14·5) or equivalent	M1	FT only for upper bounds of 24·4 AND 15·4 or 24·49 AND 15·49 (lower bounds must be 23·5 AND 14·5 else M0)
= 4(cm)	A1	CAO If M0, award B1 and an SC1 for sight of (Greatest =) 80 AND (Least =) 76
Alternative method. *Difference between least and greatest length for each side = 1(cm)*	*B1*	
4 × 1	*M1*	*FT only for differences of 0·9 or 0·99*
= 4(cm)	*A1*	*CAO*
18. Method to eliminate variable e.g. equal coefficients with appropriate addition or subtraction. First variable found, x = 4 or y = −1. Substitute to find the 2nd variable. Second variable found	 M1 A1 m1 A1	*No marks for trial and improvement.* Allow 1 error in one term, not the term with equal coefficients. C.A.O. F.T. their '1st variable'. Award no marks for unsupported correct answers.
19.(a)(i) Correct reason given. e.g. 'An angle at the circumference subtended by a diameter is a right angle'. ' line AC is a diameter'	E1	Accept any correct unambiguous wording. The key word is 'diameter'. Allow eg 'angle in a semicircle is 90°', 'line AC goes through the centre'. 'opposite a diameter' Do not accept 'because it's a right angle'.
19.(a)(ii) $\tan x = \frac{7{\cdot}5}{4{\cdot}7}$	M1	
$x = \tan^{-1}(7{\cdot}5 / 4{\cdot}7)$ or $\tan^{-1} 1.6$ or $\tan^{-1} 1.59(\ldots)$	m1	Implies M1.
= 57·9(…)(°) or 57·8(…)(°) or 58(°)	A1	C.A.O. *Alternative method to find x* *A correct and complete method (using Pythagoras's theorem and a trigonometric relationship).* *M2* *x = 57·9(…)(°) or 57·8(…)(°) or 58(°) CAO* *A1*
19.(b) (y =) 58(°)	B1	Strict FT of 'their x'.
Correct circle theorem given. e.g. 'angles (at the circumference) subtended by the same chord (or arc) are equal', 'angles in the same segment (are equal)'.	E1	Accept any correct unambiguous wording. Allow eg 'angles on the same chord (are equal)' Do not accept e.g. 'they are equal' on its own.

13. $5x - 17 + 2x + 9 + x + 20 = 180$ $8x = 168$ $x = 21$	M1 A1 A1	F.T. from ax = b. Allow all 3 marks for x = 21.
Substituting x = 21 into at least one expression. (5x – 17 =) 88(°) (2x + 9 =) 51(°) (x + 20 =) 41(°) (So not a right-angled triangle)	M1 A1	If $x \neq 21$ FT 'their derived value of x'. F.T. for this A1 if $x \geq 4$. Any **two** of these expressions correctly evaluated with no incorrect evaluation, provided the sum of the two found is > 90. (statement not required). *Note* *If further work indicates that the values found are not treated as angles (e.g. showing $51^2 + 41^2 \neq 88^2$) then award final M0A0.*
Alternative method *5x – 17 = 90 OR 2x + 9 = 90 OR x + 20 = 90* *x = 21·4 AND x = 40·5 AND x = 70*	*M1* *A2*	*Award A1 for any one of these:* *x = 21·4 OR x = 40·5 OR x = 70*
Then verifying: *If x = 21·4: 5x – 17 + 2x + 9 + x + 20 = 183.2* *AND* *If x = 40·5: 5x – 17 + 2x + 9 + x + 20 = 336* *AND* *If x = 70: 5x – 17 + 2x + 9 + x + 20 = 572* *(So not a right-angled triangle)*	*A2*	*Award A1 for any one of these:* *If x = 21·4: 5x – 17 + 2x + 9 + x + 20 = 183.2* *OR* *If x = 40·5: 5x – 17 + 2x + 9 + x + 20 = 336* *OR* *If x = 70: 5x – 17 + 2x + 9 + x + 20 = 572*
14. (AB =) 13·8 × cos 41 OR 13·8 × sin 49 = 10·4(…) (cm)	M2 A1	M1 for $\cos 41 = \frac{AB}{13·8}$ OR $\sin 49 = \frac{AB}{13·8}$
Alternative method: ***Correct** use of 'two-step' method.* *(AB) = 10·4(…)(cm)*	*M2* *A1*	*A partial trigonometric method is M0.* *Accept an answer that rounds to 10·4(cm)*
15.a(i) $x^3 + 7x$	B2	B1 for sight of x^3 + ……. OR ……+ 7x. Do not accept x×x×x + x×7 etc. Mark final answer.
15(a)(ii) $3x^2 - 4x - 15x + 20$ $3x^2 - 19x + 20$	B1 B1	Must be an expression. FT from an error in only one term (out of 4) only if of the form $ax^2 \pm bx \pm cx \pm d$.
15.(b)(i) $5n - 27 < n$ OR $n > 5n - 27$	B2	Allow B2 for an equivalent correct inequality. e.g. 4n – 27 < 0. B1 if ≤ or ≥ used in a 'correct' inequality. OR B1 for 5n – 27 > n OR n < 5n – 27
15.(b)(ii) $4n < 27$ $n < \frac{27}{4}$ (Greatest number of clocks =) 6	B1 B1 B1	FT 'their inequality' if of equivalent difficulty. FT only from an < b OR an ≤ b OR an > b OR an ≥ b. FT only from n < c where c is positive OR n ≤ d where d is positive and not an integer An answer of 6 gains all 3 marks.

4.(c) 39	B1	
5.(a) 16 and 25	B2	Answer space takes precedence. Accept 4^2 and 5^2. B1 for writing • two numbers with a difference of 9, one of which is square, or • two different square numbers in their answer space, or • listing at least three square numbers in their workings. If no marks, award SC1 for an unsupported answer of 4 and 5.
5.(b) No, AND correct reason stated e.g. • (two odd numbers) add to give an even number (and 37 is odd). • only an even and an odd number can add to make 37. • only an even and an odd number can add to make an odd number.	E1	E0 if incorrect box is ticked, even if the correct reason is given. If none of the boxes are ticked, 'no' may be implied by their reason. Accept equivalent reasons. Accept the use of 'make' or 'and' instead of 'add'. Allow 'there are no two odd numbers which add to make 37' or 'the answer will always be even'. Exemplifying two odd numbers adding to an even number by itself is insufficient.

13. (a) $(x =)\ 14{\cdot}5 \times \sin 42$	M2	Award M2 for $14{\cdot}5 \times \cos 48$ or $\frac{14{\cdot}5 \times \sin 42}{\sin 90}$ M1 for $\sin 42 = \frac{x}{14{\cdot}5}$ or $\cos 48 = \frac{x}{14{\cdot}5}$ or $\frac{x}{\sin 42} = \frac{14{\cdot}5}{\sin 90}$
$= 9{\cdot}7(02\ldots)$	A1	Allow 10 from correct working. Award M2 A0 for an unsupported answer of –13·2895… (radians) or 8·88715…. (gradians).
13. (a) Alternative method: ***Correct** use of 'two-step' method.*	*M2*	*A partial trigonometric method is M0.*
$(x) = 9{\cdot}7(02\ldots)(cm)$	*A1*	*Accept an answer that rounds to 9·7(cm)* *Award M2 A0 for an answer of -13·2895… (radians) or 8·88715…. (gradians).*
13. (b) $(y =) \cos^{-1}\frac{13{\cdot}5}{15{\cdot}8}$	M2	M1 for $\cos y = \frac{13{\cdot}5}{15{\cdot}8}$ (= 0·854..)
Correct evaluation in the range 31·3 to 31·4	A1	Allow 31 from correct working. Allow correct angles given in radians (0·5463..) or gradians (34·7812….) Note: $\cos y = 0{\cdot}85$ $y = 31{\cdot}788\ldots$ is awarded M2A0.
13. (b) Alternative method: ***Correct** use of 'two-step' method.*	*M2*	*A partial trigonometric method is M0.*
Correct evaluation in the range 31·3 to 31·4	*A1*	Allow 31 from correct working. *Allow correct angles given in radians (0·5463..) or gradians (34·7812….)*

7(a) $4500 \times (1 - 0.2(0)) \times (1 - 0.14)^9$ or $4500 \times 0.8(0) \times 0.86^9$ or equivalent	M2	For M2, do not ignore any additional years considered, unless 10 years selected or implied in later working M1 for equivalent of one of the following (which may be embedded in other working): • $4500 \times (1 - 0.2(0))$ (= 3600) • $4500 \times 0.8(0)$ (= 3600) • $4500 \times (1 - 0.14)^9$ (= 1157.97...) • 4500×0.86^9 (= 1157.97...)
An answer in the range (£)926.35 to (£)926.40	A1	An answer for 10 years (not beyond) must be selected Allow an answer of (£)926 provided not from rounding an amount outside the range given Award M1, SC1 for an answer $(4500 \times 0.8 \times 0.86^{10} =)$ (£)796.68(5....) or (£)796.69 or (£)796.70 or (£)797
7(b) $100 \times 750 \div 125$ or $100 \times \frac{750}{125}$ or equivalent	M1	
(£) 600	A1	Answer space takes precedence
7(c)		Accept equivalents using the sine rule throughout '½ width' may be referred to by any unknown
Sight of appropriate 80 (cm) (height of triangle)	B1	Check if indicated on the diagram
(½ width =) $\frac{80}{\tan 33°}$ or (½ width =) $80 \times \tan(90° - 33°)$	M2	(= 123.189... cm or 123.2 cm) FT 'their 80' provided ≤ 120 and ≠ 90 M1 for sight of $\tan 33° = \frac{80}{\text{½ width}}$ or $\tan(90° - 33°) = \frac{\text{½width}}{80}$
× 2	m1	FT provided at least M1 previously awarded, i.e. for intention to double 'their ½ width'
(Width of garage is) 246(cm) to 246.4(cm)	A1	CAO. ISW
7(d) (Maximum space =) 555 – 395 – 70 or 550 – 400 + 2 × 5 – 70 or equivalent	M2	Check the diagram M1 for any of the following: • **use** of 550 < 'their 555' ≤ 560 AND 390 ≤ 'their 395' < 400 • for sight of 555 and 395 • for sight of 550 – 400 + 2 × 5
90 (cm)	A1	CAO Award M1 and SC1 for an answer of (555 – 395 =) 160 (cm)

15. $YZ = \frac{7}{\cos 41(°)}$ or $7 \div \cos 41(°)$	M2	Award M2 for $YZ = 7 \div \sin 49$ (×sin90) or $\frac{7 (\times \sin 90)}{\sin 49}$ Award M1 for one of the following: • $\cos 41 = \frac{7}{YZ}$ • $\sin 49 = \frac{7}{YZ}$ • $\frac{YZ}{\sin 90} = \frac{7}{\sin 49}$.
= 9·27(…) or 9·28 (cm) or 9.3 (cm)	A1	Accept 9 (cm) from correct working. CAO.
15. Alternative method: ***Correct** use of 'two-step' method.*	*M2*	*A partial trigonometric method is M0.*
= 9·27(…) or 9·28 (cm) or 9.3 (cm)	*A1*	*Accept 9 (cm) from correct working.*

20.(a) $5(\cdot 0) \times 10^6$	B2	Mark final answer. Award B1 for one of the following: • sight of $0 \cdot 5 \times 10^7$ • sight of 5 000 000 • equivalent correct value but not in standard form • sight of 30 000 AND 0·006 • 5×10^n ($n \geq 3$, but not 6), following one place value error in one of the given numbers.
20.(b) $4 \cdot 795(0) \times 10^4$	B2	Mark final answer. B1 for one of the following: • sight of $479 \cdot 5(0) \times 10^2$ • $4 \cdot 8(0) \times 10^4$ • sight of 47 950 • equivalent correct value but not in standard form • sight of 47800 AND 150 • 'their 47 950' is written correctly in standard form, following one place value error in one of the given numbers or in the addition of 47800 AND 150.
21.(a) $x = \sqrt{25^2 - 10^2}$	B1	
21. (b) $\sin 40^\circ = \frac{y}{25}$	B1	

15.(a) $(x =)$ $\sin^{-1}\frac{7\cdot7}{11\cdot3}$ or $\sin^{-1}\frac{7\cdot7 \times \sin 90}{11\cdot3}$ or equivalent Allow an answer between 42·8 and 43(°) ISW	M2 A1	Check diagram for answers Award M1 for one of the following: • $\sin x = \frac{7\cdot7}{11\cdot3}$ (= 0·68(1..)) • $\frac{\sin x}{7\cdot7} = \frac{\sin 90}{11\cdot3}$ or equivalent Allow correct angles given in radians or gradians: Method: $\sin^{-1}\frac{7\cdot7}{11\cdot3}$ — Radians: 0·7496… — Gradians: 47·727…. Method: $\sin^{-1}\frac{7\cdot7 \times \sin 90}{11\cdot3}$ — Radians: 0·655… — Gradians: 47·001
15.(a) *Alternative method* ***Correct** use of a 'two-step' method.* Allow an answer between 42·8 and 43(°) ISW	*M2* *A1*	*A partial trigonometric method is M0.* *Allow 42·8(…°)* *Allow correct angles given in radians or gradians.*

$DBE = (90 - 43) = 47(°)$ OR $BED = 43(°)$	B1	**Strict FT** for $DBE = 90 -$ 'their x' or $BED =$ 'their x', provided 'their x' $\neq 45°$. Note: DBE must be acute for B1. May be implied in further work.
Valid method to find the length DE $DE = 13{\cdot}1 \times \tan 47$ $DE = \frac{13{\cdot}1}{\tan 43}$ $DE = \frac{13{\cdot}1 \times \sin 47}{\sin 43}$	M2	If B1 already awarded for 'their angle DBE' but then 'their angle BED' is incorrect and 'their BED' is then used (or vice versa) for either M2 or M1, then award B0 previously. Or award M2 for correct use of a 'two-step' method (e.g. 'Pythagoras and similar triangles' or 'Pythagoras and correct trigonometric relationship'). FT 'their angle DBE' or 'their angle BED' provided not 0°, 45°, 90° or 180°. Award M1 for one of the following: • $\tan 47 = \frac{DE}{13{\cdot}1}$ • $\tan 43 = \frac{13{\cdot}1}{DE}$ • $\frac{DE}{\sin 47} = \frac{13{\cdot}1}{\sin 43}$ or equivalent For all M2 or M1 scenarios, FT their clearly stated or shown angle BED or DBE where appropriate. For $\frac{13{\cdot}1 \times \sin 47}{\sin 43}$ FT their clearly stated or shown angles BED and DBE **only** if $BED + DBE = 90°$.
DE in the range 14·04 to 14·1 (cm) ISW	A1	Allow 14 from correct workings. FT from M2 only and provided that angle is acute and leads to a positive answer. Award B1M2A0 for any of the following unsupported answers:

Method	Radians	Gradians
$13{\cdot}1 \times \tan 47$	-1·63 to 1…	11·92 to 12
$\frac{13{\cdot}1}{\tan 43}$	-8·743 to -5·36	16·35 to 16·5
$\frac{13{\cdot}1 \times \sin 47}{\sin 43}$	-1·95 to 1·08	14·1 to 14·21

19.(a)	$7{\cdot}6 \times 10^{-3}$	B1	
19.(b)	6×10^{5}	B1	
19.(c)	$2{\cdot}8 \times 10^{4}$	B2	Mark final answer. Award B1 for one of the following: • sight of 28×10^{3} • sight of 28 000 • equivalent correct value but not in standard form • sight of 23 000 AND 5000 • 'their 28000' is written correctly in standard form, following one place value error in one of the numbers from work seen.

8(a)(i) 440 × 48 ÷ 2.2 9600 (kg)	M1 A1	May be seen in stages Mark final answer Allow answers in the inclusive range 9588 to 9601 from premature approximation Answer space takes precedence
8(a)(ii) 230 000 000 000	B1	
8(b) (Area) 2.47 × 40000 ÷ 10000 or equivalent 9.88 (acres) (Density of trees) 615 ÷ 9.88 62(.2...trees per acre) (>60)	 M1 A1 m1 A1	**Throughout, if 4 marks are awarded, penalise -1 if conclusion 'Yes' is not indicated** **On FT the conclusion may be different to 'Yes'** May be implied in further working Allow 9.8 (acres), 9.9 (acres) or 10 (acres) Depends on M1 m1 previously awarded
8(b) Alternative method 1 *(Area) 2.47 × 40 000 ÷ 10 000 or equivalent* *9.88 (acres)* *(Maximum number of trees) 9.88 × 60* *592(.8) (trees) or 593 (trees) (< 615)*	*M1* *A1* *m1* *A1*	*May be implied in further working* *Allow 9.8 (acres), 9.9 (acres) or 10 (acres)* *Depends on M1 m1 previously awarded* *Allow suitable rounding, e.g. 590 or 600*
8(b) Alternative method 2 *(Area) 2.47 × 40 000 ÷ 10 000 or equivalent* *9.88 (acres)* *(Minimum area) 615 ÷ 60* *10.25 (acres) (> 9.88)*	*M1* *A1* *M1* *A1*	*May be implied in further working* *Allow 9.8 (acres), 9.9 (acres) or 10 (acres)* *Do not allow embedded in further working* *Allow rounded to 10 (acres) provided 'their area' ($9.88m^2$) has not been rounded to 10*
8(b) Alternative method 3 *(Minimum area) 615 ÷ 60* *10.25 (acres)* *(Convert to m^2) 10000 × 10.25 ÷ 2.47* *41 497(.97 m^2) or 41 498(m^2) (>40 000)*	*M1* *A1* *m1* *A1*	*May be implied in further working* *Allow 10 (acres)* *Depends on M1 m1 previously awarded* *Accept suitable rounding, e.g. 41 000 or 41 500*
8(b) Alternative method 4 *(Trees in 2.47 acres) 615 ÷ (40 000 ÷ 10 000) or equivalent* *153.75 (trees)* *(Density of trees) 153.75 ÷ 2.47* *62(.2...trees per acre) (> 60)*	*M1* *A1* *m1* *A1*	 *May be implied in further working* *Allow 153, 153.8 or 154 (trees)* *Depends on M1 m1 previously awarded*
8(b) Alternative method 5 *(Forest area per tree) 40 000 ÷ 615* *65(.0406.. m^2)* *(Fire risk, area per tree) 10 000 ÷ (60 × 2.47)* *67(.476…m^2) (> 65)*	*M1* *A1* *M1* *A1*	*Do not allow embedded in further working*

8(c)(i) (Height of the tree =) $21 \times \tan 39$ 17.(…. m)	M2 A1	*OR alternative full method* M1 for $\tan 39 = \frac{\text{height of tree}}{21}$ CAO
8(c)(i) Alternative method 1 *Hypotenuse = 21/cos39* *(= 27.02…)* ***AND** Height* = $\sqrt{(27(.02)^2 - 21^2)}$ 16.9(7…m) to 17.(0..m)	*M2* *A1*	*M1 for Hypotenuse = 21/cos39* *(= 27.02…)* ***AND** Height*^{2} = $27(.02)^2 - 21^2$ *CAO*
8(c)(i) Alternative method 2 *(Angle of elevation)* $\tan^{-1}\frac{17}{21}$ *38.9(9…°) or 39(°)*	*M2* *A1*	*M1 tan (elevation)* = $\frac{17}{21}$ *CAO*
8(c)(i) Alternative method 3 *(Horizontal distance)* $\frac{17}{\tan 39}$ *20.9(98…m) or 21m*	*M2* *A1*	*M1 for tan 39* = $\frac{17}{\text{distance}}$ *CAO*
8(c)(ii) diameter = $\frac{1.75}{\pi}$ or (radius =) $\frac{1.75}{2 \times \pi}$ (Area of cross section =) $\pi \times (1.75 \div 2\pi)^2$ $\times 17 \div 2$ (Volume) answer in the range 2.07 (m^3) to 2.15 (m^3)	M2 M1 m1 A1	M1 for any one of the following: • $1.75 = \pi \times$ diameter • $1.75 = 2 \times \pi \times$ radius (Note: radius = $\frac{7}{8\pi}$ m, radius ≈ 0.28m) FT for 'their derived radius' provided it is from a calculation involving the use of π (Note: area of cross section = $\frac{49}{64\pi}$ m^2 area of cross section ≈ 0.24 m^2) FT provided previous M1awarded CAO, accept an answer of 2 (m^3) from correct working without sight of premature approximation leading to an answer outside the range

19. Method using angle *XYZ* $YZ = \frac{18{\cdot}6}{\tan 40(°)}$ or $\frac{18{\cdot}6 \times \sin 50}{\sin 40}$ or equivalent = 22(·166..)(cm)	M2 A1	Check diagram for answer. Award M1 for one of the following • $\tan 40(°) = \frac{18{\cdot}6}{YZ}$ • $\frac{YZ}{\sin 50} = \frac{18{\cdot}6}{\sin 40}$ or equivalent Accept an answer rounded or truncated. Award M2A0 for any of the following unsupported answers: Method: $\frac{18{\cdot}6}{\tan 40}$ — Radians: -16·648.... — Gradians: 25·600...
19. Alternative using angle YXZ *$YZ = 18{\cdot}6 \times \tan 50(°)$* *= 22(·166..)(cm)*	*M2* *A1*	*Award M1 for $\tan 50(°) = \frac{YZ}{18{\cdot}6}$* *Accept an answer rounded or truncated* *Award M2A0 for any of the following unsupported answers:* *Method: 18·6 × tan 50 — Radians: -5·057.... — Gradians: 18·6*
19. Alternative method ***Correct** use of a 'two-step' method.* *22(·166..)(cm) ISW*	*M2* *A1*	*A partial trigonometric method is M0.* *Accept an answer rounded or truncated.*

Unit 2: Intermediate Tier	Mark	Comments
7(a) Method **not directly** working with a stated or omitted number of hours difference		Methods may be shown in stages or be embedded Use this method if 2 separate numbers of hours are used, which may not be correct, i.e. ≠12 and ≠10, with or without indication of subtraction Penalise every additional **spurious** term by reducing the count of correct terms by 1*
0.324 × 8 × **(10 or 12)** × 7 × 80 ÷ 1000	M3	Allow '× 32.4' for '× 0.324' M2 for any 4 or 5 correct terms* M1 for any 3 correct terms*
0.324 × 8 × **(12 or 10)** × 7 × 80 ÷ 1000 **with** the intention to subtract	m1	Must be an indication of the intention to subtract, in either order **FT from 5 (or 6) consistent correct terms** for use of • the other value 10 or 12 respectively • 'their number of hours' are 13 **and** 11 (incorrect) Award m0 if inconsistent, i.e. not an equal number of **consistent correct terms*** between the expressions. Mark 'their better stated calculation' first if both are given
(Saving is 17.418… – 14.515…=) (£) 2.90	A1	CAO All working must be checked, do not award 5 marks for £2.90 from incorrect working.
Alternative method: *Method **directly** working with a stated or omitted number of hours difference*		*Methods may be shown in stages or be embedded* *Use this method if a single number of hours is used, which may not be correct, i.e. ≠2, or if the number of hours is omitted* *Do not allow 2 hours as a correct term from incorrect working, e.g. 13 – 11 = 2* *Penalise every additional **spurious** term by reducing the count of correct terms by 1**
0.324 × 8 × 2 × 7 × 80 ÷ 1000	*M4*	*Allow '× 32.4' for '× 0.324'* *M3 for any 5 correct terms** *M2 for any 4 correct terms** *M1 for any 3 correct terms**
(Saving is) *(£) 2.90*	*A1*	*CAO* *All working must be checked, do not award 5 marks for £2.90 from incorrect working.*

Unit 2: Intermediate Tier	Mark	Comments
7(b) Height = $\tan 68° \times 3.3$ or height = $\frac{\sin 68° \times 3.3}{\sin(90-68)°}$	M2	Or alternative correct full method, isolating height M1 for $\tan 68° = \text{height} / 3.3$ or $\frac{\text{height}}{\sin 68°} = \frac{3.3}{\sin(90-68)°}$ or equivalent
8.167… (m) or 8.17 (m) or 8.2 (m)	A1	Allow 8(m), 8.1(m) 8.16(m) from correct working

8(a) Midpoints 1, 4, 7, 11, 16	B1	
$1 \times 8 + 4 \times 12 + 7 \times 20 + 11 \times 4 + 16 \times 6$ $(= 8 + 48 + 140 + 44 + 96)$ $(= 336)$	M1	FT 'their midpoints' provided at least 4 lie within the appropriate group, including bounds throughout Use of lower bounds gives 276 Use of upper bounds gives 396
$\div 50$	m1	
6.72 or 6.7 (walks)	A1	Allow rounded to 7 (walks) from appropriate working Use of lower bounds gives 5.5(2 walks) or 6 (walks) Use of upper bounds gives 7.9(2 walks) or 8 (walks)
8(b) 06(:)53 or 6(:)53 a.m.	B1	Allow 06(:)53 a.m. or 6(:)53 Do not accept (0)6(:)53 p.m.

Unit 2: Intermediate Tier	Mark	Comments
8(c) $(\text{Height})^2 = 7.6^2 - (18.8 - 12.6)^2$ or $(\text{Height})^2 = 7.6^2 - 6.2^2$ or $\cos^{-1}(\frac{18.8-12.6}{7.6}) = 35(.3345\ldots)°$ and $\sin 35(.33\ldots)° = \frac{\text{Height}}{7.6}$ or $\tan 35(.33\ldots)° = \frac{\text{Height}}{6.2}$	M2	M1 for sight of 18.8 – 12.6 with • any attempt to use Pythagoras' Theorem (including summing rather than subtraction) • $\cos^{-1}(\frac{18.8-12.6}{7.6}) = 35(.33\ldots)°$ and an attempt to use sine or tan
$\text{Height}^2 = 19.32$ or (Height =) $\sqrt{19.32}$ or (Height =) $7.6 \times \sin 35(.33\ldots)°$ or (Height =) $6.2 \times \tan 35(.33\ldots)°$	A1	
(Height =) 4.39(54... m) or 4.4(m)	A1	Do not allow 4.3(m) from premature rounding of 35.3345…° May be implied in further working Provided at least M2 previously awarded, FT from √'their 19.32' provided < 7.6 (m)
(Volume of concrete) ½ × (12.6 + 18.8) × 4.4 × 50 or ½ × 31.4 × 4.4 × 50 or ½ × (18.8 – 12.6) × 4.4 × 50 + 12.6 × 4.4 × 50 or ½ × 6.2 × 4.4 × 50 + 12.6 × 4.4 × 50	M2	FT 'their derived 4.4' provided • 'their derived 4.4' < 7.6 • 'their derived 4.4' ≠ 6.2 • 'their derived 4.4' ≠ 'their 18.8 – 12.6' May be seen in stages, e.g. with '× 50' in further working M1 for any one of the following: (Area of cross-section) • ½ × (12.6 + 18.8) × 4.4 (= 69.08 or 69.1m^2) • ½ × (18.8 – 12.6) × 4.4 + 12.6 × 4.4 (= 13.64m^2 + 55.44m^2) (Volume cuboid) • 12.6 × 4.4 × 50 (= 55.44 × 50 = 2772 m^3) (Volume triangular prism) • ½ × (18.8 – 12.6) × 4.4 × 50 (= 13.64 × 50 = 682 m^3)
(Volume of concrete) Answer in the range 3450 (m^3) to 3455 (m^3)	A1	FT from previous M2 only and 'their derived 4.4' from an attempt to use Pythagoras' Theorem or cosine followed by sine or tan On FT from M2, allow a similar range from rounding or truncation If previous M0 A0, award SC1 for an answer of 4867 (m^3) from 'their 4.4' = 6.2

9(a) (Length of the flagpole below the rod =) $3.8 \times \sin 55°$ or $3.8 \times \cos(90° - 55°)$ or $380 \times \sin 55°$ or $380 \times \cos(90° - 55°)$	M2	Or alternative full method M1 for correct working without isolating 'length' $\sin 55° = \frac{\text{length}}{3.8}$ or $\cos(90° - 55°) = \frac{\text{length}}{3.8}$ or $\sin 55° = \frac{\text{length}}{380}$ or $\cos(90° - 55°) = \frac{\text{length}}{380}$
3.11(2…m) or 311(.2.. cm)	A1	Allow 3.1 (m) or 310 (cm)
(Total length 1.5 + 3.11 =) 4.61 (m) or 461 (cm)	A1	Must be to the nearest cm FT provided at least M1 previously awarded, i.e. for 1.5 + 'their 3(.)11' correctly evaluated, to nearest cm, and 'their 3.11' is to at least 2 decimal places If units are given they must be correct
9(b)(i) $120 \times 64 \div 80$ or 64×1.5 or 120×0.8 or $120 \div 1.25$ or $64 \div \frac{2}{3}$ or equivalent	M1	
96 (cm)	A1	Answer space takes precedence
9(b)(ii) $75 \times 80 \div 120$ or $75 \div 1.5$ or $75 \times \frac{2}{3}$ or $80 \div 1.6$ or 80×0.625 or $64 \times 75 \div 96$ or equivalent	M1	FT from (b)(i) $64 \times 75 \div$ 'their 96' or equivalent
50 (cm)	A1	Answer space takes precedence

14.(a) $(AC^2 =)\ 13{\cdot}5^2 + 10{\cdot}8^2$ or equivalent $(AC =)\ \sqrt{13 \cdot 5^2 + 10 \cdot 8^2}$ or equivalent $(AC =)$ 17·3 or 17·2(88…) or 17·29 or $\frac{27\sqrt{41}}{10}$ (cm)	M1 m1 A1	Check diagram for answers. $(AC^2 =)\ 182{\cdot}25 + 116{\cdot}64 = 298{\cdot}89$. $(AC =)\ \sqrt{298{\cdot}89}$. Sight of √'their 298·89' or √'their 298·89' evaluated is awarded m1 provided M1 previously gained. CAO. Mark final answer. Allow 17 provided from correct workings. Final answer of AC = 298·89 is M1m0A0. Accept a rounded or truncated answer. An unsupported correct answer is awarded M1m1A1.
14.(a) Alternative method ***Correct** use of a two-step trigonometric method* *(AC =)* *17·3 or 17·2(88…) or 17.29 or $\frac{27\sqrt{41}}{10}$ (cm)*	*M2* *A1*	*A partial trigonometric method is awarded M0.* *CAO.* Mark final answer. *Allow 17 provided from correct workings.* *Accept a rounded or truncated answer.*
14. (b) $(x =)\ \tan^{-1}\frac{19{\cdot}8}{8{\cdot}7}$ An answer in the range 66·2 to 66·32	M2 A1	Check diagram for answers. Award M1 for $\tan x = \frac{19{\cdot}8}{8{\cdot}7}$ (= 2·275(8..) Mark final answer. Allow 66 provided from correct workings. Accept a rounded or truncated answer. Allow correct angles given in radians or gradians. $\tan^{-1}\frac{19{\cdot}8}{8{\cdot}7}$: Radians 1·1567…; Gradians 73·6440…
14.(b) Alternative method ***Correct** use of a two-step trigonometric method* *An answer in the range 66·2 to 66·32*	*M2* *A1*	*A partial trigonometric method is awarded M0.* Mark final answer. *Allow 66 provided from correct workings.* *Accept a rounded or truncated answer.* *Allow correct angles given in radians or gradians.*