REVISE
.wales

3.11 — Compound measures — speed, density & flow rates

Mark schemes for the 3.11 question pack

Spec 3.5.8, 3.5.9, 3.5.10 — Unit 3

SOLUTIONS · 2025 SPECIFICATION

Mark schemes for the 34 questions in the corresponding revise.wales question pack (145 marks total). Sources: legacy WJEC GCSE papers, WJEC SAM, and custom-authored mark schemes. Pack layout © revise.wales.

				OR for 7, 8, 11. OR for 11, 16, 25.
3. (a)	x^9		B1	
3. (b)	$4x-7y$		B1	
3. (c)	$2x$		B1	

3(a) (diagonal^2 =) $3.3^2 + 3.3^2$ diagonal^2 = 21.78 or diagonal = $\sqrt{21.78}$ diagonal is 4.7 (cm)	 M1 A1 A1	*Scale drawings are not accepted in Q3* FT from M1 for the correctly evaluated square root of 'their 21.78' provided 'their answer' > 3.3 (cm) Must be to 1 d.p. Accept an unsupported 4.7(cm)
3(b) 11 × 4.6(669…) × 9.5 × 4.6(669…) or 11 × 4.7 × 9.5 × 4.7 or 104.5 × $(4.7)^2$ (Area =) 2276(.01cm^2)	M2 A1	FT for 'their derived diagonal', but not 3.3 cm M1 for sight of either 11 × 4.6(669…) or 9.5 × 4.6(669…) *(Height 44.3355… cm; width 51.3359…cm)* Accept answers in the range 2211 (cm^2) to 2308.41 (cm^2) from appropriate working *(Note: e.g. use of a diagonal such as 5.27(cm) allow appropriate calculation with 5.2 (cm) or 5.3 (cm) for M2, A1; however use of 5 throughout is a possible M2, A0)*

				OR for 7, 8, 11. OR for 11, 16, 23.
3. (a)	x^9		B1	
3. (b)	$4x-7y$		B1	
3. (c)	$2x$		B1	

3(a) (diagonal^2 =) $3.3^2 + 3.3^2$ diagonal^2 = 21.78 or diagonal = $\sqrt{21.78}$ diagonal is 4.7 (cm)	 M1 A1 A1	*Scale drawings are not accepted in Q3* FT from M1 for the correctly evaluated square root of 'their 21.78' provided 'their answer' > 3.3 (cm) Must be to 1 d.p. Accept an unsupported 4.7(cm)
3(b) 11 × 4.6(669…) × 9.5 × 4.6(669…) or 11 × 4.7 × 9.5 × 4.7 or 104.5 × $(4.7)^2$ (Area =) 2276(.01cm^2)	M2 A1	FT for 'their derived diagonal', but not 3.3 cm M1 for sight of either 11 × 4.6(669…) or 9.5 × 4.6(669…) *(Height 44.3355… cm; width 51.3359…cm)* Accept answers in the range 2211 (cm^2) to 2308.41 (cm^2) from appropriate working *(Note: e.g. use of a diagonal such as 5.27(cm) allow appropriate calculation with 5.2 (cm) or 5.3 (cm) for M2, A1; however use of 5 throughout is a possible M2, A0)*

				OR for 7, 8, 11. OR for 11, 16, 25.
3. (a)	x^9		B1	
3. (b)	$4x-7y$		B1	
3. (c)	$2x$		B1	

3(a) (diagonal^2 =) $3.3^2 + 3.3^2$ diagonal^2 = 21.78 or diagonal = $\sqrt{21.78}$ diagonal is 4.7 (cm)	 M1 A1 A1	*Scale drawings are not accepted in Q3* FT from M1 for the correctly evaluated square root of 'their 21.78' provided 'their answer' > 3.3 (cm) Must be to 1 d.p. Accept an unsupported 4.7(cm)
3(b) 11 × 4.6(669…) × 9.5 × 4.6(669…) or 11 × 4.7 × 9.5 × 4.7 or 104.5 × $(4.7)^2$ (Area =) 2276(.01cm^2)	M2 A1	FT for 'their derived diagonal', but not 3.3 cm M1 for sight of either 11 × 4.6(669…) or 9.5 × 4.6(669…) *(Height 44.3355… cm; width 51.3359…cm)* Accept answers in the range 2211 (cm^2) to 2308.41 (cm^2) from appropriate working *(Note: e.g. use of a diagonal such as 5.27(cm) allow appropriate calculation with 5.2 (cm) or 5.3 (cm) for M2, A1; however use of 5 throughout is a possible M2, A0)*

7. Sight of 65 500 000 or equivalent	B1	Allow use of 65 499 999 or equivalent throughout
Sight of 243 500	B1	
65 500 000 ÷ 243 500	M1	
= 268(·993…) or 269 (population/km^2)	A1	Accept 270 from correct working

7(a) 14:30 to 14:45	B1	Accept any ¼ hour period within 14:27 to 14:57 inclusive Allow e.g. 2:30(p.m.) to 2:45(p.m.)
7(b) Answer in the range 15:09 to 15:15 inclusive	B1	Allow e.g. 3:09(p.m.) to 3:15(p.m.) inclusive
7(c) $\frac{18 \times 1000}{60 \times 60}$ 5 (metres per second)	M1 A1	Or equivalent e.g. $18 \times 5 \div 18$
7(d) ½ × 18 + ½ × 1 × (18 + 14) (= 9 + 16) 25 (km)	 M2 A1	Do not penalise a more accurate estimate that uses the velocities at 14:00, 15:00 and 16:00, e.g. using ½-hour intervals. M1 for one of the two areas correct in the sum, OR M1 for 1 slip in reading If a more accurate estimate used, M2 for a full correct method M1 for a full method with at least 1 correct area calculation A1 is dependent on M2 being awarded No FT from M1 *Alternative method:* *M2 for ½×1×((0+)14+2(18))* *Award M1 if 1 error made* *A1 for 25 (km) No FT from M1*

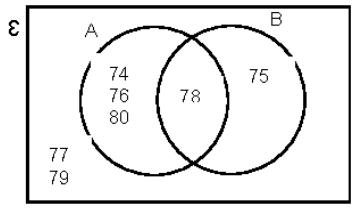
GCSE Mathematics – Numeracy Unit 1:Higher Tier Autumn 2016	Mark	Comment
7(e) Shows the distance travelled from the graph, e.g. ½ × 1 × 14 (= 7 km) or ½ × ½ × (14 + 12) + ½ × ½ × 12 (= 9.5 km)	M1	
Distance from the graph 7 (km) to 12 (km)	A1	If units are given they must be correct Must follow their working correctly
Shows use of 5 miles ≈ 8 km with a comparison conclusion, e.g. '7 km is reasonably close 8 km which is 5 miles', 'not really as 5 miles ≈ 8 km, so 9.5 km is a greater distance'	E1	Depends on M1 previously awarded Need sight of conversion 5 miles ≈ 8 km, or equivalent For this question, accept use of 3 miles is approximately 5 km
Organisation and communication	OC 1	*Organisation and communication* For OC1, candidates will be expected to: • present their response in a structured way • explain to the reader what they are doing at each step of their response • lay out their explanations and working in a way that is clear and logical • write a conclusion that draws together their results and explains what their answer means
Accuracy of writing	W1	*Accuracy of writing* 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.

10(a)(i) Tangent drawn at t = 50 Idea of increase in speed ÷ increase in time Reasonable approximation for the gradient	S1 M1 A1	 Ignore signs for M1 only Allow 1 slip in reading the scale for M1 only Only award if S1 awarded Accept a fraction not in its lowest terms Mark final answer
10(a)(ii) e.g. 10x = 2·444… and 100x = 24·444… and attempt to subtract 22/90 (ISW)	 M1 A1	 OR x = 0·2444… and 10x = 2·444… M1A0 for 2·2/9 100x – x leads to 242/990 (which simplifies to 22/90). ISW
10(b)(i) Sight of speeds of 10, 15, 25, 30 Split into at least 4 areas and attempt to sum (Area =) ½×20×(10+30 + 2(15 + 25 + 30)) = 1800 (m)	B1 M1 M1 A1	 Or equivalent. (Areas of 250, 400, 550, 600) (If 8 areas used, areas of 110, 135, ≈160, ≈210, 270, 295, 300, 300) Allow 1 slip in reading the scale CAO. A1 for an answer of ≈1780 (m) if 8 areas used. CAO.
10(b)(ii) (Total distance =) 1800 + 30 × (38 to 40 inclusive) = 2940 to 3000 (m) (Average speed =) total distance ÷ 120 = 24·5 to 25 (m/s)	 M1 A1 M1 A1	 FT 'their 1800' FT 'their total distance'

			Ignore 'recurring dot'.
2.(a)	48°	B1	
2.(b)	East	B1	

3(a) 190°	B1	
3(b) 332°	B1	
3(c)(i) 8400 ÷ 200 42 (population/km^2)	M1 A1	Or equivalent CAO
3(c)(ii) 5 × 8400 ÷ (3 + 4 + 5) 3500 (people)	M1 A1	Full method required Accept embedded answer, provided clearly Gwyndir

9. (Fuel used at 50 mph =) (50 × 3) ÷ 60 = 2·5 (gallons) or equivalent (Fuel used at 70 mph = 4·6 – 2·5) = 2·1 (gallons) (Dist travelled at 70 mph = 2·1 × 50) = 105 (miles) (Time travelling at 70 mph =) 105 ÷ 70 = 1·5 hours or equivalent	M1 A1 B1 B1 M1 A1	 FT 'their derived 2·5' provided < 4·6 FT 'their 2·1' FT 'their 105' provided an attempt has been made to use 'their 2·1' to find the distance travelled at 70 mph CAO

2. 	B2	Correct groupings of all 7 numbers within and outside the two circles (with or without a rectangle). B1 for 5 or 6 correctly placed numbers. No credit for a number shown in more than one section. Penalise −1, once only, if a number not in the universal set is noted. Ignore labelling for this B2 or B1. (i.e. ignore missing, conflicting or incorrect labels.)
	B1	*Allow intent of drawing circles and a rectangle.* Two intersecting circles correctly labelled A and B OR 'even numbers' and 'multiples of 3' (but not conflicting labels or labels that conflict number placements) within a rectangle. Allow missing 'ε' symbol.

5.

One correct evaluation $5 \le x \le 6$ — B1

2 correct evaluations $5{\cdot}55 \le x \le 5{\cdot}75$, one < 107, one > 107. — B1

2 correct evaluations $5{\cdot}65 \le x \le 5{\cdot}75$, one < 107, one > 107. — M1

$x = 5{\cdot}7$ — A1

Correct evaluation regarded as enough to identify if 'too high' or 'too low'. If evaluations not seen accept 'too high' or 'too low'.

x	$x^3 - 13x$ (or check $x^3 - 13x - 107=0$)		
5	60		
5·1	66·351		
5·2	73·008		
5·3	79·977		
5·4	87·264		
5·5	94·875		
5·6	**102·816**	5·55	98·803...
5·7	**111·093**	**5·65**	**106·912...**
5·8	119·712	5·655	107·326...
5·9	128·679	5·75	115·359...
6	138		

4. Correct construction <u>method</u> for perpendicular bisector with line drawn. Correct construction <u>method</u> for 60° at point A. Correct construction <u>method</u> for bisecting an angle with line drawn. Point P clearly identified	 B1 B1 B1 B1	*Correct construction arcs must be seen for the first three B1 marks.* Two pairs of intersecting arcs (centres at A and B). Allow if drawn at point B. Allow B1 for correct method (tolerance will be penalised with final B0). FT 'their angle of 60°' drawn at point A or point B. C.A.O. within tolerance. Intersecting lines alone with no indication that this is point P is <u>not sufficient</u> for this B1. Do not penalise if both possible positions shown. Final B1 may be awarded after B0B0B0.
<u>4. Alternative method</u> *Correct construction method for 60° at point A (or B).* *Correct construction method for bisecting the angle at A (or B) with line drawn.* *Repeating the above two stages at B (or A)* *Point P clearly identified*	 *B1* *B1* *B1* *B1*	*Correct construction arcs must be seen for the first three B1 marks* *Allow B1 for correct method (tolerance will be penalised with final B0).* *C.A.O. within tolerance.* *Intersecting lines alone with no indication that this is point P is <u>not sufficient</u> for this B1.* *Do not penalise if both possible positions shown.* *Final B1 may be awarded after B0B0B0.*

7.(a)(i)	425 kg	B1	
7.(a)(ii)	21·5 s	B1	
7.(a)(iii)	83 people	B1	
7.(b)	$2{\cdot}38 \times 10^{-2}$	B2	B1 for sight of a correct answer but not in standard form

8. One correct evaluation $1 \le x \le 2$ 2 correct evaluations $1{\cdot}55 \le x \le 1{\cdot}75$, one < 0, one > 0. 2 correct evaluations $1{\cdot}55 \le x \le 1{\cdot}65$, one < 0, one > 0. $x = 1{\cdot}6$	 B1 B1 M1 A1	*Correct evaluation regarded as enough to identify if 'too high' or 'too low'. If evaluations not seen accept 'too high' or 'too low'.* x $2x^3 + x - 10$ (or check $2x^3 + x = 10$) 1 −7 1·1 −6·238 1·2 −5·344 1·3 −4·306 1·4 −3·112 1·45 − 2·452... 1·5 −1·75 1·55 − 1·002... **1·6 −0·208 1·65 0·634...** **1·7 1·526** 1·75 2·468... 1·8 3·464 (1·62 0·123..) 1·9 5·618 (1·63 0·291..) 2 8 (1·64 0·461..)
9. 85% ≡ 6154 $\frac{6154}{85} \times 100$ OR $\frac{6154}{0{\cdot}85}$ = 7240	B1 M1 A1	Accept any indication. Implies the B1.
10. x = 54(°) Opposite angles (of a) cyclic quad. (add up to 180°). y = 108(°) Angle at the centre (is twice the angle at the circumference).	B1 E1 B1 E1	 Dependent on an attempt at 180 – 126. FT 2 × 'their 54' only if less than 360° Dependent on an attempt at 2 × 'their 54'.
11. Correct enlargement	B2	Otherwise B1 for 2 correct vertices within a triangle. OR for 3 correct vertices in the correct location not joined to form the triangle OR triangle of correct shape, size and orientation in incorrect position OR consistent correct use of an incorrect negative scale factor.
12(a). $(9p+1)(9p-1)$	B2	B1 for $(9p \ldots 1)(9p \ldots 1)$
12(b). $(7t-2)(t+3)$	B2	B1 for $(7t \ldots 2)(t \ldots 3)$
13. Sight of 297.5 AND 6.5 297.5 ÷ 6.5 = 45.77(km/h)	B1 M1 A1	Accept 6 hours 30 minutes, but not 6.3 hours. If other calculations shown, then the relevant calculation must be identified. Award M1 for their values provided 295≤d<300 AND 6<t≤7 (but not 6 hours 30 minutes). CAO. Correct answer must be clearly identified.
14. sin BAD = (2×70)/(8×19) or equivalent (BAD=) 67(.08…°) (Area of sector ABD=) 67(.08…)/360×π×8^2 Accept answers in the range 37.4(cm^2) to 37.5(cm^2) OR 37(cm^2)	M2 A1 M1 A1	Allow any unambiguous indication of angle BAD. M1 for the correct use of the formula when sinBAD is not the subject, for example: 70 = 1/2×8×19×sinBAD. Allow any answer that rounds to 67(°). Accept 292.9(…)/360×π×8^2 OR 293/360×π×8^2 for the area of the major sector ABD. FT their derived or stated value of angle BAD. Accept an answer in the range 163.5(cm^2) to 163.7(cm^2) OR 164(cm^2) for the area of the major sector ABD.

Second variable found.	A1	
7.(a) $20 \times 15 - \pi \times 4^2$	M1	
$\times 10$	m1	
$2497(\cdot\ldots)$ OR $3000 - 160\pi$	A1	Accept an answer between 2497 and 2498 inclusive OR 2500. SC1 for sight of $\pi \times 4^2 \times 10$ OR 160π (accept 502 to 503 inclusive).
7.(b) (Mass =) $2497\cdot(..) \times 2\cdot4$ OR $2497\cdot(..) \times 0\cdot0024$	M1	F.T. 'their volume in (a)'
$= 5993\cdot6(..)$(g) OR $5\cdot9936..$(kg)	A1	Accept value truncated or rounded to a whole number. Ignore units.
6(kg)	A1	F.T. from 'their 5993·6..g' or 'their 5·9936..kg' ONLY if M1 awarded AND 'their 5993·6..g' > 500g or 'their 5·9936..kg' > 0.5kg If no marks awarded, allow SC1 for (Mass =) 'their volume' × density, where density may have incorrect place value e.g. '2497·(..) × 0·024'

Unit 2: Higher Tier	Mark	Comments
1. (Volume of cylinder =) $\pi \times 2{\cdot}3^2 \times 5$	M1	May be seen or implied in later working.
$= 83(\cdot095\ldots.)\ (cm^3)$ or $26{\cdot}45\pi$	A1	Accept an answer between 83 and 83·11 inclusive.
(Density of metal =) $423{\cdot}1 \div 83(\cdot095\ldots.)$	M1	FT 423·1 ÷ 'their volume of cylinder', provided not 5 or 2·3 (derived or stated). Ignore any attempt to change units (e.g. 423·1 ÷ 83 ÷ 1000).
Accept an answer between 5 and 5·1 (g/cm^3)	A1	Mark final answer.
1. Alternative method: *(Density of metal =)* $\dfrac{423{\cdot}1}{\pi \times 2{\cdot}3^2 \times 5}$	*M2*	*Award M1 for sight of* $\pi \times 2{\cdot}3^2 \times 5$.
Accept an answer between 5 and 5·1 (g/cm^3)	*A2*	A1 for sight of $423.1/26.45\pi$ or $15.9(96\ldots)/\pi$ or any other simplified fraction with **one** step left to carry out.

4(a) (Population in 1964) $\frac{100 + 682}{100} \times 30000$ or 7.82×30000 or $30000 + 30000 \times \frac{682}{100}$ or equivalent (Population in 2014) $\frac{100 + 20}{100} \times 234600$ or 1.2×234600 281520 (people)	M1 M1 A1	(= 234600 people) M0 for 6.82×30000 (= 204600) or 1.682×30000 (= 50460) FT 'their derived 234600' including 1.2×204600 (= 245520) 1.2×50460 (= 60552) CAO
4(b) $287\,106 \div 432$ 660 (people per km^2)	M1 A2	A1 for sight of 664.597…. rounded or truncated
4(c) $1442 \times 1000 \div 1\,000\,000$ 1.4(42 g/cm^3)	M1 A1	Mark final answer Allow M1 A1 for $1442 \div 1000 = 1.4(42)$ Do not accept from incorrect working, e.g. M0 A0 if 1.442 seen with an incorrect statement, e.g. • "1 g = 1000 kg" • "g to kg is ÷ 1000"

8(a) (Distances travelled up to 11:00 =) 135 (km) AND 157.5 (km)	B1	Check diagram
(Distance =) $\sqrt{135^2 + 157.5^2 - 2\times135\times157.5\times cos49(^o)}$ $(=\sqrt{15132.33\ldots})$	M2	FT their distances for M2 or M1 Allow use of 30 and 35 M1 for $135^2 + 157.5^2 - 2\times135\times157.5\times\cos49(^o)$
= 123(.01…) (km)	A1	Must come from M2 and provided 30 and 35 not used in the cosine rule
(Time taken for Explorer to reach Magellan =) 123(.01…) ÷ 30	M1	Can only be awarded provided at least M1 previously awarded FT 'their derived 123(.01…)'
= 4.1(…) (hours) or 4 hrs 6 mins = 15:06 or 3:06 p.m.	A1 A1	FT from M1A0 for 'their 4.1(…) (hours)' provided of equivalent difficulty (not quarter or half hours involved) On FT, needs to be correct to the nearest minute, rounded or truncated If final M0A0A0 awarded, SC2 for an answer of 14:31 or 2:31 p.m. from the division by 35 OR SC1 for 3.5(1…) hours from the division by 35
8(b) (Angle at top of triangle =) $\sin^{-1}\left(\frac{sin49(^o)}{123(.01\ldots)}\times157.5\right)$ OR $\cos^{-1}\left(\frac{135^2+123(.01\ldots)^2-157.5^2}{2\times135\times123(.01\ldots)}\right)$	M2	FT their values consistently used from (a) M1 for $\frac{\sin \text{angle}}{157.5} = \frac{\sin49(^o)}{123(.01\ldots)}$ or equivalent OR M1 for $157.5^2 = 135^2+123(.01)^2 - 2\times135\times123(.01)\times\cos$ angle
75(.08…) to 75.105 (º)	A1	Must come from M2
(Bearing =) 360 – (180 – 51) – 75(.08…) or 180 – (75(.08…) – 51) or 231 – 75(.08…)	M1	FT 'their derived 75(.08…)'
= 156 (º)	A1	Allow an answer of 155.9(19…)(º)
8(b) Alternative method: *(Angle at right of triangle =)* $sin^{-1}\left(\frac{sin49(^o)}{123(.01\ldots)}\times135\right)$ OR $cos^{-1}\left(\frac{157.5^2+123(.01\ldots)^2-135^2}{2\times157.5\times123(.01\ldots)}\right)$	*M2*	*FT their values consistently used from (a)* *M1 for $\frac{\sin \text{angle}}{135} = \frac{\sin49(^o)}{123(.01\ldots)}$ or equivalent OR* *M1 for* $135^2=157.5^2+123(.01)^2 -2\times157.5\times123(.01)\times\cos$ angle
= 55.9(19…) to 56 (º)	*A1*	*Must come from M2*
(Bearing =) *360 – (180 – 51) – (180 – 49 – 55.9(19…)) or* *51 + 49 + 55.9(19…) or* *100 + 55.9(19…)*	*M1*	*FT 'their derived 55.9(19…)'*
= 156 (º)	*A1*	*Allow an answer of 155.9(19…)(º)*

2. (a) (Area =) $\frac{7{\cdot}4 + 9{\cdot}1}{2} \times 5{\cdot}7$ or equivalent	M1	(= 47·025) May be seen in stages. Allow M1 for correct intent seen. e.g. 7·4 + 9·1 × 5·7 ÷ 2
× 15·6	m1	
Allow an answer from 733 to 734 (cm^3) inclusive.	A1	CAO *Note: 733·59 or 733·6 (cm^3)*
2. (b) 733·59 × 19·3	M1	FT 'their volume from (a)' × 19·3
14158(·287(g))	A1	
Allow an answer from 14·1 to 14·2 (kg) inclusive.	B1	FT 'their 14158·287' ÷ 1000 Allow 14 from correct working. *Note: 14·158(287) or 14·16 or 14·2 (kg)*
2.(b) Alternative method (converting to g first)		
0·0193 (kg/cm^3)	*B1*	
733·59 × 0·0193	*M1*	*FT 'their volume from (a)' and FT 'their 0.0193' provided a place value error has been made.*
Allow an answer from 14·1 to 14·2 (kg) inclusive	*A1*	Allow 14 from correct working. *Note: 14·158(287) or 14·16 or 14·2 (kg)*

4(a)(i) Entries 146 and 160 in the table and the cumulative frequency diagram completed correctly (correct plots (11, 146) and (13, 160) and all plots joined)	B2	B1 for any one of the following: • 146 and 160 in the table, correct plots but **not** joined • 146 and 160 in the table, with one correct plot and one incorrect plot in completing the **cumulative** frequency diagram with plots joined • one error in the table, including FT 'their 146' + 14 and these **cumulative** entries used correctly to complete the **cumulative** frequency diagram with plots joined • correct cumulative frequency diagram with plots joined, with incorrect, incomplete or not attempted entries in the table
4(a)(ii) 8.2 to 8.4 (minutes)	B1	Answer space takes precedence Allow 8 minutes 12 seconds to 8 minutes 24 seconds FT reading from the graph for 'their median', from ½ × 'their 160', provided 'their 160' ≥ 110, with a tolerance of ½ small square from 'their **cumulative** frequency graph', provided it is possible to read 'their median' from the vertical axis on the graph paper provided
4(a)(iii) 7.2 minutes	B1	Answer space in the statement takes precedence, if blank award for indication of '7.2' (circled) in the list Allow '7' in the answer space provided 7.2 indicated in the list Do not accept '8' in the answer space if 7.2 indicated in the list
4(a)(iv) $\frac{20}{160}$ (× 100) or $\frac{1}{2}$ × 25 (%) or equivalent 12.5 (%) or 12½ (%)	M1 A1	FT for (100 ×) 20/'their 160', provided 'their 160'> 106 On FT allow rounding or truncation to 1 decimal place
4(b) (Costs are 180 + 220) (£) 400 **AND** (Profit is 700 – 180 – 220) (£) 300 **OR** (Receipts / Costs =) $\frac{700}{400}$ (× 100) (Percentage profit is) $\frac{300}{400}$ (× 100) or $\frac{700}{400}$ (× 100) – 1 (× 100) 75 (%)	B1 M1 A1	May be embedded, e.g. 700 – 400 = 300 (= 1.75 or 175%) FT 'their 400' and 700 – 'their 400' provided their costs or profit are ≠ 180, ≠ 220 and ≠ 700 CAO Allow if all costs and the total are consistently multiplied by 3.
4(c) 8(.)40 ÷ 1(.)20 or 8(.)40 – 8(.)40 ÷ 6 or equivalent (£) 7 or 700 (p)	M1 A1	Accept a **complete** and **convincing** method of trial and improvement If units are given they must be correct Sight of 7 + 1.40 = 8.40 is awarded M1 A0 unless (£)7 is selected

8. 70 $\times\left(\frac{1}{2}+\frac{1}{10}\right)$ or $\times\left(\frac{28}{56}+\frac{1}{10}\right)$ or $\times 0.6$	M2	M2 and M1 can be performed in either order, but have to come from starting with 70 May be embedded within incorrect work M1 for: • $\times\left(\frac{1}{2}+\cdots\right)$ or $\times\left(\frac{28}{56}+\cdots\right)$ OR • $\times\left(\ldots+\frac{1}{10}\right)$
$\div 1.75$ or $\times\frac{4}{7}$ or equivalent	M1	Accept use of $\div$ (1.748 to 1.76) or $\times$ (0.568 to 0.572)
$\times 11$	m1	FT from at least one M1 previously awarded
$= 264$ (miles)	A2	CAO A1 for: • sight of 42 (pints) or • sight of 24 (litres) or • a correct answer on FT only from an error in converting to litres Allow (for possibly all marks) one rounding/truncation step from using an accepted conversion from pints to litres e.g. <u>use of × 0.57 for the conversion to litres</u> 42 × 0.57 = 23.94 (possibly rounded to 24) or 42 × 0.57 × 11 = 263.34 (possibly rounded to 263)
8. <u>Alternative method:</u> 11 *$\div 1.75$ or $\times\frac{4}{7}$ or equivalent*	*M1*	*M1 and M2 can be performed in either order, but have to come from starting with 11* *Accept use of $\div$ (1.748 to 1.76) or $\times$ (0.568 to 0.572)*
$\times\left(\frac{1}{2}+\frac{1}{10}\right)$ or $\times\left(\frac{28}{56}+\frac{1}{10}\right)$ or $\times 0.6$	*M2*	*May be embedded within incorrect work* *M1 for:* • *$\times\left(\frac{1}{2}+\cdots\right)$ or $\times\left(\frac{28}{56}+\cdots\right)$ OR* • *$\times\left(\ldots+\frac{1}{10}\right)$*
$\times 70$	*m1*	*FT from at least one M1 previously awarded*
$= 264$ (miles)	*A2*	*CAO* *A1 for:* • *sight of $\frac{44}{7}$ (miles per pint) or equivalent* • a correct answer on FT only from an error in converting 11 miles per litre into miles per pint *Allow (for possibly all marks) one rounding/truncation step from using an accepted conversion from pints to litres* *e.g. <u>use of × 0.57 for the conversion to litres</u>* *11 × 0.57 = 6.27 (truncated/rounded to 6.2 or 6.3, **but not 6**) or* *11 × 0.57 × 0.6 = 3.762 (truncated/rounded to 3.7 or 3.8, **but not 4**)*

9(a) 5 $\times \frac{240}{100}$ or $\times 2.4$ or equivalent $\times \frac{4}{3}$ or $\times 1.333\ldots$ or equivalent = 16 (delivery vans)	 M1 M1 A1	A table method altering all 3 in the same manner at the same time is M0 M marks may be seen in either order e.g. Time 4, Houses 240, Vans 12 FT from M0 previously awarded Must be from use of 5 e.g. if this calculation is performed first Time 3, Houses 100, Vans 6.66… CAO
9(a) Alternative method 1: $\frac{100}{4\times5}$ *(=5 houses per hour per van)* $\frac{240}{100\div(4\times5)\times3}$ *or* $\frac{240}{5\times3}$ *= 16 (delivery vans)*	*M1* *m1* *A1*	 *CAO*
9(a) Alternative method 2: *Time 3, Houses 75, Vans 5 OR* *9.6 (or 9h36m), 240, 5* $5 \times \frac{240}{75}$ *OR* $5 \times \frac{9.6}{3}$ *or* 5×3.2 *or equivalent* *= 16 (delivery vans)*	*M1* *M1* *A1*	 *FT from 3 (time), n houses, 5 vans for* $5 \times \frac{240}{n}$ *FT from n (time), 240 houses, 5 vans for* $5 \times \frac{n}{3}$ *CAO*
9(b) Sight of $\frac{\text{angle}}{360} \times \pi \times 3^2$ or equivalent $\frac{140}{360}\times\pi\times3^2 + \frac{110}{360}\times\pi\times3^2 + \frac{70}{360}\times\pi\times3^2$ or equivalent $(7\pi/2)$ $(11\pi/4)$ $(7\pi/4)$ $+ 3\times12\times3 + 22\times3$ $= 8\pi + 174$ (cm^2)	 B1 M2 m1 A2	Allow use of $\pi = 3.14$ to 3.142 for B and M marks, but not for A marks For any of the angles 140(°), 110(°), 70(°), 140+110+70 or 320 e.g. $\frac{(140+110+70)}{360}\times\pi\times3^2$ or $\frac{320}{360}\times\pi\times3^2$ or 8π M1 for the sum of any 2 correct terms OR M1 for $\frac{x}{360} \times \pi\times3^2$ where $300 \leq x < 360$ if 140+110+70 not seen The award of M2 or M1 implies the previous B1 FT from M1 CAO. Mark final answer A1 (does not depend on m1 being awarded) for any one of the following seen • $\frac{2880\pi}{360}$ + …. or equivalent • $7\pi/2 + 11\pi/4 + 7\pi/4 + \ldots..$ • $3.5\pi + 2.75\pi + 1.75\pi + \ldots.$ • 8π

9(c)	$\sqrt{9}\times\sqrt{5} + \sqrt{5}$ or $3\sqrt{5} + \sqrt{5}$	M2	M1 for $\sqrt{45} + \sqrt{5}$ or M1 for sight of $3\sqrt{5}$
	$= 4\sqrt{5}$ (cm)	A1	CAO

Unit 1: Higher Tier	Mark	Comments
5(a)(i) 1×10^5	B1	
5(a)(ii) A suitable calculation, including an appropriate approximation, e.g. $\frac{3\,100\,000}{21\,000}$ or $\frac{3\,100\,000}{20\,000}$ or $\frac{3\,000\,000}{20\,000}$ or $\frac{3\,000\,000}{21\,000}$ or equivalent	M2	Place value must be correct Must include an approximation M1 for the idea to divide (in the correct order), that may also include one place value error, e.g. $\frac{3.1\ million}{20\,735}$, $\frac{31\,000\,000}{20\,000}$, $\frac{3\,100\,000}{20\,700}$
Answer in the range 142 (people/km^2) to 155 (people/km^2)	A1	ISW. Allow 142.8, 142.9 and 143 rounded to 140 Accept equivalents, e.g. 150 written as 1.5×10^2
5(b) Idea that 360 000 is 120%	B1	Accept from sight of trial to increase 'their value' by 20% provided 'their value' <360 000
360 000 ÷ 1.2 or equivalent	M1	Award of M1 also implies previous B1
300 000 (people)	A1	
5(c) (Length) 6.6 ÷ (4.2 ÷ 1.4) or 6.6 ÷ 3 or equivalent	M1	
Length 2.2 (cm)	A1	
(Height) 4.2 × (9.9 ÷ 6.6) or 4.2 × 1.5 or 1.4 × (9.9 ÷ 2.2) or equivalent	M1	FT 1.4 × (9.9 ÷ 'their derived length')
Height 6.3 (cm)	A1	Note: Length (from *9.9 – 6.6* =) *3.3*(cm) M0 A0 Height (from 1.4 × (9.9 ÷ *3.3*) =) 4.2(cm) M1 A1 (FT) Allow answers reversed in the answer space
5(c) Alternative method *(Height) 4.2 × (9.9 ÷ 6.6) or 4.2 × 1.5 or equivalent*	*M1*	
Height 6.3 (cm)	*A1*	
(Length) 6.6 ÷ (4.2 ÷ 1.4) or 6.6 ÷ 3 or 9.9 ÷ (6.3 ÷ 1.4) or equivalent	*M1*	*FT 9.9 ÷ ('their derived height' ÷ 1.4)*
Length 2.2 (cm)	*A1*	*Allow answers reversed in the answer space*

Unit 1: Higher Tier	Mark	Comments
8. (Average speed =) $\frac{x+36}{1+2}$ = 42 or equivalent. OR (Total distance =) x + 36 = 3 × 42 or equivalent.	M2	Must be a complete and correct method for M2. Award M1 for sight of one of the following: • $\frac{x+36}{1+2}$ • $\frac{x+36}{3}$ • $\frac{x+36}{180}$ (mins) • 3 × 42 • an appropriate 126.
$(x=)\ 90$ ISW	A1	CAO. An unsupported answer of 90 is awarded M2A1. If no marks, award SC1 for a final answer of $x=48$ (from working with 2 hours).

Unit 1: Higher Tier	Mark	Comments
9(a) Use of Volume = $\frac{\text{Mass}}{\text{Density}}$ (Maximum possible volume =) $\frac{155}{2.5}$ $= 62\ (\text{cm}^3)$	B1 M1 A1	FT 'their 155' provided $150 < \text{mass} \leq 160$ AND 'their 2.5' provided $2 \leq \text{density} < 3$ CAO If no marks awarded, SC1 for use of 155 AND 2.5
9(b)(i) Identification of correct right-angled triangle $(AD^2 =) 40^2 - (12-2)^2$ or $(AD^2 =) 40^2 - 10^2$ $AD^2 = 1500$ OR $(AD =) \sqrt{1500}$ AND $(AD =)\ 10\sqrt{15}$ (cm)	B1 M1 A1	May be implied by sight of 40 AND (12 – 2) or 10 in working Sight of $AD^2 = 1500$ OR $(AD =)\sqrt{1500}$ AND $10\sqrt{15}$ need to be seen
9(b)(ii) (Total arc length =) $\frac{150}{360} \times 2 \times \pi \times 2$ + $\frac{210}{360} \times 2 \times \pi \times 12$ (= 5π/3 or $1^2/_3\pi$) (= 14π or 42π/3) $= 15\frac{2}{3}\pi$ or $\frac{5640\pi}{360}$ or $\frac{47\pi}{3}$ (cm) or equivalent (Total length of chain =) $20\sqrt{15} + \frac{5640\pi}{360}$ (cm) or equivalent	M2 A2 B1	Allow values of π from 3.14 to 3.142 for M marks only Or equivalent M1 for $\frac{150}{360} \times 2 \times \pi \times 2$ OR $\frac{210}{360} \times 2 \times \pi \times 12$ or equivalents CAO. Allow 15.66π, 15.67π or 15.7π A1 for any one of the following: • AB = 600π/360 or equivalent (= 5π/3 or $1^2/_3\pi$), allowing 1.66π, 1.67π or 1.7π • CD = 5040π/360 or equivalent (=14π or 42π/3) • On FT from M1 for a correct evaluation of 'their $\frac{150}{360}\times2\times\pi\times2$ + $\frac{210}{360}\times2\times\pi\times12$' with 1 correct term, accepting similar notation possibilities as A2 ISW Accept use of $15\frac{2}{3}\pi$ Allow use of 15.66π, 15.67π or 15.7π FT 'their 5640π/360' provided at least 2 marks previously awarded If no marks awarded, and from using π × radius in their calculations, i.e. using the method $2\times10\sqrt{15} + \frac{150}{360}\times\pi\times2 + \frac{210}{360}\times\pi\times12$ SC3 for an answer of $20\sqrt{15} + \frac{5640\pi}{720}$ (cm) or equivalent, allowing use of 7.83(…)π OR SC2 for … + $\frac{5640\pi}{720}$ (cm) or equivalent, allowing use of 7.83(…)π OR SC1 for use of $2\times10\sqrt{15} + \frac{150}{360}\times\pi\times2 + \frac{210}{360}\times\pi\times12$

Unit 1: Higher Tier	Mark	Comments
10.		A table method altering all 3 in the same manner at the same time is M0
(3 +) 12 × 9/12 or × 0.75 or equivalent	M1	M marks may be seen in either order Allow 12 − 3 e.g. Time: 9, To fill: 9/12, Pumps: 7 or 63, 9/12, 1
× 7/5 or × 1.4 or equivalent	M1	FT from M0 previously awarded Must be from use of 12 or (12 × 9/12 =) 9 e.g. if this calculation is performed first Time: 16.8, To fill: (Full), Pumps: 5 or 1.4, 1/12, 5
= 15 hours 36 minutes	A2	CAO A1 for any one of the following: • 63/5 or $12\frac{3}{5}$ or 12.6 (hours) or 12 hours 36 min • 78/5 or $15\frac{3}{5}$ or 15.6 (hours) • FT from M1M1 for their time + 3 hours correct to the nearest minute provided of equivalent difficulty
10. Alternative method 1 (using pump-hours):		
Sight of 7 × 12 AND 7 × 3	*B1*	
(3 +) (7 × 12 − 7 × 3)/5	*M1*	
= 15 hours 36 minutes	*A2*	*CAO* *A1 for any one of the following:* • *63/5 or $12\frac{3}{5}$ or 12.6 (hours)* • *78/5 or $15\frac{3}{5}$ or 15.6 (hours)* • *FT from M1 for their time + 3 hours correct to the nearest minute provided of equivalent difficulty*
10. Alternative method 2 (using pump-hours):		
Sight of 7 × 12 AND 2 × 3	*B1*	
(7 × 12 − 2 × 3)/5	*M1*	
= 15 hours 36 minutes	*A2*	*CAO* *A1 for any one of the following:* • *78/5 or $15\frac{3}{5}$ or 15.6 (hours)* • *FT from M1 for their time correct to the nearest minute provided of equivalent difficulty*

Unit 2: Higher Tier	Mark	Comments
1(a) (2.31 ÷ 7) ÷ 0.30 or (2.31 ÷ 0.30) ÷ 7 or (231 ÷ 7) ÷ 30 or (231 ÷ 30) ÷ 7 or equivalent	M2	Allow if brackets are implied in further working May be shown in stages M1 for any of the following: • 2.31 ÷ 0.30 (= 7.7) • 2.31 ÷ 7 (= 0.33) • (231 ÷ 7) ÷ 0.30 (= 110) • (2.31 ÷ 7) ÷ 30 (= 0.011) • (231 ÷ 0.30) ÷ 7 (= 110) • (2.31 ÷ 30) ÷ 7 (= 0.011)
1.1 (kWh)	A1	CAO. Ignore incorrect units
1(b) (Height freezer door) 2 × 1800 ÷ 5 or $\frac{2}{5}$ × 1800 or 0.4 × 1800 or equivalent	M1	
720 (mm)	A1	
((Diagonal of freezer door)^2 =) $600^2 + 720^2$	M1	Or alternative **full** method FT 'their height of freezer door' including 1080 or 1800 Accept working in m or cm for possible M1, A1
Diagonal^2 = 878 400 or (Diagonal =) $\sqrt{878\,400}$	A1	
(Diagonal =) 937(.22... mm)	A1	Final answer must be given in mm FT from M1 for the correctly evaluated square root of 'their 878 400' provided 'their answer' > 'their 720' for possible A1 If final M0 A0 A0 awarded as a different length, not 'their 720', is used to calculate the diagonal, award SC1 for a correct statement of Pythagoras' Theorem, and SC1 for a correct evaluation of 'their diagonal'

4. $2x + 3(x + 6) = 78$ or equivalent	M2	Answer lines take precedence. Brackets may be implied by later correct work. Award M1 for one of the following: • Sight of $2x + 3(x + 6)$ or equivalent • $2x + 3x + 6 = 78$ (brackets omitted or incorrect).
$5x + 18 = 78$	A1	CAO. May be implied in later working.
$5x = 60$	A1	FT from M2 or M1, 'their $5x + 18 = 78$'.
$(x =)$ 12	A1	FT from M2 or M1, 'their $5x = 60$'.
12 and 18	B1	FT 'their algebraically derived 12' and 'their 12 + 6' correctly evaluated. If FT leads to a whole number answer, it must be shown as a whole number. Otherwise accept a fraction. If M2 is awarded as the first step (forming an equation), then award the following A1A1A1B1 for 12 and 18 clearly identified as final answers (even if trial and improvement is then used).

4(a)(i) States 80 (and) 100 (seconds) AND indicates 'Yes'	B1	Allow written as 100 and 80 Answer space takes precedence
4(a)(ii)I. (80 – 75 =) 5 (seconds)	B1	Not from incorrect working Answer space takes precedence
4(a)(ii)II. Answer in the inclusive range 12 to 14 (seconds)	B2	Allow in this range only provided it not from incorrect working Answer space takes precedence B1 for sight of 92 – 60 (– 20) to 94 – 60 (– 20) or 32 (–20) to 34 (– 20)
4(b) 96 (seconds)	B3	Answer space takes precedence B2 for sight of or indication of 64 (squirrels), B1 any one of the following: • for sight of or indication of 16 (squirrels) • (use of 16 squirrels) answer of 52 (seconds) B0 for 64 seconds from incorrect working, 20% of 120 = 24, with time 64 seconds B0 for 96 seconds from incorrect working, 80% of 120 = 96, with time 96 seconds

4(c) (24 ÷ 21 500) × 1 000 000 (squirrels per km^2)	M2	Accept using estimation: (24 ÷ 20 000) × 1 000 000 M1 for any one of the following, including if embedded: • 24 ÷ 21500 (= 0.001116… squirrels per m^2) • (estimate) 24 ÷ 20 000 (= 0.0012 squirrels per m^2) • 1 000 000 ÷ 21 500 (= 46.5….) • (estimate) 1 000 000 ÷ 20 000 (= 50)
1116(.27...) (squirrels per km^2) AND Conclusion indicated or unambiguously implied 'Oak'	A1	Accept 1200 from estimating, i.e. (24 ÷ 20 000) × 1 000 000 =1200 (squirrels per km^2) If no marks, award SC1 for appropriate sight of a calculation of 24 ÷ 'a number with only non-zero digits 215', provided not embedded in further working apart from multiplication or division by powers of 10
4(c) Alternative method: *(If **oak**, number of squirrels likely in Maesgwyn Forest) 21 500 × 1200 ÷ 1 000 000*	*M2*	*Allow M2 for (If chestnut) 21 500 × 100 ÷ 1 000 000 (= 2.15)* *or (if pine) 21 500 × 45 ÷ 1 000 000 (= 0.9675)* *M1 for any one of the following, including if embedded:* • *(if oak) 21 500 × 1200 (= 25 800 000)* • *(If chestnut) 21 500 × 100 (= 2 150 000)* • *(if pine) 21 500 × 45 (= 967 500)* • *21 500 ÷ 1 000 000 (= 0.0215)* • *20 000 ÷ 1 000 000 (= 0.02)*
25.8 (squirrels) AND 'Oak' indicated as conclusion	*A1*	*Allow from correct working either* *2.15 (squirrels for Chestnut so must be) Oak, or* *0.9675 or 1 (squirrels for Pine so must be) Oak* *If no marks, award SC1 for appropriate sight of **any 1** of the following calculations:* • *'a number with only non-zero digits 215' ×1200* • *'a number with only non-zero digits 215' × 45* *provided not embedded in further working apart from multiplication or division by powers of 10*

8(d) Sight of base of triangle = 3h	B1	Any letter or word may be used for the height Needs to be convincing. May be seen on diagram
$\left(\frac{\pi \times h^2}{4} + 4h^2 + \frac{3h^2}{2}\right) \times 2 = 0.1$ or $\frac{2\pi \times h^2}{4} + 8h^2 + \frac{6h^2}{2} = 0.1$ or (12.57 to 12.571)h^2 = 0.1 or equivalent	M2	Ignore a place value error from an incorrect attempt to convert m^3 into cm^3 and/or m into cm for M and m marks only but A0 Allow omission of ×2 for M2 or M1 and possibly m1 M1 for: • the sum of appropriate terms equated to 0.1, with no more than 1 error in the terms • $\left(\frac{\pi \times h^2}{4} + 4h^2 + \frac{3h^2}{2}\right) \times 2$ or equivalent
$h^2 = \frac{0.1}{2(\frac{\pi}{4}+5.5)}$ or equivalent	m1	FT if possible from M1 provided h^2 in every term Note: $\pi/4 + 5.5 = 6.285$ to 6.2855 $\pi/2 + 11 = 12.57$ to 12.571
h = 0.089 to 0.0892 (m) or equivalent	A2	CAO Ignore an incorrect attempt to convert to cm or mm Accept 0.09 (m) from correct working A1 for h = $\sqrt{\frac{0.1}{2(\frac{\pi}{4}+5.5)}}$ or $\sqrt{\frac{1}{5\pi+110}}$ or h = $\sqrt{0.00795\ldots}$

5(a) 0.03 × 4000 + 4000 or 1.03 × 4000 (= £4120) or equivalent	M1	Allow for sight of one of the following: • 4120 (irrespective of labelling) • 4240 (simple interest)
0.03 × 4120 + 4120 or 1.03 × 4120 or equivalent	M1	FT 'their 4120' (the mark is for the method) (= £123.6(0) + £4120)
(£)4243.6(0)	A1	CAO. Answer space takes precedence if completed, otherwise mark final answer for the amount If no marks, award SC1 for (£)3763.6(0) (from depreciation)
5(a) Alternative method *Sight of $1.03^2 \times 4000$* *1.0609 × 4000* *(£)4243.6(0)*	*M1* *A1* *A1*	*CAO. Answer space takes precedence if completed, otherwise mark final answer for the amount* *If no marks, award SC1 for (£)3763.6(0) (from depreciation)*
5(b)(i) 100 × 42 ÷ (100 + 40) or 42 ÷ 1.4 or equivalent	M1	
(£) 30	A1	CAO. Answer space takes precedence Accept a correct answer from trial and improvement

5(b)(ii) (Volume of gold = mass ÷ density =)
$6 \times 10^{-3} \times 1000 \div 20$
or $6 \div 20$
or $6 \times 10^{-3} \div (20 \div 1000)$
or $6 \times 10^{-3} \div 0.02$
or equivalent
	M2	Must be dimensionally correct
		
		M1 for any one of the following:
		• sight of $6 \times 10^{-3} \times 1000$ (= 6 g)
		• sight of $20 \div 1000$ (= 0.02 kg/cm^3)
		• method with incorrect place value, 'their mass' ÷ 'their density' provided that
		  • the only non-zero digit in 'their mass' = 6 and
		  • the only non-zero digit in 'their density' = 2
		e.g. $6 \times 10^{-3} \div 20$, $6 \times 10^{-3} \div 0.2$, $600 \div 20$, $6000 \div 20$

0.3 (cm^3) or $\frac{3}{10}$ (cm^3)	A1	CAO, allowing 3×10^{-1} (cm^3)

		"it can't be negative".
8. $3{\cdot}2 \times 10^4 \div 1000 \div 8 \times 5$ or equivalent	M2	Answer space takes precedence. Operations can be made in any order Award M1 for sight of one of the following • $3{\cdot}2 \times 10^{(1)}$ (km) • $3{\cdot}2 \times 10^4 \div 1000$ or answer of 32 • $3{\cdot}2 \times 10^4 \div 1000 \div 8$ or answer of 4 • $3{\cdot}2 \times 10^4 \div 1000 \times 5$ or answer of 160 • $3{\cdot}2 \times 10^4 \div 8 \times 5$ or answer of 20 000 • $3{\cdot}2 \times 10^4 \div 1{\cdot}6$ or answer of 20 000 • One place value error (e.g. 2×10^x, $3{\cdot}2 \div 1{\cdot}6$).
20 or equivalent	A1	CAO

End of solutions