

MARK SCHEME

Question			Answer	Marks	Part marks and guidance	
1	a		5400 or 5401 or 5402 final answer	2	M1 for figs 35 ÷ figs 648, soi by figs 540[1...] or for 0.000 064 8 seen	
	b		Any reference to average/inexact weight oe [in packet weight or weight of a grain] or recognising that the number of grains of salt must be integer oe	1		Condone any mention of • average for variation and/or • size for weight Mark the best part if no contradiction or wrong statement See appendix

Question	Answer	Marks	Part marks and guidance
2	Poppy, Sesame, Pumpkin with correct comparable values shown	4	B3 for all 3 quantities seen <u>correct in comparable form</u> or B2 for 8.4×10^{-5} or 8.4×10^{-2} seen or seen <u>correct in comparable form</u>: - pumpkin with poppy eg implied by [250 poppy =] 0.075 - or - pumpkin with sesame eg implied by [250 sesame =] 0.91 or B1 poppy and sesame seen <u>correct in comparable form</u> or [pumpkin =] 0.084 or 0.000 084 seen or [250 poppy =] 0.000 075 oe seen or [250 sesame =] 0.000 91 oe seen

Condone weights as answer

Quantities given in the question (bold in table) need not be rewritten

Comparable forms include:

In kilograms:		
Pop	0.000 000 3	3×10^{-7}
Pum	0.000 084	8.4×10^{-5}
Ses	0.000 003 64	3.64×10^{-6}

In grams:		
Pop	0.000 3	3×10^{-4}
Pum	0.084	8.4×10^{-2}
Ses	0.003 64	3.64×10^{-3}

Must not be a mix of standard and ordinary form

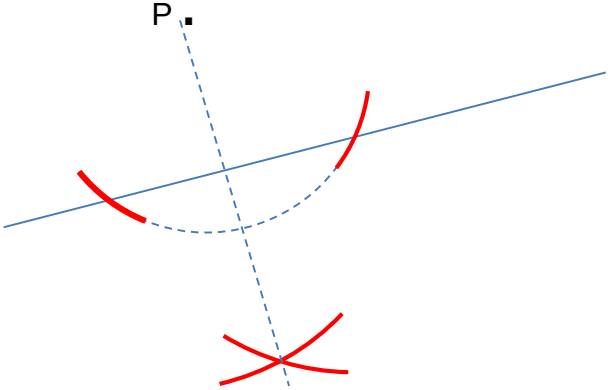
Accept consistent multiples for full marks. eg.
250 poppy = 0.075 and
250 sesame seeds = 0.91

May be all fractions with common denominator

Question		Answer	Marks	Part marks and guidance	
3	a	Correct answer based on angle or area/arc length	1	The angle [for black] • is too small oe or • is less than a fifth oe or • should be 72 oe The area/arc length [for black] • is too small oe or • is less than a fifth oe	Accept 26 to 30 for “the angle” Accept “not equal to” for “too small” or “less than” See appendix
	b	Any comment recognising limitations in range of the vertical scale	1		EG It does not start at zero or It starts at 113 See appendix
4		[expected profit is £] 80 with 200 and 120 seen	4	B1 for [£] 200 or 20 000[p] AND M2 for $0.1 \times 400 \times 3$ soi 120 or M1 for 0.1×400 soi 40 <u>Alternative method</u> B1 for [£] 200 or 20 000[p] M1 for $\frac{their200-100}{3}$ [prizes] soi 33[.3...] M1 for 0.1×400 soi 40 A1 for she is giving away too many prizes oe <u>Alternative method</u> B1 for [£] 200 or 20 000[p] M1 for $\frac{their200-100}{3}$ [prizes] soi 33[.3...] M1 for $\frac{their33[.3...]}{400}$ soi 0.08[3...] A1 for the probability of winning the game is too great oe	Apply scheme to consistent working in pence rather than £.

Question	Answer	Marks	Part marks and guidance	
5	Answer which rounds to 61.6 nfwv	3	M2 for $\tan^{-1}\left(\frac{37}{20}\right)$ oe or M1 for $\tan[x =] \frac{37}{20}$ oe If M0 scored then SC1 for answers 28.4, 28 or angles that round to 28.4 if correct working seen.	
			Condone answer of 62 only if correct working seen Answers of 68.5 or 68.4(5..) [grads] or 1.08 or 1.07(5..) [rads] imply M2 Alternative method After correct <u>method</u> for Pythagoras soi by 42.0 to 42.1 M2 for $\sin^{-1}\left(\frac{37}{\text{their } \sqrt{20^2+37^2}}\right)$ or $\cos^{-1}\left(\frac{20}{\text{their } \sqrt{20^2+37^2}}\right)$ or M1 for $\sin[x =] \frac{37}{\text{their } \sqrt{20^2+37^2}}$ or $\cos[x =] \frac{20}{\text{their } \sqrt{20^2+37^2}}$ or M0 for just Pythagoras reaching AC = 42.0 to 42.1 Do not condone answer of 62 following an interim answer seen that does not round to 61.6 0 for scale drawing	

Question	Answer	Marks	Part marks and guidance
6	108 nfww	4	B3 for $\frac{108}{300}$ OR M3 for $(300 - \frac{23}{50} \times 300) \div 3 \times 2$ oe or M2 for $300 - \frac{23}{50} \times 300$ soi 162 or M1 for $\frac{23}{50} \times 300$ oe soi 138 <u>Alternative method</u> M1 for [p(white or red) =] $1 - \frac{23}{50}$ soi $\frac{27}{50}$ M1 for <i>their</i> $\frac{27}{[50]} \div 3 \times 2$ soi $\frac{18}{[50]}$ M1 for <i>their</i> 18×6 or <i>their</i> $\frac{18}{50} \times 300$

Question	Answer	Marks	Part marks and guidance	
7	Ruled perpendicular constructed with correct arcs (one pair intersecting AB)	2	Condone dashed line B1 for correct arcs (one pair intersecting AB) only but no line or correct ruled line but no, or incomplete construction arcs 	

Set protractor to 90° and check 88° to 92° at AB

Correct construction arcs as shown (may be two pairs of arcs used to draw line through P)
Ignore other arcs if correct arcs clearly used to construct line

Condone perpendicular extending beyond AB but must pass through P and reach AB (no daylight)

Alternative arcs.

One centred on A length AP and one centred on B length BP meeting below AB (may also pass through P). Use overlay as check

Candidates may use points on AB other than A and B for this construction. In such cases check radii of arcs using on-line ruler to judge.

Question			Answer	Marks	Part marks and guidance	
8			$y = 6x + 2$ oe final answer	4	B3 for $6x + 2$ as final answer or for $y = 6x + 2$ oe seen and then spoiled as final answer OR B2 for $y = 6x + k$ oe $0 < k < 7$ or for $y = mx + 2$, $m > 0$ and $m \neq 6$ or B1 for gradient or $m = 6$ stated or for $y = 6x$ or for $[y =] 6x + k$ $k \neq 0$ or 7 oe or for $mx + 2$, $m > 0$ and $m \neq 6$ B0 for $y = 6x + 7$ (as given)	Accept $y - 26 = 6(x - 4)$ as equivalent Do not allow other letters for x <u>Alternative methods</u> M1 for $6 \times 4 + 7$ soi 31 M1 for <i>their</i> $31 - 26$ soi 5 M1 for $7 - \text{their } 5$ OR M1 for $[\pm]6 \times 4$ soi 24 or -24 M1 for $26 - \text{their } 24$ soi 2 M1 for $6x + \text{their } 2$

Question			Answer	Marks	Part marks and guidance																																																	
9			Correct solution is $x \leq -3$ from algebraic working No and number line shows $x \geq -3$ oe or No and draws the correct inequality on number line or No and “the arrow points the wrong way” oe	M3 A1dep	M2 for $8x - 3x \leq -10 - 5$ or better, or for $5 + 10 \leq 3x - 8x$ or better or M1 for $8x - 3x$, or $3x - 8x$, or $[\pm]5x$, or $-10 - 5$, or $5+10$, or $[\pm]15$ seen A1 dep on M3 After 0 scored, allow SC1 for number line shows $x \geq -3$ or “the arrow points the wrong way” oe but only if no incorrect working shown or correct substitution of a value $\neq -3$ and conclusion that inequality is false oe	For M2 and M1 condone incorrect inequality sign or “equals”. <u>Alternative method</u> 3 trials for values of x where $x < -3$, $x = -3$ and $x > -3$ <u>and</u> correct conclusion can score full marks. Without the correct conclusion, maximum for this approach is SC1 for only the 3 correct trials (as described above) <table><tr><th>x</th><th>$8x + 5$</th><th></th><th>$3x - 10$</th></tr><tr><td>-6</td><td>-43</td><td><</td><td>-28</td></tr><tr><td>-5</td><td>-35</td><td><</td><td>-25</td></tr><tr><td>-4</td><td>-27</td><td><</td><td>-22</td></tr><tr><td>-3</td><td>-19</td><td>=</td><td>-19</td></tr><tr><td>-2</td><td>-11</td><td>></td><td>-16</td></tr><tr><td>-1</td><td>-3</td><td>></td><td>-13</td></tr><tr><td>0</td><td>5</td><td>></td><td>-10</td></tr><tr><td>1</td><td>13</td><td>></td><td>-7</td></tr><tr><td>2</td><td>21</td><td>></td><td>-4</td></tr><tr><td>3</td><td>29</td><td>></td><td>-1</td></tr><tr><td>4</td><td>37</td><td>></td><td>2</td></tr></table>	x	$8x + 5$		$3x - 10$	-6	-43	<	-28	-5	-35	<	-25	-4	-27	<	-22	-3	-19	=	-19	-2	-11	>	-16	-1	-3	>	-13	0	5	>	-10	1	13	>	-7	2	21	>	-4	3	29	>	-1	4	37	>	2
x	$8x + 5$		$3x - 10$																																																			
-6	-43	<	-28																																																			
-5	-35	<	-25																																																			
-4	-27	<	-22																																																			
-3	-19	=	-19																																																			
-2	-11	>	-16																																																			
-1	-3	>	-13																																																			
0	5	>	-10																																																			
1	13	>	-7																																																			
2	21	>	-4																																																			
3	29	>	-1																																																			
4	37	>	2																																																			

Question	Answer	Marks	Part marks and guidance	
10	[0].88% [increase] <u>Alternative method</u> The two answers are different oe dep on B5	6	B5 for 1.0088 or [0].0088 seen or B4 for 1.0088x where x is any letter or M4 for $k \times 1.04 \times [0].97 \div k$ oe or $(k \times 1.04 \times [0].97 - k) \div k$ oe or M3 for $k \times 1.04 \times [0].97$ oe or M2 for $k \times 1.04$ oe or $k \times [0].97$ oe or M1 for 1.04 or [0].97 or 4% of k found or 3% of k found If 0 scored then SC3 for figs 10088 or 88 seen <u>Alternative method</u> B5 for correct answers to both $k \times 1.04 \times [0].97$ and $k \times 1.01$ OR M3 for $k \times 1.04 \times [0].97$ oe or M2 for $k \times 1.04$ oe or $k \times [0].97$ oe or M1 for 1.04 or [0].97 or 4% of k found or 3% of k found and M1 for $k \times 1.01$ oe	

accept [0].9% increase after 1.0088 found
For M marks, k is any seen starting value or a letter.

eg **M4** for $1.04 \times [0].97$ as k assumed to be 1.

eg **M3** for $104 \times [0].97$ as k assumed to be 100.

M2 or M1 may be embedded in an incorrect calculation, or in stages
eg **M2** for $\underline{k} \times 1.4 \times \underline{[0].97}$
eg **M1** for $k \times 1.4 \times \underline{[0].03}$

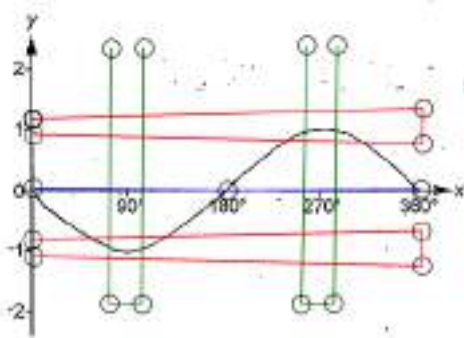
Alternative method
Answers to these calculations must be checked

Question			Answer	Marks	Part marks and guidance	
11	a	i	$2 \times 3^{11} \times 5$	1		Condone answers switched
			1771470	1		
		ii	$2^6 \times 3^{11} \times 5^6$	3	B1 for 3^{11} in answer and M1 for 2 and 5 identified as factors	Accept written in full without indices eg in factor tree
	b		21	3	M1 for 3^2 or $(3^2)^5$ or 3^{10} seen and M1 for 11 + <i>their</i> 10 soi after attempt at converting 9^5 to power of 3 Alternative method by trials: 3 marks for answer 21 but M0 for just converting to ordinary number and a wrong trial	M1M1 for answer 3^{21} eg M1M1 for $(3^2)^5 = 3^7$ and $3^{11} \times 3^7 = 3^{18}$

Question		Answer	Marks	Part marks and guidance	
12	a		2	B1 for at least 10 correct entries	
		(0)			
		1			
		2			
		3			
		4			
	b		4	B3 for $\frac{1000}{46656}$ oe isw wrong cancelling or for 0.0214(33...) oe as final answer OR B1FT for $\frac{10}{36}$ oe and M1 for <i>their</i> $\frac{10}{36} \times \text{their} \frac{10}{36} \times \text{their} \frac{10}{36}$	FT from their completed table in part (a) $\frac{10}{36} = \frac{5}{18} = 0.2777... \text{ to } 0.278$ Common mistake: B1 M0 for $3 \times \frac{10}{36}$
		125			
		5832			

Question	Answer	Marks	Part marks and guidance	
13	$\frac{(2x) + (2x + 2) + (2x + 4) + (2x + 6)}{4}$ $= \frac{8x + 12}{4}$ $= 2x + 3$ which is an integer OR $(2x) + (2x + 2) + (2x + 4) + (2x + 6)$ $= 8x + 12$ $= 4(2x + 3)$ which is divisible by 4 oe	4	M1 for $2x$, $2x + 2$, $2x + 4$ and $2x + 6$ seen and M1 for adding their four terms in x, eg. $(2x) + (2x + 2) + (2x + 4) + (2x + 6)$ and M1 for <i>their</i> $(8x + 12) \div 4$ or better, condoning lack of brackets, or for $4(2x + 3)$ and A1dep (dep on M0M1M1 or M1M1M1) for correct algebraic mean for <i>their</i> four terms and conclusion eg. $2x + 3$ is an integer or $4(2x + 3)$ which is divisible by 4 If 0 scored, allow SC1 for a numerical example with any 4 consecutive even integers with mean correctly calculated	Or equivalent algebraic representations of 4 consecutive even numbers. In this case, x does not need to be defined as being an integer. Using x, $x + 2$, $x + 4$, $x + 6$ oe does not score the first M mark unless x stated as even integer, but can score up to 3 marks for $(x) + (x + 2) + (x + 4) + (x + 6)$ <i>their</i> $(4x + 12) \div 4$ or better, or for $4(x + 3)$ and the relevant conclusion Using $x + 1$, $x + 3$, $x + 5$, $x + 7$ oe does not score the first M mark unless x stated as odd integer but can score up to 3 marks similar to above.

Question	Answer	Marks	Part marks and guidance	
14	1250 nfww	5	M4 for $[6x^2 =] 2 \times 625$ or B4 for final answer 1244 to 1250.05 OR M1 for $3x^2$ oe or 625 and M1 for $3x^2 = 625$ oe and A1 for $[x =] \sqrt{\frac{625}{3}}$ or $\frac{25\sqrt{3}}{3}$ oe or 14.4 to 14.434 soi (14.4 to 14.434 seen implies M1M1A1) and M1 for $6 \times \text{their } x^2$ If 0 scored, SC1 for starting from $x^2 = 25$ and final answer 150 or starting from $2x^2 = 25$ and final answer 75	
			<u>Special cases:</u> Starting from $3x^2 = 25$ oe soi M1M0 for $3x^2 = 25$ A1 for $[x =] \sqrt{\frac{25}{3}}$ or $\frac{5\sqrt{3}}{3}$ oe or 2.88 to 2.89 soi (2.88 to 2.89 seen implies M1M0A1) M1 for $6 \times \text{their } x^2$ soi by 50 Starting from $2x^2 = 625$ oe soi M1M0 for $2x^2 = 625$ A1 for $[x =] \sqrt{\frac{625}{2}}$ or $\frac{25\sqrt{2}}{2}$ or 17.6 to 17.7 soi (17.6 to 17.7 seen implies M1M0A1) M1 for $6 \times \text{their } x^2$ (1875 as final answer implies M1M0A1M1A0) Starting from $x^2 = 625$ oe soi M1M0 for $x^2 = 625$ A0 (equation has been simplified and it is a more substantial error) M1 for $6 \times \text{their } x^2$ (3750 as final answer implies M1M0A0M1A0)	

Question	Answer	Marks	Part marks and guidance
15	$(5x + 2)(x + 1)$ oe using two pairs of brackets -0.4 oe and -1	2 1	M1 for any two factors that give two correct terms when expanded or partial factorisation such as $5x(x + 1) + 2(x + 1)$ or $x(5x + 2) + [1](5x + 2)$ Correct or FT <i>their</i> two factors Condone missing final bracket for up to full marks Up to full marks can be awarded for solving using non-integer factorisations such as $5(x + 0.4)(x + 1)$ oe NB Working backwards from the answers scores only the final mark eg. $(x + 0.4)(x + 1) = 0$ without seeing a factor of 5 or division by 5 leading to -0.4 and -1 Any other method, award B1 for both answers correct
16	Correct sketch of $y = -\sin x$ 	3	There must be at least one cycle to gain any marks. B1 for a positive or negative sine curve shape starting at (0, 0) and B1 for maximums at $(..., 1)$ and minimum at $(..., -1)$ and B1 for maximum only at $(270, ...)$ and minimum only at $(90, ...)$ eg B1B1B0 for $y = \sin x$ drawn B0B1B0 for $y = \pm \cos x$ drawn B1B1B0 for $y = \sin 2x$ drawn Before using overlay, check blue line is the x-axis All maximums and minimums within red on overlay Maximum and minimum within green on overlay

Question			Answer	Marks	Part marks and guidance
17	a		6.39 [pm] or 1839	4	Condone 1839pm for full marks B3 for 39 or answer rounding to 39.1 or 3°39 to 3°39'6.07" or 6°39 to 6°39'6.07" or 219 or answer rounding to 219.1 OR M1 for $[t =] \frac{3250}{890}$ oe soi by 3.65(...) and M1FT for $60 \times (\text{their time})$ soi or evidence from <i>their</i> answer by using calculator key <u>Alternative method (converting speed to km/min)</u> M1 for $890 \div 60$ soi by $\frac{89}{6}$ or $14\frac{5}{6}$ oe or 14.8[3...] and M1FT for $[t =] 3250 \div \text{their } 14.8[3...]$ eg $3\frac{58}{89}$ <i>their</i> time could be fraction or decimal and could be just the non-integer part (check using calculator)

Question	Answer	Marks	Part marks and guidance	
b	3345 to 3350 nfww	4	B1 for 42 seen AND M2 for $[x^2 =] 3250^2 + 4960^2 - 2 \times 3250 \times 4960 \cos \theta$ or soi by $[x^2 =] 11205110$ to 11205111 or M1 for correct cosine rule with x^2 not as subject <u>Alternative method (using horizontal/vertical components and Pythagoras)</u> M3 for $\sqrt{(4960 \sin 57 - 3250 \sin 15)^2 + (3250 \cos 15 - 4960 \cos 57)^2}$ or M2 for $4960 \sin 57 - 3250 \sin 15$ or $3250 \cos 15 - 4960 \cos 57$ or M1 for two of $4960 \sin 57$, $3250 \sin 15$, $3250 \cos 15$ or $4960 \cos 57$	May be seen on sketch diagram For M2 or M1, θ is a number in the range $15 \leq \theta \leq 57$ eg $\cos \theta = \frac{3250^2 + 4960^2 - x^2}{2 \times 3250 \times 4960}$ Allow numerical values to imply relevant trig functions as below for M marks: • $4960 \sin 57 = 4159$ to 4160 • $3250 \sin 15 = 841$ to 842 • $3250 \cos 15 = 3139$ to 3140 • $4960 \cos 57 = 2701$ to 2702 • $4960 \sin 57 - 3250 \sin 15 = 3317$ to 3319 • $3250 \cos 15 - 4960 \cos 57 = 437$ to 439 • $(4960 \sin 57 - 3250 \sin 15)^2 = 11\,002\,489$ to $11\,015\,761$ • $(3250 \cos 15 - 4960 \cos 57)^2 = 190\,969$ to $192\,721$

Question	Answer	Marks	Part marks and guidance	
18	8.74[...] nfww	4	M3 for $[r =] \sqrt[3]{\frac{2100}{\pi}}$ or M2 for $\pi r^3 = 2100$ oe M1 for $\frac{1}{3} \pi r^2(3r)$ oe <u>Alternative method</u> using h M3 for $[h =] \sqrt[3]{\frac{56700}{\pi}}$ soi by 26.2[3...] or M2 for $\pi h^3 = 56700$ oe M1 for $\frac{1}{3} \pi \left(\frac{h}{3}\right)^2 h$ oe	
19	a	4	B2 for 29 or $\sqrt{29}$ or 5.38(5...) to 5.39 or M1 for $2^2 + 5^2$ or $\sqrt{2^2 + 5^2}$ or $2^2 + (-5)^2$ or $\sqrt{2^2 + (-5)^2}$ AND B1 for $x^2 + y^2 = k$ where k is a number > 0 or $x^2 + y^2 = r^2$	Accept answer of 8.7 after M3 May be done in stages eg M3 for $\sqrt[3]{668. (...)}$ eg. M2 for $3\pi r^3 = 6300$ or $\frac{1}{3} \pi r^2(3r) = 2100$ etc eg. M1 for πr^3 eg. M1 for $\frac{1}{27} \pi h^3$
	b	2	M1 for $-\frac{2}{5}$ oe or -0.4 seen or use of $m_1 m_2 = -1$ with <i>their</i> radius gradient	M1 for $[y =] \frac{5}{2} x [+ c]$ oe Condone $-\frac{2}{5} x$ seen for M1

Question	Answer	Marks	Part marks and guidance	
20 a	$1^4 - 1^2 - 9 = -9$ $2^4 - 2^2 - 9 = 3$ Sign change, solution between $x = 1$ and $x = 2$	3	M2 for $1^4 - 1^2 - 9 = -9$ and $2^4 - 2^2 - 9 = 3$ or M1 for $1^4 - 1^2 - 9$ or $2^4 - 2^2 - 9$ soi by -9 or 3 <u>Alternative method</u> After $x^4 - x^2 = 9$ seen M2 for $2^4 - 2^2 = 12$ and $1^4 - 1^2 = 0$ A1 for $12 > 9$ and $0 < 9$ so solution between $x = 1$ and $x = 2$ OR M1 for $2^4 - 2^2$ or $1^4 - 1^2$ soi by 12 or 0 <u>Alternative method</u> SC3 for using an iterative equation that converges to a value in the range 1.85 to 1.95 and concluding statement that $1 < 1.85$ to $1.95 < 2$ oe or SC2 for using an iterative equation that converges to a value in the range 1.85 to 1.95 <u>Alternative method</u> SC3 for using quadratic formula (see (b)) leading to a value in the range 1.88 to 1.89 and concluding statement that $1 < 1.88$ to $1.89 < 2$ oe or SC2 for using quadratic formula (see (b)) leading to a value in the range 1.88 to 1.89	Accept other values of x used between 1 and 2 (see table in part (b)). For full marks, the two values need to produce a sign change. Examples just sufficient for third mark include: sign change $-9 < 0 < 3$ $x = 1$ gives an answer < 0 and $x = 2$ gives an > 0 Examples insufficient for third mark: so x lies between 1 and 2 If candidates refer to their working in part (b) within part (a), award marks for any of the final 2 alternative methods.

Question	Answer	Marks	Part marks and guidance																																			
b	Two correct evaluations in the range 1.85 to 1.95, one which gives a positive value and the other giving a negative value	M3	M2 for two correct evaluations between 1 and 2, one which gives a positive value and the other giving a negative value	Likely values: accept rot to 1 or more dp <table border="1"><thead><tr><th>x</th><th>x⁴ – x² – 9</th></tr></thead><tbody><tr><td>1.1</td><td>-8.7459</td></tr><tr><td>1.2</td><td>-8.3664</td></tr><tr><td>1.25</td><td>-8.12109...</td></tr><tr><td>1.3</td><td>-7.8339</td></tr><tr><td>1.4</td><td>-7.1184</td></tr><tr><td>1.5*</td><td>-6.1875</td></tr><tr><td>1.6</td><td>-5.0064</td></tr><tr><td>1.7</td><td>-3.5379</td></tr><tr><td>1.75*</td><td>-2.68359...</td></tr><tr><td>1.8</td><td>-1.7424</td></tr><tr><td>1.85</td><td>-0.70899...</td></tr><tr><td>1.875*</td><td>-0.1560...</td></tr><tr><td>1.9</td><td>0.4221</td></tr><tr><td>1.9375*</td><td>1.3379....</td></tr><tr><td>1.95</td><td>1.656506</td></tr><tr><td>2</td><td>3</td></tr></tbody></table>	x	x ⁴ – x ² – 9	1.1	-8.7459	1.2	-8.3664	1.25	-8.12109...	1.3	-7.8339	1.4	-7.1184	1.5*	-6.1875	1.6	-5.0064	1.7	-3.5379	1.75*	-2.68359...	1.8	-1.7424	1.85	-0.70899...	1.875*	-0.1560...	1.9	0.4221	1.9375*	1.3379....	1.95	1.656506	2	3
	x	x ⁴ – x ² – 9																																				
1.1	-8.7459																																					
1.2	-8.3664																																					
1.25	-8.12109...																																					
1.3	-7.8339																																					
1.4	-7.1184																																					
1.5*	-6.1875																																					
1.6	-5.0064																																					
1.7	-3.5379																																					
1.75*	-2.68359...																																					
1.8	-1.7424																																					
1.85	-0.70899...																																					
1.875*	-0.1560...																																					
1.9	0.4221																																					
1.9375*	1.3379....																																					
1.95	1.656506																																					
2	3																																					
1.9	and A1dep	or M1 for one correct evaluation between 1 and 2 Dependent on achieving at least M2 OR SC1 for 1.9 with no worthwhile working <u>Alternative method by iteration</u> M1 rearranges to a correct iterative formula (converging or diverging) M1 attempts first iteration (either substitution of 1≤x≤2 seen or found to at least 2dp rot) M1 continues further iteration(s) to reach x in the range 1.85 to 1.95 A1 for 1.9 <u>Alternative method by quadratic formula</u> M2 for [x ² =] $\frac{-(-1) \pm \sqrt{(-1)^2 - 4(1)(-9)}}{2(1)}$ soi by 3.54[1..] or M1 for this formula with at most two errors AND M1 for x = $\sqrt{\text{their } 3.54[1..]}$ soi by 1.88 to 1.89 A1 for 1.9	<u>Alternative iteration method notes</u> condone missing subscripts eg M1 for x = $\sqrt{\sqrt{9 + x^2}}$ and M1 for $\sqrt{\sqrt{9 + 1^2}}$ or 1.77[8..] or 1.78 If candidates refer to or use their working in part (a) within part (b), award up to full marks for part (b).																																			

Question	Answer	Marks	Part marks and guidance	
21	2.625 nfww	4	M3 for $2.1 \times \sqrt[3]{\frac{15.625}{8}}$ oe or $2.1 \div \sqrt[3]{\frac{8}{15.625}}$ or M2 for $\sqrt[3]{\frac{15.625}{8}}$ soi by $\frac{5}{4}$ or 1.25 oe or $\sqrt[3]{\frac{8}{15.625}}$ soi by $\frac{4}{5}$ or 0.8 oe or M1 for $\frac{15.625}{8}$ soi by $\frac{125}{64}$ oe or 1.95(31...) or $\frac{8}{15.625}$ soi by $\frac{64}{125}$ oe or 0.512 If 0 scored then SC1 for 4.1 to 4.11 as final answer	

Accept 2.6, 2.62 or 2.63 as final answer after **M3**

May be done in stages, including rounding to at least 3 sig figs of intermediate steps

May see as length ratio, eg. **M2** for $\sqrt[3]{8} : \sqrt[3]{15.625}$ soi by 2 : 2.5 oe

May see as volume ratio, eg. **M1** for 8 : 15.625 oe
 May also be seen as part of wrong approach
 eg. $\frac{15.625}{8 \div 2.1}$ seen or done in stages scores **M1**

Question			Answer	Marks	Part marks and guidance	
22	a		17 150	1		
	b		$16\,807 \div 17\,150 = 0.98$	1	Condone: $17150 \times [0].98 = 16807$ $16807 \div [0].98 = 17150$	
	c		15 818 to 15 819	2	M1 for 17150×0.98^4 or <i>their</i> (a) $\times 0.98^4$ or for 16807×0.98^3 and A1FT from <i>their</i> (a) $\times 0.98^4$ correctly evaluated <u>Alternative methods using division</u> M1 for $16000 \div 0.98^4$ A1 for 17300 to 17350 is greater than 17150 OR M1 for $16000 \div 0.98^3$ A1 for 16900 to 17000 is greater than 16807	FT from <i>their</i> (a), and only if method shown Accept “[population in] 2018” for 17150 Accept “[population in] 2019” for 16807
	d		17 500 nfww	2	M1 for 17150×0.98^{-1} oe or <i>their</i> (a) $\times 0.98^{-1}$ oe or 16807×0.98^{-2} oe	NB: M1 for $0.98^{-1} = 1.02[04\dots]$ and $17150 \times 1.02[04\dots]$ but M0 for $17150 \times 1.02 = 17493$