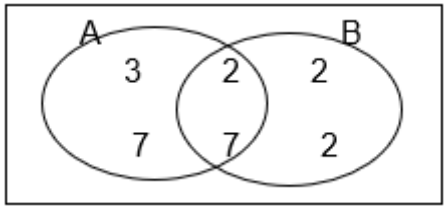
Question			Answer	Marks	Part marks and guidance	
1			2 5 1	3	**B1** for each	
2 (19)			Two from: • Horizontal scale uneven • No vertical scale • Vertical scale does not start at 0	2	**B1** for each	See Appendix Mark the best part of a statement if no contradiction If more than two reasons (often two in one statement), mark the worst two
3 (20)			18 nfww	3	**B2** for answer $\frac{18}{99}$ or **M2** for $\frac{2 \times 99}{11}$ oe or **B1** for $\frac{\mathbf{2}}{\mathbf{11}}$ or **M1** for [$k \times$] $\frac{\mathbf{99}}{\mathbf{11}}$ or **M1** for $\frac{a}{b} \times 99$	e.g. $\frac{99}{11} = 9$ and then 2×9 For **B1** accept $\frac{\mathbf{2}}{\mathbf{11}}$, 0.181 to 0.182 or 18.1% to 18.2% Condone k as 0.5 or 1 or an integer $3 \leq k \leq 10$ Do not imply **M1** from just 9 seen $0 < \frac{a}{b} < 1$ and either $a = 2$ or $b = 11$

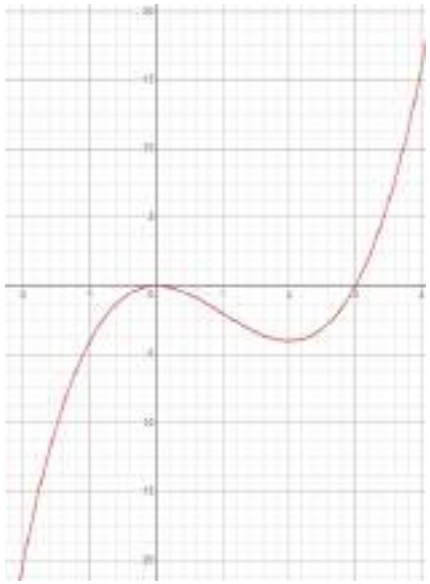
Question			Answer	Marks	Part marks and guidance	
4 (21)	(a)	(i)	30 nfww	4	**M1** for 5 × 150 implied by 750 [km] **M2** for *their* 750 ÷ (2.5 × 10) oe or **M1** for 2.5 × 10 implied by 25 OR **M1** for 5 × 150 implied by 750 [km] **M2** for *their* 750 ÷ 2.5 ÷ 10 oe or **M1** for *their* 750 ÷ 2.5 implied by 300	Not from 150 ÷ 5 A correct answer in working, subsequently spoilt, scores max **M1M1** *Their* 750 from attempt at 5 × 150; condone 150 for *their* 750 *Their* 750 from attempt at 5 × 150; condone 150 for *their* 750
		(ii)	Correct reason indicating roads/paths unlikely to be straight oe	1		See Appendix
	(b)		The units are not the same oe 1 : 15 000 000	1 1		See Appendix eg should have multiplied by 100 000 or one is cm and the other is km Condone: • poorly placed zero separators e.g. 150, 000, 00 • correct other forms • inclusion of units

Question			Answer	Marks	Part marks and guidance	
5 (22)	(a)				Allocate marks similarly for other methods such as five triangles using an angle of 72. If in doubt, consult TL. There must be evidence of angle or trig work to score any marks e.g. working back from 247.75 to *h* = 8.258…is likely to score 0 or B1	
			[angle =] 36 or 54	**B1**	in correct place if only shown on diagram	Do not award 36 or 54 if calculated as an area
			$[h =]\frac{6}{\tan 36}$ or 6 × tan54 or $\frac{6sin54}{sin36}$ may be implied by 8.258 to 8.259 or 8.26 following **M1** but **not** from area	**M2**	**M1** for $\tan 36 = \frac{6}{h}$ or $\tan 54 = \frac{h}{6}$ or $\frac{6}{\sin 36} = \frac{h}{\sin 54}$ or $\frac{\sin 36}{6} = \frac{\sin 54}{h}$	Accept other notation used for '*h*'
			$10 \times \frac{1}{2} \times 6 \times their\ h$ oe	**M2dep**	**M1** for $\frac{1}{2} \times 6 \times their\ h$ oe may be implied by 24.774 to 24.775	*Their h* **dep** on previous **M2** or **M1** Accept correct use of $\frac{1}{2}ab\sin C$
			247.748 to 247.749	**A1**		
	(b)		5.45 or 5.449 to 5.450 nfww	**3**	**M2** for $h = \frac{450 \times 3}{247.75}$ oe or **M1** for $\frac{1}{3}h \times 247.75 = 450$ oe	247.75 may be *their* more accurate 247.748 to 247.749 or 247.7, 247.8 or 247.74 from **(a)** Use of incorrect formula is not **MR**

Question			Answer	Marks	Part marks and guidance	
6 (23)	(a)		1176	2	**M1** for $2^3 \times 3 \times 7^2$ oe or for  or for listing at least three correct terms in each list 294, 588, 882, ... AND 56, 112, 168, ...	e.g. $2\times2\times2\times3\times7\times7$ Accept no box but need to see A and B
	(b)		13 nfww	2	**M1** for [26 =] 2 [×] 13 oe	For **M1** accept 2, 13 or similar possibly seen in a factor tree, diagram etc

Question			Answer	Marks	Part marks and guidance	
7	(a)		Both bags may have 5 apples and 7 bananas or both bags may have 5 apples and 12 fruit	1	Accept 5 : 7 and $\frac{5}{12}$ are equivalent or 5 + 7 = 12 with $\frac{5}{12}$ or $\frac{5}{12}$, $\frac{7}{12}$ with 5 : 7	See Appendix Check for working at the top of the page
			A numerical example with some explanation (*n* fruit where *n* is a multiple of 12, $n \neq 12$)	1		More than just numbers
			"Finley might be correct or might not be correct"	1dep	Dep on at least one other mark If **0** scored **SC1** for explanation along lines of: don't know how many fruit in the bag and middle box ticked	Accept single tick, cross or other highlight

Question			Answer	Marks	Part marks and guidance	
	(b)		56 as answer nfww	**3**	<u>By ratios:</u> **B2** for both 40 : 56 and 44 : 56 identified or for 10 : 14, 11 : 14 and 44 : 56 or **B1** for 2 ratios equivalent to 5 : 7 and 11 : 14 with a common number of bananas <u>By equation:</u> **B2** for a correct equation that would lead directly to the number of bananas or **B1** for a correct equation that would lead directly to the number of apples or total fruit, either before or after the addition of 4 apples <u>By fractions:</u> **B2** for $\frac{40[+4]}{96[+4]}$ and $\frac{44}{100}$ identified or **B1** for 2 fractions of the form $\frac{5k+4}{12k+4}$, where *k* is a positive integer <u>All methods:</u> If **0** scored **SC1** for answer 44 or 100	eg. 10 : 14 and 11 : 14 or 20 : 28 and 22 : 28 eg: *b* = bananas, *a* = apples, *t* = original total **B2** for $\frac{5b}{7} + 4 = \frac{11b}{14}$ oe or better or **B1** for $\frac{5t}{12} + 4 = \frac{11(t+4)}{25}$ oe or better or for $\frac{5a+4}{7a} = \frac{11}{14}$ oe or better eg $\frac{9}{16}$, $\frac{14}{28}$ oe, $\frac{19}{40}$, $\frac{24}{52}$ oe, $\frac{29}{64}$, $\frac{34}{76}$ oe $\frac{39}{88}$, $\frac{44}{100}$ oe
8	**(a)**		-4 and 0	**2**	**B1** for one correct value	

Question			Answer	Marks	Part marks and guidance	
	(b)		Correct curve 	**3**	**B2FT** for 6 or 7 points accurately plotted or **B1FT** for 4 or 5 accurately plotted	Mark curve first. Curve must pass within ½ small square of the correct seven points **FT** *their* values from the table in **(a)** but accept only the correct curve Accuracy ± ½ small square radially If no points plotted mark the curve at the *x*-values Condone curve not having max at (0, 0) and min at (2, -4) as long as it passes through correct points Condone wobbly curve and slight feathering Do not condone straight line segments
	(c)		3.4	**1FT**	Strict **FT** from graph to 1 d.p.	Do not accept answers to more than 1 d.p. or answers without a graph If curve is between two grid lines accept either value eg if crossing between 3.4 and 3.5 accept 3.4 or 3.5 If curve has more than one *x* value where *y* = 5 then they must give all

Question			Answer	Marks	Part marks and guidance	
9	(a)		$\frac{30}{360} \times \pi \times 12^2$ oe 37.69 to 37.704	M2 A1	**M1** for $\pi \times 12^2$ implied by 144π or 452.3 to 452.45 **A0** for just 37.7	**M2** oe e.g. $\frac{360}{30} = 12$ and $\frac{\pi \times 12^2}{12}$ Condone 3.14 or $\frac{22}{7}$ for π in **M** marks **M0** for 12π without working
	(b)		68.5 to 68.6 nfww	4	<u>With area of parallelogram as 120 or from an attempt at 20 × 6:</u> **M3** for $\frac{their(20 \times 6) - 37.7}{their(20 \times 6)}$ [× 100] oe or **M2** for *their* (20 × 6) – 37.7 implied by 82.3 or for $\frac{37.7}{their(20 \times 6)}$ [× 100] implied by 31.4 to 31.5 or **M1** for 20 × 6 implied by 120 <u>If correct method for area of parallelogram is not shown or an incorrect value is used:</u> If *A* > 37.7 **SC2** for $\frac{A - 37.7}{A}$ [× 100] oe or **SC1** for $\frac{37.7}{A}$ [× 100]	If 120 not used, *their* (20 × 6) must come from attempt at 20 × 6 Note there are other methods for finding area of a parallelogram 37.7 may be *their* more accurate 37.69 to 37.704 from **(a)** **M3** oe e.g. 100 – $\frac{37.7 \times 100}{their(20 \times 6)}$ e.g **SC2** for $\frac{240 - 37.7}{240}$ [× 100] oe For **SC** marks method must be shown; do not imply from an answer only

Question			Answer	Marks	Part marks and guidance	
10	(a)		(9 + 10 + 11 + 12) – (5 + 6 + 7 + 8) = 16	1		May be shown in stages Accept 42 – 26 = 16 May be explained via sum of differences of paired cells eg 4 × 4 from (9 – 5), (10 – 6) etc

	(b)		Eg. Top half: $n + (n + 1) + (n + 2) + (n + 3) = 4n + 6$ Bottom half: $(n + 4) + (n + 5) + (n + 6) + (n + 7) = 4n + 22$ $(4n + 22) – (4n + 6) = 16$	**5**	**B2** consistent algebraic terms for consecutive numbers for the whole grid or **B1** consistent algebraic terms for at least 3 consecutive numbers AND **M2** for algebraic sums for top half and bottom half of grid or **M1** for algebraic sum for top half or bottom half of grid AND **A1dep** for sum of bottom half – sum of top half = 16 shown algebraically or explained from correct working. <u>Alternative method for pairs of numbers</u> **B2** as above AND **M2** for the difference of four pairs of algebraic terms from top and bottom calculated or **M1** for the one pair of algebraic terms from top and bottom calculated AND **A1dep** for all four differences summed to 16 shown numerically or explained from correct working If **0** scored, allow **SC1** for a correct numerical or described example showing an overall difference of 16	eg. n, $n + 1$, $n + 2$, $n + 3$, $n + 4$, $n + 5$, $n + 6$, $n + 7$ For **M2** and **M1** FT expressions of form $an + b$, $b \neq 0$ eg. Top half: $2n + (2n + 1) + (2n + 2) + (2n + 3) = 8n + 6$ Bottom half: $(2n + 4) + (2n + 5) + (2n + 6) + (2n + 7) = 8n + 22$ Accept unsimplified or simplified for **M** marks **A1** is **dep** on **B2M2** scored Condone $\begin{array}{r} 4n + 22 \\ [-]\ 4n + 6 \\ \hline 16 \end{array}$ **A0** for $4n + 22 – 4n + 6$ or for just $22 – 6$ or for use of $2n$, $2n + 1$, $2n + 2$ etc as their algebraic terms eg. “difference between n+4 and n is 4” Must not be the numbers 5 to 12

Question			Answer	Marks	Part marks and guidance	
11	(a)		$\frac{10}{28}$ oe	2	**M1** for $\frac{10}{k}$ with $k > 10$ or $\frac{m}{28}$ with $0 < m < 28$ or for $\frac{4+6}{13+6+5+4}$ If **0** scored, **SC1** for answer 10 : 28 or 5 : 14	Accept 0.357 to 0.36
	(b)		Eg. P(seats given late) = $\frac{5}{9}$ P(seats given on time) = $\frac{13}{19}$ 0.55[5…] to 0.56 and 0.68 to 0.68[4…] or 0.6 and 0.7 or $\frac{95}{171}$ and $\frac{117}{171}$ AND Yes/correct [because] oe	3	**M1** for P(seats given late) = $\frac{5}{9}$ oe **M1** for P(seats given on time) = $\frac{13}{19}$ oe	Condone lack of labelling; mark to candidate's benefit. Condone wrong labelling for **M** marks only Include working on the diagram Allocate similar marks if working with probabilities for "no seats": $\frac{4}{9}$ $\frac{6}{19}$ 0.4[4…] and 0.3[1] to 0.32 $\frac{76}{171}$ and $\frac{54}{171}$ For full marks must convert both to a comparable form and give a correct conclusion Comparable form may be decimal, percentage or fractions with common denominator or numerator
12			≤ $x < 2$	1 2	**B1** for $x \leq 2$ or $x > 2$	

Question			Answer	Marks	Part marks and guidance	
13	(a)		40 nfww	4	**B1** for freq density 3.2 for 0-5 bar soi **M2 for** 1.4 × 10 and 2 × 5 may be implied by 14 and 10 or **M1** for 1.4 × 10 may be implied by 14 OR For $k \neq 1$ **M3** for *their* $(16k + 10k + 14k) \div k$ or **M2** for $16k + 10k + 14k$ or **M1** for two from $16k$, $10k$, $14k$	Figures may be seen on bars Could be implied by correct fd used for bars 2 and 3 or from scale on diagram e.g **M3** for (40 + 25 + 35) ÷ 2.5 or **M2** for 40 + 25 + 35 or **M1** two from 40, 25, 35 **M3** for (80 + 50 + 70) ÷ 5 or **M2** for 80 + 50 + 70 or **M1** two from 80, 50, 70
	(b)		Bar for 30-45 drawn with height 3 small squares	2	**M1** for 9 ÷ 15 soi by 0.6	Condone good freehand

Question			Answer	Marks	Part marks and guidance	
14			13.5 and 6.5 with correct working	5		'Correct working' requires evidence of Pythagoras or quadratic Accept $\frac{27}{2}$ and $\frac{13}{2}$
					M2 for [h^2 =] $12.5^2 - 12^2$ or better or **M1** for $12^2 + h^2 = 12.5^2$ or better	Allow other letters or $t - 10$ for h and allocate marks as per main method
					B1 for $h = 3.5$ AND	Accept -3.5 or ±3.5
					M1 for 10 + *their* 3.5 soi by 13.5 or 10 – *their* 3.5 soi by 6.5	*Their* 3.5 from use of Pythagoras
					If **0**, **1** or **2** scored, instead award **SC3** for both 13.5 and 6.5 as answers with no or insufficient working If **0** or **1** scored, instead award **SC2** for either 13.5 or 6.5 as answer with no working or insufficient working	<u>Alternative method 1:</u> **M3** for $t^2 - 20t + 87.75 = 0$ or **M2** for $144 + t^2 - 20t + 100 = 156.25$ or **M1** for $12^2 + (t - 10)^2 = 12.5^2$ AND **M1** for correct method to solve *their* 3-term quadratic

Question			Answer	Marks	Part marks and guidance	
15			$y = \frac{6912}{x^3}$ oe	3	**M1** for $y = \frac{k}{x^3}$ oe soi by $4 = \frac{k}{12^3}$ oe **B1** for [k =] 6912	
16			$6x^{3.5}$ nfww final answer	4	Mark coefficient and indices separately: **B1** for 6 from $\frac{9 \times 2}{3}$ AND **B3** for $x^{3.5}$ nfww or **B2** for $x^{7.5}$ from $x^7 \times \sqrt{x}$ or for $x^{-3.5}$ or $\frac{\square}{x^{3.5}}$ from $\frac{\sqrt{x}}{x^4}$ or **B1** for $\sqrt{x} = x^{\frac{1}{2}}$ or $x^{0.5}$ **B1** for x^3 from $\frac{x^7}{x^4}$	Accept equivalent fractions in place of decimal powers If attempting both $\frac{x^7}{x^4}$ and $\frac{\sqrt{x}}{x^4}$ mark to candidate's benefit rather than choice

Question			Answer	Marks	Part marks and guidance	
17	(a)		$x = 0.1818\ldots$ $100x = 18.1818\ldots$ $99x = 18$ $x = \frac{18}{99} = \frac{2}{11}$	3	**M1** for $100x = 18.1818\ldots$ and **M1** for $100x - x = 18.1818\ldots - 0.1818\ldots$ or better	For full marks, clear step by step process must be evident x and $100x$ to same number of dp (min of 2dp) or both to min of 4dp or accept $x = 0.\dot{1}\dot{8}$ and $100x = 18.\dot{1}\dot{8}$ Apply marks in a similar way to other methods eg **M1** and **M1** for $10000x - 100x$ etc <u>If attempting non-calculator 2÷11:</u> For full marks, need to see all "carry-overs" of 9 and 2 and answer to division of 0.181… **M2** for "carry-over" of 9 and 2 and answer to division of 0.18 or **M1** for "carry-over" of 9 and answer 0.1…
	(b)		$0.\dot{1}\dot{8} \times 5$ or $\frac{2}{11} \times 5$ or 'multiply by 5' oe $= 0.\dot{9}\dot{0}$ nfww	1 1dep	**dep** on first mark	Accept equivalent calculations or words e.g. $0.\dot{1}\dot{8} \div 2 = 0.\dot{0}\dot{9}$ and $0.\dot{0}\dot{9} \times 10$ 'divide by 2 and then multiply by 10' Working may be to min of 4dp but answer must use recurring notation Answer only scores **0**

Question			Answer	Marks	Part marks and guidance	
18			17.5 to 17.6 with correct working	6		'Correct working' requires evidence of at least **M1M1**
					M2 for $AC = \frac{8 \sin 60}{\sin 20}$ or **M1** for $\frac{AC}{\sin 60} = \frac{8}{\sin 20}$ oe	
					A1 for 20.2 to 20.3	**A1** implies **M2** after **M1** seen
					AND	
					M2 for $\sqrt{their20.3^2 + 6^2 - 2 \times their20.3 \times 6 \times \cos 55}$ or **M1** for $their20.3^2 + 6^2 - 2 \times their20.3 \times 6 \times \cos 55$	*Their* 20.3 or 20 from use of trig May be performed in stages
					If **0**, **1** or **2** scored, instead award **SC3** for 17.5 to 17.6 with no working or insufficient working	
					If **0** or **1** scored, instead award **SC2** for 306.6 to 308.4 with no working or insufficient working	
					If **0** scored, instead award **SC1** for 20.2 to 20.3 with no working or insufficient working	

19			$\frac{169}{12}$ or $14\frac{1}{12}$ or $14.08\dot{3}$ with correct working	**5**		'Correct working' requires evidence of at least **M2M1** or **M1M1M1** **SC3** applies to all methods
					<u>Gradients and equation of straight line</u> **M2** for gradient of tangent = $\frac{12}{5}$ oe soi or for gradient of tangent = $\frac{5}{p-12}$ or **M1** for gradient of radius = $-\frac{5}{12}$ soi or gradient of tangent = $\frac{-1}{their \text{ gradient of radius}}$	Mark to candidate's advantage if gradients not labelled Do not mix marks across two methods (ie do not give gradient marks and another M1 for 13 from Pythagoras)
					AND	
					M2 for $0 = \frac{12}{5}p - \frac{169}{5}$ or better or for $5 = \frac{12}{5}(p - 12)$ or better or for $\frac{5}{p-12} = \frac{12}{5}$ or better	**M2** must be a correct equation solely in terms of *p* or solely in terms of *x* e.g. $0 = \frac{12}{5}x - \frac{169}{5}$ or better
					or	
					M1 for $y = their\ \frac{12}{5}x + c$ or better or for $y = \frac{5}{p-12}x + c$ or better or for $y - {}^{-}5 = their\ \frac{12}{5}(x - 12)$ or better or $\frac{-1}{their \text{ gradient of radius}} = \frac{5}{p-12}$ or better	For **M1** allow FT $their\ \frac{12}{5}$ if from $m_1 = \frac{-1}{m_2}$
					If **0**, **1** or **2** scored, instead award **SC3** for answer $\frac{169}{12}$ or $14\frac{1}{12}$ or $14.08\dot{3}$ with no or insufficient working	PTO for alternative methods

Question			Answer	Marks	Part marks and guidance	
					Alternative method (Pythagoras and trig): **M1** for [O to (12, -5)] $\sqrt{12^2+5^2}$ may be implied by 13 in working or on diagram **M1** for [angle *at O*] sin $\theta = \frac{5}{13}$ or cos $\theta = \frac{12}{13}$ or tan $\theta = \frac{5}{12}$ or better (do not imply from just an angle) AND **M2** for [p =] $\frac{13}{\frac{12}{13}}$ or **M1** for cos *their*$\theta = \frac{13}{p}$ or $p = \frac{13}{\cos their\theta}$ (*Their* θ from earlier trig work)	Alternative method (Pythagoras and equations) **M2** for $13^2 + (p - 12)^2 + 5^2 = p^2$ oe or **M1** for $(p - 12)^2 + 5^2$ oe or for $\sqrt{12^2+5^2}$ may be implied by 13 in working or on diagram AND **M2** for $338 - 24p = 0$ oe or **M1** for $169+p^2-24p+144+25 = p^2$ or better

Question			Answer	Marks	Part marks and guidance	
20			$\frac{5x-19}{x-3}$ final answer nfww	5	**M2** for $\frac{x-7}{x-3}$ nfww or **M1** for $(x + 7)(x – 7)$ AND **M2** for $4x – 12 + x – 7$ or **M1** for $4(x – 3) + x – 7$ <u>Alternative method:</u> **M2** for $4(x^2 + 4x – 21)$ or better or **M1** for $4(x + 7)(x – 3)$ AND **M2** for $(5x – 19)(x + 7)$ or **M1** for $5x^2 + 16x – 133$	For **M2** and **M1** accept written as separate fractions e.g. **M2** for $\frac{4x-12}{x-3} + \frac{x-7}{x-3}$