Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1			The third line should be 2 – 5 $3x = 2 - 5$ $3x = -3$ $x = -1$	1 1	Accept any correct response, look for answers in the working space (see appendix) [The third line] should be 2 – 5 **1** She did 5 – 2 it should be 2 – 5 **1** It should be – 5 not – 2 **1** 5 should be subtracted by 2 **0** The error is in $3x = 5 - 2$ **0** **Examiner's Comments** Most described the error and the correction as we had expected. The main error was that some thought in line 2 that $4x - x$ should have been $x - 4x$ giving $-3x$. As in part (a) a few just gave the line where the error was without comment.
			Total	**2**	
2	a		16, 30, 34 in any order with correct working	5	**M1** for $x + 5 + 3x + 1 + 2x + 8 = 80$ may be implied by a subsequent correct equation **M1** for simplifying *their* equation to $ax + b = c$ implied by $6x + 14 = 80$ **M1** for the first correct step in solving "Correct working" requires evidence of at least **M1** leading to $x = 11$ or **M2** if using trials Note for all methods: $x = 11$ scores **M1M1M1** if there is some supporting work but on its own scores **SC1**

					their $ax + b = c$ e.g. $6x = 80 - 14$ **M1** for substituting *their* 11 into $x + 5$, $3x + 1$ and $2x + 8$ <u>Alternative method using trials</u> **M2** for at least one complete correct evaluation of $x + 5 + 3x + 1 + 2x + 8$ If **0** or **1** scored, instead award **SC2** for 16, 30, 34 in any order with no or insufficient working If **0** scored **SC1** for $x = 11$ with no or insufficient working **<u>Examiner's Comments</u>** This question was generally very well answered, with most candidates using an algebraic approach and solving the equation correctly. Some attempted to use trials and we required just one complete evaluation of the three expressions with the number tried, then added and the result clearly seen.	<u>Alternative method</u> **M2** for $80 - 5 - 1 - 8$ oe or 66 or **M1** for $5 + 1 + 8$ or 14 **M1** for *their* 66 ÷ *their* 6 implied by 11 **M1** for substituting *their* 11 into $x + 5$, $3x + 1$ and $2x + 8$
	b		*Their* fully correct conclusion after **M2** scored	3	**M2** for $\sqrt{(their16)^2 + (their30)^2}$ correctly evaluated or for $(their16)^2 + (their30)^2$ and $(their34)^2$	eg **3** marks for Yes, $\sqrt{16^2 + 30^2} = 34$ Yes, $16^2 + 30^2 = 1156$ and $34^2 = 1156$

					both correctly evaluated OR **M1** for $\sqrt{(their16)^2 + (their30)^2}$ either not evaluated or incorrectly evaluated or for (*their*16)^2 + (*their*30)^2 and (*their*34)^2 either not evaluated or incorrectly evaluated or for (*their*16)^2 + (*their*30)^2 correctly evaluated	or eg after 15, 30, 34 No, $15^2 + 30^2 = 1125$ and $34^2 = 1156$ Adapt the scheme for equivalent correct methods e.g. Pythagoras using hypotenuse and subtraction
					<u>Alternative methods</u> Cosine rule : [cos … =] $\frac{16^2+30^2-34^2}{2\times16\times30}$ = 0 hence angle … = 90 **M1** for correct cos rule statement for angle, **M1** for 0 OR cos −1 or arc cos with 90 and **A1** for “Yes” (**A1** dep on **M2**) Algebra : **M1** for both $(x + 5)^2 + (2x + 8)^2 = x2 + 10x + 25 + 4x^2 +32x + 64 = 5x^2 + 42x + 89$ and $(3x + 1)2 = 9x^2 + 6x + 1$ [leading to $4x^2 – 36x – 88 =0$ and $(x – 11)(4x + 8)$] and **M1** for substituting $x = 11$ into $5x^2 + 42x + 89$ and $9x^2 + 6x + 1$ and getting 1156 or for accepting x = 11 and rejecting x = – 2 for correct reason “Yes” Trigonometry(not cos rule) : The use of sin, cos or tan to find the other two acute angles will not lead to an exact angle of 90° therefore award just **M1** for two correct statements, one about each angle e.g $\sin[\ldots] = \frac{16}{34}$ *and* $\sin[\ldots] = \frac{30}{34}$ and **M1** for two angles to at least 2 dp e.g. 28.07[2…] and 61.92[7…] or 61.93 an award max. of **M2** because this method will not show exactly that it is a right-angle. The one exception is $\sin^{-1}(\frac{16}{34}) + \sin^{-1}(\frac{30}{34})$ etc which, if seen, could score **3** marks.	

					Examiner's Comments It was expected that Pythagoras' theorem would be used and clearly demonstrated that it holds for these three values, so showing that the largest angle was a right angle. It was not sufficient to just write down 'Pythagoras' theorem', we required to be shown that it holds for this triangle. The cosine rule was another good method, if a little more demanding. Using normal trigonometry is harder as it assumes the right angle and also the other two angles are irrational numbers, so showing they sum to 90 is difficult.
			Total	**8**	
3	a		$3(x + 5)$ oe final answer	1	Equivalent includes $3x + 15$ **Examiner's Comments** Many candidates answered this question correctly. The common incorrect answers were $x + 5 \times 3$, $x + 15$ or $3x + 5$ with no bracket. A high number of candidates did not recognise the importance of brackets.
	b		$^-7$ with correct working	5	accept any correct method — "Correct working" requires evidence of at least **B1B1** or **B1M1** or **M2** if using trials **B1** for [output =] $2 \times$ *their*$\{3(x + 5)\} - 1$ oe — **B1** implied by $2 \times 3(x + 5) - 1$ or better or output through inverse of B as $x + 1$ — e.g. $6x + 30 - 1$ **B1 dep** for *their* $\{2 \times 3(x + 5) - 1\} = 2x + 1$ oe — dep. on previous **B1** or output through inverse of A as $\frac{x+1}{3} - 5$ — Note: $3x + 15 + 2x - 1 = 2x + 1$ scores **B0B0**

					or $x + 1 =$ *their* $\{3(x + 5)\}$	**M1 B1 B1** implied by $6x + 29 = 2x + 1$
					M1 for e.g. *their* $6x + 30 – 1 = 2x + 1$ or *their* $3x = x + 1 – 15$ or inverse method $\frac{x+1}{3} - 5 = x$ **M1** for *their* $\{4x = –28$ or $–2x = 14\}$ oe	The first **M1** is for dealing with bracket(s) correctly in a linear equation and the second **M1** is for correctly getting the linear equation, with x's on both sides, into the form $ax = b$.
					<u>Alternative method using trials</u>	
					M2 for at least two complete correct evaluations of both $6x + 29$ oe(or functions) and $2x + 1$ or **M1** at least one complete correct evaluation of both $6x + 29$ oe and $2x + 1$ If **0** or **1** scored **SC3** for answer $^-7$ with no or insufficient working	We can only follow through an equation with x's on both sides for **M1** or x's on both sides and a bracket for **M2**.
					<u>Examiner's Comments</u> Those with strong algebraic skills processed the information effectively, while those with weak algebraic skills could not cope with the demands of the question and often put more than one incorrect attempt down. Writing down a combined expression proved difficult, mainly due to the absence of brackets in the many attempts. The expansion of single brackets was also poorly executed with the second term in the	

					bracket usually not multiplied by the factor outside. Manipulation of an equation with an 'x' term on both sides proved difficult to many. Another error was to see $6x + 30 - 1$ evaluated to $6x - 29$.
			Total	**6**	
4	a		An error in the numerators identified	1	**Response** **Mark** For additional information refer to **2023 June (J56004) Mark scheme Appendix** within downloadable additional mark guidance. **Examiner's Comments** Most candidate recognised what was wrong with the expression and were able to convey that in their answer, however a few fell a little short of an acceptable statement. Statements such as 'they should be cross multiplying' were far too vague and lacked the detail required. We needed to know what was wrong with the expression and we did accept a corrected expression.
	b		This question was discounted and all candidates were awarded 1 mark.	1	**Examiner's Comments** The intention for this question was for students to note that the negative sign should be on the top of the fraction. While the expression given is not in the standard form, it does not however contain an error; it is a perfectly valid, if unusual, first step. After analysing candidate performance during marking, we decided the fairest approach was to award all candidates 1 mark.
			Total	**2**	
5	a		$[1^3 + 1^2 - 5] = {}^-3$ $[2^3 + 2^2 - 5] = 7$ Sign change [so solution between $x = 1$ and $x = 2$] or ${}^-3 < 0 < 7$	M1 M1 A1	Must indicate their input and output Dep. on at least **M1** and different signs 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.

					Alternative method 1 for $x^3 + x^2 = 5$ **M2** for $1^3 + 1^2 = 2$ and $2^3 + 2^2 = 12$ or **M1** for $1^3 + 1^2 = 2$ or $2^3 + 2^2 = 12$ may be implied by 2 or 12 and **A1** for e.g. $2 < 5 < 12$ dep. on at least **M1** and 5 lies inbetween *their* two values Alternative method 2 **SC3** for using an iterative equation that converges to a value between 1.35 and 1.45 **and** concluding statement such as $1 < 1.35$ to $1.45 < 2$ or **SC2** for using an iterative equation that converges to a value between 1.35 and 1.45	Acceptable answers for third mark are x = 1 gives answer < 0 and x = 2 gives answer >0 Note: so answer lies between 1 and 2 is not sufficient on its own or answer is in the middle is insufficient If within **part (a)** a candidate refers to their working in **part (b)** you must award the marks for this method
					Examiner's Comments Most found the two values at x = 1 and x = 2, but some did not comment on how this shows that there is a solution (the reason we required was that 0 lies between the two values they had found). We allowed other values to be calculated, as long as they were within 1 & 2 and if the two signs were different. At this stage we	

					did not expect an attempt at a solution, or to use an iterative formula.
	b		Two correct evaluations in the range 1.35 ≤ values ≤ 1.49, one which gives a positive value and the other giving a negative value 1.4	M3 A1	**M2** for two correct evaluations 1 < values < 2, one which gives a positive value and the other giving a negative value or **M1** for one correct evaluation between 1 < value < 2 Dependent on achieving at least M2 <u>Alternative method 1</u> See appendix for values of $x^3 + x^2$. <u>Alternative method 2</u> **M1** rearranges to a correct iterative formula (converging or diverging) **M1** <u>attempts</u> first iteration (either substitution seen or found to at least 2dp figures may be rot to at least 2 s.f.

x	x^3+x^2-5	x	x^3+x^2-5
1.1	–2.459	1.35	–0.71712
1.2	–1.832	1.36	–0.63494
1.3	–1.113	1.37	–0.55175
1.4	–0.296	1.38	–0.46753
1.5	0.625	1.39	–0.38228
1.6	1.656	1.40	–0.29600
1.7	2.803	1.41	–0.20868
1.8	4.072	1.42	–0.12031
1.9	5.469	1.43	–0.03089
		1.44	0.05958
		1.45	0.15113
		1.46	0.24374
		1.47	0.33742
		1.48	0.43219
		1.49	0.52805

rot)	
M1 continues iteration to reach *x* in the range 1.35 to 1.45	
A1 for 1.4	
Dep. on **M2**	*condone missing suffixes in formula here* e.g.
OR	$x_{n+1} = \sqrt{\frac{5}{x_n+1}}$ converges and leads to values
If **0** scored	1.5811388… , 1.39180797… , 1.44584536…
SC1 for 1.4 with no worthwhile working	If they refer to *their* working in **part (a)** which is relevant then award up to full marks in **part (b)**

Table for $x^3 + x^2$

x	x^3+x^2	x	x^3+x^2
1.1	2.541	1.35	4.28288
1.2	3.168	1.36	4.36506
1.3	3.887	1.37	4.44825
1.4	4.704	1.38	4.53247
1.5	5.625	1.39	4.61772
1.6	6.656	1.40	4.70400
1.7	7.803	1.41	4.79132
1.8	9.072	1.42	4.87969
1.9	10.469	1.43	4.96911
		1.44	5.05958
		1.45	5.15113
		1.46	5.24374
		1.47	5.33742
		1.48	5.43219

					1.49	5.52805 For additional information refer to **2023 June (J56004) Mark scheme Appendix** within downloadable additional mark guidance. **<u>Examiner's Comments</u>** Firstly, if any calculations in part (a) were relevant then they should be repeated here or indicated. Secondly, we require both the input value and the output value to be clear and the output value to be accurate to ideally at least three significant figures. As this is iteration, we expect attempts near the solution and to both sides of it. The common error was to write $x^3 + x^2 = x^5$ and attempt the fifth root of 5.	
			Total	**7**		
6			1.316	4	**B3** for answer 1.3160 to 1.3161 OR **M3** for $[r =] \sqrt[4]{3}$ oe or **M2** for $r^4 = 3$ or **M1** for $r^6 = 3r^2$ <u>Trials or insufficient method:</u> **B4** for answer 1.316 or **B3** for answer 1.3160 to 1.3161 or **M2** for at least three correct trials of r^4 oe or of r^6 <u>and</u> $3r^2$ oe	eg **M3** for $\sqrt{3} = 1.73[2\ldots]$ and $\sqrt{1.73[2\ldots]}$ Accept evaluations to 2sf rot

					or **M1** for at least two correct trials of r^4 oe or of r^6 <u>and</u> $3r^2$ oe	Accept evaluations to 2sf rot
					<u>Examiner's Comments</u> Many candidates had little idea how to approach this question and many were unable to translate the information in the question into expressions involving the second and sixth terms. Of the candidates who did manage to arrive at $r^6 = 3r^2$, very few could solve this and some very poor algebra was seen. A few candidates attempted trials, but rarely went far enough (perhaps perturbed by the decimal nature of their answers).	
			Total	**4**		
7			(–2, 4) and (–4, –2) with correct working	6		'Correct working' requires evidence of at least **M1M1M1**
					M1 for $x^2 + (3x + 10)^2 = 20$	Award equivalent marks if working in terms of *y*
					M1 for expanding *their* square term e.g. $9x^2 + 30x + 30x + 100$	May be in a grid May be implied by subsequent working
					M1 for simplifying *their* quadratic equation e.g. $10x^2 + 60x + 100 = 20$ or better	*Their* quadratic must include an *x* term Simplified: $10x^2 + 60x + 80$ [= 0] or $x^2 + 6x + 8$ [= 0]
					M1 for correctly factorising *their* 3-term quadratic equation	e.g. $(x + 2)(x + 4)$, $(5x + 10)(2x + 8)$

					or for correct use of quadratic formula for *their* 3-term quadratic equation or for correct completing the square — e.g. reaching $d(x + e)^2 + f$ **A1** for one correct point or two correct x-values If **0** or **1** scored, instead award **SC2** for 2 correct points with no or insufficient working If **0** scored **SC1** for 1 correct point or 2 correct x-coordinates or 2 correct y-coordinates with no or insufficient working **<u>Examiner's Comments</u>** For some candidates, this was a question that they knew how to answer and they worked their way through the required algebra carefully, often gaining full marks. On the other hand, many candidates did not attempt this question. Others attempted to find one or both pairs of coordinates by trials, but this rarely had any success. Of those who squared $y = (3x + 10)$ and substituted into $x^2 + y^2 = 20$, the majority went on to at least get the two correct values of x. The few who started by rearranging to $x = \frac{y-10}{3}$ before squaring and substituting for x^2 were much less successful because of the fractions they had introduced. A few began by making basic errors such as (3x

					+ 10)^2 = $9x^2$ + 100, thereby altering the difficulty of the question and gaining no further credit.	
			Total	**6**		
8			$2\left(x+\frac{3}{4}\right)^2-\frac{169}{8}$ as final answer with correct working	5	Method 1: **B3** for $2\left(x+\frac{3}{4}\right)^2$ in final answer with correct working or **M1** for $2x^2 - 5x + 8x - 20$ oe **M1** for 2 $2\left(x^2+\frac{3}{2}x\right)$[– 20] oe AND **M1** for [-*b* =] $-2\left(their\ \frac{3}{4}\right)^2 - 20$ soi by $-\frac{169}{8}$ Method 2: **B3** for $2\left(x+\frac{3}{4}\right)^2$ in final answer with correct working or **M1** for $2x^2 - 5x + 8x - 20$ oe	'Correct working' requires evidence of at least **M1** Accept decimal and mixed number equivalents throughout eg. $2(x + 0.75)^2 -$ 21.125 $2\left(x+\frac{3}{4}\right)^2-21\frac{1}{8}$ May be in a grid May be in a grid

or for $2(x^2 + ax + ax + a^2) - b$ oe

M1 for $4ax = 3x$ soi by $\frac{3}{4}$

AND

M1 for $[-b =]\ -2\left(their\ \frac{3}{4}\right)^2 - 20$ soi by $-\frac{169}{8}$

<u>Method 3:</u>

B3 for $2\left(x + \frac{3}{4}\right)^2$ in final answer with correct working

or

M1 for roots –4 and 2.5

M1 for turning point at $[x =]\ \frac{-4+2.5}{2}$ soi by $-\frac{3}{4}$

AND

M1 for $[-b =]$

$(2(their - \frac{3}{4}) - 5))((their - \frac{3}{4}) + 4)$ soi by $-\frac{169}{8}$

If no or insufficient working

SC2 for $2\left(x + \frac{3}{4}\right)^2 - \frac{169}{8}$

or

SC1 for $2\left(x + \frac{3}{4}\right)^2 [+k]$

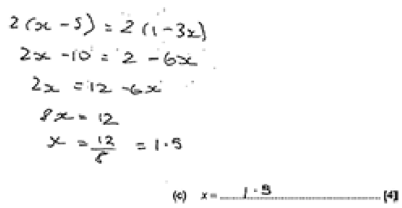
<u>**Examiner's Comments**</u>

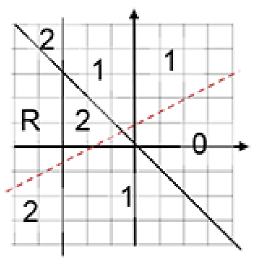
The vast majority of candidates made a start, but only about 1/4 of them progressed successfully beyond the M1 mark for expanding $(2x - 5)(x +$

					4) as $2x^2 + 8x - 5x - 20$. Virtually all candidates who did continue tried to solve the question as a ‘completing the square’ problem. Most appeared unfamiliar with how to deal with the coefficient of x^2 not being 1, which is shown as an example in 6.01f of the specification. The most common wrong answer was $2(x + 1.5)^2 - 22.25$. Some candidates expanded this to check whether it was correct, which sometimes led them changing their answer to $2(x + 0.75)^2$, giving access to earn the B3 mark if some method was shown. Many of these candidates still did not get the correct value for b, with the common wrong value being $^-21.25$ from failing to double the 0.75^2. A small number of candidates realised that the question did not have to be solved by completing the square at all. Instead, they expanded both expressions and matched coefficients, usually very successfully. Using symmetry to identify the x-coordinate of the turning point (7.01c of the specification) was also included on the mark scheme; this was rarely seen, but almost always successful.
			Total	**5**	
9			$\frac{A}{10} - 3$ or $\frac{1}{10}(A - 30)$ or $\frac{A-30}{10}$ with correct working or other simplified equivalents	5	**B4** for $\frac{A\text{cm}^2}{10} - 3$ ect with correct working OR The below assumes PQ = x. Mark similarly use of SR = x. **M2** for $10x + \frac{1}{2} \times 6 \times 10$ or $\frac{10(x+x+6)}{2}$ oe or for $10x$ and 30, may be indicated on diagram ‘Correct working’ requires evidence of at least **M2** Condone use of PQ, PQ + 6 etc instead of x and $x + 6$ Working may be on diagram For **M2** accept area A – 30 for area $10x$

					A1 for [A =] $10x + 30$ or $10(x + 3)$ or **M1** for lengths x and $x + 6$ oe or for area $10x$ or area 30 AND **M1FT** for $10x = A - 30$ or $x + 3 = \frac{A}{10}$ If **0** or **1** scored, instead award **SC2** for $\frac{A}{10} - 3$ or $\frac{1}{10}(A - 30)$ or $\frac{A-30}{10}$ with no or insufficient working	For **A1** accept equivalents such as $\frac{A}{5} = 2x + 6$, $2A = 20x + 60$ For **M** and **A** marks, both lengths must be in terms of the same variable eg PQ and PQ + 6, not x and y unless $y = x + 6$ subsequently seen FT $ax + b = A$ or $a(x + b) = A$ ($a \neq \pm1$ or 0, $b \neq 0$)
					Examiner's Comments Good responses tended to be characterised by working that was easily followed, but in many cases, working was haphazard and often difficult to follow. For some this led to self-induced slips in their working. A number of candidates scored 1 mark, usually for the area of the triangle. Some tried to use Pythagoras' theorem or trigonometry to find the unnecessary length QR. Many others mixed up their PQ and SR lengths. The main difficulty for those that made progress was in rearranging 'for the length PQ in terms of A'. Many got to the M2A1 answer of $10x + 30$, but no further. Overall, of those that did score marks, the trapezium method and the rectangle + triangle method were used in roughly equal numbers	

					and the use of 'x' and 'x + 6' was more successful than the use of 'PQ' and 'PQ + 6'. The omission of brackets was a common problem and statements such as $A = 5 \times 2x + 6$ or other similar variations were often seen. A small proportion of candidates left units in their answer. A very efficient solution was to define the area of the rectangle as both 10PQ and A – 30, which led to a simple solution for PQ.
			Total	**5**	
10			1.5 or $1\frac{1}{2}$ or $\frac{3}{2}$	4	For 4 marks, condone $\frac{12}{8}$ or $\frac{6}{4}$ isw incorrect cancelling/conversion **M1** for $2(x - 5) = 2(1 - 3x)$ or $\frac{x-5}{1-3x} = 1$ Embedded answer scores M3 maximum **M1** for $2x - 10 = 2 - 6x$ or $x - 5 = 1 - 3x$ **M1** for reaching $ax = b$, FT *their* previous working provided previous working is of the form $dx + e = f + gx$ This final method mark may be implied from the answer **<u>Examiner's Comments</u>** A number of candidates showed a clear step by step method by removing the denominator of the fraction and writing $2(x - 5) = 2(1 - 3x)$ before expanding the brackets, collecting terms and giving a correct solution. Some using this approach omitted essential brackets or made errors in expanding the brackets, but were able to score a method mark for correctly collecting like terms to reach $ax = b$ for their equation. Many candidates were however unable to deal with the fraction in the equation; a common error was to incorrectly cancel terms in the fraction as a first step. **Misconception**

					Algebraic fractional expressions such as $\frac{2(x-5)}{1-3x}$ do not share common numeric or algebraic factors in the numerator and denominator and consequently cancelling is not possible. When removing the denominator from a fraction in an algebraic equation, always use a bracket initially, for example 2(x − 5) = 2(1 − 3x), so that all terms in the denominator are multiplied by 2. Exemplar 2  This is an example of a model solution where each stage is shown as a separate line of working. Brackets are used when removing the denominator of the fraction to make sure that the full expression is multiplied by 2. In line 2, the brackets are correctly expanded before the terms in x are isolated on one side of the equation. The candidate completes the solution to earn 4 marks.
			Total	**4**	
11	a		$\frac{14}{37}$ final answer	1	Ignore attempts to convert correct final answer to a decimal **<u>Examiner's Comments</u>** Most candidates were able to give the next term correctly. Common errors were adding either 5 or 9 tothe denominator (from the difference of the first two or last two denominators respectively), leading toanswers of $\frac{14}{31}$ or $\frac{14}{35}$.

	b		$\frac{3n-1}{(n+1)^2+1}$ oe final answer	3	**M2** for $3n - 1$ or $(n + 1)^2 + 1$ **oe** or **M1** for $3n$ [+ k] or for a quadratic expression in n **oe**	For 3 marks oe e.g. $\frac{3n-1}{[1]n^2+2n+2}$, Condone consistent use of different variable for all marks e.g. M2 for $3x - 1$ Where k is a value, or 'k' For M2 and M1 expressions do not need to be in a fraction
					Examiner's Comments Many found this part of the question difficult and did not reach the correct expression. Candidates who attempted to work on the sequence for numerator and the denominator separately did reasonably well and generally scored at least part marks for either one correct expression or one of a similar form. Finding the nth term of the numerator was done better than the denominator. Many candidates were unable to visualise the fractional form of the nth term and made little progress.	
			Total	**4**		
12			Correct region indicated 	5	**B2** for $y - 1 = \frac{1}{2}x$ broken line or **B1** for $y - 1 = \frac{1}{2}x$ solid line	Use overlay as a guide for accuracy must pass through or touch small circles (when extended if necessary) position is 2 small dots each way from correct position of ends of line Allow shorter accurate line provided it defines their region

					AND	See marks on diagram for next 3 marks Grid assumes $y-1=\frac{1}{2}x$ is correct
					B1FT for *R* correct side of $y-1=\frac{1}{2}x$	Mark position of R first. If R not labelled then accept other clear indication.
					B1 for *R* correct side of $x = -3$ **B1** for *R* correct side of $y = -x$	If $y-1=\frac{1}{2}x$ <u>not attempted</u> then allow B1B1 max for region FT dep on **sloping** line drawn that is long enough to define the region chosen on grid
					<u>Examiner's Comments</u> A small number of candidates scored full marks here. Some scored 4 marks with the only error being drawing a solid line instead of a broken line for $y-1>\frac{1}{2}x$, however the majority of candidates drew the line incorrectly. After drawing an incorrect line, follow through marks for identifying the region were available and most candidates secured a follow through mark for a correct region relative to their line. Many candidates also gained the mark for a region satisfying $y \le {}^{-}x$, but fewer gained the mark for a region satisfying $x \le {}^{-}3$. A few candidates did not clearly label or shade their region and in those cases, marks were not given. **Misconception** When drawing the line $y-1>\frac{1}{2}x$, most candidates drew a solid line rather than a broken line. The strict inequality > indicated that the line should not be included in the region.	
			Total	**5**		
13	a		(3*x* + 2) (3*x* – 2) final answer	2		

					M1 for answer a pair of factors of the type ($ax + b$)($ax - b$), where $a = 3$ or $b = 2$ or for correct answer seen / For 2 marks or M1, condone omission of final bracket **<u>Examiner's Comments</u>** Many candidates gave the correct answer here. A common incorrect answer was ($3x - 2$)($3x - 2$). The majority of candidates did not recognise the expression given as the difference of two squares and tried to work with a pair of brackets with other factors of $9x^2$ and 4.
	b		($3x + 4$)($x - 2$) $-\frac{4}{3}$ oe and 2	M2 B1	For M2 and M1 condone omission of final bracket **M1** for $3x(x - 2) + 4(x - 2)$ or $x(3x + 4) - 2(3x + 4)$ / For M2, condone $\frac{(3x-6)(3x+4)}{3}$ followed by or for ($3x + a$)($x + b$) where $ab = -8$ / $x - 2$ [= 0] and $3x + 4$ [= 0] or $3b + a = -2$ / If no product of factors shown, $x - 2 = 0$ and $3x + 4 = 0$ gets M1 only After $3x(x - 2) + 4(x - 2)$ or $x(3x + 4) - 2(3x + 4)$ and then correct answers allow M2B1 Correct or **FT** *their* two factors dep on factors of the form ($3x \pm a$)($x \pm b$) / Accept –1.33… **<u>Examiner's Comments</u>** Many candidates were able to correctly factorise the quadratic expression into the required form, but from there not all were able to extract the correct solutions. After correctly factorising, an answer of $x = {}^{-}4$ rather than $x = -\frac{4}{3}$ was fairly

					common. Of those that didn't factorise correctly, some had incorrect signs in the brackets, such as $(3x - 4)(x - 2)$. A method mark was given where the expansion of the brackets led to two correct terms in the original equation including the term $3x^2$. Candidates were also given a follow through mark for the solutions, provided they came from factors of the form $(3x \pm a)(x \pm b)$. A small number of candidates did not follow the instruction in the question and attempted to use the quadratic formula to solve the equation. **Assessment for learning** When asked to factorise a quadratic expression involving 3 terms, always write the two factors as a product with brackets, e.g. $(3x + 4)(x - 2)$. Do not leave them as two separate expressions that are not linked.
			Total	**5**	
14			$\frac{24x+5}{3x+5}$ final answer	4	**M3** for $\frac{30x+50-6x-45}{[3x+5]}$ soi by $\frac{24x+5}{[3x+5]}$ or **M2** for $\frac{30x+50-(6x+45)}{[3x+5]}$ or $\frac{10(3x+5)-6x-45}{[3x+5]}$ or **M1** for $10(3x + 5)$ Max **M3** if answer spoiled by further incorrect algebraic manipulation (eg. incorrect cancelling of terms) Allow full marks for a correct equivalent answer as a single fraction e.g. $\frac{48x+10}{6x+10}$ **<u>Examiner's Comments</u>** The algebraic manipulation required in this question was beyond most candidates, but the more able generally scored full marks. The usual issue for these candidates was in dealing with the subtraction sign correctly.

			Total	**4**	
15			$2(3x - 1)(5x + 2)$	3	**B2** for $(6x - 2)(5x + 2)$ as final answer or for $(3x - 1)(10x + 4)$ as final answer or for $(3x - 1)(5x + 2)$ as final answer or **M1** for two brackets which give two correct terms for $30x^2 + 2x - 4$ or for $15x^2 + x - 2$ **<u>Examiner's Comments</u>** Candidates who performed well across the paper as a whole were often successful. Some were able to find two brackets that, when expanded, produced two of the three terms to score 1 mark. The majority of candidates made little progress.
			Total	**3**	
16	a		$\frac{10}{3}$ oe	3	**M2** for $6t - 2 = 18$ oe — 3.33[3…] or unsimplified, e.g. 20/6 or **M1** for $6t - 2$ or $18 + 2$ or 20 — e.g. $6 = 20/t$ **<u>Examiner's Comments</u>** Most candidates made good progress, and many found the correct value of t. A small number of candidates stopped at $6t = 20$ or proceeded to an inaccurate answer of 3.
	b		$[x =]\ 4(y - 3)$ oe	2	

					M1 for $y=\frac{x}{4}+3$ or better or for correct reverse flowchart with arrows reversed $\leftarrow \times 4 \leftarrow -3 \leftarrow$ **Examiner's Comments** Many candidates scored full marks. The use of brackets within 4(y – 3) was very good. Many other candidates scored 1 mark for $y=\frac{x}{4}+3$.	
			Total	**5**		
17	a		[k =] 0	1		
	b	i	$y = 3x - 1$ ruled 0.1 to 0.3 and 2.1 to 2.3	M2 A2	**M1** for correct freehand or short line or for $y = 3x - k$ ruled or $y = ax - 1$ ruled but not $y = -1$ **A1** for each After **A0, SC1** for both values correct	For M2 must cross curve twice Accuracy ± 1mm at (0, –1) and (1, 2) Only award if M2 scored previously 0.15287… , 2.1804….
		ii	$1 = (3x - 1)(x - 2)$ $3x^2 - x - 6x + 2$ $3x^2 - 7x + 1 = 0$	M1 B2 A1	For correctly expansion of brackets B1 for 3 terms correct in expansion Dep on M1B2 with no errors or omissions	Allow recovery from missing brackets for M1 or ‘ = 1’ For B2 accept $3x^2 - 7x + 2$ For B1 $-7x$ counts as two terms
			Total	**9**		

18	a		(x + 11)(x + 7) [= 0] –11 and –7	M2 B1	**M1** for $(x + a)(x + b)$ [= 0] where $ab = 77$ or $a + b = 18$ or for $x(x + 11) + 7(x + 11)$ or $x(x + 7) + 11(x + 7)$ **FT** *their* factors if of the form $(x + a)(x + b)$ with a, b integers Condone omission of final bracket If partial factors and answers –11 and –7 award M2B1 **Examiner's Comments** This was a well answered question. Most were able to either give the correct factors or attempt to find them. Those that did give correct factors usually gave the correct solutions.
	b	i	$(x + 9)^2 – 4$ final answer	3	**B1** for $(x + 9)^2$ **B2FT** for [+] 77 – (*their a*)^2 after (*x* + *their a*)^2 correctly evaluated or **B1** for [+] 77 – (*their a*)^2 shown If 0 scored, **SC2** for final answer $(x + 9) – 4$ FT can be implied e.g. $(x + 10)^2 – 23$ gets B2FT **Examiner's Comments** This was slightly less well answered than the previous part, but a significant number understood the strategy of completing the square; executed it correctly and gave the answer. Errors included $(x + 9)^2 + 77$ and $(x + 9) – 4$ but in each of these cases partial marks were given.

		ii	(–9, –4)	2	**FT** *their* 18(b)(i) if in form $(x + a)^2 + b$ **B1FT** for each value **<u>Examiner's Comments</u>** Fewer were able to connect their answer to part (b) (i) to this part, but a significant minority were successful.
			Total	**8**	
19			–1, 0, 1, 2, 3	3	**B2** for 5 correct values with one extra or for 4 correct with no extras or for $-1 \le x < 4$ or **M1** for $-4 + 3 \le x$ or $x < 1 + 3$ oe — For M1, condone incorrect inequality sign or equals **<u>Examiner's Comments</u>** More able candidates used a structured approach and solved the inequality algebraically and then considered values of x that satisfied the interval. Others attempted trials and often did not obtain one or more of the solutions. A significant number gave the integers that satisfied the inequality $-4 \le x < 1$.
			Total	**3**	
20	a	i	$[u_3 =]\ x + y$ $[u_4 =]\ y + x + y\ [= x + 2y]$	1 1	**<u>Examiner's Comments</u>** The candidates who were confident with algebra answered this part correctly. Others used numbers to show the formula works. A few gave the third term as $x + y$ but simply wrote $x + 2y$ for the fourth term without showing where it came from.

					In ‘Show that…’ questions, candidates must have no omissions or incorrect work shown. **OCR support** A poster detailing the different command words and what they mean.	
	ii		3 2 with correct working	6	**M2** for [u_7 =] 7 + x + y + 7 + x + y + 7 oe or better or **M1** for [u_5 =] x + y + 7 oe or better and **B1** for $x + 2y = 7$ oe **B1FT** for *their* $(2x + 2y + 21) = 31$ oe **M1** for solving *their* equations e.g. subtracting equations to give $x = 3$ If **0** or **1** scored, instead award **SC2** for answers [x =] 3 and [y =] 2 with no or insufficient working If **0** scored, instead award **SC1** for [x =] 3 or [y =] 2 or both correct answers switched, with no or insufficient working	“Correct working” requires evidence of at least **B1 B1** or **M2 or M1 M1** e.g. $2x + 2y + 21$ or $2x + 3y + x + 2y + 2x + 3y$ or $5x + 8y$ e.g. $x + y + x + 2y$ or $2x + 3y$ e.g. $5x + 8y = 31$ **FT** *their* u_7 e.g. multiplying one equation and correctly adding or subtracting to eliminate one variable correct answers with trials will score **6** marks **M1** for each correct trial (value of x and a value of y) up to a maximum of **M3** e.g. $x = 1$ $y = 4$ gives

					1 4 5 9 [14 23 37] **Examiner's Comments** Those candidates who produced correct expressions usually went on to find the correct answers. The method of trials usually required a systematic approach with many trials to find the answer, the algebraic method proved much shorter.
	b		$(\sqrt{3})^{n-1}$ or $3^{\frac{1}{2}(n-1)}$ oe	2	**M1** for common ratio of $\sqrt{3}$ implied by answer of $(\sqrt{3})^x$ **Examiner's Comments** Most candidates could not work out what type of sequence this was, some treated it as an arithmetic sequence while others changed the terms to decimals. They needed to identify the common ratio as $\sqrt{3}$ to have any chance of writing down the expression.
	c		3 –5	3	**B2** for b = 3 OR **M1** for [–1 5 13 23] – [1 4 9 16] implied by –2 1 4 7 **B1** for c = –5 condone 3n for **2** marks If equations used **M1** for e.g. 1 + b + c = –1 oe 4 + 2b + c = 5 oe Allow any correct method **Examiner's Comments** Many looked at the differences which was not necessary as the first term had been given as n^2. The first step should have been to subtract the n^2 values from those given or, the longer method, to produce a pair of simultaneous equations from the terms given.

			Total	**13**	
21			Some algebraic working leading to an answer of 3 –3	5	**M1** for e.g. $x^2 + (x - 6)^2 = 18$ **M1** for expanding *their* square term e.g. $x^2 - 12x + 36$ — condone one error in expanding brackets **M1** for $2x^2 - 12x + 18 = 0$ or better — simplifying to $ax^2 - bx + c$ **M1** for $[2](x - 3)^2$ or $(2x - 6)(x - 3)$ — e.g. solving *their* quadratic equation by e.g. factors or quadratic formula If **0** scored **SC2** for correct answers with no algebraic working — Note : apply scheme to substitution for x e.g. **M1** for $(y + 6)^2 + y^2 = 18$ etc **<u>Examiner's Comments</u>** The main error was candidates not making the substitution, for either x or y, into the quadratic equation. Those candidates who did, almost always solved these equations correctly.
			Total	**5**	
22	a		it should be –17 $x = \frac{y-17}{3}$	1 1	accept any correct explanation allow correct equation if written in the question just missing "$x =$ " For additional information refer to **2022 November (J56004) Mark scheme Appendix** within downloadable additional mark guidance. **<u>Examiner's Comments</u>** Many candidates identified the error, but they did

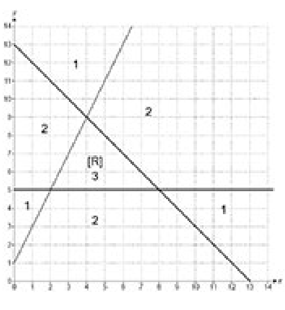
					not give the ‘correct answer’. Some omitted the ‘x =’ and some did not correct the addition of 17.
	b		it should be 2x $x = \frac{\sqrt{A}}{2}$ or $x = \sqrt{\frac{A}{4}}$	1 1	Do not accept ± 2*x* or “the error is that they missed the ±” Do not penalise twice missing the “*x* =”. allow correct equation if written in the question just missing “*x* = ” For additional information refer to **2022 November (J56004) Mark scheme Appendix** within downloadable additional mark guidance. **<u>Examiner’s Comments</u>** Many candidates did not identify the error in the third line. The most common mistake was to suggest that division by 4 was necessary in the second line. Some candidates could not produce the ‘correct answer’, some produced $x = \frac{A}{4}$ while others did not have x as the subject and gave $4x = \sqrt{A}$.
			Total	**4**	
23			140	4	**M1** for 11 = 3 + 20*a* oe implied by [0].4 **A1** for [*a* =] [0].4 **M1** for $3 \times 20 + \frac{1}{2} \times$ *their* 0.4×20^2 Alternative method **M3** for $3 \times 20 + \frac{1}{2} \times (11 - 3) \times 20$ oe OR Condone one error in second **M1**. If *their a* is clearly stated do not count as an error. Equivalent includes $\frac{1}{2}(11 + 3) \times 20$

					M1 for 3 × 20 **M1** for $\frac{1}{2} \times (11 - 3) \times 20$ **M1** for *their* (3 × 20) + *their* $(\frac{1}{2} \times (11 - 3) \times 20)$ **Examiner's Comments** This question was found to be difficult for the majority. Many candidates did not know what the variables represented. They did not realise that they had to find the value of a. Some used either 3 or 11 – 3 or 8 as the value of a. Even with an incorrect value for a, some demonstrated that they could use the second formula correctly.	may be implied by 60 may be implied by 80
			Total	**4**		
24	a		$\frac{4-6n}{(2n+3)(n^2+1)}$ final answer	4	**M1** for consistent common denominator of $(2n + 3)(n^2 + 1)$ **M1** for $4(n^2 + 1) - 2n(2n + 3)$ **M1** for correct expansion of one bracket **Examiner's Comments** Generally, when a question demands a fraction is written 'in its simplest form' it should be written as a product of brackets rather than as a polynomial expression in *n*. In the numerator some candidates did multiply the brackets out, $4(n^2 + 1) - 2n(2n + 3)$, but then would write the final term of this as $+ 6n$ and not $- 6n$; they had forgotten that they were multiplying $- 2n$ by $+ 3$. Many candidates would have all three parts correct but algebraic slips would mean they did not score full marks.	Condone $\frac{4-6n}{2n^3+3n^2+2n+3}$ for **4** marks and allow numerator $2(2 - 3n)$ allow e.g. $\frac{4(n^2+1)}{(2n+3)(n^2+1)} - \frac{2n(2n+3)}{(2n+3)(n^2+1)}$ Condone brackets crossed out
	b		$\frac{x+3}{2x+5}$ final answer	5	**M2** for $(x + 3)(x - 4)$ or **M1** for brackets which give 2 correct terms **M2** for $(2x + 5)(x - 4)$	Condone brackets crossed out

					or **M1** for brackets which give 2 correct terms **<u>Examiner's Comments</u>** Many candidates were able to factorise the numerator, a few though wrote $(x-3)(x+4)$ while others gave $(x-6)(x+6)$ or $(x+1)(x-12)$. However, they found the denominator much harder to factorise and there were many alternatives to the correct pair such as $(x+4)(x-5)$ or $(2x+2)(x-2.5)$.	
			Total	**9**		
25			$\{x: {}^-6 \le x \le 2\}$ final answer and with correct working	5	**B4** for $^-6 \le x \le 2$ with correct working and not written separately OR **M2** for $(x+6)(x-2)$ or $\frac{-4\pm\sqrt{4^2-4\times1\times-12}}{2}$ or **M1** for brackets which give two correct terms or the formula with at most two errors **B1** $^-6$ and 2 If **0** or **1** scored award instead **SC2** for $\{x : {}^-6 \le x \le 2\}$ If **0** scored **SC1** for $^-6 \le x \le 2$ **<u>Examiner's Comments</u>** Candidates were expected to factorise the quadratic expression, or to use the quadratic formula, to find the two roots of the companion equation. Many candidates, however, tried to add 12 to both sides and then tried to solve their equation by factorising the expression x^2+4x. They often reached a solution such as $x=\sqrt{3}$ Those who did find −6 and 2 were usually unable to express the solution using set notation. Some put the inequality symbols the wrong way round.	"correct working"; requires at least **M2** e.g. $(x+6)(x-2)$ condone $x(x-2)+6(x-2)$ for **M2** could be seen as roots on a sketch of graph or with incorrect inequality symbols <u>completing the square</u>: allow $(x+2)^2-16$ for **M2** or $(x+2)^2+k$ for **M1**

			Total	**5**	
26	a		accurate curve	3	**B2** for 6 or 7 points accurately plotted or **B1** for 4 or 5 points accurately plotted tolerance $\pm\frac{1}{2}$ small square radially for curve and points, condone a wobbly curve and slight feathering or tram lines in no more than 3 sections but no ruled lines **Examiner's Comments** The plotting was usually very accurate with the exception that the point (1, 1) was often plotted at (1, 0). Some curves were drawn very inaccurately. When marking, particular attention is given to check that the curve goes through the correctly plotted points. A few candidates used a ruler but the expectation is that curves are to be drawn by hand.
	b		$x = {}^{-}1$ oe	1	**Examiner's Comments** This was usually answered well with $y = {}^{-}1$ as a very common incorrect answer. Some candidates tried to use $y = mx + c$ which made this part very tricky.
	c		${}^{-}2.8$ or ${}^{-}2.7$ 0.7 or 0.8	2	**B1** for either If **0** or **1** scored **FT** *their* curve for **1** or **2** marks or **SC1** for an answer in each of ${}^{-}2.8$ to ${}^{-}2.7$ and 0.7 to 0.8 tolerance $\pm\frac{1}{2}$ small square radially **Examiner's Comments** Many candidates tried to calculate the answers from the equation and completely ignored the instruction to 'use the graph'. Many gave the answer to more than 1 decimal place despite the request in the question.

					Assessment for learning Read each question very carefully and give the answer(s) in the form requested.
			Total	**6**	
27			[a =] $^{-}5$ [b =] 2	2	**B1** for one correct or **M1** for any pair of original brackets correctly expanded e.g. $3x^2+ax+6x+2a$ or $1[x]\times3[x]\times b[x] = 6[x^3]$ or $2\times a\times3 = -30$ or better allow seen in a table **<u>Examiner's Comments</u>** The working space was small to try to indicate to candidates that there was a quick method to find the answers from the coefficient of x^3, by $1 \times 3 \times b = 6$ and by using the constant term to find the value of a. Those who tried to multiply all the brackets out usually did not find the correct answers because they made at least one error in the bracket expansions.
			Total	**2**	
28			accept any correct method e.g. $(2n + 1)(2m + 1)$ e.g. $4nm + 2n + 2m + 1$ or $4nm + 2(n + m) + 1$ Statement showing that the expression is odd e.g. first three terms are even and add 1 to an even gives odd	M1 M2 A1	accept any letters condone poor use of brackets throughout if the terms are correct correctly expanding *their* brackets **M1** for any three terms out of the four correct (middle term of three counts as two terms) e.g. $2(2nm + n + m) + 1$ and a short statement "even + odd = odd" **A1** dep. on two method marks If **0** scored award **SC1** for $2n + 1$ etc seen or for **M1** accept e.g. $(2n + 1)(2m + 1)$ without any explanation BUT only accept e.g. $(x + 1)(x + 3)$ if they state that x is even for **M1** and **M2** only accept brackets that **could** be the product of two odd numbers e.g. **M2** for $x^2+ [1]x + 3x + 3$ or better **A1** for statement showing expression is odd e.g. x is even so x^2 and $4x$ are even so +3 makes odd

					for the correct expansion of any two brackets including e.g. $x(x + 1)$ **Examiner's Comments** This question was well answered. Many candidates used expressions such as $2n + 1$ to represent an odd number and from there they would multiply together their two terms. Many candidates found it difficult to show that the final expression was an odd number; the most successful attempts usually divided this expression by 2 and then they would be left with a decimal or they factorised their expression with 2 or 4 as a common factor and they would usually be left with + 1 or + 3 on the end.	
			Total	**4**		
29			E.g. Correct inequalities shown on diagram, correct region R identified and correct area calculation ½ × 6 × 4 [= 12] 	6	**B1** for line $y = 5$ **B1** for line $x + y = 13$ AND **B1** for correct side of $y = 2x + 1$ **B1** for correct side of $y = 5$ **B1** for correct side of $x + y = 13$ AND **M1dep** for ½ × 6 × 4 [= 12] oe	Condone good freehand lines, which can be dashed or solid. Lines need only be one square long for line mark but they must be fit for purpose to define their region Mark the region which is labelled, but if no labelling mark the single region which is shaded (or unshaded) or implied by area calculation of correct region R Use diagram for these three marks If extra lines, mark those bounding R. If no R, mark poorest two Dep on region R being correct Accept counting squares but check areas bounding $y = 2x + 1$

					Accept split into two triangles 4 and 8 oe **Examiner's Comments** Many candidates drew the correct line for $y = 5$, with only a few instances of $y = 4$, $y = 6$ or $x = 5$ being seen. Candidates had greater difficulty in drawing $x + y = 13$ and the line was often either omitted or else interpreted as meaning the two lines $x = 13$ and $y = 13$. Candidates who drew the correct lines often proceeded to identify the correct region for R. Although it should have been straightforward to then find the area of the triangle through ½ × base × height, some candidates attempted $\frac{1}{2}$ $ab\sin C$, often measuring a, b and C and then fudging the values to obtain an answer of 12 cm^2. Such attempts scored 0 marks for the area unless absolutely accurate. Candidates who did not draw $x + y = 13$ correctly sometimes added the line $y = 9$, therefore creating a trapezium of area 12 cm^2 for an incorrect region R bounded by $y = 5$, $y = 9$, $y = 2x + 1$ and the y-axis. This is an example that scored 2 marks, because $y = 5$ was correct and their region R was the correct side of $y = 5$ but not the correct side of $y = 2x + 1$.
			Total	**6**	
30	a		$(x - 4)^2 - 7$ final answer	3	**B1** for $(x - 4)^2$ AND **B2FT** for $- 7$ or **M1** for $9 - (their\ {}^-4)^2$ oe shown If 0 or 1 scored, allow **SC2** for final answer $(x - 4) - 7$ No FT from $(x - 3)^2$ FT can be implied, check $9 - (their\ {}^-4)^2$ **Examiner's Comments** Many candidates had little problem with this question and scored full marks. Errors were sometimes made with directed numbers in the

					expansion of $(x-4)^2$, leading to +25. Some did not realise the need to subtract 16 from the expression and simply had +9 at the end. Expressions involving $(x^2-4x)^2$ and $(x-8)^2$ were often seen with the latter usually having a value of +9 following the bracket, the values having been taken directly from the question. Where candidates had an incorrect bracket, most were not able to follow through to find an appropriate constant and little in the way of method was presented.
	b		$4+\sqrt{7}$ $4-\sqrt{7}$ final answer with working from **(a)**	2FT	**M1** for *their* $(x-4)^2$ = *their* 7 FT from *their* (a) for solutions in exact form if working shown Answers only score 0 Do not FT where $b = 0$ e.g. $(x-4)^2$ If their b is a perfect square, allow FT for $a+\sqrt{b}$ and $a-\sqrt{b}$ or simplified as two integers If $b < 0$, a max of M1 **<u>Examiner's Comments</u>** Many candidates did not follow the instructions to use part (a). Candidates who used the quadratic formula scored 0 marks. In addition, many candidates gave their final answers as decimals even though the exact answers were also often seen somewhere in the working.
			Total	**5**	
31			4 and 25 nfww	4	**B3** $\frac{10a^4 \times a^8}{25a^5} = \frac{2a^7}{5}$ OR **B2** for $k = 4$ Or **M1** any correct simplification of $\frac{a^k \times a^8}{a^5} = a^7$ eg Otherwise, condone embedded answers for M marks only **M1** applying correctly a law of indices May be seen within an attempt to simplify with other coefficients. Allow $[m] = 10 \times 5 \div 2$

$[a^k \times]\ a^3\ [= a^7]$ or $[a^k \times a^8 =]\ a^{12}$
$a^k = a^4$

$\frac{a^{k+8}}{[a^5]}[= a^7]$

$k + 8 - 5 = 7$ oe
and
B2 for $m = 25$
or
M1 for $\frac{10}{m} = \frac{2}{5}$ oe

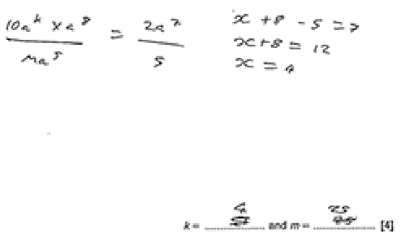
Examiner's Comments

This question was not answered well and exposed widespread weakness in handling algebraic expressions containing fractions. Occasionally, elegant algebra leading to a quick solution was seen. Candidates were a little more successful in finding index *k* than constant *m*.

Hardly any candidates realised they could separate out the *a* terms and the constants on both sides. A common misconception was to treat the numerators and denominators separately, leading to $k + 8 = 7$, $k = -1$ from the numerators alone; and the denominators were then compared giving $m = 5$.

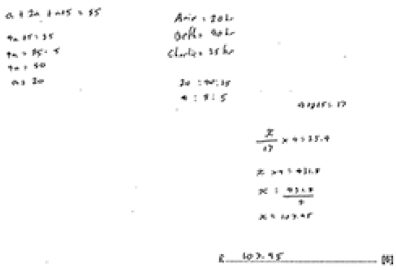
Another common error was when cross-multiplying by 5 with $5(10a^k \times a^8)$ becoming $50a^k \times 5a^8$, eventually leading to $m = 125$.

Work was often not well presented; it was difficult to follow the process candidates were attempting and often they did not give a final answer. Sometimes there was a correct use of an index rule in the middle of a lot of wrong work. To ensure consistency in marking, the scheme marked the indices and constants separately, with 2 marks for each. A productive use of an index rule needed to be applied to the starting expression, with the remaining indices also being correct.



					The candidate ignores the constants and focuses on applying the laws of indices to the given four indices. Ideally, they should have shown $\frac{10}{m} = \frac{2}{5}$ too, but there was no requirement to show working and so full marks are still given for the correct answers.	
			Total	**4**		
32			107.95 with correct working	6	**B1** for 2*a* or *a* + 5 or 4*a* + 5 or 25.4[0] + 5*x* seen **M1** for *a* + 2*a* + *a* + 5 = 85 or better or for a trial correctly evaluated **A1** for [*a* =] 20 [hours] AND **M2** for $\frac{25.4[0]}{their\ 20} \times 85$ or 1.27×85 oe or 25.4[0] + 50.8[0] + $\frac{25.4[0]}{their\ 20} \times their25$ oe or 25.4[0] + 1.27 × 40 + 1.27 × 25 oe or **M1** for $\frac{25.4[0]}{their\ 20}$ implied by 1.27 or $\frac{25.4[0]}{4}$ implied by 6.35 If 0 or 1 scored, instead award **SC2** for 107.95 with no or insufficient working If 0 scored, instead award **SC1** for 20	"correct working" requires at least **M1**AND**M1** or **M2** If working in pence: • Allow up to 5 part marks for consistent working • Allow full marks if answer is clearly stated as 10795 p[ence] **M1** implied by sub into *a* + 2*a* + *a* [+ 5] with evaluation **B1 max** possible for using 5*a* instead of *a* + 5 e.g. **M2** for $\frac{25.4[0]}{4} \times 17$ Method marks may be earned in stages May see equivalent algebraic methods. There are possibly many algebraic methods for this question. Examiners should use the main scheme as a template, matching steps or positions in the solution as best as possible. If in doubt, contact your Team Leader. For example:

					[hours] with no or insufficient working Non-algebraic methods may earn up to full marks. There are possibly many algebraic methods for this question. Examiners should use the main scheme as a template, matching steps or positions in the solution as best as possible. **Exemplar Responses** (tips): Amir : Beth : Charlie are 25.4 : 50.8: 25.4 + 5x (where x is hourly rate of tips) (total tips): 25.4 + 50.8 + 25.4 + 5x = 85x. This is on the scheme at B1. There is an equation on the scheme, so M1 would be a good judgement. B1 M1 (solving): x = 1.27 (substitution into either side of the equation) eg 85 × 1.27 (final answer) 107.95 And then this would be the A1 This is on the scheme at M2. The answer is correct and the candidate has satisfied the “correct working” requirement and so is awarded full marks. A1 M2 **Examiner’s Comments** While many candidates gave the correct final answer, a few were not given full marks due to lack of working. There were several possible methods that could be used to reach the final answer. Candidates needed to show a minimum of M1M1 or M2 to enable full marks. This was typically met by showing (i) an algebraic equation such as $a + 2a + a + 5 = 85$ or a trial and correct evaluation of $a + 2a + a + 5$, together with a tips per hour or tips per 5 hours calculation implied by 1.27 or 6.35, or (ii) a more concise but clear approach using ratios. Insufficient working included just the values 20, 31.75, 107.95 with no supporting method. Generally, solutions were not presented in a logical manner with unstructured working being ‘scattered’ across the page. Many solutions started in the middle of the answer space and, on running out of space, continued above the initial working. Some candidates used a trial and improvement

33					method for the hours, with no totals indicated. Those using an algebraic approach often created a suitable equation, but many did not solve accurately: $a + 2a + a + 5 = 85$ becoming $3a = 80$ was a common incorrect simplification. Another common error was the expression for Charlie, often written as '$2a + 5$' or '$5a$', the latter simplifying the problem and therefore losing access to the majority of the marks. Some candidates could access the problem but showed little supporting work. Having spotted the correct value for *a*, these candidates would often continue with just a list of totals for each person and no indication of the key divisions and multiplications being made. Some candidates used the ratio of the hours (1 : 2 : 1.25) to calculate the final amount in a much shorter method, such as 25.4 × 4.25.  We can assume that the candidate is using *a* to represent the number of hours worked by Amir. They then have algebraic expressions $2a$ and $a + 5$ for the hours worked by Beth and Charlie (B1 for either of these). The algebraic terms are summed, equated to 85 (M1) and solved to reach $a = 20$ (A1) and hence the hours worked by each person. There are various approaches available from here. This candidate uses a ratio method, first simplifying 20 : 40 : 25 to 4 : 8 : 5. They then set up an equation for Amir's share of the tips: $\frac{4}{17}$ of the total tips (x) which is given as £25.40 in the question (equivalent to M2). They then solve the equation to reach the total tips of £107.95. The candidate has shown sufficient working (M1M1 or M2) for full marks. The presentation of the work is also clear.
			Total	**6**	
33			3 frames with correct working	6	

					Algebraic method: **B5** for [one frame =] 52 [cm] with $x = 10$ and $2x^2 - 12x - 80$ [= 0] or better or **M3** for $2x^2 - 12x - 80$ [= 0] or better **A1** for [x =] 10 or **M2** for $(2x - 4)(x - 4)$ [= 96] oe or better seen or **B1** for $2x - 4$ or $x - 4$ seen OR **Trial and improvement:** **B5** for [one frame =] 52 [cm] with $x = 10$ and 16 by 6 [= 96] shown or **B4** for $x = 10$ and 16 by 6 [= 96] selected or **B3** for **selects** 6 by 16 [= 96] If 0, 1 or 2 scored, instead award **SC3** for [one frame =] 52 [cm] with no or insufficient working If 0 or 1 scored, instead award **SC2** for $x = 10$ with no or insufficient working	"Correct working" requires B5 For **B5** and **M3A1** isw for use of $x = -4$ For B5 or M3 allow equivalent 3 term quadratic e.g. $2x^2 - 12x = 80$ Allow equivalents for M2 e.g. $2 \times 2 \times 2x + 2 \times 2(x - 4) + 96 = 2x^2$ May be on diagram B3 not just for seeing 6 by 16 it must be selected in some way e.g. ringed, underlined, used
					Examiner's Comments Candidates found this question very challenging. A few were successful in setting up a correct algebraic equation involving the product of $(x - 4)$ and $(2x - 4)$ equal to 96 before simplifying to a three-term quadratic equation and then solving to find $x = 10$. Those candidates usually went on to correctly find and justify the final answer 3. Others were able to set up a correct product of terms but then made no further progress. Many didn't correctly relate the algebraic measurements on the diagram to the area given,	

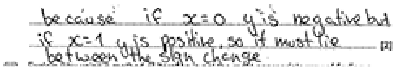
					so despite doing some algebraic working, it was not correct in relation to the diagram. The majority of candidates did not attempt to use algebra and instead, for example, tried to find paired products of 96 usually without further progress. There were a high number of 'no response' to this question.
			Total	**6**	
34			$\frac{5\pi r}{6}$ with correct working	5	**B4** for correct unsimplified answer with correct working OR **M1** for $\frac{60}{360}\times[2\times]\,\pi k$ oe **A1** for $\frac{60}{360}\times 2\pi r$ oe or better isw incorrect cancelling/simplification AND **M1** for $\frac{60}{360}\times[2\times]\,\pi\frac{3k}{2}$ **A1** for $\frac{60}{360}\times \pi 3r$ oe or better isw incorrect cancelling/simplification If 0 or 1 scored, instead award **SC2** for final answer $\frac{5\pi r}{6}$ oe simplified answer with no or insufficient working Condone '×' sign oe in simplified answer if otherwise correct e.g. $\frac{5}{6}\times\pi r$ "correct working" requires **M1A1M1A1** Condone *R* for *r* throughout For method marks, allow use of 3.14, 3.142, 22/7 for π Where *k* is numeric or algebraic **but does not** come from squaring Allow e.g. *k* = 2, *r*, *d*, 0.4 , 0.4*x* For A1 accept e.g. 0.333 πr Correct expression implies M1A1 For M1 must use *their* previous *k* e.g. uses *k* = 10 for first M1 then uses 15 here for $\frac{3k}{2}$ gets 2nd M1 **unless** the expression is correctly stated as $\frac{60}{360}\times\pi 3r$ oe which gets M1A1 Correct expression implies M1A1

					Examiner's Comments Candidates found this question very challenging and there were a number of 'no response'. Some worked out the area of the sector. Those attempting an arc calculation for AB often preferred to replace *r* with a constant value. In those cases, credit was given for the arc CD if the constant used was consistent with the ratio 2 : 3 for that used in AB. A number of candidates gave a correct fraction $\frac{60}{360}$ for the sector but then evaluated this as 6. In this case, method marks were awarded provided the fraction was shown. A small number of candidates found correct expressions in terms of *π* and *r* for the two arcs AB and CD and most of these then added correctly and gave a simplified expression. A few misunderstood the demand and gave the full perimeter of the shaded shape ABCD for which they were given partial credit.
			Total	**5**	
35			$([–]12)^2 + 5^2$ $144 + 25 = 169$ or $\sqrt{144+25} = 13$ and $\sqrt{169} = 13$	1 1	Accept equivalent reasoning e.g. For first mark $13^2 – ([–]12)^2$ e.g. For second mark $169 – 144 = 25$ $\sqrt{25} = 5$ If $–12^2 + 5^2$ do not allow first mark If $\sqrt{169}$ evaluated then it must be 13 For 2 marks there must be no errors leading to the answer **Examiner's Comments** Although a number of candidates omitted this part, many that attempted it were able to earn at least partial credit. As this is a 'show that' question, candidates must communicate correctly and make no errors in their mathematics for full credit. Many used substitution of –12 and 5 into the circle formula but most wrote $–12^2 + 5^2$ instead of $(–12)^2 + 5^2$ before giving 144 + 25. In these cases 1 of the 2 marks was awarded only.

			Total	2	
36	a		s = 230 with 4, 3 and 10 or 100 seen	4	**B2** for 4, 3 and 10 or 100 or **B1** for two correct AND **M1** for $(3 \times 10) + ½(4 \times 10^2)$ or correct substitution of unrounded or incorrectly rounded values If **0** scored then **SC1** for sight of 230 For all marks condone e.g. 3.00, 4.0, 10.0 used These values may be written in the stem of the question For M1 e.g. allow a mixture $(2.93 \times 10.1) + ½(4.1 \times 10^2)$ **<u>Examiner's Comments</u>** Many were successful in rounding the values to one significant figure and then correctly substituting into the given formula before giving the correct answer 230 m. A number of candidates, having correctly rounded, made errors in substitution, sometimes confusing *u* with *a*, or giving $3 \times 10 + 0.5 \times (4 \times 10)^2$. Many candidates chose not to round the values and attempted a complex calculation involving 4.06, 10.1 and 2.93. These candidates earned a method mark for a correct substitution only. **Assessment for learning** Candidates need to carefully read the instructions given within questions. Here they are told to round values to 1 significant figure before attempting an estimation. Many candidates spent time doing a complex calculation that was not needed. **Exemplar 1**

					$S = \cancel{8}3\times10+\frac{1}{2}4\times10^2$ $S = 30+\frac{1}{2}4\times100$ $S=30+\frac{1}{2}400$ $S=30+200$ $S=230$ Harper didnt half the values to the right of the equation Model response with the rounded values correctly substituted into the formula and then correct evaluation to 230.
	b		$t = [\pm]\sqrt{\frac{2s}{a}}$ oe final answer	3	Square root must dip below fraction line in final answer unless $\left(\frac{2s}{a}\right)$ bracketed For 3 marks oe e.g. $t = [\pm]\sqrt{\frac{2\times s}{a}}$, $t = \sqrt{\frac{s}{\frac{1}{2}a}}$ **M2** for first two steps correctly completed e.g. $\frac{2s}{a} = t^2$ or answer $[\pm]\sqrt{\frac{2s}{a}}$ (no $t =$) **M2** for e.g. $\frac{s}{\frac{a}{2}} = t^2$, $\frac{s}{\frac{1}{2}a} = t^2$, $\frac{s}{0.5a} = t^2$ or **M1** for first step correctly completed e.g. $2s = at^2$ or $\frac{s}{a} = \frac{1}{2}t^2$ Allow **M1** for $\frac{s}{0.5} = at^2$ oe If **0** scored, **SC1** for final answer $t = [\pm]\sqrt{\frac{\frac{1}{2}s}{a}}$ oe for **SC1** e.g. $t = [\pm]\sqrt{\frac{s}{2a}}$ **<u>Examiner's Comments</u>** There were many correct answers given. Candidates were given full credit for answers that were correct but not fully simplified, e.g. $t = \sqrt{\frac{s}{\frac{1}{2}a}}$. Some candidates gave a correct expression but omitted 't ='. The most successful candidates dealt with the rearrangement one step at a time rather than merging several together. The common errors were in the order of the

					steps attempted. For example, many candidates in their first step of the rearrangement chose to take the square root. Other errors included not taking the inverse, for example multiplying *s* by $\frac{1}{2}$ rather than multiplying by 2.
			Total	**7**	
37					
		i	5	1	**Examiner's Comments** Very well answered. Any errors seen were the result of arithmetic errors when substituting into the formula.
		ii	At x = 0 oe **and** $y < 0$ or y is negative or $y = -2$ or curve is below x-axis and at $x = 1$, y is positive or $y > 0$ or $y = 5$ or curve is above the x - axis **and** change of sign oe [between $x = 0$ and $x = 1$] or the curve crosses the x-axis between 0 and 1 or solution/q lies between 0 and 1	1 1 dep	If y value evaluated then must be correct for 2 marks or 1 mark Dep on first mark If **0** scored, **SC1** for change of sign oe or the curve crosses the x-axis between 0 and 1 oe For 2 marks needs to refer <u>$x = 0$ negative oe</u> and <u>$x = 1$ positive oe and change of sign/graph crosses axis/solution between 0 and 1 oe</u> e.g. For 2 marks At $x = 0$ the curve is below the x-axis, at $x = 1$ the curve is above the x-axis so there is a change of sign **Exemplar Responses** Response **Mark** The graph is below the x-axis at x = 0 and above the x – axis at x = 1 so the solution lies between 0 and 1 **2** $0^2 - (6 \times 0) - 2 = -2$ and $1^2 + (6 \times 1) - 2 = 5$ so there is a sign change from −2 to 5 BOD x = 0 and x = 1 implied in reasoning and a correct statement regarding sign change **2** Because at q, y = 0, but at 1 y = 5 and at 0 y is negative. So the solution is in between 0 and 1 (BOD x = 0 and x = 1 implied in reasoning similar to above and correct conclusion stated) **2** When q = 0 graph is negative, when q = 1 graph is positive so there is a sign change (BOD q is on the x-axis so take q as x here) **BOD2**

					The graph is positive at 1 and negative at zero so the solution lies in between 0 and 1 [BOD first mark allow as 1 and 0 imply x = 1 and x = 0 and the conclusion is correct for 2nd mark) **BOD2** When x = 1, y = 5 and the graph intersects the x- axis between 0 and 1 so that is where the solution lies [Does not mention x = 0 and negative and second mark dep on first but gets SC1] **SC1** The graph crosses the x-axis between 0 and 1 [2nd mark dep on 1st mark and does not specifically mention x = 0 and x = 1 being negative and positive so zero but gets SC1] **SC1** There is a change of sign (2nd mark dep on first mark buts gets SC1) **SC1** The root lies between 0 and 1 (not adding to question asked – no reasons given for this) **0** **<u>Examiner's Comments</u>** Candidates needed to reflect on the values of *y* when *x* = 0 and when *x* = 1 and then explain on the sign change from negative to positive. A few candidates were able to articulate this well and give a full explanation. Some mentioned sign change without justification and were given partial credit. For the majority, there was little understanding shown. **Exemplar 2**  because if x = 0 y is negative but if x = 1 y is positive, so it must lie between the sign change [2] A correct response where the candidate references the values for the equation when *x* = 0 and *x* = 1 and to justify the sign change conclusion.
		iii	Correct response concerning accuracy/time taken/refer to specific more efficient methods e.g. Iteration gives an estimate oe Iteration can be a lengthy process oe [to get an accurate result]	1	e.g. The quadratic formula/complete the square is quicker/more accurate/easier Trial and improvement is less efficient/takes too long You can always go to more decimal places It will not give an exact/accurate answer

						It will take many iterations There are two solutions, iteration is used to find one at a time Mark the best if more than one answer given Do not accept incorrect statement e.g. It would be quicker/easier to factorise the equation
					<u>Examiner's Comments</u> This was answered better than Question 13 (a) (ii). Many stated that this was either too time consuming or may lead to estimates of solutions. Some stated that there were more efficient specific methods such as completing the square or using the quadratic formula that would give exact answers. There were some vague responses, e.g. 'it is too hard', 'there are better methods' and 'there are two solutions', without giving the detail needed. **Exemplar 3**  because completing the square is most easier and simpler in this case An example of a correct response where the candidate refers to specific better methods to solve the equation.	
			Total	**4**		
38	a		59	4	**B3** for x = 17 or **M2** for 2(x + 28) = 5(x + 1) oe or better or for 45 : 18 seen or **M1** (x + 28) **and** (x + 1) seen or better	For M2 accept [P =] 45 and [R =] 18 (An answer of 76 may indicate this but check working for 45 and 18) For M1, could appear as $\frac{5}{x+28}$ $\frac{2}{x+1}$

					or e.g. $5y = 28 + x$ and $2y = x + 1$ **Examiner's Comments** Candidates found this question challenging and very few were able to combine ratio 5 : 2 to form a correct equation using the information given in the Venn diagram. The most successful responses included an equation equivalent to $2(x + 28) = 5(x + 1)$ and continued to find the value of x. A few other candidates were successful in using trial and improvement with values in the ratio 5 : 2 and finding 45 : 18 gave the correct values for set P and set R. Many candidates appeared to be randomly trying values for x, with little success.
	b		$\frac{28}{45}$ oe	2FT	**B2FT** for $\frac{28}{their(a)-14}$ dep on 0 < answer < 1 or **B1** for numerator 28 or for denominator 45 or *their* (a) – 14 isw cancelling/conversion For FT - if fraction is simplified or given as a decimal check for equivalents for B2FT or B1 **B1** must be part of a proper fraction $0 < P < 1$ **Examiner's Comments** Those who answered part (a) correctly invariably gave the correct probability in this part. Many other candidates were able to score 1 mark for giving a proper fraction with the numerator 28. A follow through was available for 2 marks from an incorrect answer in part (a) but this was rarely awarded.
			Total	**6**	
39	a		$y = \frac{30}{\sqrt{x}}$ oe	3	**M1** for $y = \frac{k}{\sqrt{x}}$ oe **B1** for [**k** =] 30 eg condone $y = \frac{k}{\sqrt{36}}$ for **M1**

					Examiner's Comments **AfL** Most candidates were able to write a statement such as $y = \frac{k}{\sqrt{x}}$ and to find k = 30. It is always good practice to complete this working with the conclusion $y = \frac{30}{\sqrt{x}}$, and this was required for the full three marks.	
	b		2.25 oe	3	**B2** for $\sqrt{x} = \frac{3}{2}$ oe or **M1** for $20 = \frac{their\ 30}{\sqrt{x}}$ or $\frac{20}{5} = \frac{\sqrt{36}}{\sqrt{x}}$	
			Total	**6**		
40	a		$2^3 - 5 \times 2 - 1 = {}^{-}3$ $3^3 - 5 \times 3 - 1 = 11$ Sign change so solution between x = 2 and x = 3	3	**M2** for $2^3 - 5 \times 2 - 1 = -3$ and $3^3 - 5 \times 3 - 1 = 11$ or **M1** for $2^3 - 5 \times 2 - 1$ or $3^3 - 5 \times 3 - 1$ soi by $^{-}3$ or 11 <u>Alternative method</u> After $x^3 - 5x = 1$ seen **M2** for $2^3 - 5 \times 2 = {}^{-}2$ and $3^3 - 5 \times 3 = 12$ **A1** for $^{-}2 < 1$ and $12 > 1$ so solution between x = 2 and x = 3 OR **M1** for $2^3 - 5 \times 2$ or $3^3 - 5 \times 3$ soi by $^{-}2$ or 12 <u>Alternative method</u> **SC3** for using an iterative equation that converges to a value in the range 2.25 to 2.35 **and** concluding statement that 2 < 2.25 to 2.35 < 3 oe or **SC2** for using an iterative equation that converges to a value	Accept other values of x used between 2 and 3 (see table in part (b)). For full marks, the two values need to produce a sign change. Examples just sufficient for third mark include: change of sign $^{-}3 < 0 < 11$ x = 2 gives an answer < 0 and x = 3 gives an > 0 Examples insufficient for third mark: so x lies between 2 and 3 If within part **(a)** candidates <u>refer to</u> their working in part **(b)**, award marks for this final alternative method.

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>in the range 2.25 to 2.35

<u>Examiner’s Comments</u>

Misconception

A sizeable number of candidates believed the quadratic formula could be adapted to solve a cubic equation.

When asked to show that a solution lies between two given values, it is not enough to just perform two calculations; a correct concluding statement either in words (e.g. “change in sign”) or symbols (e.g. $^{-}3 < 0 < 11$) is also required for full marks.

When asked to find the solution to an equation correct to a given accuracy using a numerical method, it is not sufficient to only test x values of that given accuracy. Many candidates tested x = 2.3 and x = 2.4, and chose x = 2.3 for their final answer. This scored three marks out of four. For full marks, they should also be testing a value such as x = 2.35 to make that decision.</td><td></td></tr>
<tr><td></td><td>b</td><td></td><td>Two correct evaluations in the range 2.25 to 2.35, one which gives a positive value and the other giving a negative value

2.3</td><td>M3
and
A1dep</td><td>M2 for two correct evaluations between 2 and 3, one which gives a positive value and the other giving a negative value

or

M1 for one correct evaluation between 2 and 3

Dependent on achieving at least M2

<u>Alternative method</u>
M1 rearranges to a correct iterative formula (converging or diverging)

M1 <u>attempts</u> first iteration (either</td><td>Likely values: accept rot to 2+sf

<table>
<tr><th>x</th><th>$x^3 - 5x - 1$</th><th>x</th><th>$x^3 - 5x - 1$</th></tr>
<tr><td>2.1</td><td>-2.239</td><td>2.25</td><td>-0.859</td></tr>
<tr><td>2.2</td><td>-1.352</td><td>2.26</td><td>-0,757</td></tr>
<tr><td>2.25</td><td>-0.859</td><td>2.27</td><td>-0.653</td></tr>
<tr><td>2.3</td><td>-0.333</td><td>2.28</td><td>-0.548</td></tr>
<tr><td>2.4</td><td>0.824</td><td>2.29</td><td>-0.441</td></tr>
<tr><td>2.5</td><td>2.125</td><td>2.30</td><td>-0.333</td></tr>
<tr><td>2.6</td><td>3.576</td><td>2.31</td><td>-0.224</td></tr>
<tr><td>2.7</td><td>5.183</td><td>2.32</td><td>-0.113</td></tr>
<tr><td>2.75</td><td>6.047</td><td>2.33</td><td>-0.001</td></tr>
<tr><td>2.8</td><td>6.952</td><td>2.34</td><td>0.113</td></tr>
<tr><td>2.9</td><td>8.889</td><td>2.35</td><td>0.228</td></tr>
</table>

Condone missing subscripts

If within part (b) candidates <u>refer to</u> their working in part (a), award up to full marks for part (b).</td></tr>
</table>

					substitution seen or found to at least 2dp (rot) **M1** continues iteration(s) to reach x in the range 2.25 to 2.35 **A1** for 2.3 If **0** scored **SC1** for answer 2.3 with no worthwhile working **<u>Examiner's Comments</u>** **AfL** In this part included the qualifier "You must show your working". This was used to minimise the advantage provided by a calculator having a polynomial equation solver facility. A few unsupported responses of x = 2.3 were seen and given one mark only.	
			Total	**7**		
41	a		Subst into correct formula (may be implied) and partial simplification $25 = 20t - 4t^2$ seen and correct completion to $4t^2 - 20t + 25 = 0$	2 1dep	B2 for $25 = 20t - \frac{1}{2} \times 8 \times t^2$ oe or $25 = 20t + (-4)t^2$ or **B1** for subst eg $25 = 20t + \frac{1}{2}(-8)t^2$ Dep on previous 2 marks	Only accept $25 = 20t - 4t^2$ if subst seen For **B1**, condone ambiguity caused by missing brackets
	b		2.5 oe	3	**M2** for $(2t - 5)(2t - 5)$ or **M1** for any two factors that give two correct terms when expanded or for partial factorisation $2t(2t - 5)$	eg a sign error, short fraction line, short root but condone missing brackets

					$-5(2t-5)$ OR **M2** for $[t=]\frac{20\pm\sqrt{400-400}}{8}$ or better **M1** for $[t=]\frac{-(-20)\pm\sqrt{(-20)^2-4\times4\times25}}{2\times4}$ with at most one error	
	c		Shows $v = 0$ and concludes “stationary”	3	**M1** for $[v^2 =]\ 20^2 + 2(^-8)25$ or $[v =]\ 20 + (^-8)\times$*their* (b) **A1** $v = 0$ If **0** scored, instead award **SC2** for $v = 0$ and other values substituted into a relevant equation as a correct check or **SC1** for $v = 0$	
			Total	**9**		
42			$y=\frac{4}{3t-17}$ or $y=\frac{-4}{17-3t}$	5	**B4** for $\frac{4}{3t-17}$ or $y=\frac{2}{1.5t-8.5}$ as final answer OR **M2** for $10y + 4 = 3ty - 7y$ or $5+\frac{2}{y}=1.5t-3.5$ or **M1** for $\frac{2(5y+2)}{y}=3t-7$ $= 3t-7$ or $5y+2=\frac{y(3t-7)}{2}$ or $10y + 4$ or $3ty - 7y$ seen or $5+\frac{2}{y}=\frac{3t-7}{2}$ or $\frac{5y+2}{y}=1.5t-3.5$	To award full marks, solution must be correct eg $4 = 3ty - 7y - 10y$ or $\frac{2}{y}=1.5t-3.5-5$ $= 1.5t - 3.5 - 5$ ft for formulae of equal difficulty (eg must include a *ty* term oe) eg $4 = y(3t - 17)$ or $\frac{y}{2}=\frac{1}{1.5t-8.5}$

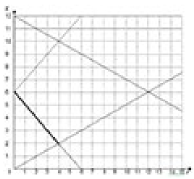
					M1ft for correctly collecting y terms on one side and non-*y* terms on the other (need not be simplified at this stage) **M1ft** for factorising *their* 2 or 3 terms	
			Total	**5**		
43			$2x + 7$ as final answer	2	**B1** for each part or **M1** for $3x + 6$ or $^{-}x + 1$ **Examiner's Comments** More candidates simplified $3(x + 2) – (x – 1)$ to $2x + 5$ than obtained the correct answer of $2x + 7$.	
			Total	**2**		
44			5 : 6 nfww	4	**B3** for $5kn : 6kn$ $k>0$ or equivalent correct unsimplified ratio seen OR **M1** for two ratios with a common number of mints implied by … : $10k$ **and** $10k$: … seen, $k>0$ with one correct ratio or for $2.5n : 5$ seen **A1** for $5kn : 10k : 6kn$ **Examiner's Comments** **AfL** There have been several similar questions in the past but this was the first time that an algebraic element has been included. The success rate was very good, with half of the candidates scoring at least three marks out of four. The	Accept for all part marks *n* replaced by a consistent integer Eg $2.5n : 3n$ or $5n : 6n$ or 10 : 12 etc May be seen as two separate ratios Eg $5n$: 10 and 10 : $6n$ or 10 : 20 and 20 : 12 etc For **M1** the examples just require the common 10 or the common 20 etc

					most common and productive strategy was to rewrite the two given ratios so that they had a common number of mints (usually indicated as 10). The required ratio could then be identified as $5n : 6n$ which scored three marks, the correct simplified answer being 5 : 6.	
			Total	**4**		
45			$\frac{2(x-5)}{x+2}$ or $\frac{2x-10}{x+2}$ final answer	5	**M2** for $2(x-5)(x+5)$ or $(2x-10)(x+5)$or **M1** for $2(x^2-25)$**M2** for $(x+2)(x+5)$or **M1** for $x(x+2)+5(x+2)$or $x(x+5)+2(x+5)$or for $(x+a)(x+b)$ where $a+b=7$ or$ab=10$	For method marks condone omission of final bracket
			Total	**5**		
46			$z = 17 - 2x^2$ final answer	4	**B3** for answer $17 - 2x^2$ OR **M3** for $7=4\left(\frac{x^2-5}{2}\right)+z$ **oe** or $2x^2 + z = 17$ **oe** or $x^2-2\left(\frac{7-z}{4}\right)=5$ or better or **M2** for $y=\frac{2x^2-10}{4}$ **oe** or $y=\frac{7-z}{4}$ **oe** or $4y = 2x^2 - 10$ or $(2x^2 - 4y) + (4y + z) = 10 + 7$ **oe** or **M1** for $2x^2 - 4y = 10$ or $-2y = 5 - x^2$ or $4y = 7 - z$ or better	Correct unsimplified formula in x and z M2 sets up for substitution with y explicit or for method for elimination by equating coefficients of y and correct method to eliminate y M1 equates coefficients of y or first step in rearrangement to eliminate
			Total	**4**		
47			$2n^3 + 2n^2 + 8n - 6$ or $2(n^3 + n^2 + 4n - 3)$ $2(n^3 + n^2 + 4n - 3)$	M5 A1	**M3** for $2n^3 + n^2 - 6n^2 + 4n^2 + 2n - 12n - 3n - 6$ **oe** or better	$2n^3 - n^2 - 13n - 6$ when simplified ie $2n^2 + n - 6n - 3$ or

					or condone one error in coefficients in simplified expression $2n^3 + 2n^2 + 8n – 6$ or **M2** for one correct expanded pair or **M1** for 3 correct terms out of 4 in expanded pair (term in n counts as 2 terms) **M1** for $3n^2 + 21n$ Accept e.g. each term is divisible by 2 or $(2n^3 + 2n^2 + 8n – 6) \div 2 = n^3 + n^2 + 4n – 3$ <u>Alt method</u> Alt method for **6** marks Fully correct reasoning with even and odds for n and for each term when n is even and when n is odd $(2n +1)$ $(n – 3)$ $(n + 2)$ and $3n(n + 7)$ e.g. if n is even , $(2n + 1)$ is odd etc or **M3** for fully correct reasoning with even and odds but only considering n is even or n is odd not both	better or $2n^2 + 4n + n + 2$ or better or $n^2 + 2n – 3n – 6$ or better Must include e.g. if n is even, $2n + 1$ is odd, $n – 3$ is odd, $n + 2$, is even then odd × odd × even = even and $3n$ is even and $n + 7$ is odd, even × odd = even , then even + even = even **and** repeat when n = odd
			Total	**6**		
48	a		$x < 4$	3	Mark final answer **M1** for $4x – 12 < x$ or $x – 3 < \frac{x}{4}$ **M1** for correct step[s] to $ax < b$ FT *their* first step **<u>Examiner's Comments</u>** Solving inequalities, many candidates either gave a value as the answer rather than an inequality, or when dividing by a negative term did not change the direction of the inequality symbol.	For method marks, condone incorrect inequality sign or 'equals' sign e.g. Answer $x = 4$, $x > 4$ implies M1M1
	b		Correct representation of *their* (a) on number line	2	**Strict FT** *their* (a) dep on an inequality in (a)	If e.g. 3 on answer line and x < 3 in working

					B1FT for *their* correct hollow or solid circle **B1FT** for *their* correct arrow direction then allow FT from x < 3 If answer 4 in (a) then allow x < 4 here Both B1's must be with *their* value from part above If no arrow then *their* line must stretch to end of line
			Total	**5**	
49			10 nfww	4	**M1** for 5 × 4 **M1** for 200 or 199 used **M1dep** for *their* 200 ÷ *their* area, **dep** on first M1 nfww for 4 marks no errors in calculating values and at least one of 5, 4, 200 or 199 used Allow for 20 or for 4.9 × 4.1 [20.09] or with one unrounded value [19.6 or 20.5] Allow for 198.5 ÷ (4.9 × 4.1) **<u>Examiner's Comments</u>** Some candidates tried to complete long decimal calculations instead of making an estimate by rounding the values to 200, 4 and 5 which would have made for a very straightforward calculation. Looking for key words in the demand of the question like 'estimate' should guide candidates to round values in the calculation appropriately.
			Total	**4**	
50			[a=] 3 [b=] ⁻5 [c=] 1	4	**B2** for *a* = 3 or **M1** for second differences = 6 **M1** for revised terms of –4 –9 –14 –19 or **B1** for either *b* = –5 or *c* = 1 Condone e.g. $3n^2$ at least two terms See appendix for alternative methods
			Total	**4**	

51			[x=] −4 [y=] −1 [x=] 4 [y=] 7 with correct algebraic working	5	accept any correct method **M1** for correct substitution e.g. $(x-3)^2 + (x+3)^2$ [= 50] **M1** for expanding both brackets correctly e.g. $x^2 - 3x - 3x + 9 + x^2 + 3x + 3x + 9$ [=50] **M1** for simplifying their equation e.g. $2x^2 = 32$ or $2x^2 - 32$ [= 0] **A1FT** for $x = -4, 4$ If **0** scored **SC2** for [x=] −4[y=] −1 [x=] 4 [y=] 7 with no working or **SC1** for both x values with no working or a correct pair of x and y values with no working	"Correct algebraic working" requires evidence of at least M1M1 implied by $2x^2 + 18$ [= 50] condoning one error or better to $ax^2 = b$ or to $ax^2 + bx + c$ [= 0] **FT** *their* quadratic equation See appendix for alternative methods
			Total	**5**		
52			87 253 278 with correct working	7	**B1** for $3n - 8$ **B1** for $3n - 8 + 25$ or better **M1** for writing a correct equation equal to 618 using *their* expressions e.g. $n + 3n - 8 + 3n - 8 + 25 = 618$ or better **M1** for simplifying *their* equation e.g. $7n + 9 = 618$ **A1FT** for correctly solving *their* equation e.g. $n = 87$ **M1** for substituting *their* 87 into both	"Correct working" requires evidence of at least **B1 B1** Expressions could start from B or C. See appendix for a more complete set of trials

					expressions e.g.3×87 – 8 and 3×87 – 8 + 25 oe Trials: **B1** for one complete trial with $n \geq 3$ **B1** for second complete trial $n \geq 3$ If **0** or **1** scored **SC3** for 87, 253, 278 with **B1** only or **SC2** for 87, 253, 278 with no working	
			Total	**7**		
53	a		≥ ≤ ≤	2	**B1** for two correct or “> < <”	i.e correct but no equals
	b		$x + y \geq 6$ or $y \geq 6 - x$ oe	3	**B1** for the correct straight line drawn  **B1** for correct equation for *their* line e.g. $x + y = 6$ oe	implied by e.g. $x + y = 6$ oe and accept a ruled or good freehand line bold line shows minimum length implied by e.g. answer of $x + y \leq 6$ oe
			Total	**5**		
54			−3, 8	4	**B1** for $(x + 3)^2$ or $-6 \div 2$ **B2FT** for +8, correct or ft *their* $(x + 3)^2$ or **M1** for (*their* $-3)^2$ + 6 × (*their* −3) + 17 **B1FT** for $(-a, b)$ **FT** *their*$\{(x + a)^2 + b\}$ to a maximum of **3** marks If no working **B2** for either ordinate correct	accept any correct method(see appendix) **B3** implied by $(x + 3)^2 + 8$
			Total	**4**		
55			x^8	1		

			Total	**1**	