Mark scheme

Question			Answer/Indicative content	Marks	Guidance	
1			$-\frac{11}{2}$ **oe** and 2 with correct working	6	**B3** for $2x^2 + 15x + 22$ [= 0] **oe** or **M2** for $x^2 - 22 = 3x^2 + 15x$ or better or **M1** for $x^2 - 22 = 3x(x + 5)$ **M2** for $(2x + 11)(x + 2)$ [= 0] or **M1** for $2x(x + 2) + 11(x + 2)$ or for $x(2x + 11) + 2(2x + 11)$ or for $(2x + a)(x + b)$ where $ab = 22$ or $2b + a = 15$ If **0** or **1** scored instead award **SC2** for correct answers	Correct working requires at least **B3** and **M1** For **B3** accept negative version, accept $2x^2 + 15x = 22$ **M2** and **M1 FT** *their* 3-term quadratic **M2** alt method correct substitution into formula or correct complete square **M1** condone 1 error in substitution into formula For complete square, correct **FT** $(x + a)^2$
			Total	**6**		
2			$3^x \times 3^{2y} = 3^3$ $x + 2y = 3$ one further step leading to $y = \frac{3 - x}{2}$	M2 M1 A1	**B1** for 3^{2y} or 3^3	For **M2** accept equivalent work with all terms in other bases e.g. 9 Accept $(3^2)^y$ for 3^{2y} Allow **B1** for writing one other term correctly in base 9 e.g. $[3^x =]\ 9^{\frac{x}{2}}$

					M1 dep on M2	For **M1** accept correct equivalent equation
			Total	**4**		
3			$2n^2 + 3 + 2(n + 1)^2 + 3$ $2n^2 + 3 + 2n^2 + 4n + 2 + 3$ or better $4n^2 + 4n + 8$ Correct conclusion e.g. $4(n^2 + n + 2)$ and multiple of 4 Each of the terms is divisible by 4 so multiple of 4	M2 M2 A1 A1	**M1** for $2(n + 1)^2 + 3$ or $2(n – 1)^2 + 3$ **Dep** on **M2 FT** *their* consecutive algebraic terms For all brackets correctly expanded **M1** for a squared bracket correctly expanded e.g. [2] $(n^2 + n + n + 1)$ or better **FT** *their* consecutive algebraic terms after **M2M2** earned With no errors or omissions seen	Accept $2(n + a)^2 + 3 + 2(n + b)^2 + 3$ **oe** where there is a difference of 1 between a and b **M1** accept any bracket squared expansion seen e.g. $(2n + 5)^2 = 4n^2 + 10n + 10n + 25$ or better or $[2](n^2 – n – n + 1)$ if $2(n – 1)^2$ used Accept e.g. $4n^2 – 4n + 8$ if n and $n – 1$ used
			Total	**6**		
4			$^-0.4$ **oe**	3	**M1** for correct first step **M1 FT** *their* first step to ax = b	Embedded answer scores **M2** max If not shown, **M1** implied by $10x = b$ or $ax = {}^-4$ $10x = {}^-4$ or $^-10x = 4$
			Total	**3**		

5			No and 5 × 3 + 11 = 26 **oe** Or No and (23 – 11) ÷ 5 = 2.4 **oe** Or No the equation would need to be $y = 5x + 8$	2	**M1** for 5 × 3 + 11 or for 23 – 11 ÷ 5	For **2** marks no errors seen accept No and (3, 26) or (2.4, 23) For **M1** allow no/incorrect evaluation
			Total	**2**		
6	a		$y \le x + 5$ **oe** and $y < 12$	3	**B2** for $y \le x + 5$ **oe** or **B1** for y … $x + 5$ **oe** but with = or an incorrect inequality symbol **B1** for $y < 12$	Accept inequalities in either order
	b		20 **nfww**	4	**B2** for (3, 8) and (8, 8) or (7, 12) and (12, 12) identified or for base 5 and perpendicular height 4 both identified or **B1** for (3, 8) or (8, 8) or (7, 12) or (12, 12) or for base = 5 or height = 4 AND **M1** for *their* base × *their* perpendicularheight	May be seen on diagram Must identify base and perpendicular height of parallelogram in working or on diagram Do not allow if slant height used
			Total	**7**		

7	a		$\frac{1}{8}$ or [0].125 -6	2	**B1** for each	
	b		4 4	2	**B1** for each	
			Total	**4**		
8			$a = 5$ $b = 11$ $a = -5$ $b = 11$ with correct working	6	**M1** for constant term identified as $-4a^2$ or seen in *their* expansion **M1** for *their* constant term = –100 **A1** for $a = 5$ or $a = -5$ AND **M1** for $b = 36 - a^2$ or for coefficient of x^2 identified as $36 - a^2$ or seen in *their* expansion **M1** for $b = 36 - (their\ a)^2$ evaluated If **0, 1** or **2** scored instead award **SC3** for both correct pairs of answers $a = 5$ and $b = 11$ $a = -5$ and $b = 11$ If **0** or **1** scored instead award **SC2** for $a = 5$ and $a = -5$ or for $a = 5$ and $b = 11$ or for $a = -5$ and $b = 11$ If **0** scored instead award **M1** for $(3x + a)(3x - a) = 9x^2 - a^2$ or for $(3x + a)(x^2 + 4) = 3x^3 + ax^2 + 12x + 4a$ or for	"Correct working" requires evidence of at least **M1** AND **M1** Full expansion is $9x^4 + 3ax^3 - 3ax^3 + 36x^2 - a^2x^2 + 12ax - 12ax - 4a^2$ or better scores at least **M1** AND **M1** May be seen as $36x^2$ and $-a^2x^2$ in the expansion Trials **M1M1M1M1** for $(3x + 5)(3x - 5)(x^2 + 4)$ expanded and simplified to $9x^4 + 11x^2 - 100$ **A1** for $a = 5$ or $a = -5$ or **M1M1M1** for $(3x + 5)(3x - 5)(x^2 + 4)$ expanded to $9x^4 + 15x^3 - 15x^3 + 36x^2 - 25x^2 + 60x - 60x - 100$ or better **A1** for $a = 5$ or $a = -5$

					$(3x - a)(x^2 + 4) = 3x^3 - ax^2 + 12x - 4a$ or **SC1** for $a = 5$ or $a = -5$ or at least one answer with $b = 11$	
			Total	**6**		
9			$f = k - e$ **oe** final answer	2	**B1** for answer $k - e$ or **M1** for $e + f = k$	
			Total	**2**		
10	a		$x + 3$ $x + 3 + x + 6$ [$= 2x + 9$]	1 1		Intent to add correct successive algebraic terms must be clearly conveyed e.g.  A list of the terms x, 3, $x + 3$, $x + 6$ $2x + 9$ is insufficient for the second mark but scores the first mark for $x + 3$
	b		13 **nfww**	4	**M2** for $3x + 15 = 54$ or **M1** for $x + 6 + 2x + 9$ or better **M1 FT** for [$x =$] $\frac{54 - \textit{their } 15}{\textit{their } 3}$	**M2** may be subsequently implied by arithmetic working **FT** must be from $ax + b = c$ May be seen in stages as two arithmetic steps or as formal algebra Correct answer from trials scores **4**
			Total	**6**		
11	a		÷ 3 –2	2	**B1** each or **SC1** wrong order	

	b		[m =] 0.4 **nfww** [p =] 5 **nfww**	5	**M1** for $3m + p = 6.2$ **oe** **M1** for $6m + p = 7.4$ **oe** AND **B2** for $m = 0.4$ **nfww** or $p = 5$ **nfww** or **M1** for $6m - 3m = 7.4 - 6.2$ or $3m = 1.2$ or $2p - p = 12.4 - 7.4$ If **0** scored, instead award **SC1** for two answers which satisfy one of the original conditions	Correct answer from trial and improvement scores **5**
			Total	**7**		
12	a		5, 6, 7	3	**B2** for 3 correct values with one extra or for 2 correct values OR **M1** for $8 + 4 < 3x$ or better **M1** for $3x \le 19 + 4$ or better	For **M** marks condone use of incorrect inequality sign or equals
	b		–5 is smaller than –3	1		Accept: It should be $-5 < x < -3$ **oe** $-3 < x$ contradicts $x < -5$ **oe** –5 and –3 should be switched **oe** Signs are wrong way around
			Total	**4**		
13	a		Correct curve within tolerance	3	**B2** for 7 points accurately plotted	Tolerance $\pm\frac{1}{2}$small square radially for curve and points,

					or **B1** for 4 points accurately plotted	some daylight between $y = -6$ and curve, condone a wobbly curve and slight feathering or tram lines in no more than 3 sections but no ruled lines and no dashed lines
	b		$x = 0.5$ **oe**	1		
	c		−2 and 3	2	**B1** for either answer If **1** scored **FT** *their* curve for **2** marks or If **0** scored **FT** *their* curve for **1** or **2** marks	For **FT** use tolerance $\pm\frac{1}{2}$small square radially
			Total	**6**		
14			[y =] $112x^3$ with correct working	6	**B2** for $y = 1.75t^3$ or **M1** for $y = kt^3$ or better e.g. $14 = k2^3$ or $k = 1.75$ **B2** for $t = 4x$ or **M1** for $t = mx$ or better e.g. $16 = m4$ or $m = 4$ **M1** for $y = 1.75(4x)^3$ If **0**, **1** or **2** scored, instead award **SC3** for $y = 112x^3$ with no working or insufficient working	"Correct working" requires evidence of at least **M1M1** or **B2** condone e.g. $y = kt^3$ and $k = 1.75$ for **B2** Condone e.g. $t = mx$ and $m = 4$ for **B2** For **M1FT** allow combining *their* two expressions for y and t
			Total	**6**		

15	a		$3 \times 14 - 10$ or $\frac{32+10}{3} = 14$ oe	M1		Condone 42 − 10or $3u_3 - 10 = 32$ then $3u_3 = 42$ then $u_3 = 14$
	b		8	3	**M2** for $\frac{14+10}{3}$ or better or **M1** for $u_3 = 3u_2 - 10$ or better	e.g. **M2** for $\frac{24}{3}$ e.g. **M1** for $14 = 3u_2 - 10$
	c		5 $u_2 = u_1$, so all terms will be equal	B1 B1	If **0** scored **SC1** for next term = 5 or $3 \times 5 - 10$ seen	For additional information refer to '2024 November, J560/04, Alternative, Mark Scheme Appendix' within downloadable extra resource materials.
			Total	**6**		
16	a		$[2^3 - 6 \times 2 + 1 =]\ -3$ $[3^3 - 6 \times 3 + 1 =]\ 10$ and any indication of a sign change [so solution lies between 2 and 3]	M1 M1 A1	Must indicate their input and output Dependent on at least **M1** and different signs	Accept other values of x used between 2 and 3, correct to 2 figs rot (see table in part **(c)**). For full marks, the two values need to produce a sign change <u>Alternative method</u> **SC3** for using an iterative equation that converges **and** concluding statement that first two values lie between 2 and 3 **oe** For additional information refer to '2024 November, J560/04, Alternative, Mark Scheme Appendix'

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>within downloadable extra resource materials.</td></tr>
<tr><td></td><td>b</td><td></td><td>[x = 2.5] 1.625

$2 < x < 2.5$</td><td>B1
B1</td><td></td><td>Condone equals signs and condone in words, allow a smaller correct interval</td></tr>
<tr><td></td><td>c</td><td></td><td>Two correct evaluations in the range $2 < x < 2.5$, one which gives a positive value and the other giving a negative value

[x =] 2.4</td><td>M2
A1</td><td>M1 for one correct evaluation in the range $2 < x < 2.5$

Dependent on achieving at least M1

<u>Alternative method</u>
M1 rearranges to a correct iterative formula (converging or diverging)
M1 <u>attempts</u> first two iterations (either substitution seen or found to at least 2dp rot)
A1 for 2.4

If 0 scored SC1 for 2.4 with no worthwhile working</td><td>Working for (c) may be seen in (b)

Examples
<table><tr><td>2.05</td><td>−2.684875</td></tr><tr><td>2.1</td><td>−2.339</td></tr><tr><td>2.15</td><td>−1.961625</td></tr><tr><td>2.2</td><td>−1.552</td></tr><tr><td>2.25</td><td>−1.109375</td></tr><tr><td>2.3</td><td>−0.633</td></tr><tr><td>2.35</td><td>−0.122125</td></tr><tr><td>2.4</td><td>0.424</td></tr><tr><td>2.45</td><td>1.006125</td></tr></table>
condone missing suffixes here
e.g.
$x_{n+1} = \sqrt[3]{6x_n - 1}$ with $x_0 = 2$,

$x_1 = 2.22398\ldots$, $x_2 = 2.31109\ldots$</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>8</td><td></td><td></td></tr>
</table>

17	a		$v = u + at$ written or better e.g. $32 = u + 3 \times 9$ [u =] $32 - 3 \times 9$ [= 5] or $32 - 27$ [= 5]	B1 B1	If **0** scored **SC1** for $5 + 3 \times 9$ or $5 + 27$ [= 32]	Written means selected and better includes $u = v - at$
	b		166.5	3	**M2** for $32^2 = 5^2 + 2 \times 3 \times s$ or better **oe** or **M1** for $v^2 = u^2 + 2as$ seen	
			Total	**5**		
18	a		Correct tree diagram	2	**B1** for 0.6 on missing branch in task 1 **B1** for $1 - x$ on both missing branches in task 2	If there is more than one answer on any branch, choose the one on the dotted line first
	b		They are independent **oe**	1		Pick the best comment, see Appendix*. *Refer to 'Qn11b, 2024 June, Alternative J560/04, Mark Scheme Appendix' within downloadable resource materials.
	c		0.36	4	**M2** for $0.4(1 - x) + 0.6x = 0.472$ or better or **M1** for $0.4(1 - x) + 0.6x$ or better **M1** for rearranging *their* linear equation, $kx + a = b$, to make kx the subject ($0<k$) OR **M2** for $1 - 0.4x - 0.6(1 - x) = 0.472$ or	e.g. **M2** for $0.4 + 0.2x = 0.472$ e.g. **M1** for $0.4 + 0.2x$ e.g. $0.472 - 0.4 = 0.2x$ or better allow similar equations involving $1 - 0.472$ e.g $0.4x + 0.6(1 - x) = 0.528$ e.g. $0.472 - 0.4 = 0.2x$ or better

					better or **M1** for 1 – 0.4x – 0.6(1 – x) or better **M1** for rearranging *their* linear equation, $kx + a = b$, to make kx the subject (0< k) OR **FT** *their* **(a)** if not correct for up to 3 marks e.g. if in (**a**) 1 - x is replaced with e.g. 0.6 then **M2** for 0.4 × 0.6 + 0.6x = 0.472 or better or **M1** for 0.4 × 0.6 + 0.6x or better **M1** for rearranging *their* linear equation, $kx + a = b$, to make kx the subject (0< k) If **0** scored **SC1** for any 2 branches correctly written down and added e.g. 0.4(1 – x) + 0.6(1 – x)	e.g. 0.6x = 0.472 – 0.4 × 0.6 or better Alternative method using trials **M1** for each correct trial up to **M3** and the correct answer from trials scores **4** marks, see appendix* *Refer to 'Qn11c, 2024 June, Alternative J560/04, Mark Scheme Appendix' within downloadable resource materials. Exactly two branches
			Total	**7**		
19	a		$\frac{x-4}{3}$ or $\frac{x}{3}-\frac{4}{3}$ oe	2	**B1** for x - 4 written in the correct place on the diagram or in the working space or **B1** for answer $\frac{x}{3}-4$ **oe** or $\frac{x+4}{3}$ **oe** or 3(x - 4) **oe** or correct answer using a different variable	(x - 4) ÷ 3 scores **2** marks x - 4 ÷ 3 scores **1** mark
	b		×15 + 64	4	**B3** for 15x and +64 or **B2** for ×15 or +64 in the correct place or **M2** for 3 × (5(x + 4)) [+ 4] or better or	**B3** may be seen on the diagram or as an expression Note: the variable x can be any letter for the **B** and **M** marks

					M1 for $5(x + 4)$ or better	
			Total	**6**		
20	a		$(5x - 7)(x + 2)$ **oe** -2 and $\frac{7}{5}$ **oe**	M2 B1FT	**M1** for $(5x + a)(x + b)$ with $a + 5b = 3$ or $ab = -14$ or $5x(x + 2) - 7(x + 2)$ or $x(5x - 7) + 2(5x - 7)$ correct or **FT** *their* linear factors	For **M2** and **M1** condone the omission of the final bracket. $\frac{(5x-7)(5x+10)}{5}$ followed by $5x - 7$ [= 0] and $x + 2$ [= 0] scores **M2**. If no products of factors shown then $5x - 7 = 0$ and $x + 2 = 0$ scores **M1**. After $5x(x + 2) - 7(x + 2)$ or $x(5x - 7) + 2(5x - 7)$ followed by correct answers award **M2B1 BOD**
	b		$(x + 5)^2 - 6$	3	**B1** for $(x + 5)^2$ **B2FT** *their* $(x + a)^2$ for *their* $- 6$ If **0** scored **SC2** for 'correct' answer with missing power or power written in the wrong place	e.g. $(x + 19)^2 - 342$ scores **B2FT** e.g. **SC2** for $(x + 5) - 6$ or $(x + 5^2) - 6$
			Total	**6**		
21			16 **nfww**	4	**B2** for 22.5 **M1** for 360 ÷ *their* 22.5 seen OR **B1** for $7a$ and a or $8a$ **M1** for $7a + a = 180$ **oe** **M1** for 360 ÷ *their* 22.5 seen	a = exterior angle and allow any consistent single letter **B1 M1** implied by $8a = 180$ or $\frac{180}{7+1}$ **oe** Alternative for number of sides: e.g. **M1** for $\frac{180(n-2)}{n} =$ $180 -$ *their* 22.5

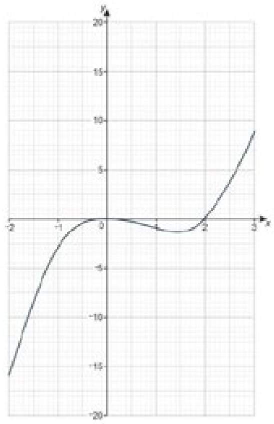
					Alternative method 1: **M2** for 7 × 360 = 180(n – 2) or better or **M1** for $\frac{180(n-2)}{n} = 7 \times \frac{360}{n}$ and **M1** for 180n = 2520 + 360 **oe** Alternative method 2: Use of trials by choosing a value for n. **M1** for each correct trial up to a maximum of **M3** for using <u>two</u> of these [exterior angle] = $\frac{360}{n}$ (formula A) [interior angle] = $\frac{180(n-2)}{n}$ (formula B) interior + exterior = 180 and for checking that interior = 7 × exterior if **0** scored **SC1** for one of formula A or B seen or used	 If they get 16 from any number of trials they score **4** marks. Trials can be seen from a calculation or a list. See Appendix* for likely results *Refer to 'Qn6, 2024 June, Alternative J560/04, Mark Scheme Appendix' within downloadable resource materials.
			Total	**4**		
22			[a =] 11.2 [b =] 2.4 with correct working	5	**B4** for one correct answer <u>with correct working</u> OR **M1** for $\frac{a+a+b+a+2b+3a-b}{4} = 18$ **oe** **M1** for 3a – b – a = 20 **oe** **M1** for equating coefficients of one variable for *their* linear equations **M1** for correct method to eliminate one variable for *their* original linear equations	"Correct working" requires evidence of at least **M1M1** for the two equations and **M1** for some evidence of solving them e.g. 6a + 2b = 72 e.g. 2a – b = 20 dependant on two linear equations e.g. 6a – 3b = 60 or 4a – 2b = 40 or 3a + b = 36 dependant on two linear equations e.g. 10a = 112 Allow one numerical error in each step of

					If **0**, **M1** or **M2** scored, instead award **SC3** for answers 11.2 and 2.4 with no working or insufficient working If **0** or **M1** scored, instead award **SC2** for a = 2.4 and b = 11.2 with no working or insufficient working If **0** scored, instead award **SC1** for two answers which satisfy one of the original conditions	solving *their* equations A sign error is not an arithmetic error Substitution method: **M1** and **M1** for the two equations**M1** dependant on two linear equations and for rearranging one equation to make one variable thesubject e.g. $a = \frac{20+b}{2}$ **M1** for substituting it into *their* other equation Trials (need to see the mean or total, and the range evaluated for each): **M1** for each correct trial up to a maximum of 3 After three correct trials, correct final answers score **5**
			Total	**5**		
23			Both inequalities $x \geq 12$, $x \leq -12$ as final answer	3	**B2** for answer one of $x \geq 12$ or $x \leq -12$ or **M1** for $x^2 \geq 144$ or for $(x+12)(x-12)$	Allow **3** marks for $-12 \geq x \geq 12$ final answer **B2** implied by answer e.g. $-12 \leq x \geq 12$ or $x \geq \pm 12$ as one element of inequality correct **M1** implied by 12 **or** -12 seen in answer
			Total	**3**		
24			$\frac{3n}{6n-1}$**oe** final answer	3	**B2** for denominator $6n - 1$ **oe**	Condone consistent use of different variable for all marks e.g. **B2** for denominator $6x - 1$

					or for $3n$ and $6n - 1$ seen or **B1** for $3n$ **oe** or for $6n - c$ **oe**	For B marks **isw** attempts to cancel after seen in fraction **B2** for denominator e.g. $5 + 6(n - 1)$ **oe** May not be in a fraction For **B1** expressions do not need to be in a fraction where c is any number including zero, or 'c' **B1** for e.g. $6n$, $6n - c$, $6n + 1$, $-7 + 6(n + 1)$ Do not allow as part of an incorrect expression e.g. $n^2 + 3n$
			Total	**3**		
25			$2x^3 + 3x^2 - 23x - 12$ final answer	3	**B2** for correct but unsimplified answer or for 3 correct terms in final answer with no more than 4 terms or **B1** for expansion of any two of the given brackets with three correct terms	e.g. $2x^3 + 9x^2 - 6x^2 - 27x + 4x - 12$ $2x^3 + 2x^2 + x^2 - 24x + x - 12$ $2x^3 + 8x^2 - 5x^2 - 20x - 3x - 12$ For **B2** accept correct terms on grid The simplified x term counts as two correct terms $2x^2 + 8x + x + 4$ [+] $9x$ counts as two terms $x^2 + 4x - 3x - 12$ [+1] x counts as two terms $4x^2 - 6x + x - 3 - 5x$ counts as two terms For **B1** accept e.g. x^2, [+] $4x - 3x$, $- 12$ on grid If in a longer train of 'random' terms only award **B1** if four correct consecutive terms are given
			Total	**3**		

26			$D = \sqrt[3]{16a}$ or $D = \sqrt[3]{16a^3}$ final answer	4	**M3** for 16 [π]a^3 = [π]D^3 or better or **M2** for $\frac{4}{3}[\pi]a^3 = \frac{1}{3}[\pi] \times \frac{D^2}{4} \times D$ **oe** or **M1** for $\frac{1}{3}\pi \times \frac{D^2}{4} \times D$	Condone *d* for *D*throughout Answer $\sqrt[3]{16a}$ or $\sqrt[3]{16a^3}$ allow **M3** For method marks condone 3.14, 3.142 or $\frac{22}{7}$ for π For method marks ignore any units For **M3** removes fractions and simplifies terms in *D* **M3** accept e.g. $16a^3 = D^3$ Must see correct expression in *D* for **M1**
			Total	**4**		
27			$\left(-\frac{7}{2}, \frac{49}{2}\right)$**oe** and (1, 2) with correct working	6	**M2** for $2x^2 + 5x - 7$ [= 0] or **M1** for $2x^2 = 7 - 5x$ **M2** for $(2x + 7)(x - 1)$ [= 0] or **M1** for $(2x + a)(x + b)$ where $ab = -7$ or $2b + a = 5$ or for correct partial factors $2x(x - 1) + 7(x - 1)$ or $x(2x + 7) - [1](2x + 7)$ **A1dep on M2M2** for either pair of coordinates correct or for both *x* values correct or both *y* values correct If **0, 1** or **2** scored, instead award **SC3** for answers	Accept (–3.5 , 24.5) Correct working requires evidence of at least **M2M2** For **M2** accept e.g. $7 - 5x - 2x^2$ [= 0] Strict **FT** *their* 3-term quadratic equation or expression e.g. If **M2** awarded for $7 - 5x - 2x^2$ [= 0] then factors should be correct for this equation for **M2** or **M1** Accept correct use of quad formula or completing the square, **M2** if completely correct, **M1** if one error in substitution in formula or $(x + a)^2$ correct if completing the square

					$\left(-\frac{7}{2}, \frac{49}{2}\right)$ **oe** and (1, 2) If **0** or **1** scored, instead award **SC2** for answer $\left(-\frac{7}{2}, \frac{49}{2}\right)$ **oe** or for both *x* values correct or both *y* values correct If **0** scored, **SC1** for one answer (1, 2)	If **A1** for correct *x*– values or *y* – values after correct partial factorisation award **M2** for factors Refer to 'Additional Guidance Qn21, 2024 June, Alternative J560/05, Mark Scheme Appendix' within downloadable resource materials, for work with equations in terms of *y*
			Total	**6**		
28			24	4	**M1** for [v =] 5 + 2 × 3 **M2** for *their* $\frac{(5+2\times3)^2-5^2}{(2\times2)}$ or better or **M1** for *their* $(5 + 2 \times 3)^2 = 5^2 + 2 \times 2 \times s$	**M1** implied by [v =] 11 Condone other variable used for *s* but not *v, u, a* or *t* See AG if other kinematics formulas used. Refer to 'Additional Guidance Qn9, 2024 June, Alternative J560/05, Mark Scheme Appendix' within downloadable resource materials.
			Total	**4**		
29	a		−3 and 9	2	**B1** for one correct value	
	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 $\frac{1}{2}$ small square of the correct seven points **FT** *their* values from the table in **(a)** but accept only the

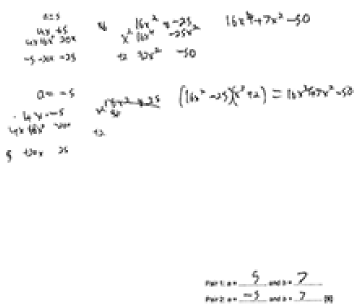
						correct curve Accuracy $\pm\frac{1}{2}$ small square radially If no points plotted mark the curve at the *x*-values Condone curve not having max at (0, 0) as long as it passes through correct points Condone wobbly curve and slight feathering Do not condone straight line segments
	c		2.5	1FT	Strict **FT** 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 e.g. if crossing between 2.4 and 2.5 accept 2.4 or 2.5 If curve has more than one *x* value where $y = 3$ then they must give all
			Total	**6**		
30			e.g. Top half: $n + (n+1) + (n+2) + (n+3) + (n+4) = 5n+10$ Bottom half: $(n+5) + (n+6) + (n+7) + (n+8) + (n+9)$ $= 5n+35$ $(5n + 35) - (5n + 10) = 25$	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	e.g. n, $n + 1$, $n + 2$, $n + 3$, $n + 4$, $n + 5$, $n + 6$, $n + 7$, $n + 8$, $n + 9$ For **M2** and **M1 FT** expressions of form $an + b$, $b \neq 0$ e.g. Top half: $2n + (2n + 1) + (2n + 2) + (2n + 3) + (2n + 4) = 10n + 10$

					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 = 25 shown algebraically or explained from correct working. <u>Alternative method for pairs of numbers</u> **B2** as above AND **M2** for the difference of five 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 five differences summed to 25 shown numerically or explained from correct working If **0** scored, allow **SC1** for a correct numerical or described example showing an overall difference of 25	Bottom half: $(2n + 5) + (2n + 6) + (2n + 7) + (2n + 8) + (2n + 9) = 10n + 35$ Accept unsimplified or simplified for **M** marks **A1** is **dep** on **B2M2** scored Condone $5n + 35$ $\underline{[-]5n + 10}$ 25 **A0** for $5n + 35 – 5n + 10$ or for just 35 – 10 or for use of 2n, $2n + 1$, $2n + 2$ etc as their algebraic terms e.g. "difference between n n+5 and n is 5" Must not be the numbers 5 to 14
			Total	**5**		
31			e.g.. P(seats given late) = $\frac{6}{11}$ P(seats given on time) = $\frac{12}{20}$ 0.5[45…] to 0.55 and 0.6[0] or $\frac{30}{55}$ and $\frac{33}{55}$	3	**M1** for P(seats given late) = $\frac{6}{11}$**oe**	Condone lack of labelling; mark to candidate's benefit. Condone wrong labelling for **M** marks only Include working on

			AND Yes/correct [because] **oe**		**M1** for P(seats given on time) = $\frac{12}{20}$ **oe**	the diagram Allocate similar marks if working with probabilities for "no seats": $\frac{5}{11}$ $\frac{8}{20}$ 0.45[4…] and 0.4 $\frac{25}{55}$ and $\frac{22}{55}$ 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
			Total	**3**		
32			$\frac{5x-31}{x-7}$ final answer **nfww**	5	**M2** for $\frac{x-3}{x-7}$ **nfww** or **M1** for (x + 3)(x – 3) AND **M2** for 4x – 28 + x – 3 or **M1** for 4(x – 7) + x – 3 <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 – 31)(x + 3) or **M1** for 5x^2 − 16x – 93	For **M2** and **M1** accept written as separate fractions e.g. **M2** for $\frac{4x-28}{x-7}+\frac{x-3}{x-7}$
			Total	**5**		
33			6$x^{3.5}$ **nfww** final answer	4		

					Mark coefficient and indices separately: **B1** for 6 from $\frac{4\times3}{2}$ AND **B3** for $x^{3.5}$ **nfww** or **B2** for $x^{6.5}$ from $x^6\times\sqrt{x}$ or for $x^{-2.5}$ or $\frac{1}{x^{2.5}}$ from $\frac{\sqrt{x}}{x^3}$ or **B1** for $\sqrt{x}=x^{\frac{1}{2}}$ or $x^{0.5}$ **B1** for x^3 from $\frac{x^6}{x^3}$ Accept equivalent fractions in place of decimal powers If attempting both $\frac{x^6}{x^3}$ and $\frac{\sqrt{x}}{x^3}$ mark to candidate's benefit rather than choice
			Total	**4**	
34	a		$\frac{1}{4}$ or [0].25 −6	2	**B1** for each **<u>Examiner's Comments</u>** Few candidates had both *k* and *m* correct and just over half had neither correct. The most common wrong answers were −4 for *k* and 6 for *m*.
	b		8 9	2	**B1** for each **<u>Examiner's Comments</u>** The mark distribution was almost identical to part (a). *m* was correct more often than *k*. The most common wrong answers were 6 for *k* and 6 for *m*.

			Total	**4**		
35			$a = 5$ $b = 7$ $a = -5$ $b = 7$ with correct working	6	**M1** for constant term identified as $-2a^2$ or seen in *their* expansion **M1** for *their* constant term = -50 **A1** for $a = 5$ or $a = -5$ AND **M1** for $b = 32 - a^2$ or for coefficient of x^2 identified as $32 - a^2$ or seen in their expansion M1 for $b = 32 - (\text{their } a)^2$ evaluated If **0, 1 or 2** scored instead award **SC3** for both correct pairs of answers $a = 5$ and $b = 7$ $a = -5$ and $b = 7$ If **0** or **1** scored instead award **SC2** for $a = 5$ and $a = -5$ or for $a = 5$ and $b = 7$ or for $a = -5$ and $b = 7$ If **0** scored instead award **M1** for $(4x + a)(4x - a) = 16x^2 - a^2$ or for $(4x + a)(x^2 + 2) = 4x^3 + ax^2 + 8x + 2a$ or for $(4x - a)(x^2 + 2) = 4x^3 - ax^2 + 8x - 2a$ or	Correct working requires evidence of at least **M1** AND **M1** Full expansion is $16x^4 + 4ax^3 - 4ax^3 + 32x^2 - a^2x^2 + 8ax - 8ax - 2a^2$ or better scores at least **M1** AND **M1** May be seen as $32x^2$ and $-a^2x^2$ in the expansion Trials: **M1M1M1M1** for $(4x + 5)(4x - 5)(x^2 + 2)$ expanded and simplified to $16x^4 + 7x^2 - 50$ **A1** for $a = 5$ or $a = -5$ or **M1M1M1** for $(4x + 5)(4x - 5)(x^2 + 2)$ expanded to $16x^4 + 20x^3 - 20x^3 + 32x^2 - 25x^2 + 40x - 40x - 50$ or better **A1** for $a = 5$ or $a = -5$

					SC1 for a = 5 or a = -5 or at least one answer with b = 7 **<u>Examiner's Comments</u>** The question provided a test of candidates' ability to expand brackets, and many did manage to either expand one pair of brackets correctly or to find the constant term as $-2a^2$, either of which scored M1. Half of these candidates were also able to get the correct coefficient for x^2 as $32 - a^2$. Other candidates making an attempt often lost terms in their expansions so that terms did not cancel out as they should, or they miscopied their work from one line to the next. Few candidates knew what to do with their expansion, with many attempting to make their expansion equal to the question's right-hand side and then rearranging to equal 0 before abandoning their work. The few successful candidates matched the constant terms as $-2a^2 = -50$, hence a = 5 and −5, and b could then be found by matching the coefficients of x^2 as $32 - a^2 = b$. Exemplar 3  There is not a lot of working shown here but it is an interesting response. Only a few candidates from this entry scored full marks on this question and this was one of them. The order of the working is not clear and on first sight, it looks like trials or a fluke. However, if that were the case it is unlikely the candidate would find a as both 5 and -5. Closer inspection, suggests there is a bit more going on here, perhaps not written, which at least suggests

there are alternative ways of answering this question using deduction and insight similar to the technique of factorisation by inspection covered in A Level Maths.

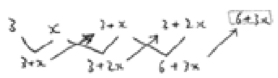
This candidate has been very efficient, showing less working than to be expected in a 'you must show your working' question. However, this response is covered in the minimum requirement for full marks by the alternative method on the mark scheme. The candidate has likely multiplied the constant terms in their head, reaching the equivalent of $-2a^2 = -50$, mentally processed this to $a^2 = 25$ and hence they reach $a = \pm 5$. Only then do they put pen to paper. The two grid expansions of $(4x + a)(4x - a)$ with $a = 5$ and $a = -5$ are conducted on the left-hand side of the page. These both produce $16x^2 - 25$ (condoning the sign omission in one of the grids as this is really a check rather than new work). So, the candidate then has $(16x^2 - 25)(x^2 + 2)$ which is then expanded by the grid method, enabling them to see that $b = 7$.

Overall, the candidate has performed the most relevant parts of the mark scheme's main method without the need to find the full expansion. However, it would have been helpful to examiners to see $-2a^2 = -50$.

The candidate's approach gives rise to consideration of an accessible alternative method although not seen, where candidates produce the same lines of working but in reverse. Focussing on obtaining the right-hand side's required coefficient of x^4 and the required value of the constant can only lead to $(16x^2 - 25)(x^2 + 2)$ since there are no x^3 or x terms present on the right-hand side. This can then be expanded to give $b = 7$. Factorisation of $16x^2 - 25$ as $(4x + 5)(4x - 5)$ is within the specification, but candidates would then need to interpret this as meaning both $a = 5$ and $a = -5$.

Assessment for learning

In their struggles with this question, some candidates made multiple attempts, none of which produced an answer on the answer line. Therefore, as per the marking guidance this is treated as choice and the poorest attempt would

					be marked. Candidates should be advised in future similar situations to make the decision as to which attempt they wish to be marked and to cross-through the others.
			Total	**6**	
36			$f=\frac{k}{e}$ oe final answer	2	**B1** for answer $\frac{k}{e}$ oe or **M1** for e [x] $f = k$ or for $\frac{1}{e}=\frac{f}{k}$ **<u>Examiner's Comments</u>** The majority of the candidates scored full marks, and some candidates scored one mark for reaching $ef = k$. For full marks candidates needed to write their answer as a formula, $f=\frac{k}{e}$, and not just $\frac{k}{e}$.
			Total	**2**	
37	a		$3 + x$ $3 + x + 3 + 2x$ [= $6 + 3x$]	1 1	Intent to add correct successive algebraic terms must be clearly conveyed eg  A list of the terms 3, x, $3 + x$, $3 + 2x$, $6 + 3x$ is insufficient for the second mark but scores the first mark for $3 + x$ **<u>Examiner's Comments</u>** About a quarter of candidates scored full marks and another quarter scored 1 mark for writing the third term as $3 + x$. A common wrong expression for the third term was $3x$. This was a 'show that' demand with the answer

					given, so just putting 6 + 3*x* in a list of terms was insufficient for the second mark. Instead, candidates needed to show it being the result of the third term + the fourth term,written as 3 + *x* + 3 + 2*x* = 6 + 3*x* or similar as per the mark scheme. Candidates who merely replaced *x* with a value to generate a sequence scored zero.
	b		13 nfww	4	**M2** for 9 + 5*x* = 74 or **M1** for 3 + 2*x* + 6 + 3*x* or better **M1 FT** for [*x* =] $\frac{74 - their\ 9}{their\ 5}$ **M2** may be subsequently implied by arithmetic working FT must be from a*x* + b = c May be seen in stages as two arithmetic steps or as formal algebra Correct answer from trials scores 4 **<u>Examiner's Comments</u>** Candidates who had shown correctly how to obtain the fifth term in part (a), usually also found the sixth term as 9 + 5*x*, scoring M1. Writing this as part of the equation 9 + 5*x* = 74, scored M2 rather than M1. Many candidates solved the equation correctly and thus scored full marks. A few candidates resorted to trial and improvement either to solve their equation or to generate several Fibonacci sequences starting with 3 and various trial values for *x*. A final answer of *x* = 13 scored full marks but there were no part marks available for trials. Candidates who had an incorrect equation could score a follow through mark as long as their equation was of comparable difficulty to the correct one.
			Total	**6**	
38	a		÷2 −3	2	**B1** each

					or **SC1** wrong order **<u>Examiner's Comments</u>** The great majority of candidates scored the mark for the two inverse operations of − 3 and ÷ 2, but less than half of these gave those operations in the correct order.
	b		[m =] 0.5 nfww [p =] 6 nfww	5	**M1** for $5m + p = 8.5$ oe **M1** for $10m + p = 11$ oe AND **B2** for $m = 0.5$ nfww or $p = 6$ nfww or **M1** for $10m - 5m = 11 - 8.5$ or $5m = 2.5$ or $2p - p = 17 - 11$ If **0** scored, instead award **SC1** for two answers which satisfy one of the original conditions Correct answer from trial and improvement scores **5** **<u>Examiner's Comments</u>** About half of the candidates scored full marks and a quarter scored zero. The anticipated approach was to write the information as a pair of fairly simple simultaneous equations, scoring 2 marks with a further 3 marks for their correct solution. However, the most often seen methods were a variety of types of trials, some with a structure and others very random. If successful, trials scored 5 marks but if unsuccessful then zero was given.
			Total	**7**	
39	a		5, 6, 7	3	

					B2 for 3 correct values with one extra or for 2 correct values OR **M1** for $10 + 2 < 3x$ or better **M1** for $3x \le 21 + 2$ or better For **M** marks condone use of incorrect inequality sign or equals **Examiner's Comments** Generally, candidates either understood the notation and scored 2 or 3 marks, or they did not and scored zero. Some candidates omitted the question, despite is being a standard style of question. Candidates scoring 2 marks rather than 3 included those who listed 4 in their answer and those who obtained $12 < 3x < 23$ or better, with two separate inequalities being accepted.
	b		−6 is smaller than −3	1	Accept: It should be $-6 < x < -3$ oe $-3 < x$ contradicts $x < -6$ oe −6 and −3 should be switched oe Signs are wrong way around **Examiner's Comments** Many candidates appeared unfamiliar with the set notation in this question, with comments such as 'there should not be a colon' seen. Acceptable responses needed to show a recognition either in words that '−6 is smaller than −3' or similar, or in symbols such as it should be $-6 < x < -3$.
			Total	**4**	
40	a		$\frac{1}{2}$ oe	1	

					Examiner's Comments Many candidates attempted to answer this part, and a few were successful. Common incorrect answers were $\frac{1}{24}$, 24, $\sqrt[3]{8}$ and 2^{-3}.
	b		$2^x \times 2^{2y} = 2^4$ $x + 2y = 4$ one further step leading to $y = 2 - \frac{x}{2}$	M2 M1 A1	**B1** for 2^{2y} or 2^4 **M1 dep on M2** For M2 accept equivalent work with all terms in other bases e.g. 4 Accept $(2^2)^y$ for 2^{2y} Allow B1 for writing one other term correctly in base 4 or base 16 e.g. $[2^x =]\ 4^{\frac{x}{2}}$ or $[4^y =]\ 16^{\frac{y}{2}}$ For M1 accept correct equivalent equation **Examiner's Comments** Candidates who recognised that all the terms could be written in terms of base 2 often achieved full credit. Many unsuccessful candidates attempted to substitute values or $y = 2 - \frac{x}{2}$ into the original equation.
			Total	**5**	
41			$2n^2 + 1 + 2(n + 1)^2 + 1$ $2n^2 + 1 + 2n^2 + 4n + 2 + 1$ or better $4n^2 + 4n + 4$ Correct conclusion e.g. $4(n^2 + n + 1)$ and multiple of 4 Each of the terms is divisible by 4 so multiple of 4	M2 M2 A1 A1	**M1** for $2(n + 1)^2 + 1$ or $2(n - 1)^2 + 1$ Dep on M2 FT *their* consecutive algebraic terms For all brackets correctly expanded **M1** for a squared bracket correctly expanded e.g. [2] $(n^2 + n + n + 1)$ or better **FT** *their* consecutive algebraic terms after M2M2 earned Accept $2(n + a)^2 + 1 + 2(n + b)^2 + 1$ oe where there is a difference of 1 between *a* and *b* M1 accept any bracket squared expansion seen e.g. $(2n + 3)^2 = 4n^2 + 6n + 6n + 9$ or better or [2]$(n^2 - n - n + 1)$ if $2(n - 1)^2$ used Accept e.g. $4n^2$ –

					With no errors or omissions seen 4n + 4 if n and n – 1 used **Examiner's Comments** The few candidates who recognised that the (n + 1)th term was 2(n + 1)^2 + 1 generally achieved full credit. The majority of candidates attempted to substitute numbers into the nth term. This method did not achieve credit as the question demand asks for a proof.
			Total	**6**	
42	a		$y \le x + 4$ oe and $y < 9$	3	**B2** for $y \le x + 4$ oe or **B1** for $y \ldots x + 4$ oe but with = or an incorrect inequality symbol **B1** for $y < 9$ Accept inequalities in either order **Examiner's Comments** A small number of candidates fully answered this part correctly. Some candidates found the equations for both boundary lines but were unable to write the correct inequality to describe the region. Candidates were more successful in giving $y < 9$ than $y \le x + 4$. Many struggled to find the equation of the boundary line $y = x + 4$ using the parallel line property with $y = x$ and having y – intercept 4.
	b		12 nfww	4	**B2** for (2, 6) and (6, 6) or (5, 9) and (9, 9) identified or for base 4 and perpendicular height 3 both identified or **B1** for (2, 6) or (6, 6) or (5, 9) or (9, 9) or for base = 4 or height = 3 AND May be seen on diagram Must identify base and perpendicular height of parallelogram in working or on diagram Do not allow if slant height used

					M1 for *their* base × *their* perpendicular height **Examiner's Comments** This part was omitted by many candidates. A small number attempting this were successful and others earned method marks by annotating the diagram with correct values for the length and/or the perpendicular height of the parallelogram. Some wrote coordinates of vertices and received partial credit. A misconception for some was to write 3 as the slant height of the parallelogram.
			Total	**7**	
43			$\frac{1}{3}$ and 5 with correct working	6	**B3** for $3x^2 – 16x + 5$ [= 0] oe or **M2** for $x^2 – 5 = 4x^2 – 16x$ or better or **M1** for $x^2 – 5 = 4x(x – 4)$ **M2** for $(3x – 1)(x – 5)$ [= 0] or **M1** for $3x(x – 5) – 1(x – 5)$ or for $x(3x – 1) – 5(3x – 1)$ or for $(3x + a)(x + b)$ where $ab = 5$ or $3b + a = –16$ If **0** or **1** scored instead award **SC2** for correct answers Correct working requires at least B3 and M1 For B3 accept negative version, accept $3x^2 – 16x = –5$ M2 and M1 FT *their* 3-term quadratic M2 alt method correct substitution into formula or correct complete square M1 condone 1 error in substitution into formula For complete square, correct FT $(x + a)^2$ **Examiner's Comments** Many candidates removed the denominator $x – 4$ from the fraction as the first step and often used brackets when doing this. A number made errors when expanding the bracket, e.g. $4x(x – 4) = 4x^2 – 16$. A small number attempted to incorrectly factorise $x^2 – 5$ to $(x – 5)(x + 5)$. Those that did

					manipulate the algebra correctly to 3-term quadratic sometimes went on to give the correct solutions. The preferred method was to factorise the quadratic equation although a few used the formula. Those that factorised sometimes made sign errors. Examiners awarded method marks for those that used a correct method to solve their 3-term quadratic equation.
			Total	**6**	
44			-0.3 oe	3	**M1** for correct first step **M1** FT *their* first step to to $ax = b$ Embedded answer scores **M2** max If not shown, **M1** implied by $10x = b$ or $ax = -3$ $10x = -3$ or $-10x = 3$ **<u>Examiner's Comments</u>** Most candidates answered this well. Those that made errors were usually in the signs when dealing with inverse operations, collecting terms in *x* and the numbers on each side of the equation.
			Total	**3**	
45			No and 4 × 3 + 9 = 21 oe Or No and (23 – 9) ÷ 4 = 3.5 oe Or No the equation would need to be $y = 4x + 11$	2	**M1** for 4 × 3 + 9 or for 23 – 9 ÷ 4 For 2 marks no errors seen accept No and (3, 21) or (3.5, 23) For M1 allow no/incorrect evaluation **<u>Examiner's Comments</u>** This was answered well by a number of candidates. The most common approach was to substitute $x = 3$ into $y = 4x + 9$ and show that $y = 21$ and not 23. A number of candidates omitted this part.
			Total	**2**	

46	a		$5 \times 22 - 8$ or $\frac{102+8}{5} = 22$ oe	M1	Condone 110 – 8 or $5u_3 - 8 = 102$ then $5u_3 = 110$ then $u_3 = 22$ **Examiner's Comments** This question was aimed at those aiming for the highest grades and many candidates did not attempt it. Those who did often made a good attempt at this part and showed the necessary working of 5 × 22 – 8.
	b		6	3	**M2** for $\frac{22+8}{5}$ or better or **M1** for $u_3 = 5u_2 - 8$ or better e.g. **M2** for $\frac{30}{5}$ e.g. **M1** for $22 = 5u_2 - 8$ **Examiner's Comments** Part (a) was designed to help scaffold this part, where candidates were expected to write an equation $22 = 5u_2 - 8$ and then rearrange it to find u_2.
	c		2 $u_2 = u_1$, so all terms will be equal	B1 B1	If **0** scored **SC1** for next term = 2 or 5 × 2 – 8 seen For additional information refer to '2024 November, J560/04, Mark Scheme Appendix: item 4' within downloadable extra resource materials. $u_2 = u_1$, so all terms will be equal **1** every term is 2 **1** because $u_2 = 2$ **0** because u_2 equals u_1 **0** **Examiner's Comments** As in part (a) it was hoped that many would calculate 5 × 2 – 8 = 2. Indeed, some did do this. However, a common error was candidates

					noticing that u_1 was 2 × 1, leading to a lot of u_{50} = 2 × 50 = 100 as the answer.
			Total	**6**	
47	a		[$2^3 - 3 \times 2 - 4 =$] –2 [$3^3 - 3 \times 3 - 4 =$] 14 and any indication of a sign change [so solution lies between 2 and 3]	M1 M1 A1	Must indicate their input and output Dep. on at least **M1** and different signs Accept other values of x used between 2 and 3, correct to 2 figs rot, (see table in part (c)). For full marks, the two values need to produce a sign change. <u>Alternative method</u> **SC3** for using an iterative equation that converges **and** concluding statement that first two values lie between 2 and 3 oe For additional information refer to '2024 November, J560/04, Mark Scheme Appendix: item 5' within downloadable extra resource materials. Sign change …. **A1** -2 < 0 < 14 **A1(BOD)** answer lies between 2 and 3 **A0** answer is in the middle is insufficient **A0**

x	fn
2	-2
2.1	-1.039
2.2	0.048
2.3	1.267

					<table><tr><td>2.4</td><td>2.624</td></tr><tr><td>2.5</td><td>4.125</td></tr><tr><td>2.6</td><td>5.7765</td></tr><tr><td>2.7</td><td>7.583</td></tr><tr><td>2.8</td><td>9.552</td></tr><tr><td>2.9</td><td>11.689</td></tr></table> **Examiner's Comments** This question was similar to others we have set on this topic, here in part (a) we just need the values to be calculated by substituting both $x = 2$ and $x = 3$ into the function and noticing the change of sign. Some started to evaluate other values for x between 2 and 3 and this was unnecessary extra work.
	b		$[x = 2.5]$ 4.125 $2 < x < 2.5$	B1 B1	Condone equals signs and condone in words, allow a smaller correct interval **Examiner's Comments** Candidates needed to substitute $x = 2.5$ and look at the sign, then pick the two values with a sign change. Many did the substitution and gave the correct value but did not progress further.
	c		Two correct evaluations in the range $2 < x < 2.5$, one which gives a positive value and the other giving a negative value $[x =]$ 2.2	M2 A1	<table><tr><td>**M1** for one correct evaluation in the range $2 < x < 2.5$ Dependent on achieving at least **M1** <u>Alternative method</u> **M1** rearranges to a correct iterative formula (converging or diverging) and **M1** <u>attempts</u> first two</td><td>Working for **(c)** may be seen in **(b)** Examples <table><tr><td>2.05</td><td>-1.53488</td></tr><tr><td>2.1</td><td>-1.039</td></tr><tr><td>2.15</td><td>-0.51163</td></tr><tr><td>2.2</td><td>0.048</td></tr></table></td></tr></table>

					iterations (either substitution seen or found to at least 2dp rot) and **A1** for 2.2 OR If **0** scored **SC1** for 2.2 with no worthwhile working *condone missing suffixes here* e.g. $x_{n+1} = \sqrt[3]{3x_n + 4}$ with x_0 = 2, x_1 = 2.1544…, x_2 = 2.1872… **Examiner's Comments** Here was the part to start evaluating the function for values of x between 2 and 2.5. Many candidates did not attempt this part, but a few did give the correct answer.
			Total	**8**	
48	a		correct curve within tolerance	3	**B2** for 8 points accurately plotted or **B1** for 5 points accurately plotted tolerance $\pm\frac{1}{2}$ small square radially for curve and points, some daylight between y = -8 and curve , condone a wobbly curve and slight feathering or tram lines in no more than 3 sections but no ruled lines and no dashed lines **Examiner's Comments** There were many candidates who left this question unanswered, those who plotted the points accurately did achieve some credit. The lines drawn did not always go through the points plotted and between x = 0 and x = 1 it is necessary to see the curve dip down and not be drawn as a horizontal line.
	b		x = 0.5 oe	1	

2.25	0.640625
2.3	1.267
2.35	1.927875
2.4	2.624
2.45	3.356125

					Examiner's Comments There were very few correct answers, many of the incorrect answers were not the equations of straight lines.	
	c		-2.3 or -2.4 3.3 or 3.4	2	**B1** for either answer **SC1** for an answer to more than 1 dp in each of -2.4 to -2.3 and 3.3 to 3.4 If **1** scored **FT** *their* curve for **2** marks or if **0** scored **FT** *their* curve for **1** or **2** marks or for **SC1** **Examiner's Comments** Those candidates who drew the graph correctly usually answered this part correctly as well, but some did give answers that showed they did not know where to find these answers, where the curve crosses the x-axis.	tolerance small $\pm\frac{1}{2}$ square radially
			Total	**6**		
49			[y =] $56x^2$ with correct working	6	**B2** for $y = 3.5t^2$ or **M1** for $y = kt^2$ or better e.g. $14 = k2^2$ or $k = 3.5$ **B2** for $t = 4x$ or **M1** for $t = mx$ or better e.g. $12 = m^3$ or $m = 4$ **M1** for $y = 3.5(4x)^2$ If **0**, **1** or **2** scored, instead award **SC3** for $y = 56x^2$ with no working or insufficient working **Examiner's Comments** Many candidates did start to answer this	"Correct working" requires evidence of at least **M1M1** or **B2** condone e.g. $y = kt^2$ and $k = 3.5$ for **B2** condone e.g. $t = mx$ and $m = 4$ for **B2** for **M1FT** allow combining *their* two expressions for y and t

					question correctly, but they would often write the equations as, e.g. $t = kx$ and then give $k = 4$ but they did not write the complete equation $t = 4x$. These candidates would then find it difficult to combine the two equations. **Assessment for learning** The purpose of these questions is often to write out the equation linking two variables and that finding the value of the constant of proportionality, usually k, is not the end of the process.
			Total	**6**	
50	a		$v = u + at$ written or better e.g. $21 = u + 2 \times 8$ [u =] $21 - 2 \times 8$ [= 5] or $21 - 16$ [= 5]	B1 B1	If **0** scored **SC1** for $5 + 2 \times 8$ or $5 + 16$ [= 21] | written means selected and better includes $u = v - at$ **<u>Examiner's Comments</u>** Many did not know which formula to use. Some attempted to use the second formula, which will not give the answer required. The information given were the values for *a*, *v* and *t*, but very few wrote down these variables.
	b		104	3	**M2** for $21^2 = 5^2 + 2 \times 2 \times s$ or better oe or **M1** for $v^2 = u^2 + 2as$ seen | Equivalents include e.g. 6 + 8 + 10 + 12 + 14 + 16 + 18 + 20 **<u>Examiner's Comments</u>** The distance travelled, *s*, is only in the second formula, but many tried to use the first formula. As in part (a), there is a need for candidates to identify the variables given and those that are required.
			Total	**5**	

51	a		Hiro and square roots of 16 are 4 and $^{-}4$ **oe**	1		Accept: Hiro because Riley only used the positive square root; Hiro because verification of $^{-}3$. Do not accept: Two solutions expected for a quadratic; Hiro because …
	b		6.37 and [0].63 with correct algebraic working	4	**M2** for correct substitution into the formula e.g. $\frac{^{-}(^{-}7)\pm\sqrt{(^{-}7)^2-4[\times1]\times4}}{2[\times1]}$ oe allowing one error or for solving by completing the square e.g. $\left(x-\frac{7}{2}\right)^2-\left(\frac{7}{2}\right)^2+4=0$ **oe** **and** $x=\pm\sqrt{(^{-}4)+\left(\frac{7}{2}\right)^2}+\frac{7}{2}$ **oe** or better or **M1** for correct substitution into the formula, allowing two errors, or for completing the square e.g. $\left(x-\frac{7}{2}\right)^2-\left(\frac{7}{2}\right)^2+4=0$ **oe** or better and	"Correct working" requires evidence of at least **M2** For **oe** allow better up to $\frac{7\pm\sqrt{49-16}}{2}$ but do not allow $\frac{7\pm\sqrt{33}}{2}$ Condone 7^2 for $(^{-}7)^2$

					A1 for 6.37 or [0].63 **nfww** or for both solutions correct **nfww** but to more than 2 dp, to just 1 dp or in exact form If **0** scored, instead award **SC1** for both answers correct or to more than 2 dp, to just 1 dp or in exact form with no working or insufficient working	e.g. 6.37228… and 0.62771…. 6.4 and 0.6, $\frac{7 \pm \sqrt{33}}{2}$
			Total	**5**		
52	a		$3^5 - 60 \times 3 - 200 = {}^-137$ and $4^5 - 60 \times 4 - 200 = 584$ Sign change so solution between $x = 3$ and $x = 4$	3	**M2** for $3^5 - 60 \times 3 - 200 = -137$ and $4^5 - 60 \times 4 - 200 = 584$ or **M1** for $3^5 - 60 \times 3 - 200$ **soi** by $^-137$ or $4^5 - 60 \times 4 - 200$ **soi** by 584 <u>Alternative method</u> After $x^5 - 60x = 200$ seen **M2** for $3^5 - 60 \times 3 = 63$ and $4^5 - 60 \times 4 = 784$ **A1** for 63 < 200 and 784 >200 so solution between $x = 3$ and $x = 4$ OR **M1** for $3^5 - 60 \times 3$ **soi** by 63 or $4^5 - 60 \times 4$ **soi** by 784 <u>Alternative method</u> **SC3** for using an iterative equation that converges to a value in the range 3.25 and 3.35 **and** concluding statement that 3 < 3.25 to 3.35 < 4 **oe**	Accept other values of x used between 3 and 4 (see table in part (b)). For full marks, the two values need to produce a sign change or values either side of 200 if using alternative method. Examples just sufficient for third mark include: Change of sign $^-137 < 0 < 584$ $x = 3$ gives an answer < 0 and $x = 4$ gives an answer > 0 Example insufficient for third mark: so x lies between 3 and 4 If within part **(a)** candidates <u>refer to</u> their working in part **(b)**, award marks for this final alternative method.

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<td></td>
<td>or
SC2 for using an iterative equation that converges to a value in the range 3.25 to 3.35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b</td>
<td></td>
<td>Examples:
when $x = 3.1$ $y = {}^{-}99[.7…]$, so $3.1 < p < 4$
when $x = 3.5$ $y = 115[.2…]$, so $3 < p < 3.5$
when $x = 3.1$ $y = {}^{-}99[.7…]$ and when $x = 3.5$ $y = 115[.2…]$, so $3.1 < p < 3.5$</td>
<td>3</td>
<td>Dependent on achieving at least M2

M2 for one further value of y evaluated correctly, possibly rot or truncated to 2 or more sf, for a value of x such that $3 < x < 4$

OR

M1 for working shown to calculate one further value of y for a value of x such that $3 < x < 4$

<u>Alternative method</u>
After $x^5 – 60x = 200$ seen
Award marks as for the main method, but with one evaluation being < 200 and the other being > 200

Note after SC considered in part (a):
if SC2 was awarded then they must use a value of x that produces a smaller interval than $3 < x <$ their x-value in (a) or their x-value in (a) $< x < 4$

If 0 scored, instead award
SC1 or SC2 if evidence for M1 or M2 has not been credited in part (a)</td>
<td>Likely values: accept rot to 2+sf
<table>
<tr><th>x</th><th>$x^5 – 60x$</th><th>$x^5 – 60x – 200$</th></tr>
<tr><td>3.1</td><td>100.2915</td><td>-99.7085</td></tr>
<tr><td>3.2</td><td>143.5443</td><td>-56.4557</td></tr>
<tr><td>3.25</td><td>167.5908</td><td>-32.4092</td></tr>
<tr><td>3.26</td><td>172.6036</td><td>-27.3964</td></tr>
<tr><td>3.27</td><td>177.6856</td><td>-22.3144</td></tr>
<tr><td>3.28</td><td>182.8376</td><td>-17.1624</td></tr>
<tr><td>3.29</td><td>188.0602</td><td>-11.9398</td></tr>
<tr><td>3.3</td><td>193.3539</td><td>-6.64607</td></tr>
<tr><td>3.31</td><td>198.7196</td><td>-1.28042</td></tr>
<tr><td>3.32</td><td>204.1578</td><td>4.157762</td></tr>
<tr><td>3.33</td><td>209.6691</td><td>9.669132</td></tr>
<tr><td>3.34</td><td>215.2544</td><td>15.25435</td></tr>
<tr><td>3.35</td><td>220.9141</td><td>20.9141</td></tr>
<tr><td>3.4</td><td>250.3542</td><td>50.35424</td></tr>
<tr><td>3.5</td><td>315.2188</td><td>115.2188</td></tr>
<tr><td>3.6</td><td>388.6618</td><td>188.6618</td></tr>
<tr><td>3.7</td><td>471.4396</td><td>271.4396</td></tr>
<tr><td>3.75</td><td>516.5771</td><td>316.5771</td></tr>
<tr><td>3.8</td><td>564.3517</td><td>364.3517</td></tr>
<tr><td>3.9</td><td>668.2420</td><td>468.2420</td></tr>
</table>

A correct narrower range scores 0 unless accompanied</td>
</tr>
</table>

						by the relevant correct calculations. Calculations in support of $x = 3$ or $x = 4$ need not be repeated from part **(a)**
			Total	**6**		
53			$\frac{x-3}{x-4}$	5	**M4** for $\frac{x(x+4)(x-3)}{x(x+4)(x-4)}$ or $\frac{(x+4)(x-3)}{(x+4)(x-4)}$ OR **M2** for $[x](x+4)(x-3)$ or **M1** for $[x](x(x-3)+4(x-3))$ or $[x](x(x+4)-3(x+4))$ or for $[x](x+a)(x-b)$ where $a - b = 1$ or $ab = {}^{-}12$ and **M1** for $[x](x+4)(x-4)$ or $\frac{x(x^2+x-12)}{x(x^2-16)}$ or $\frac{x^2+x-12}{x^2-16}$ or for $x^2 + x - 12$ and $x^2 - 16$ or any other partially factorised form of the numerator or denominator	For **M2** and **M1** marks, if written as a quotient, condone [x] not being consistently present in both or cancelled out from both Also award **M2** and **M1** marks for factorising without first factorising [x]. e.g. $(x^2+4x)(x-3)$ earns **M2**
			Total	**5**		
54			[0].6 **oe** with correct working	5	<u>By Equation:</u> **M3** for $5k + 12$ and $10(5 - 2.5)k$ **oe** or **M1** for $5k + 12$ **M1** for $(5 - 2.5)k$ or $2.5k$ AND **M1FT** for $20k = 12$	Correct working" requires evidence of at least **M3** $5k + 12$ [**M1**] = $17k$ [**isw**, but ruled out of **M3** and **M1FT** if $17k$ used] $5 - 2.5k = 2.5k$ [**M1** bod]

<table>
<tr>
<td></td><td></td><td></td><td></td><td></td>
<td>If 0 or 1 scored, instead award
SC2 for answer [0].6 with no working or insufficient working
If 0 scored, instead award
SC1 for $\frac{^-48}{19}$ or $^-2.526…$ to -2.53 as final answer

<u>By Trials</u>:
M4 for 5k + 12 and either 10(5 – 2.5)k oe or (5 – 2.5)k oe both correctly evaluated with k = 0.6

or

M3 for 5k + 12 and either 10(5 – 2.5)k oe or (5 – 2.5)k oe both correctly evaluated in one trial with consistent k

or
M1 for 5k + 12 correctly evaluated in one trial
M1 for either 10(5 – 2.5)k oe or (5 – 2.5)k oe correctly evaluated in one trial

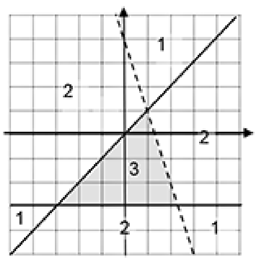
SC award marks as above</td>
<td>FT their linear equation in the form ak + b = ck

SC1 is from × 10 of wrong function

<table>
<tr><th>k</th><th>5k+12</th><th>10 (5–2.5)k</th><th>(5–2.5)k</th></tr>
<tr><td>0.5</td><td>14.5</td><td>12.5</td><td>1.25</td></tr>
<tr><td>0.6</td><td>15</td><td>15</td><td>1.5</td></tr>
<tr><td>0.7</td><td>15.5</td><td>17.5</td><td>1.75</td></tr>
<tr><td>0.8</td><td>16</td><td>20</td><td>2</td></tr>
<tr><td>0.9</td><td>16.5</td><td>22.5</td><td>2.25</td></tr>
<tr><td>1</td><td>17</td><td>25</td><td>2.5</td></tr>
<tr><td>2</td><td>22</td><td>50</td><td>5</td></tr>
<tr><td>3</td><td>27</td><td>75</td><td>7.5</td></tr>
<tr><td>4</td><td>32</td><td>100</td><td>10</td></tr>
<tr><td>5</td><td>37</td><td>125</td><td>12.5</td></tr>
<tr><td>6</td><td>42</td><td>150</td><td>15</td></tr>
<tr><td>7</td><td>47</td><td>175</td><td>17.5</td></tr>
<tr><td>8</td><td>52</td><td>200</td><td>20</td></tr>
<tr><td>9</td><td>57</td><td>225</td><td>22.5</td></tr>
<tr><td>10</td><td>62</td><td>250</td><td>25</td></tr>
</table></td>
</tr>
<tr><td></td><td></td><td></td><td>Total</td><td>5</td><td></td><td></td></tr>
<tr><td>55</td><td>a</td><td></td><td>2
14</td><td>1
1FT</td><td>FT from their 2</td><td></td></tr>
<tr><td></td><td>b</td><td></td><td>[a =] 2
[b =] $^-3$</td><td>3</td><td>B2 for [a =] 2
or B1 for [b =] $^-3$
or M1 for second difference +4 or for a correct pair of simultaneous equations</td><td>e.g. a + b = $^-1$ and 4a + b = 5</td></tr>
</table>

			Total	**5**		
56			$2x^2 - 5x - 4x - 41 + 6$ [= 0] or better $(2x + 5)(x - 7)$ $^-2.5$ **oe** 7	M1 M2 B1	**M1** for two brackets giving two correct terms **FT** *their* brackets	e.g. $2x^2 - 9x - 35$ [= 0]
			Total	**4**		
57			6561 with no extras	3	**M1** for $\frac{x^{-\frac{1}{4}} \times x^{\frac{7}{8}}}{x^{\frac{1}{2}}}$ = 3 or better **M1** for $\frac{-1}{4}+\frac{7}{8}-\frac{1}{2}=\frac{1}{8}$ or better e.g. $x^{\frac{1}{8}} = 3$	<u>Alternative method:</u> **M1** for $x^{\frac{1}{2}-\frac{7}{8}}$ or $x^{-\frac{3}{8}}$ or $x^{-\frac{1}{4}+\frac{7}{8}}$ or $x^{\frac{5}{8}}$ **M1** for $x^{-\frac{1}{4}-\mathit{their}\,-\frac{3}{8}}$ or $x^{\frac{5}{8}-\frac{1}{2}}$ or $x^{\frac{1}{8}}$ Could be $x^{\frac{3}{8}}$ or $x^{-\frac{1}{8}}$ depends on which side of the equation
			Total	**3**		
58			$^-2$ $^-1$ 0 1 2 3	3	**B2** for 5 correct and none incorrect or 6 correct and 1 incorrect OR **M1** for $^-9 - 3 < 4x$ or better **M1** for $4x \le 15 - 3$ or better If **0** scored, award **SC1** for $x = {^-3}$ and $x = 3$	e.g $\frac{-12}{4} < x$ or $^-3 < x$ e.g. $x \le \frac{12}{4}$ or $x \le 3$
			Total	**3**		
59	a		Expanding the brackets gives – x **oe** $(x - 5)(x + 6)$	1 1		Accept any correct response, look for answers in the working space.

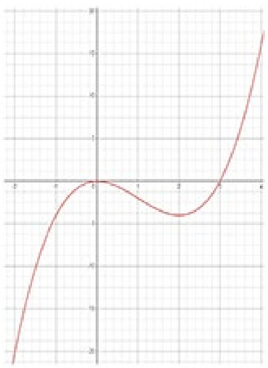
					Response Mark Expanding brackets gives – x **1** The signs are the wrong way round (condone inverted) **1** The minus sign is on the wrong one **1** They are the wrong factors **0** The answer is $(x - 5)(x + 6)$ **0** The answer is 5 or $^-6$ **0**
	b		The third line should be 6 – 10 $4x = 6 - 10$ $4x = {}^-4$ $x = {}^-1$	1 1	Accept any correct response, look for answers in the working space. **Response Mark** [The third line] should be 6 – 10 **1** They did 10 – 6 and it should be 6 – 10 **1** It should be – 10 not – 6 **1** 10 should be subtracted by 6 **0** The error is in $4x = 10 - 6$ **0**
			Total	**4**	
60			95	4	**M1** for $5x - 160 = 2(x + 25)$ **oe** **M1** for $5x - 160 = 2x + 50$ **FT** *their* 4 term linear equation with brackets **M1** for $x = 70$ **FT** *their* 4 term linear equation **FT** linear equation with more than 4 terms but not fewer, must have at least two terms in x
			Total	**4**	
61			$a = 12$ $b = {}^-4$	3	**B2** for $a - 5 = 7$ or $6 - b = 10$ or better or **M1** for $x^2 + ax + 6 = 5x + b$ **oe** **B2** implied by one correct value e.g. $0 = 5x + b - x^2 - ax - 6$
			Total	**3**	
62	a		2	1	
	b		Correct curve	3	

					B2FT for 7 or 8 correct plots or **B1FT** for 5 or 6 correct plots	Mark curve first, accuracy ± 1 mm, $\frac{1}{2}$small square Condone slight feathering Condone ruled segment between $x = {}^{-}4$ and $x = {}^{-}3.5$ only If curve incorrect then mark plots, accuracy ± 1 mm If no plot, curve implies plot
	c		${}^{-}1$	1		
			Total	**5**		
63			$y = {}^{-}3$ ruled and $y = {}^{-}3x + 4$ broken line and correct region indicated 	6	**B1** for $y = {}^{-}3$ ruled **B2** for $y = {}^{-}3x + 4$ broken line or **B1** for $y = {}^{-}3x + 4$ solid line AND **B1** for **R** on correct side of $y = x$ **B1** for **R** on correct side of $y = {}^{-}3$ **B1** for **R** on correct side of *their* $y = {}^{-}3x + 4$	Penalise **1** mark only for good freehand lines Additional lines treat as choice Length of line should be fit for purpose to identify *their* region See marks on diagram for the final **B3**, marks provided all lines drawn correctly For region, **FT** *their* $y = {}^{-}3x + 4$ provided line with negative gradient only but no **FT** for $y = {}^{-}3$ if incorrect Condone shading in or out of region provided **R** is clearly identified
			Total	**6**		
64			Translation $\begin{pmatrix}-2\\-11\end{pmatrix}$	4	**B3** for translation $\begin{pmatrix}-2\\k\end{pmatrix}$	If more than one transformation given then **M2** maximum

					or translation $\begin{pmatrix} k \\ -11 \end{pmatrix}$ OR **M2** for [y =] $(x + 2)^2 - 7 - 2^2$ or better or **M1** for [y =] $(x + 2)^2$ seen **B1** for translation	
			Total	**4**		
65	a		256	1		
	b		0.12 0.56 1.92	3	**B1** for 0.56 **B1** for 1.92 **B1FT** for 0.68 – *their* 0.56	*Their* 0.56 < 0.68
			Total	**4**		
66	a		$12a^7$ final answer	2	**B1** for answer ka^7 or $12a^k$ or for correct answer seen then spoiled	
	b		$5x(x - 3)$ final answer	2	**B1** for answer $5(x^2 - 3x)$ or $x(5x - 15)$ or for correct answer seen then spoiled	Condone omission of final bracket for **2** marks or **B1**
			Total	**4**		
67			$6x^{3.5}$ 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 $\frac{\sqrt{x}}{x^4}$	Accept equivalent fractions in place of decimal powers If attempting both $\frac{x^7}{x^4}$ and $\frac{\sqrt{x}}{x^4}$ mark to

					or **B1** for $\sqrt{x} = x^{\frac{1}{2}}$ or $x^{0.5}$ **B1** for x^3 from $\frac{x^7}{x^4}$ **Examiner's Comments** Only about 10% of candidates scored full marks here. The most commonly scored marks were B1 for 6 from $\frac{9 \times 2}{3}$ and B1 for x^3 from $\frac{x^7}{x^4}$. Very few candidates demonstrated that they knew $\sqrt{x} = x^{\frac{1}{2}}$, with many just ignoring it, or treating it as x or even x^2. A few candidates tried to deal with the $\sqrt{x}$ by squaring expressions, often the starting one. This would have led to $36x^7$, which is the square of the answer and so would need to have been squared at the end, however candidates did not progress that far, with errors often being made at the squaring stage. Other unsuccessful approaches included multiplying top and bottom by x^4.	candidate's benefit rather than choice
			Total	**4**		
68			$\frac{5x-19}{x-3}$ 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 $4(x - 3) + x - 7$ Alternative method: **M2** for $4(x^2 + 4x - 21)$ or better or **M1** for $4(x + 7)(x - 3)$ AND **M2** for $(5x - 19)(x + 7)$	For **M2** and **M1** accept written as separate fractions e.g. **M2** for $\frac{4x-12}{x-3} + \frac{x-7}{x-3}$

					or **M1** for $5x^2 + 16x - 133$ **<u>Examiner's Comments</u>** About 20% of candidates scored full marks. Dealing with the '4 +' term caused the greatest problem. Most candidates decided to start by factorising the difference of two squares and then cancelling down the resulting fraction. Many did this accurately and scored M2. Following the cancellation, errors were common however and several candidates changed a sign in the process, for example quite often ($x - 3$) changed to ($x + 3$). Relatively few candidates were able to use correct algebra to continue beyond $4 + \frac{x-7}{x-3}$; those that could proceed did usually go on to obtain the correct final answer, however some made slips when collecting terms. Others started the question by correctly combining the two terms as $\frac{4(x+7)(x-3)+x^2-49}{(x+7)(x-3)}$, scoring M1. Some achieved the second and third marks by expanding and simplifying the numerator to $5x^2 + 16x - 133$, however very few could factorise this for the fourth mark. Other candidates decided to start by expanding the denominator. This in itself was not productive and scored 0 marks. Having done this, candidates often cancelled the x^2 and x terms from the numerator and the denominator, leaving a value of $4 + \frac{-49}{-21}$ that then led to an incorrect final answer of $\frac{19}{3}$.
			Total	**5**	
69	a		-4 and 0	2	**B1** for one correct value **<u>Examiner's Comments</u>** Many could not correctly evaluate y when $x = ^-1$, with responses of 2 or $^-10$ being very common.

					However, the vast majority of candidates correctly worked out that when $x = 3$, y would be 0. **Assessment for learning** Candidates often struggle to evaluate formulae or expressions that involve negative numbers. Sometimes, they may be more successful applying mental or pen and paper techniques (or at least using these methods to check their calculator's answer). When using a calculator, it is essential that candidates are aware how to correctly use brackets around negative numbers. For example, here many will have keyed: (i) ⁻1 'x^3' – 3 × ⁻1 'x^2', which gives an answer of 2, or (ii) (⁻1) 'x^3' – (3 × ⁻1) 'x^2', which gives an answer of ⁻10.
	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

					Examiner's Comments Most candidates were able to plot at least six of their points with sufficient accuracy to score B2. There were however instances of candidates incorrectly using the vertical scale when trying to plot at $y = {}^{-}2$ or $y = {}^{-}4$. The correct curve was required for the full 3 marks.
	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 **Examiner's Comments** Most candidates with a graph in part (b) attempted to use it correctly to solve the equation here. Some made an error in reading the *x*-axis scale.
			Total	**6**	
70			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 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

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.	or simplified for **M** marks
<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	**A1** is **dep** on **B2M2** scored Condone $\begin{array}{r} 4n + 22 \\ \underline{[-]\ 4n + \ \ 6} \\ 16 \end{array}$ **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

<u>Examiner's Comments</u>

Candidates seemed comfortable using algebra in this question. Working was usually clear and well set out. The most common issue came at the final step when showing the difference of 16, where the final mark could not be given because of an incorrectly written statement (such as ‘4n + 22 – 4n + 6 = 16’).

Mistakes in the early steps were usually in setting up the algebraic terms. Some made progress if they chose consecutive terms (e.g.

					$2n$, $2n + 1$, …). The terms n, $2n$, $3n$, etc. were quite common, but these do not represent consecutive integers (and candidates also simplified the algebraic summation required at the next stage) and therefore scored 0 marks. Candidates that didn't provide an algebraic proof often gave at least one correct numerical example, earning an SC mark.
			Total	**5**	
71			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 **<u>Examiner's Comments</u>** Many misinterpreted the values in the diagram as representing the number of seats available rather than the number of journeys. Many responses hence just compared 13 and 5, or 6 and 4. For those making a correct attempt, a variety of comparisons were made, usually the relative frequencies of seats being available ($\frac{13}{19}$

					and $\frac{5}{9}$) or not available ($\frac{6}{19}$ and $\frac{4}{9}$). Having given the correct relative frequencies, not all candidates converted these to a comparable form, such as decimals, percentages or fractions with a common denominator.
			Total	**3**	
72			$\left(-\frac{5}{3}, \frac{25}{3}\right)$oe and (1, 3) with correct working	6	**M2** for $3x^2 + 2x - 5$ [= 0] or **M1** for $3x^2 = 5 - 2x$ **M2** for $(3x + 5)(x - 1)$ [= 0] or **M1** for $(3x + a)(x + b)$ where $ab = -5$ or $3b + a = 2$ or for correct partial factors $3x(x - 1) + 5(x - 1)$ or $x(3x + 5) -$ [1] $(3x + 5)$ **A1dep on M2M2** for either pair of coordinates correct or for both x values correct or both y values correct If 0, 1 or 2 scored, instead award **SC3** for answers $\left(-\frac{5}{3}, \frac{25}{3}\right)$oe and (1, 3) If 0 or 1 scored, instead award **SC2** for answer $\left(-\frac{5}{3}, \frac{25}{3}\right)$oe or for both x values correct or both y values correct If 0 scored, **SC1** for one answer (1, 3)
					Accept (–1.67 or –1.666 to –1.667 , 8.33[3]…) Correct working requires evidence of at least M2M2 For M2 accept e.g. $5 - 2x - 3x^2$ [= 0] Strict FT *their* 3-term quadratic equation or expression e.g.If M2 awarded for $5 - 2x - 3x^2$ [= 0] then factors should be correct for this equation for M2 or M1 Accept correct use of quad formula or completing the square, M2 if completely correct, M1 if one error in substitution in formula or $(x + a)^2$ correct if completing the square If A1 for correct x– values or y – values after correct partial factorisation award M2 for factors See AG for work with equations in terms of y

					A few may choose to work in terms of *y* If working in terms of *y* **M2** for $3y^2 - 34y + 75$ [= 0] accept $-75 + 34y - 3y^2$ [= 0] or **M1** for $\frac{5-y}{2} = \sqrt{\frac{y}{3}}$ oe or better **M2** for $(3y - 25)(y - 3)$ [= 0] accept equivalent negative version factors $-(3y - 25)(y - 3)$ [= 0] oe or **M1** for $(3y + a)(y + b)$ where $ab = 75$ accept equivalent negative version factors $-(3y + a)(y + b)$ or $3b + a = -34$ Allow M1 for factors that when expanded give one other term correct as well as '$3y^2$' or for correct partial factors $3y(y - 3) - 25(y - 3)$ or $y(3y - 25) - 3(3y - 25)$ accept equivalent negative version partial factors If A1 for correct *y* values after correct partial factors award M2 for factors **<u>Examiner's Comments</u>** This question proved challenging for many candidates, but there were a number that answered it perfectly. Those that combined the given equations to form the correct quadratic equation almost always went on to factorise correctly and obtain at least one correct pair of solutions for *x* or one correct coordinate. Most did not attempt to combine the two given equations and often a graphical approach was attempted instead, with candidates tabulating values for the two graphs. This often led to the solution (1, 3), for which they were credited. A few unwisely attempted to set up an equation in *y*, which proved much more difficult and was rarely successful. A number of candidates made no attempt at the question.
			Total	**6**	
73			24 nfww	4	**M1** for [v =] [0+] 3 × | nfww – not from 2 × 3 × 4

4 **M2** for *their* $(3 \times 4)^2 \div (2 \times 3)$ or better or **M1** for *their* $(3 \times 4)^2 = 2 \times 3 \times s$	M1 implied by [v =] 12 but not if obtained from $0 = u + 3 \times 4$, this gets M0 If eqn not used and $d = st$ answer 12 then M0 Condone other variable used for s but not v, u, a or t See AG if other kinematics formulas used

Candidates may choose to use Kinematics formulas other than those given

If $s = ut + ½ at^2$ used instead of given formulae, allow M3 for [s =] [0×4 +] $\frac{1}{2} \times 3 \times 4^2$

OR
After <u>v</u> = 12

Allow M2 for [s =] $\frac{0+12}{2} \times 4$ or [s =] $12 \times 4 - \frac{1}{2} \times 3 \times 4^2$

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

Almost all candidates attempted this question, although some did not get further than finding *v.* A minority were able to give the correct answer and showed correct working. One of the main issues was uncertainty of what the different variables represented, for example substituting the given values into the first equation to get $0 = u + 3 \times 4$. Others used *speed* = *distance* ÷ *time* instead of the given formulae, for which no credit was given.

Of those that found *v* and then correctly substituted into the second equation to find *s*, a number obtained 24 yet went on to do a further calculation, such as 24 × 4 to then give a final distance of 96 m.

Misconception

A proportion of candidates were not able to

					identify what *u*, *v*, *a*, *s* and *t* represent. There was particular confusion between *u* and *v*. **Misconception** Some candidates did not recognise that (because the particle has constant acceleration) the given kinematic formulae need to be used. The *speed* = *distance* ÷ *time* formula is only to be used if there is no acceleration.
			Total	**4**	
74			Both inequalities $x \geq 10$, $x \leq -10$ as final answer	3	**B2** for answer one of $x \geq 10$ or $x \leq -10$ or **M1** for $x^2 \geq 100$ or for $(x + 10)(x - 10)$ Allow 3 marks for $-10 \geq x \geq 10$ final answer B2 implied by answer e.g. $-10 \leq x \geq 10$ or $x \geq \pm 10$ as one element of inequality correct M1 implied by 10 **or** -10 seen in answer **<u>Examiner's Comments</u>** The vast majority of candidates scored at least one mark on this question, but only a few gained all three. Those that took the square root of 100 were less likely to get 2 solutions as many took only the positive root, leading to $x \geq 10$. There was some awareness of the difference of two squares to get two solutions, but very few managed to get the inequalities correctly afterwards. It is important that candidates keep the correct inequality sign throughout their working and particularly when writing the final response.
			Total	**3**	
75			$\frac{2n}{4n+1}$ oe final answer	3	**B2** for denominator Condone consistent use of different variable for all marks e.g. B2 for denominator $4x + 1$

					$4n + 1$ oe or for $2n$ **and** $4n + 1$ seen or **B1** for $2n$ oe or for $4n + c$ oe For B marks isw attempts to cancel after seen in fraction B2 for denominator e.g. $5 + 4(n - 1)$ oe May not be in a fraction For B1 expressions do not need to be in a fraction where c is any number including zero, or 'c' B1 for e.g. $4n$, $4n + c$, $4n - 1$, $3 + 4(n - 1)$ Do not allow as part of an incorrect expression e.g. $2n^2 + 4n$ **Examiner's Comments** Most candidates either gained full marks or did not score. Many realised that the numerator had a difference of 2 and the denominator a difference of 4, then wrote $\frac{2n}{4n}$. A very common error was to then cancel this fraction and give $\frac{1}{2}n$. Many candidates appeared unfamiliar with finding expressions for the numerator and denominator separately. A few candidates gave the correct response in working yet gave $\frac{1}{2}n$ or equivalent as the final response. Partial credit was given to those who gave a correct expression for the numerator or the denominator in working.
			Total	**3**	
76			$4x^3 + 5x^2 - 23x - 6$ final answer	3	**B2** for correct but unsimplified answer or for 3 correct terms in final answer with no more than 4 terms or **B1** for expansion of any two of the e.g. $4x^3 + 13x^2 - 8x^2 - 26x + 3x - 6$ $4x^3 + 4x^2 + x^2 - 24x + x - 6$ $4x^3 + 12x^2 - 7x^2 - 21x - 2x - 6$ For B2 accept correct terms on grid the simplified x term counts as two correct

					given brackets with three correct terms	terms $4x^2 + 12x + x + 3$ [+] $13x$ counts as two terms $x^2 + 3x - 2x - 6$ [+1] x counts as two terms $4x^2 - 8x + x - 2$ – $7x$ counts as two terms For B1 accept e.g. x^2, [+] $3x - 2x$, $- 6$ on grid If in a longer train of 'random' terms only award B1 if four correct consecutive terms are given
					<u>Examiner's Comments</u> This question was very well answered, with candidates right across the ability range scoring well. Candidates were generally confident with the expansion of brackets. A few tried to expand all 3 brackets at the same time and candidates should be reminded that a much more successful approach is to expand a pair of brackets first, then deal with the third bracket. The grid method was used very successfully by many, with work set out clearly and methodically. Candidates should take care when transferring terms from line to line, both in their working and also to the answer line. Transcription errors were made by some that prevented full marks being given, particularly with indices.	
			Total	**3**		
77			$R = \sqrt[3]{2}x$ or $R = \sqrt[3]{2x^3}$ final answer	4		Condone r for R throughout Answer $\sqrt[3]{2}x$ or $\sqrt[3]{2x^3}$ allow M3 For method marks condone 3.14, 3.142 or $\frac{22}{7}$ for π

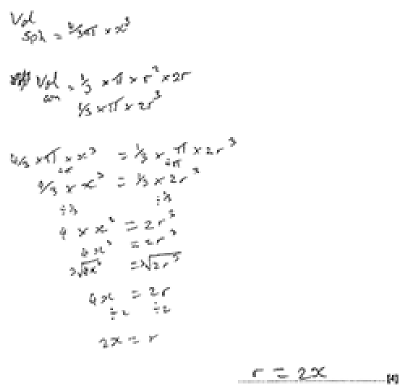
					M3 for $12[\pi]x^3$ or $6[\pi]R^3$ or better Or **M2** for $\frac{4}{3}[\pi]x^3 = \frac{1}{3}[\pi] \times R^2 \times 2R$ oe or **M1** for $\frac{1}{3}\pi \times R^2 \times 2R$	For method marks ignore any units For M3 removes fractions and simplifies terms in R M3 accept e.g. $2x^3 = R^3$ Must see correct expression in R for M1

Examiner's Comments

Many candidates were able to score some marks on the question, but only a few gave a fully correct response. Candidates often scored 2 marks by correctly substituting R and $2R$ into the cone formula and x into the sphere formula and then equating them, but they generally struggled to simplify further. A common error was not simplifying $R^2 \times 2R$ within the formula for the volume of the cone. Many were also unable to simplify the fractions and so struggled to reach $2x^3 = R^3$.

Those that did reach $2x^3 = R^3$ were sometimes unable to deal with the cube root correctly and gave final a response of $2x = R$.

Exemplar 2



In this example the candidate shows a correct method as far as $4x^3 = 2R^3$, which earns 3 method marks. Following this they attempt to

					cube root but do it incorrectly. The mistake seen here was one made by a number of candidates.
			Total	**4**	
78	a		$(3x - 2)(x + 4)$ oe -4 and $\frac{2}{3}$	M2 B1FT	**M1** for $(3x + a)(x + b)$ with $a + 3b = 10$ or $ab = -8$ or $3x(x + 4) - 2(x + 4)$ or $x(3x - 2) + 4(3x - 2)$ correct or **FT** *their* linear factors For **M2** and **M1** condone the omission of the final bracket. $\frac{(3x-2)(3x+12)}{3}$ followed by $3x - 2$ [= 0] and $x + 4$ [= 0] scores **M2**. If no products of factors shown then $3x - 2 = 0$ and $x + 4 = 0$ scores **M1**. After $3x(x + 4) - 2(x + 4)$ or $x(3x - 2) + 4(3x - 2)$ followed by correct answers award **M2B1 BOD** Condone $0.\dot{6}$ or 0.666… or 0.67 for $\frac{2}{3}$ **<u>Examiner's Comments</u>** The common errors included either not writing the two factors in full (such as leaving them as $3x(x + 4) - 2(x + 4)$) or incorrect factorisations such as $(3x - 4)(x + 2)$ or $(3x + 4)(x - 2)$. Despite the request in the question, there were many who used the quadratic formula.
	b		$(x + 4)^2 - 5$	3	**B1** for $(x + 4)^2$ **B2FT** *their* $(x + a)^2$ for *their* -5 If **0** scored **SC2** for 'correct' answer with missing power or power written in the wrong place e.g. $(x + 11)^2 - 110$ scores **B2FT** e.g. **SC2** for $(x + 4) - 5$ or $(x + 4^2) - 5$ **<u>Examiner's Comments</u>** This was answered much better than similar questions in the past. Many gave the brackets

					correctly as $(x + 4)^2$, but there were sometimes errors with the value of *b*. Some wrote $(x + 8)^2 - 11$.
			Total	**6**	
79			32 nfww	4	**B2** for 11.25 **M1** for 360 ÷ *their* 11.25 seen OR **B1** for 15*a* and *a* or 16*a* **M1** for 15*a* + *a* = 180 oe **M1** for 360 ÷ *their* 11.25 seen *a* = exterior angle and allow any consistent single letter **B1 M1** implied by 16*a* = 180 or $\frac{180}{15+1}$ oe Alternative method 1: **M2** for 15 × 360 = 180(*n* – 2) or better or **M1** for $\frac{180(n-2)}{n} = 15 \times \frac{360}{n}$ and **M1** for 180*n* = 5400 + 360 oe Alternative for number of sides: e.g. **M1** for $\frac{180(n-2)}{n}$ = 180 – *their*11.25 Alternative method 2: Use of trials by choosing a value for *n*. **M1** for each correct trial up to a maximum of **M3** for using <u>two</u> of these [exterior angle] = $\frac{360}{n}$ (formula A) [interior angle] = $\frac{180(n-2)}{n}$ (formula B) interior + exterior = 180 and for checking that interior = 15 × exterior If they get 32 from any number of trials they score **4** marks. Trials can be seen from a calculation or a list. see appendix for likely results if **0** scored **SC1** for one of formula A or B seen or used

sides	interior	exterior			
5.00	108.00	72.00	35.00	169.71	10.29
6.00	120.00	60.00			

7.00	128.57	51.43
8.00	135.00	45.00
9.00	140.00	40.00
10.00	144.00	36.00
11.00	147.27	32.73
12.00	150.00	30.00
13.00	152.31	27.69
14.00	154.29	25.71
15.00	156.00	24.00
16.00	157.50	22.50
17.00	158.82	21.18
18.00	160.00	20.00
19.00	161.05	18.95
20.00	162.00	18.00
21.00	162.86	17.14
22.00	163.64	16.36
23.00	164.35	15.65
24.00	165.00	15.00
25.00	165.60	14.40
26.00	166.15	13.85
27.00	166.67	13.33
28.00	167.14	12.86
29.00	167.59	12.41
30.00	168.00	12.00
31.00	168.39	11.61
32.00	168.75	11.25
33.00	169.09	10.91
34.00	169.41	10.59

Examiner's Comments

Many found this difficult. A large number attempted it as if the interior angle and the exterior angle sum to 360° and not 180°, therefore giving an answer of 16 rather than 32.

					Some correctly found the exterior angle of 11.25° and the interior angle of 168.75° but did not know how to use these to find the number of sides. Some thought the formula to find the interior angle of a regular polygon was 180(n – 2). Few seemed to know the formula 360 ÷ n.
			Total	**4**	
80	a		Correct tree diagram	2	**B1** for 0.4 on missing branch in task 1 **B1** for 1 – x on both missing branches in task 2 If there is more than one answer on any branch, choose the one on the dotted line first **<u>Examiner's Comments</u>** In the first task almost everyone answered 0.4. In the second task some candidates put 1 – x, but others had y or 0.4. There were a few who initially put 1 – x, but then replaced it with a decimal, usually 0.4, 0.6 or their answer to part (c).
	b		They are independent oe	1	Pick the best comment, see appendix **Mark** The pass before does not affect the results after **1** They are independent **1** The first task results do not affect the second **1** Passing first task does not affect the second task **1** Passing the second does not rely on passing the first **1** They are not linked **1** Same probability to pass second on both times **0** The probabilities of the tests do not change **0** The probability of passing will always stay the same **0** Both second tests are the same **0** **<u>Examiner's Comments</u>** We saw a large variety of answers. Some were correct about statistical independence. Incorrect answers included that there were only two

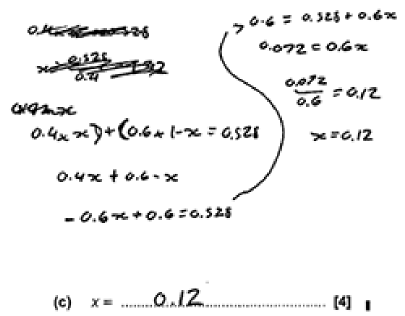
					outcomes or that the probabilit ies were the same for both tasks.
	c		0.36	4	**M2** for $0.6(1 - x) + 0.4x = 0.528$ or better or **M1** for $0.6(1 - x) + 0.4x$ or better **M1** for rearranging *their* linear equation, $kx + a = b$, to make kx the subject ($0< k$) e.g. **M2** for $0.6 - 0.2x = 0.528$ e.g. **M1** for $0.6 - 0.2x$ e.g. $0.6 - 0.528 = 0.2x$ or better OR **M2** for $1 - 0.6x - 0.4(1 - x) = 0.528$ or better or **M1** for $1 - 0.6x - 0.4(1 - x)$ or better **M1** for rearranging *their* linear equation, $kx + a = b$, to make kx the subject ($0< k$) allow similar equations involving $1–0.528$ e.g $0.6x + 0.4(1 - x) = 0.472$ e.g. $0.6 - 0.528 = 0.2x$ or better OR **FT** *their* **(a)** if not correct for up to **3** marks e.g. if in **(a)** $1 - x$ is replaced with e.g. 0.4 then **M2** for $0.6 \times 0.4 + 0.4x = 0.528$ or better or **M1** for $0.6 \times 0.4 + 0.4x$ or better **M1** for rearranging *their* linear equation, $kx + a = b$, to make kx the subject ($0< k$) e.g. $0.4x = 0.528 - 0.6 \times 0.4$ or better alternative method using trials **M1** for each correct trial up to **M3** and the correct answer from trials scores **4** marks, see appendix If **0** scored **SC1** for any 2 branches correctly written down and added e.g. $0.6(1 - x) + 0.4(1 - x)$ exactly two branches

Value(x)	probability
0.2	0.56
0.21	0.558

0.22	0.556
0.23	0.554
0.24	0.552
0.25	0.55
0.26	0.548
0.27	0.546
0.28	0.544
0.29	0.542
0.3	0.54
0.31	0.538
0.32	0.536
0.33	0.534
0.34	0.532
0.35	0.53
0.36	0.528
0.37	0.526
0.38	0.524
0.39	0.522
0.4	0.52
0.41	0.518
0.42	0.516
0.43	0.514
0.44	0.512
0.45	0.51

Examiner's Comments

Many answers involved the use of just one branch, so common responses were $0.4x = 0.528$ or $0.6x = 0.528$, leading to answers of 1.32 or 0.88. Others solved the equation $0.6(1 - x) = 0.528$, which led to an answer of 0.12. The most common error was not to use or expand brackets, so we often saw things such as $0.6 \times 1 - x$ 'simplified' to $0.6 - x$.

					Assessment for learning Expressions such as ‘0.6’ multiplied by ‘1 – *x*’ should be written 0.6(1 – *x*) using brackets to preserve the priority of operations, so that the subtraction is done before the multiplication. To write this without brackets must be 0.6 – 0.6*x*. Exemplar 1  The first line should be 0.4 × *x* + 0.6 × (1 – *x*) = 0.528. The second line would then become 0.4*x* + 0.6 – 0.6*x* = 0.528, which leads to the correct answer of 0.36.
			Total	**7**	
81	a		$\frac{x+3}{5}$ or $\frac{x}{5}+\frac{3}{5}$ oe	2	**B1** for *x* + 3 written in the correct place on the diagram or in the working space or **B1** for answer $\frac{x}{5}$+ 3 oe or $\frac{x-3}{5}$ oe or 5(x + 3) oe or correct answer using a different variable (*x* + 3) ÷ 5 scores **2** marks *x* + 3 ÷ 5 scores 1 marks **<u>Examiner’s Comments</u>** There were many correct answers. The common error was to write the two operations in the wrong order, so giving an answer of $\frac{x}{5}$+ 3. Other candidates wrote their answer as *x* + 3 ÷ 5 (which has the correct operations, but mathematically the incorrect order), or wrote the regular function taking the input as *x* and so giving 5*x* – 3.

	b		×15 + 27	4	**B3** for $15x$ and $+27$ or **B2** for ×15 or +27 in the correct place or **M2** for $5 \times (3(x + 2))$ [– 3] or better or **M1** for $3(x + 2)$ or better **<u>Examiner's Comments</u>** There were a number of correct answers. Others gained credit by working out $3(x + 2)$ or $5 \times 3(x + 2)$. There were also several candidates who made sign errors in their calculations and wrote $5 \times 3(x + 2) – 3 = 15x – 27$.	**B3** may be seen on the diagram or as an expression Note: the variable x can be any letter for the **B** and **M** marks
			Total	**6**		
82			[a =] 15.6 [b =] 7.2 with correct working	5	**B4** for one correct answer <u>with correct working</u> OR **M1** for $\frac{a + a + b + a + 2b + 3a – b}{4} = 27$ oe **M1** for $3a – b – a = 24$ oe **M1** for equating coefficients of one variable for *their* linear equations **M1** for correct method to eliminate one variable for *their* original linear equations If **0, M1** or **M2** scored, instead award **SC3** for answers 15.6 and 7.2 with no working or insufficient working If **0** or **M1** scored, instead award **SC2** for a = 7.2 and b =	"Correct working" requires evidence of at least **M1M1** for the two equations and **M1** for some evidence of solving them e.g. $6a + 2b = 108$ e.g. $2a – b = 24$ dependant on two linear equations e.g. $6a – 3b = 72$ or $4a – 2b = 48$ or $3a + b = 54$ dependant on two linear equations e.g. $5b = 36$ Allow one numerical error in each step of solving *their* equations A sign error is not an arithmetic error Substitution

					15.6 with no working or insufficient working If **0** scored, instead award **SC1** for two answers which satisfy one of the original conditions	method: **M1** and **M1** for the two equations **M1** dependant on two linear equations and for rearranging one equation to make one variable the subject e.g. *a* = $\frac{24+b}{2}$ **M1** for substituting it into *their* other equation Trials (need to see the mean or total, and the range evaluated for each): **M1** for each correct trial up to a maximum of 3 After three correct trials, correct final answers score 5
					Examiner's Comments Those who attempted this using trials were always unsuccessful. The most successful method was to write down the two linear equations and to solve them algebraically. When writing the equations, the first one was often seen as $a + a + b + a + 2b + 3a – b ÷ 4 = 27$, which often ended up as $6a + 2b = 27$ (where the '÷ 4' had been forgotten) or $6a — 2b = 108$ (where there is a sign error). Many were unable to solve these equations algebraically. While most candidates multiplied or divided correctly, when adding or subtracting then they would make an error, usually in the *b*s. For example, they might subtract the *a*s and the numbers, but add the *b*s.	
			Total	5		
83			$\frac{11x-8}{2x+3}$ final answer	4	**M3** for $\frac{16x+24-5x-32}{(2x+3)}$ soi by $\frac{11x-8}{(2x+3)}$ or **M2** for $\frac{16x+24-(5x+32)}{(2x+3)}$ or	Max **M3** if answer spoiled by further incorrect algebraic manipulation (e.g. incorrect cancelling of

					$\frac{8(2x+3)-5x-32}{(2x+3)}$ or **M1** for $8(2x + 3)$	terms) Allow full marks for a correct equivalent answer as a single fraction e.g. $\frac{22x-16}{4x+6}$
			Total	**4**		
84	a		$\frac{11}{3}$ oe	3	**M2** for $6t - 3 = 19$ oe or **M1** for $6t - 3$ or $19 + 3$ or 22	3.66[6…] or unsimplified, e.g. 22/6 e.g. $6 = 22/t$
	b		[x =] $3(y + 4)$ oe	2	**M1** for $y = \frac{x}{3} - 4$ or better or for correct reverse flowchart with arrows reversed $\longleftarrow \times 3 \longleftarrow + 4 \longleftarrow$	
			Total	**5**		
85			$2(3x + 2)(5x - 3)$	3	**B2** for $(6x + 4)(5x - 3)$ as final answer or for $(3x + 2)(10x - 6)$ as final answer or for $(3x + 2)(5x - 3)$ as final answer or **M1** for two brackets which give two correct terms for $30x^2 + 2x - 12$ or for $15x^2 + x - 6$	
			Total	**3**		
86	a		$(x + 11)(x + 5)$ [= 0] -11 and -5	M2 B1	**M1** for $(x + a)(x + b)$ [= 0] where $ab = 55$ or $a + b = 16$ or for $x(x + 11) + 5(x + 11)$ or $x(x + 5) + 11(x + 5)$	Condone omission of final bracket If partial factors and answers -11 and -5 award M2B1

					FT *their* factors if of the form $(x + a)(x + b)$ with a, b integers	
	b	i	$(x + 8)^2 – 9$ final answer	3	**B1** for $(x + 8)^2$ **B2FT** for [+] 55 – (*their* a)^2 after (x + *their* a)2 correctly evaluated or **B1** for [+] 55 – (*their* a)^2 shown If 0 scored, **SC2** for final answer $(x + 8) – 9$	FT can be implied e.g. $(x + 9)^2 – 26$ gets B2FT
		ii	$(–8 , –9)$	2	**FT** *their* 18(b)(i) if in form $(x + a)^2 + b$ **B1FT** for each value	
			Total	**8**		
87	a		[k =] 0	1		
	b	i	$y = 2x + 4$ ruled $^-3.5$ to $^-3.3$ and $^-1.7$ to $^-1.5$	M2 A2	**M1** for correct freehand or short line or for $y = 2x + k$ ruled or $y = ax + 4$ ruled but not $y = 4$ **A1** for each After **A0, SC1** for both values correct	For M2 must cross curve twice Accuracy ± 1mm at (0, 4) and ($^-1$, 2) Only award if M2 scored previously $^-3.3660$… , $^-1.63397$….
		ii	$1 = (2x + 4)(x + 3)$ $2x^2 + 4x + 6x + 12$ $2x^2 + 10x + 11 = 0$	M1 B2 A1	For correct 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 $2x^2 + 10x + 12$ For B1 $10x$ counts as two terms

			Total	**9**		
88			$^-2, ^-1, 0, 1, 2$	3	**B2** for 5 correct values with one extra or for 4 correct with no extras or for $^-3 < x \le 2$ or **M1** for $^-1 - 2 < x$ or $x \le 4 - 2$ oe	For M1, condone incorrect inequality sign or equals
			Total	**3**		
89	a	i	$[u_3 =]\ x + 2y$ $[u_4 =]\ x + 2y + 2y\ [= x + 4y]$	1 1		
		ii	3 2 with correct working	6	**M2** for $[u_7 =]\ 11 + x + 2y + 11 + x + 2y + 11$ oe or better Or **M1** for $[u_5 =]\ x + 2y + 11$ oe or better AND **B1** for $x + 4y = 11$ oe **B1FT** for *their* $(2x + 4y + 33) = 47$ 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 **B1B1** or **M2** or **M1M1** e.g. $2x + 4y + 33$ or $2x + 6y + x + 4y + 2x + 6y$ or $5x + 16y$ e.g. $x + 2y + x + 4y$ or $2x + 6y$ e.g. $5x + 16y = 47$ **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]
	b		$(\sqrt{5})^{n-1}$ or $5^{\frac{1}{2}(n-1)}$ oe	2	**M1** for common ratio of $(\sqrt{5})$ implied by answer of $(\sqrt{5})^k$	

	c		$^-3$ 1	3	**B2** for $b = {}^-3$ OR **M1** for [$^-1$ $^-1$ 1 5] − [1 4 9 16] implied by $^-2$, $^-5$, $^-8$, $^-11$ **B1** for $c = 1$	Condone ^-3n for **2** marks If equations used **M1** for e.g. $1 + b + c = {}^-1$ oe $4 + 2b + c = {}^-1$ oe Allow any correct method
			Total	**13**		
90			Some algebraic working leading to an answer of $^-2$ 2	5	**M1** for e.g. $x^2 + (x + 4)^2 = 8$ **M1** for expanding *their* square term e.g. $x^2 + 8x + 16$ **M1** for $2x^2 + 8x + 8 = 0$ or better **M1** for $[2](x + 2)^2$ or $(2x + 4)(x + 2)$ If **0** scored, instead award **SC2** for correct answers with no algebraic working	Condone one error in expanding brackets Simplifying to $ax^2 - bx + c$ e.g. solving *their* quadratic equation by e.g. factors or quadratic formula Note: apply scheme to substitution for x e.g. **M1** for $(y - 4)^2 + y^2 = 8$, etc
			Total	**5**		
91	a		It should be +15 $x = \frac{y+15}{4}$	1 1		Accept any correct explanation, Allow correct equation if written in the question just missing "$x =$ "
					Response Mark It should be +15 **1** The sign of 15 is wrong **1** The error is subtracting 15 (or taking away 15) **1** They have subtracted 15 **1** The sign on the right should not be minus **1** They have to do the inverse of − 15 **1** The 15 maintained a negative sign on the other side **1**	

	b		It should be $\frac{x}{3}$ $x=3\sqrt{A}$ or $x=\sqrt{9A}$	1 1	Do not accept $\pm\frac{x}{3}$ 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* = " **Response Mark** It should be $\frac{x}{3}$ **1** It should be $\sqrt{9}$ **1** Take the root of 9 **1** Include 9 in the square root **1** Only A is rooted **1 bod** They just square rooted A **1 bod** They should have multiplied by 9 first **0**
			Total	**4**	
92			142.5	4	**M1** for 14 – 5 =15*a* oe implied by [0].6 **A1** for [*a* =] [0].6 **M1** for 5 × 15 + $\frac{1}{2}$× *their* 0.6 × 15^2 <u>Alternative method</u> **M3** for 5 × 15 + $\frac{1}{2}$(14 – 5)× 15 oe OR **M1** for 5×15 **M1** for $\frac{1}{2}$(14 – 5)×15 **M1** for *their* (5 × 15) + *their* $\left(\frac{1}{2}\right)$(14 – 5)×15 | Condone one error in second **M1**. If *their a* is clearly stated do not count as an error Equivalent includes $\frac{1}{2}$(14 + 5)×15 May be implied by 75 May be implied by 67.5
			Total	**4**	
93			$\frac{A}{8}$ − 2 or $\frac{1}{8}$(*A* − 16) or $\frac{A-16}{8}$ with correct working or other simplified equivalents	5	**B4** for $\frac{Acm^2}{8}$ − 2 etc with correct working | 'Correct working' requires evidence of at least **M2**

					OR The below assumes PQ = x. Mark similarly use of SR = x. **M2** for $8x + \frac{1}{2} \times 4 \times 8$ or $\frac{8(x+x+4)}{2}$ **oe** or for $8x$ and 16, may be indicated on diagram **A1** for $[A =]\ 8x + 16$ or $8(x + 2)$ or **M1** for lengths x and $x + 4$ oe or for area $8x$ or area 16 AND **M1FT** for $8x = A - 16$ or $x + 2 = \frac{A}{8}$ If **0** or **1** scored, instead award **SC2** for $\frac{A}{8} - 2$ or $\frac{1}{8}(A - 16)$ or $\frac{A-16}{8}$ with no or insufficient working	Condone use of PQ, PQ + 4 etc instead of x and $x + 4$ Working may be on diagram For **M2** accept area A – 16 for area $8x$ For **A1** accept equivalents such as $\frac{A}{4} = 2x + 4$, $2A = 16x + 32$ For **M** and **A** marks, both lengths must be in terms of the same variable e.g. PQ and PQ + 4, not x and y unless $y = x + 4$ subsequently seen FT $ax + b = A$ or $a(x + b) = A$ ($a \neq \pm1$ or 0, $b \neq 0$)
			Total	**5**		
94			1.495	4	**B3** for answer 1.4953 to 1.4954 OR **M3** for $[r =]\ \sqrt[4]{5}$ **oe** or **M2** for $r^4 = 5$ or **M1** for $r^7 = 5r^3$ <u>Trials or insufficient method:</u> **B4** for answer 1.495	e.g. M3 for $\sqrt{5} =$ 2.23[6…] and $\sqrt{2.23[6...]}$

					or **B3** for answer 1.4953 to 1.4954 or **M2** for at least three correct trials of r^4 **oe** or of r^7 <u>and</u> $5r^3$ **oe** or **M1** for at least two correct trials of r^4 **oe** or of r^7 <u>and</u> $5r^3$ **oe**	Accept evaluations to 2sf **rot** Accept evaluations to 2sf **rot**
			Total	**4**		
95			($^-1$, 3) and ($^-3$, $^-1$) with correct working	6	**M1** for $x^2 + (2x + 5)^2 = 10$ **M1** for expanding *their* square term e.g. $4x^2 + 10x + 10x + 25$ **M1** for simplifying *their* quadratic equation e.g. $5x^2 + 20x + 25 = 10$ or better **M1** for correctly factorising *their* 3-term quadratic equation or for correct use of quadratic formula for *their* 3-term quadratic equation or for correct completing the square **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	'Correct working' requires evidence of at least **M1M1M1** Award equivalent marks if working in terms of y May be in a grid May be implied by subsequent working *Their* quadratic must include an x term Simplified: $5x^2 + 20x + 15$ [= 0] or $x^2 + 4x + 3$ [= 0] e.g. $(x + 1)(x + 3)$, $(5x + 5)(x + 3)$ e.g. reaching $d(x + e)^2 + f$

			Total	**6**		
96			$2\left(x-\frac{3}{4}\right)^2-\frac{169}{8}$ as final answer with correct working	5	<u>Method 1:</u> **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 $2\left(x^2-\frac{3}{2}x\right)$[– 20] **oe** AND **M1** for [^-b =] $^-2\left(their\left(^-\frac{3}{4}\right)\right)^2$ – 20 **soi** by <u>Method 2:</u> **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** or for $2(x^2 + ax + ax + a^2) - b$ **oe** **M1** for $4ax = {^-3}x$ **soi** by [a =] $^-\frac{3}{4}$ AND **M1** for [^-b =] – $2\left(their\left(^-\frac{3}{4}\right)\right)^2$ – 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 $^-2.5$ and 4 **M1** for turning point at [x =] $\frac{^-2.5+4}{2}$ **soi**	'Correct working' requires evidence of at least **M1** Accept decimal and mixed number equivalents throughout e.g. $2(x - 0.75)^2 - 21.125$ $2\left(x-\frac{3}{4}\right)^2-21\frac{1}{8}$ May be in a grid May be in a grid

					by $\frac{3}{4}$ AND **M1** for [^-b =] $\left(2\left(their\ \frac{3}{4}\right)+5\right)\left(\left(their\ \frac{3}{4}\right)-4\right)$ **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 $2\left(x-\frac{3}{4}\right)^2$ [$+k$]	
			Total	**5**		
97	a		$2(x-3)$ **oe** final answer	1		Equivalent includes $2x-6$
	b		3 with correct working	5	accept any correct method **B1** for [output =] 5 × *their* {$2(x-3)$} + 4 **oe** or output through inverse of B as $\frac{3x-9}{5}$ **B1dep** for *their* {5 x $2(x-3)+4$} = $3x-5$ oe or output through inverse of A as $\frac{3x-9}{5\times2}$ or $\frac{3x-9}{5}$ *their* [$2(x-3)$] **M1** for e.g. *their* $10x-30+4=3x-5$ or *their* $3x-9=10x-30$ or inverse method $\frac{3x-9}{10}+3=x$ **M1** for *their* {$7x=21$} **oe** <u>Alternative method using trials</u>	"Correct working" requires evidence of at least **B1B1** or **B1M1** or **M2** if using trials **B1** implied by 5 x $2(x-3)+4$ or better e.g. $10x-30+4$ **dep** on previous **B1** Note: $2x$ 6 $3x$ 5 $3x$ 5 scores **B0B0** **M1 B1 B1** implied by $10x-26=3x-5$ 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 $ax=b$. We can only follow through an equation with x's on both sides for **M1** or x's on both

					M2 for at least two complete correct evaluations of both $10x - 26$ **oe**(or functions) and $3x - 5$ or **M1** at least one complete correct evaluation of both $10x - 26$ **oe** and $3x - 5$ If **0** or **1** scored **SC3** for answer 3 with no or insufficient working	sides and a bracket for **M2**.
			Total	**6**		
98	a		An error in the numerators identified	1	**Response Mark** Swop brackets in the numerator **1** They multiplied the 3 by (x – 4) it should have been (x + 1) **1** The brackets have been multiplied by the wrong number it should be 3(x + 1) **1** The (x – 4) and (x + 1) should be the other way round **1** The numerators have been multiplied by the wrong/own denominators **1** (Correct answer is given) **1** They have multiplied the wrong numerator by the wrong denominator **1** It should be this $\frac{3(x+1)-2(x-4)}{(x-4)(x+1)}$ (single fraction only) **1** They multiply the numerator and the denominator rather than the opposite denominator **1(BOD)** They did not cross multiply **0** They have multiplied their denominators by their numerators instead of adding them **0**	
	b		The + sign in the square root should have been a – sign	1		
			Total	**2**		
99	a		$[2^3 + 2^2 - 20] = {}^-8$ $[3^3 + 3^2 - 20] = 16$ Sign change [so solution between x = 2 and x = 3] or ${}^-8 < 0 < 16$	M1 M1 A1	Must indicate their input and output **Dep** on at least **M1** and different signs	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.

						<u>Alternative method 1</u> for $x^3 + x^2 = 20$ **M2** for $2^3 + 2^2 = 12$ and $3^3 + 3^2 = 36$ or **M1** for $2^3 + 2^2 = 12$ or $3^3 + 3^2 = 36$ may be implied by 12 or 36 and **A1** for e.g. $12 < 20 < 36$ **dep** on at least **M1** and 20 lies inbetween their two values <u>Alternative method 2</u> **SC3** for using an iterative equation that converges to a value between 2.35 and 2.45 **and** concluding statement such as $2 < 2.35$ to $2.45 < 3$ or **SC2** for using an iterative equation that converges to a value between 2.35 and 2.45	Acceptable answers for third mark are $x = 2$ gives answer < 0 and x = 3 gives answer >0 Note: so answer lies between 2 and 3 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
	b			Two correct evaluations in the range $2.35 \le$ values ≤ 2.49, one which gives a positive value and the other giving a negative value 2.4	M3 A1	**M2** for two correct evaluations $2 <$ values < 3, 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**	Figures may be **rot** to at least 2 s.f.

x	x^3+x^2-5	x	x^3+x^2-5
2.1	-6.329	2.35	-1.49962
2.2	-4.512	2.36	-1.28614
2.3	-2.543	2.37	-1.07105
2.4	-0.416	2.38	-0.85433
2.5	1.875	2.39	-0.63598
2.6	4.336	2.40	-0.416
2.7	6.973	2.41	-0.19438
2.8	9.792	2.45	0.028888
2.9	12.799	2.43	0.253807

<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 **rot**)

M1 continues iteration to reach x in the range 2.35 to 2.45

A1 for 2.4
Dep on **M2**

OR
If **0** scored
SC1 for 2.4 with no worthwhile working

2.44	0.480384
2.45	0.708625
2.46	0.938536
2.47	1.170123
2.48	1.403392
2.49	1.638349

condone missing suffixes in formula here
e.g.

$$x_{n+1} = \sqrt{\frac{20}{x_n + 1}}$$

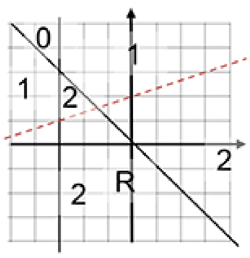
converges and leads to values 3.162278… , 2.192045… , 2.503113…

If they refer to *their* working in **part (a)** which is relevant then award up to full marks in **part (b)**

x	$x^3 + x^2$	x	$x^3 + x^2$
2.1	13.671	2.35	18.50038
2.2	15.488	2.36	18.71386
2.3	17.457	2.37	18.92895
2.4	19.584	2.38	19.14567

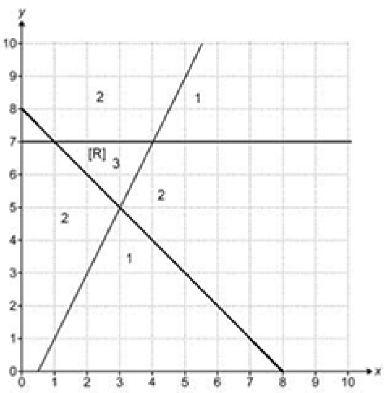
					<table><tr><td>2.5</td><td>21.875</td><td>2.39</td><td>19.36402</td></tr><tr><td>2.6</td><td>24.336</td><td>2.40</td><td>19.58400</td></tr><tr><td>2.7</td><td>26.973</td><td>2.41</td><td>19.80562</td></tr><tr><td>2.8</td><td>29.792</td><td>2.42</td><td>20.02889</td></tr><tr><td>2.9</td><td>32.799</td><td>2.43</td><td>20.25381</td></tr><tr><td></td><td></td><td>2.44</td><td>20.48038</td></tr><tr><td></td><td></td><td>2.45</td><td>20.70863</td></tr><tr><td></td><td></td><td>2.46</td><td>20.93854</td></tr><tr><td></td><td></td><td>2.47</td><td>21.17012</td></tr><tr><td></td><td></td><td>2.48</td><td>21.40339</td></tr><tr><td></td><td></td><td>2.49</td><td>21.63835</td></tr></table>
			Total	**7**	
100	a		16, 29 and 35 in any order with correct working	5	**M1** for $x + 6 + 2x + 9 + 4x - 5 = 80$ may be implied by a subsequent correct equation **M1** for simplifying *their* equation to $ax + b = c$ implied by $7x + 10 = 80$ **M1** for the first correct step in solving *their* $ax + b = c$ e.g. $7x = 80 - 10$ **M1** for substituting *their* 10 into $x + 6$, $4x - 5$ and $2x + 9$ <u>Alternative method using trials</u> **M2** for at least one complete correct evaluation of $x + 6 + 2x + 9 + 4x - 5$ If **0** or **1** scored, instead award **SC2** for 16, 29, 35 in any order with no or insufficient working "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** <u>Alternative method</u> **M2** for 80 – 6 – 9 + 5 **oe** or 70 or **M1** for 6 + 9 – 5 or 10 **M1** for *their* 70 ÷ *their* 7 implied by 10 **M1** for substituting *their* 10 into $x + 6$, $4x - 5$ and $2x + 9$

					If **0** scored **SC1** for x = 10 with no or insufficient working	
	b		*Their* fully correct conclusion after **M2** scored	3	**M2** for $\sqrt{(their\ 16)^2 + (their\ 29)^2}$ correctly evaluated or for (*their* 16)^2 + (*their* 29)^2 and (*their* 35)^2 both correctly evaluated OR **M1** for $\sqrt{(their\ 16)^2 + (their\ 29)^2}$ either not evaluated or incorrectly evaluated or for (*their* 16)^2 + (*their* 29)^2 and (*their* 35)^2 either not evaluated or incorrectly evaluated or for (*their* 16)^2 + (*their* 29)^2 correctly evaluated <u>Alternative methods</u> Cosine rule : [cos … =] $\frac{16^2+29^2-35^2}{2\times16\times29}$ = 0.13… or 0.14v hence angle … ≠ 90 [97.928…°] **M1** for correct cos rule statement for angle, **M1** for ≠ 0 OR cos^{-1} or arc cos with 98 and **A1** for “No” (**A1 dep** on **M2**) Algebra : **M1** for both $(x + 6)^2 + (2x + 9)^2 = x^2 + 12x + 36x + 4x^2 + 36x + 81 = 5x^2 + 48x + 117$ and $(4x – 5)^2 = 16x^2 − 40x + 25$ [leading to $11x^2 – 88 – 92 = 0$ {which has roots of 8.935… and −0.935…}] and **M1** for substituting x = 10 into $5x^2 + 48x + 117$ and $16x^2 + 40x + 25$ and getting 1037 and 1225 for correct reason “No”	e.g. **3** marks for No, $\sqrt{16^2+29^2} \neq 35$ No, $16^2 + 29^2 = 1097$ and $35^2 = 1225$ or e.g. after 16, 30, 34 Yes, $16^2 + 30^2 = 1156$ and $34^2 = 1156$ Adapt the scheme for equivalent correct methods e.g. Pythagoras using hypotenuse and subtraction
			Total	**8**		
101	a		$\frac{13}{35}$ final answer	1		

						Ignore attempts to convert correct final answer to a decimal
	b		$\frac{3n-2}{(n+1)^2-1}$ **oe** final answer	3	**M2** for $3n - 2$ 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. $\frac{3n-2}{[1]n^2+2n}$, Condone consistent use of different variable for all marks e.g. **M2** for $3x - 2$ Where k is a value, or 'k' For **M2** and **M1** expressions do not need to be in a fraction
			Total	**4**		
102			Correct region indicated 	5	**B2** for $y - 2 = \frac{1}{3}x$ broken line or **B1** for $y - 2 = \frac{1}{3}x$ solid line AND **B1FT** for R correct side of $y - 2 = \frac{1}{3}x$ **B1** for R correct side of $x = {}^-3$ **B1** for R correct side of $y = {}^-x$	Allow shorter accurate line provided it defines their region See marks on diagram for next 3 marks Grid assumes $y - 2 = \frac{1}{3}x$ is correct Mark position of R first. If R not labelled then accept other clear indication If $y - 2 = \frac{1}{3}x$ <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
			Total	**5**		
103	a		$(2x + 5)(2x - 5)$ final answer	2		

					M1 for answer a pair of factors of the type $(ax + b)(ax - b)$, where $a = 2$ or $b = 5$ or for correct answer seen	For 2 marks or M1, condone omission of final bracket
	b		$(2x + 3)(x - 4)$ $\frac{-3}{2}$ **oe** and 4	M2 B1	**M1** for $2x(x - 4) + 3(x - 4)$ or $x(2x + 3) - 4(2x + 3)$ or for $(2x + a)(x + b)$ where $ab = {}^{-}12$ or $2b + a = {}^{-}5$ Correct or **FT** *their* two factors **dep** on factors of the form $(2x \pm a)(x \pm b)$	For **M2** and **M1** condone omission of final bracket For **M2**, condone $\frac{(2x+3)(2x-8)}{2}$ followed by $x - 4$ [= 0] and $2x + 3$ [= 0] If no product of factors shown, $x - 4 = 0$ and $2x + 3 = 0$ gets **M1** only After $2x(x - 4) + 3(x - 4)$ or $x(2x + 3) - 4(2x + 3)$ and then correct answers allow **M2B1**
	c		$\frac{5}{3}$ or $1\frac{2}{3}$ or $1.\dot{6}$	4	**M1** for $3(x - 4) = 3(1 - 2x)$ or $\frac{x-4}{1-2x} = 1$ **M1** for $3x - 12 = 3 - 6x$ or $x - 4 = 1 - 2x$ **M1** for reaching $ax = b$, **FT** *their* previous working provided previous working is of the form $dx + e = f + gx$	For **4** marks, accept 1.66… or 1.67 and condone $\frac{15}{9}$ **isw** incorrect cancelling/conversion Embedded answer scores **M3** maximum This final method mark may be implied from the answer
			Total	**9**		
104			133.5[0] with correct working	6		"correct working" requires at least **M1**AND**M1** or **M2**

						B1 for 3*a* or *a* + 4 or 5*a* + 4 or 25.5[0] + 4*x* seen **M1** for *a* + 3*a* + *a* + 4 = 89 or better or for a trial correctly evaluated **A1** for [*a* =] 17 [hours] AND **M2** for $\frac{25.5[0]}{their\ 17}$ × 89 or 1.5 × 89 oe or 25.5[0] + 76.5[0] + $\frac{25.5[0]}{their\ 17}$ × *their* 21 oe or 25.5[0] + 1.5 × 51 + 1.5 × 21 oe or **M1** for $\frac{25.5[0]}{their\ 17}$ implied by 1.5 or $\frac{25.5[0]}{5}$ implied by 5.1[0] If 0 or 1 scored, instead award **SC2** for 133.5[0] with no or insufficient working If 0 scored, instead award **SC1** for 17 [hours] with no or insufficient working	If working in pence: • Allow up to 5 part marks for consistent working • Allow full marks if answer is clearly stated as 13350 p[ence] **M1** implied by sub into *a* + 3*a* + *a* [+ 4] with evaluation **B1 max** possible for using 4*a* instead of *a* + 4 e.g. **M2** for $\frac{3}{2}$× 89 Method marks may be earned in stages May see equivalent algebraic methods. See Appendix. 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. If in doubt, contact your Team Leader. For example: (tips) Ariel : Blake : Casey is 25.5 : 76.5 : 25.5 + 4*x* (where *x* is hourly rate of tips) This is on the scheme at B1 **B1** (total tips) 25.5 + 76.5 + 25.5 + 4*x* = 89*x* There is an equation on the scheme, so M1 would be a good judgement **M1** (solving) *x* = 1.5 And then this would be the A1	

					A1 (substitution into either side of the equation) e.g. 89 × 1.5 (final answer) 133.5[0] 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 **M2**	
			Total	**6**		
105			E.g. Correct inequalities shown on diagram, correct region R identified and correct area calculation ½ × 3 × 2 [= 3] 	6	**B1** for line $y = 7$ **B1** for line $x + y = 8$ AND **B1** for correct side of $y = 2x - 1$ **B1** for correct side of $y = 7$ **B1** for correct side of $x + y = 8$ AND **M1dep** for ½ × 3 × 2 [= 3] 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 that is labelled, but if no labelling mark the single region that 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 2 and 1 oe
			Total	**6**		
106	a		$(x + 2)^2 - 3$ final answer	3	**B1** for $(x + 2)^2$	

					AND **B2FT** for – 3 or **M1** for 1 – (*their* 2)^2 oe shown If 0 or 1 scored, allow **SC2** for final answer (x + 2) – 3	No FT from $(x + 1)^2$ FT can be implied, check 1 – (*their* 2)^2
	b		$^-2 + \sqrt{3}$ $^-2 - \sqrt{3}$ final answer with working from **(a)**	2FT	**M1** for *their* $(x + 2)^2$ = *their* 3 FT from *their* (a) for solutions in exact form if working shown	Answers only score 0 Do not FT where b = 0 e.g. $(x + 2)^2$ 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
			Total	**5**		
107			2 and 12 nfww	4	**B3** $\frac{9a^2 \times a^5}{12a^3} = \frac{3a^4}{4}$ OR **B2** for $k = 2$ or **M1** any correct simplification of $\frac{a^k \times a^5}{a^3} = a^4$ e.g. [a^k ×] a^2 [= a^4] or [$a^k \times a^5$ =] a^7 $a^k = a^2$ $\frac{a^{k+5}}{[a^3]}$ [= a^4] $k + 5 – 3 = 4$ oe	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.

					and **B2** for $m = 12$ or **M1** for $\frac{9}{m} = \frac{3}{4}$oe	Allow $[m] = 9 \times 4 \div 3$
			Total	**4**		
108		i	5	1		
		ii	At $x = 0$ oe **and** $y < 0$ or y is negative or $y = -4$ 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 1dep	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 **Response Mark** 1 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** 2 $0^2 + (8 \times 0) - 4 = {}^-4$ and $1^2 + (8 \times 1) - 4 = 5$ so there is a sign change from ${}^-4$ to 5 *BOD x = 0 and x = 1 implied in reasoning and a correct statement regarding sign change* **2** 3 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** 4 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** 5 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** 6 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*	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

					SC1] **SC1** 7 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** 8 There is a change of sign *(2nd mark dep on first mark buts gets SC1)* **SC1** 9 The root lies between 0 and 1 *(not adding to question asked – no reasons given for this)* **0**
		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
			Total	**4**	
109	a		54	4	**B3** for $x = 15$ or **M2** for $3(x + 11) = 2(x + 24)$ oe or better or for 39 : 26 seen or **M1** $(x + 11)$ and $(x + 24)$ seen or better For M2 accept [P =] 39 and [F =] 26 (An answer of 69 may indicate this but check working for 39 and 26)

						For M1, could appear as $\frac{3}{x+24}$ $\frac{2}{x+11}$ or e.g. $3y = 24 + x$ and $2y = x + 11$
	b		$\frac{8}{13}$ oe	2FT	**B2FT** for $\frac{24}{their(a) - 15}$ dep on $0 < \text{answer} < 1$ or **B1** for numerator $8n$ or for denominator $13n$ or *their* (a) – 15	isw cancelling/conversion after correct answer seen 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 $0 < P < 1$
			Total	**6**		
110			3 frames with correct working	6	**Algebraic method:** **B5** for [one frame =] 50 [cm] with $x = 7$ and $3x^2 – 12x – 63$ [= 0] or better or **M3** for $3x^2 – 12x – 63$ [= 0] or better **A1** for [x =] 7 or **M2** for $(3x – 3)(x – 3)$ [= 72] oe or better seen or **B1** for $3x – 3$ or $x – 3$ seen OR **Trial and improvement:** **B5** for [one frame =] 50 [cm] with $x = 7$ and 18 by 4 [= 72] shown or **B4** for $x = 7$ and 18 by 4 [= 72] selected or **B3** for **selects** 4 by 18	"Correct working" requires B5 For **B5** and **M3A1** isw for use of $x = {}^{-}3$ For B5 or M3 allow equivalent 3 term quadratic e.g. $3x^2 – 12x = 63$ Allow equivalents for M2 e.g. $2 \times 1.5 \times 3x + 2 \times 1.5(x – 3) + 72 = 3x^2$ May be on diagram B3 not just for seeing 4 by 18 it must be selected

					[= 72] If 0, 1 or 2 scored, instead award **SC3** for [one frame =] 50 [cm] with no or insufficient working If 0 or 1 scored, instead award **SC2** for $x = 7$ with no or insufficient working	in some way e.g. ringed, underlined, used
			Total	**6**		
111			$\frac{7\pi r}{12}$ with correct working	5	**B4** for correct unsimplified answer with correct working OR **M1** for $\frac{45}{360} \times [2 \times]\pi k$ oe **A1** for $\frac{45}{360} \times 2\pi r$ oe or better isw incorrect cancelling/simplification AND **M1** for $\frac{45}{360} \times [2 \times]\ \pi\frac{4k}{3}$ **A1** for $\frac{45}{360} \times \pi\frac{8}{3}r$ oe or better isw incorrect cancelling/simplification If 0 or 1 scored, instead award **SC2** for final answer $\frac{7\pi r}{12}$ oe simplified answer with no or insufficient working	Condone '×' sign oe in simplified answer if otherwise correct e.g. $\frac{7}{12} \times \pi r$ "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. $k = 3$, r, d, $\frac{3}{7}$, $\frac{3}{7}x$ For A1 accept e.g. $0.25\ \pi r$ Correct expression implies M1A1 For M1 must use *their* previous k e.g. uses $k = 6$ for first M1 then uses 8 here for $\frac{4k}{3}$ gets 2nd M1 **unless** the expression is correctly stated as $\frac{45}{360} \times \pi\frac{8}{3}r$ oe which gets

						M1A1 Correct expression implies M1A1
			Total	**5**		
112			$8^2 + ([^-]6)^2$ $64 + 36 = 100$ or $\sqrt{64+36} = 10$ and $\sqrt{100} = 10$	1 1	Accept equivalent reasoning e.g. For first mark $10^2 - 8^2$ e.g. For second mark $100 - 64 = 36$ $\sqrt{36} = \pm 6$	If $8^2 + {}^-6^2$ do not allow first mark If $\sqrt{100}$ evaluated then it must be 10 For 2 marks there must be no errors leading to the answer
			Total	**2**		
113	a		$s = 350$ with 6, 5 and 10 or 100 seen	4	**B2** for 6, 5 and 10 or 100 or **B1** for two correct AND **M1** for $(5 \times 10) + ½(6 \times 10^2)$ or correct substitution of unrounded or incorrectly rounded values If **0** scored then **SC1** for sight of 350	For all marks condone e.g. 5.00, 6.0, 10.0 used These values may be written in the stem of the question For M1 e.g. allow a mixture $(4.92 \times 10.3) + ½(6.1 \times 10^2)$
	b		$x = [\pm]\sqrt{\frac{2E}{k}}$ oe final answer	3		Square root must dip below fraction line in final answer unless $\left(\frac{2E}{k}\right)$ bracketed

					M2 for first two steps correctly completed e.g. $\frac{2E}{k} = x^2$ or answer $[\pm]\sqrt{\frac{2E}{k}}$ (no x =) or **M1** for first step correctly completed e.g. $2E = kx^2$ or $\frac{E}{k} = \frac{1}{2}x^2$ If **0** scored, **SC1** for final answer $x = [\pm]\sqrt{\frac{\frac{1}{2}E}{k}}$ oe	For 3 marks oe e.g. $x = [\pm]\sqrt{\frac{2 \times E}{k}}$, $x = \sqrt{\frac{E}{\frac{1}{2}k}}$ **M2** for e.g., $\frac{E}{\frac{k}{2}} = x^2$, $\frac{E}{\frac{1}{2}k} = x^2$, $\frac{E}{0.5k} = x^2$ Allow **M1** for $\frac{E}{0.5} = kx^2$ oe oe for **SC1** e.g. $x = [\pm]\sqrt{\frac{E}{2k}}$
			Total	**7**		
114			accept any correct method e.g. $(2n + 1)(2n + 5)$ e.g. $4n^2 + 12n + 5$ or $4n^2 + (10 + 2)n + 5$ Statement showing that the expression is odd e.g. first two terms are even and add 5 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. $2(2n^2 + 6n) + 5$ 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 the correct expansion of any two brackets including e.g. $x(x + 1)$	for **M1** accept e.g. $(2n + 1)(2n + 5)$ without any explanation BUT only accept e.g. $(x + 1)(x + 5)$ 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 $x^2 + [1]x + 5x + 5$ or better **A1** for statement showing expression is odd e.g. "x is even so x^2 and $6x$ are even so + 5 makes odd"

			Total	**4**		
115	a		$\frac{9-6n}{(n+1)(2n^2+3)}$ final answer	4	**M1** for consistent common denominator of $(n + 1)(2n^2 + 3)$ **M1** for $3(2n^2 + 3) – 6n(n + 1)$ **M1** for correct expansion of one bracket	Condone $\frac{9-6n}{2n^3+2n^2+3n+3}$ for **4** marks and allow numerator $3(3 – 2n)$ allow e.g. $\frac{3(2n^2+3)}{(n+1)(2n^2+3)} - \frac{6n(n+1)}{(n+1)(2n^2+3)}$ Condone brackets crossed out
	b		$\frac{x+5}{3x+4}$ final answer	5	**M2** for $(x – 3)(x + 5)$ or **M1** for brackets which give 2 correct terms **M2** for $(3x + 4)(x – 3)$ or **M1** for brackets which give 2 correct terms	Condone brackets crossed out
			Total	**9**		
116			$\{x : {}^-2 < x < 7\}$ final answer and with correct working	5	**B4** for $−2 < x < 7$ with correct working and not written separately OR **M2** for $(x – 7)(x + 2)$ or $\frac{5 \pm \sqrt{(-5)^2 - 4 \times 1 \times -14}}{2}$ or **M1** for brackets which give two correct terms or the formula with at most two errors **B1** ${}^-2$ and 7 If **0** or **1** scored award instead **SC2** for $\{x : {}^-2 < x < 7\}$ If	"correct working" requires at least **M2** e.g. $(x – 7)(x + 2)$ condone $x(x + 2) – 7(x + 2)$ for **M2** could be seen as roots on a sketch of graph or with incorrect inequality symbols <u>completing the square:</u> allow $\left(x-2\frac{1}{2}\right)^2 - 20\frac{1}{4}$ for **M2** or $\left(x-2\frac{1}{2}\right)^2 + k$ for **M1**

					0 scored **SC1** for $^{-}2 < x < 7$	
			Total	**5**		
117	a		accurate curve	3	**B2** for 7 or 8 points accurately plotted or **B1** for 4, 5 or 6 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
	b		$x = {}^{-}1.5$ oe	1		
	c		$^{-}3.9$ or $^{-}3.8$ or $^{-}3.7$ 0.7 or 0.8 or 0.9	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 $^{-}3.9$ to $^{-}3.7$ and 0.7 to 0.9	tolerance ±1 small square radially
			Total	**6**		
118			[a =] $^{-}4$ [b =] 3	2	**B1** for one correct or **M1** for any pair of original bracketscorrectly expanded e.g. $2x^2 + ax + 6x + 3a$ or 1[x] × 2[x] × b[x] 6[x^3] or 3 × a × 2 = $^{-}24$ or better	allow seen in a table
			Total	**2**		
119	a		$y = \frac{42}{\sqrt{x}}$ oe	3	**M1** for $y = \frac{k}{\sqrt{x}}$ oe **B1** for [k =] 42	e.g. condone $y = \frac{k}{\sqrt{49}}$ for **M1**
	b		1.96 **oe**	3		

					B2 for $\sqrt{x} = \frac{42}{30}$ oe Or **M1** for $30 = \frac{\textit{their } 42}{\sqrt{x}}$ or $\frac{30}{6} = \frac{\sqrt{49}}{\sqrt{x}}$	
			Total	**6**		
120	a		$0^3 + 2 \times 0 - 2 = {}^-2$ $1^3 + 2 \times 1 - 2 = 1$ Sign change so solution between $x = 0$ and $x = 1$	3	**M2** for $0^3 + 2 \times 0 - 2 = {}^-2$ and $1^3 + 2 \times 1 - 2 = 1$ Or **M1** for $0^3 + 2 \times 0 - 2 = {}^-2$ or $1^3 + 2 \times 1 - 2 = 1$ **soi** by $^-2$ or 1 <u>Alternative method</u> After $x^3 + 2x = 2$ seen **M2** for $0^3 + 2 \times 0 = 0$ and $1^3 + 2 \times 1 = 3$ **A1** for $0 < 2$ and $3 > 2$ so solution between $x = 0$ and $x = 1$ OR **M1** for $0^3 - 2 \times 0$ or $1^3 + 2 \times 1$ **soi** by 0 or 3 <u>Alternative method</u> **SC3** for using an iterative equation that converges to a value in the range 0.75 to 0.85 **and** concluding statement that $0 < 0.75$ to $0.85 < 1$ **oe** Or **SC2** for using an iterative equation that converges to a value in the range 0.75 to 0.85	Accept other values of x used between 0 and 1 (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 $^-2 < 0 < 1$ $x = 0$ gives an answer < 0 and $x = 1$ gives an answer > 0 Examples insufficient for third mark: so x lies between 0 and 1 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>b</td>
<td></td>
<td>Two correct evaluations in the range 0.75 to 0.85, one which gives a positive value and the other giving a negative value

0.8</td>
<td>M3
A1dep</td>
<td>M2 for two correct evaluations between 0 and 1, one that gives a positive value and the other giving a negative value

Or M1 for one correct evaluation between 0 and 1

Dependent on achieving at least M2

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

M1 for <u>attempting</u> first iteration (either substitution seen or found to at least 2dp (rot))

M1 for continuing iteration(s) to reach x in the range 0.75 to 0.85

A1 for 0.8

If 0 scored, SC1 for answer 0.8 with no worthwhile working</td>
<td>Likely values: accept rot to 2+sf

<table>
<tr><th>x</th><th>x^3+2x-2</th><th>x</th><th>x^3+2x-2</th></tr>
<tr><td>0.1</td><td>−1.799</td><td>0.76</td><td>−0.041</td></tr>
<tr><td>0.2</td><td>−1.592</td><td>0.77</td><td>−0.003</td></tr>
<tr><td>0.3</td><td>−1.373</td><td>0.78</td><td>0.0346</td></tr>
<tr><td>0.4</td><td>−1.136</td><td>0.79</td><td>0.073</td></tr>
<tr><td>0.5</td><td>−0.875</td><td>0.81</td><td>0.151</td></tr>
<tr><td>0.6</td><td>−0.584</td><td>0.82</td><td>0.191</td></tr>
<tr><td>0.7</td><td>−0.257</td><td>0.83</td><td>0.232</td></tr>
<tr><td>0.75</td><td>−0.078</td><td>0.84</td><td>0.273</td></tr>
<tr><td>0.8</td><td>0.112</td><td>0.85</td><td>0.314</td></tr>
<tr><td>0.9</td><td>0.529</td><td></td><td></td></tr>
</table>

Condone missing subscripts

If within part (b) candidates <u>refer</u> to their working in part (a), award up to full marks for part (b)</td>
</tr>
<tr>
<td></td><td></td><td></td><td>Total</td><td>7</td><td></td><td></td>
</tr>
<tr>
<td>121</td>
<td>a</td>
<td></td>
<td>Substitution into correct formula (may be implied) and partial simplification</td>
<td>2
1dep</td>
<td>B2 for
$24 = 16t + \frac{1}{2} \times -5 \times t^2$ oe

or $24 = 16t + (-2.5)t^2$</td>
<td>Only accept $24 = 16t - 2.5t^2$ if substitution seen</td>
</tr>
</table>

			$48 = 32t - 5t^2$ **oe** seen and correct completion to $5t^2 - 32t + 48 = 0$		Or **B1** for substitution e.g. $24 = 16t + \frac{1}{2}(-5)t^2$ Dep on previous **2** marks	For **B1**, condone ambiguity caused by missing brackets
	b		Shows $v = 0$ and concludes "stationary"	3	**M1** for $[v^2 =]\ 16^2 + 2 \times {}^-5 \times 25.6$ **A1** for $v = 0$ If **0** scored, instead award **SC2** for $v = 0$ and other values substituted into a relevant equation as a correct check Or **SC1** for $v = 0$	
	c		2.4 and 4 **oe**	3	**M2** for $(5t – 12)\ (t – 4)$ Or **M1** for any two factors that give two correct terms when expanded or for partial factorisation $5t(t – 4) – 12(t – 4)$ OR **M2** for $[t =]\frac{32 \pm \sqrt{1024 - 960}}{10}$ or better Or **M1** for $[t =]\frac{-(-32) \pm \sqrt{32^2 - 4 \times 5 \times 48}}{2 \times 5}$ with at most one error	e.g. a sign error, short fraction line, short root but condone missing brackets
			Total	**9**		
122			$a = \frac{5}{2b - 23}$ or $a = \frac{-5}{23 - 2b}$	5		

					B4 for $\frac{5}{2b-23}$ or $a=\frac{2.5}{b-11.5}$ as final answer OR **M2** for $20a + 5 = 2ab - 3a$ or $4+\frac{1}{a}=0.4b-0.6$ Or **M1** for $\frac{5(4a+1)}{a}=2b-3$ or $4a+1=\frac{a(2b-3)}{5}$ or $20a + 5$ or $2ab - 3a$ seen or $4+\frac{1}{a}=\frac{2b-3}{5}$ or $\frac{4a+1}{a}=0.4b-0.6$ **M1FT** for correctly collecting *a* terms on one side and non-*a* terms on the other (need not be simplified at this stage) **M1FT** for factorising *their* 2 or 3 terms	To award full marks, solution must be correct e.g. $5 = 2ab - 20a - 3a$ or $\frac{5}{a}=2b-20-3$ FT for formulae of equal difficulty (e.g. must include an *ab* term **oe**) e.g. $5 = a(2b - 23)$ or $\frac{a}{5}=\frac{1}{2b-23}$
			Total	**5**		
123			$x + 10$ as final answer	2	**B1** for each part Or **M1** for $2x + 6$ or $^{-}x + 4$	
			Total	**2**		
124			$\frac{3(x-2)}{x+6}$ or $\frac{3x-6}{x+6}$ final answer	5	**M2** for $3(x - 2)(x + 2)$ or $(3x - 6)(x + 2)$ Or **M1** for $3(x^2 - 4)$ **M2** for $(x + 2)(x + 6)$ Or **M1** for $x(x + 2) + 6(x + 2)$ or $x(x + 6) + 2(x + 6)$ or for $(x + a)(x + b)$	For method marks condone omission of final bracket

					where $a + b = 8$ or $ab = 12$	
			Total	**5**		
125			$z = 2y^2 - 6$ final answer	4	**B3** for answer $2y^2 - 6$ Or **M3** for $8 = 6\left(\frac{7-y^2}{3}\right) + z$ **oe** or $2y^2 - z = 6$ **oe** or $3\left(\frac{8-z}{6}\right) + y^2 = 7$ or better Or **M2** for $x = \left(\frac{14-2y^2}{6}\right)$ oe or $x = \left(\frac{8-z}{6}\right)$ oe or $6x = 14 - 2y^2$ or $(6x + 2y^2) - (6x + z) = 14 - 8$ **oe** Or **M1** for $6x + 2y^2 = 14$ or $3x = 7 - y^2$ or $6x = 8 - z$ or better	Correct unsimplified formula in y and z **M2** sets up for substitution with x explicit or for method for elimination by equating coefficients of x and correct method to eliminate x **M1** equates coefficients of x or first step in rearrangement to eliminate x
			Total	**4**		
126			$2n^3 + 8n^2 - 20n + 10$ or $2(n^3 + 4n^2 - 10n + 5)$ $2(n^3 + 4n^2 - 10n + 5)$	M5 A1	**M3** for $2n^3 - 4n^2 + 10n^2 - n^2 - 5n + 2n - 20n + 10$ **oe** or better or condone one error in coefficients in simplified expression $2n^3 + 8n^2 - 20n + 10$ Or **M2** for one correct expanded pair Or **M1** for 3 correct terms out of 4 in	$2n^3 + 5n^2 - 23n + 10$ when simplified i.e. $2n^2 - n + 10n - 5$ or better or $2n^2 - n - 4n + 2$ or better or $n^2 + 5n - 2n - 10$ or better

					expanded pair (term in n counts as 2 terms) AND **M1** for $3n^2 + 3n$ Accept e.g. each term is divisible by 2 or $(2n^3 + 8n^2 - 20n + 10) \div 2 = n^3 + 4n^2 - 10n + 5$ <u>Alternative method</u> Alternative 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 $(2n - 1)(n + 5)(n - 2)$ and $3n(n + 1)$, 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	Must include e.g. if n is even, $2n - 1$ is odd, $n + 5$ is odd, $n - 2$ is even, then even × odd × odd = even and $3n$ is even and $n + 1$ is odd, even × odd = even, then even + even = even **and** repeat when n = odd
			Total	**6**		
127	a		$x > 3$	3	Mark final answer **M1** for $3x - 6 > x$ or $x - 2 > \frac{x}{3}$ **M1** for correct step[s] to $ax > b$ FT *their* first step	For method marks, condone incorrect inequality sign or 'equals' sign e.g. Answer $x = 3$, $x > 3$ 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. 4 on answer line and $x < 4$ in working then allow FT from $x < 4$ If answer 4 in **(a)**

					B1FT for *their* correct hollow or solid circle **B1FT** for *their* correct arrow direction	then allow $x < 3$ here Both **B1**'s must be with *their* value from part **(a)** If no arrow then *their* line must stretch to end of line
			Total	**5**		
128	a		⁻1	1		
	b		Correct graph	3	Curves must not be joined or touch either axis **B2FT** for 7 or 8 correct plots Or **B1FT** for 5 or 6 correct plots	Condone slight feathering, no ruled segments If curve incorrect, mark the plots If large blob for plot, check centre of blob
			Total	**4**		
129			57 292 279 with correct working	7	**B1** for 5*n* + 7 **B1** for 5*n* + 7 – 13 or better **M1** for writing a correct equation equal to 628 using *their* expressions e.g. $n + 5n + 7 + 5n + 7 - 13 = 628$ or better **M1** for simplifying *their* equation e.g. $11n + 1 = 628$ **A1FT** for correctly solving *their* equation e.g. $n = 57$ **M1** for substituting	'Correct working' requires evidence of at least **B1B1** Expressions could start from J or M

					their 57 into both expressions e.g. 5 × 57 + 7 and 5 × 57 + 7 – 13 **oe** <u>Trials</u> **B1** for one complete trial with $n \geq 3$ **B1** for second complete trial $n \geq 3$ If **0** or **1** scored **SC3** for 57, 292, 279 with **B1** only Or **SC2** for 57, 292, 279 with no working	
			Total	**7**		
130	a		≤ ≤ ≥	2	**B1** for two correct or "< < >"	i.e. correct but no equals
	b		$x + 2y \geq 6$ **oe**	3	**B1** for the correct straight line drawn, from (6, 0) to (0, 3) – but line need not go past intersection with $y = 2x$. **B1** for correct equation for *their* line e.g. $x + 2y = 6$ **oe**	Implied by e.g. $x + 2y = 6$ **oe** and accept a ruled or good freehand line Implied by e.g. answer of $x + 2y \leq 6$ **oe**
			Total	**5**		
131			4, $^-11$	4	**B1** for $(x - 4)^2$ or 8 ÷ 2 **B2FT** for -11, correct or FT *their* $(x - 4)^2$ Or **M1** for $(their + 4)^2 - 8 \times (their + 4) + 5$ **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 **B3** implied by $(x - 4)^2 - 11$

					<u>Alternative method – find the line of symmetry</u> Find the two points where e.g. $y = 5$ **M1** for $x^2 – 8x + 5 = 5$ **A1** for $x(x – 8) = 0$ so $x = 0$ or $x = 8$ **B1** each for line of symmetry is $x = 4$ and by substitution $y = {}^-11$ to a maximum of **3** marks	
			Total	**4**		
132			[a =] 2 [b =] $^-3$ [c =] 5	4	**B2** for $a = 2$ Or **M1** for second differences = 4 **M1** for revised terms of 2, $^-1$, $^-4$, $^-7$ Or **B1** for either $b = {}^-3$ or $c = 5$ <u>Alternative method</u> **M1** for using simultaneous equations e.g. $a + b + c = 4$ $4a + 2b + c = 7$ $9a + 3b + c = 14$ **M1** for subtracting e.g. $3a + b = 3$ $5a + b = 7$ **A1** for $a = 2$	Condone e.g. $2n^2$ At least two terms
			Total	**4**		
133			[x =] 5 [y =] 9 [x =] $^-5$ [y =] $^-1$ with correct algebraic working	5	Accept any correct method **M1** for correct substitution e.g. $(x − 4)^2 + (x + 4)^2$ [=82] **M1** for expanding both brackets correctly	"Correct algebraic working" requires evidence of at least **M1M1** Implied by $2x^2 + 32$[=82] Condoning one error

					e.g. $x^2 - 4x - 4x + 16 + x^2 + 4x + 4x + 16$[=82] **M1** for simplifying *their* equation e.g. $2x^2 = 50$ or $2x^2 - 50$[=0] **A1FT** for $x = -5, 5$ <u>Alternative method</u> **M1** for correct substitution e.g. $(y - 4 - 4)^2 + y^2$[=82] **M1** for expanding the bracket correctly e.g. $y^2 - 8y - 8y + 64 + y^2$[=82] **M1** for simplifying *their* equation e.g. $2y^2 - 16y - 18$[=0] or better e.g. $y^2 - 8y - 9$[=0] **A1** for $y = -1, 9$ If **0** scored **SC2** for [x=] − 5 [y=] − 1 and [x=]5 [y=]9 with no working Or **SC1** for both x values with no working or a correct pair of x and y values with no working	Or better to $ax^2 = b$ or to $ax^2 + bx + c$[=0] FT *their* quadratic equation
			Total	**5**		
134			a^{10}	1		
			Total	**1**		
135	a		Taylor and square root of 9 is 3 and $^-3$ oe	1		Accept: Taylor because Sasha only used the positive square root Taylor because verification of $^-5$. Do not accept:

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Two solutions expected for a quadratic;
Sasha because …</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td colspan="2"><u>Examiner's Comments</u>

Many candidates thought Sasha was correct. Those correctly identifying Taylor sometimes could not give a correct reason for doing so. The reason given should have noted ±3 arising at the square root stage. However, those candidates who verified that Taylor's two solutions worked had a basis for their choice and so gained the mark. Those candidates who merely said that all quadratics have two solutions had not related their statement to this question and, in fact, were making an incorrect generalisation.</td></tr>
<tr><td></td><td>b</td><td></td><td>4.30 and [0].70
with correct algebraic working</td><td>4</td><td>M2 for correct substitution into the formula,

eg. $\frac{-(-5)\pm\sqrt{(-5)^2-4\,[\times1]\times3}}{2[\times1]}$ oe allowing

one error
or for solving by completing the square

eg. $\left(x-\frac{5}{2}\right)^2-\left(\frac{5}{2}\right)^2+3=0$ oe

and $x=\pm\sqrt{(-3)+\left(\frac{5}{2}\right)^2}+\frac{5}{2}$ oe or better

or

M1 for correct substitution into the formula, allowing two errors, or for completing the square eg. $\left(x-\frac{5}{2}\right)^2-\left(\frac{5}{2}\right)^2+3[=0]$oe or better</td><td>"Correct working" requires evidence of at least M2

For oe allow better up to $\frac{5\pm\sqrt{25-12}}{2}$

but do not allow $\frac{5\pm\sqrt{13}}{2}$

Condone 5^2 for $(^-5)^2$</td></tr>
</table>

					and **A1** for 4.30 or [0].70 nfww or for both solutions correct nfww but to more than 2 dp, to just 1 dp or in exact form If **0** scored, instead award **SC1** for both answers correct or to more than 2 dp, to just 1 dp or in exact form with no working or insufficient working eg. 4.30277… and 0.69722…. 4.3 and 0.7, $\frac{5\pm\sqrt{13}}{2}$ **Examiner's Comments** The quadratic formula was given on the formula sheet and candidates of all abilities made an attempt to substitute into it. Most identified *a*, *b* and *c* correctly, but errors occurred in writing and evaluating the parts involving the b term as it was negative. About a third of candidates both substituted and evaluated correctly, but some of these did not give the final answer to the requested accuracy. A few candidates used the method of completing the square, then solving the equation. These tended to be the higher performing candidates and most attempts were successful. **Assessment for learning** When substituting negative values into formulae (the quadratic formula, in particular), it is a good idea to write them in brackets, e.g. ($^-5$), before doing any simplifying. Calculators are also more likely to give a correct answer if brackets are used, e.g. $(^-5)^2$ will be given as 25, whereas $^-5^2$ may be given as $^-25$.
			Total	**5**	
136	a		$3^5 - 70 \times 3 - 150 = {}^-117$ and $4^5 - 70 \times 4 - 150 = 594$	3	

			Sign change so solution between $x = 3$ and $x = 4$		**M2** for $3^5 - 70 \times 3 - 150 = {}^{-}117$ and $4^5 - 70 \times 4 - 150 = 594$ or **M1** for $3^5 - 70 \times 3 - 150$ soi by ${}^{-}117$ or $4^5 - 70 \times 4 - 150$ soi by 594	Accept other values of x used between 3 and 4 (see table in part (b)). For full marks, the two values need to produce a sign change or values either side of 150 if using alternative method. Examples just sufficient for third mark include:
					<u>Alternative method</u> After $x^5 - 70x = 150$ **seen**	Change of sign ${}^{-}117 < 0 < 594$
					M2 for $3^5 - 70 \times 3 = 33$ and $4^5 - 70 \times 4 = 744$	$x = 3$ gives an answer < 0 and $x = 4$ gives an answer > 0
					A1 for $33 < 150$ and $744 > 150$ so solution between $x = 3$ and $x = 4$ OR **M1** for $3^5 - 70 \times 3$ soi by 33 or $4^5 - 70 \times 4$ soi by 744	Examples insufficient for third mark: so x lies between 3 and 4
					<u>Alternative method</u> **SC3** for using an iterative equation that converges to a value in the range 3.25 and 3.35 **and** concluding statement that $3 < 3.25$ to $3.35 < 4$ oe or **SC2** for using an iterative equation that converges to a value in the range 3.25 to 3.35	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><u>Examiner's Comments</u>

Similar questions have been set in the past and have been answered reasonably well. However, on this occasion, many of the candidates omitted the entire question.

Candidates needed to evaluate y for x = 3 and x = 4 as $^{-}$117 and 594 and note that a change of sign had occurred.</td></tr>
<tr><td></td><td>b</td><td></td><td>Examples:
when x = 3.1 y = $^{-}$80[.7…], so 3.1 < p < 4
when x = 3.5 y = 130[.2…], so 3 < p < 3.5
when x = 3.1 y = -80[.7…] and when x = 3.5 y = 130[.2…], so 3.1 < p < 3.5</td><td>3</td><td>Dependent on achieving at least M2

M2 for one further value of y evaluated correctly, possibly rot or truncated to 2 or more sf, for a value of x such that 3 < x < 4

OR

M1 for working shown to calculate one further value of y for a value of x such that 3 < x < 4

<u>Alternative method</u>
After $x^5 - 70x = 150$ seen
Award marks as for the main method, but with one evaluation being < 150 and the other being >150

Note after SC considered in part (a): if SC2 was awarded then they must use a value of x that produces a smaller interval than 3 < x < their x-value in (a) or their x-value in (a) < x < 4

If 0 scored, instead award
SC1 or SC2 if evidence

Likely values:
accept rot to 2+sf
<table>
<tr><th>x</th><th>x^5–70x</th><th>x^5–70x–150</th></tr>
<tr><td>3.1</td><td>69.292</td><td>-80.708</td></tr>
<tr><td>3.2</td><td>111.544</td><td>-38.456</td></tr>
<tr><td>3.25</td><td>135.091</td><td>-14.909</td></tr>
<tr><td>3.26</td><td>140.004</td><td>-9.996</td></tr>
<tr><td>3.27</td><td>144.986</td><td>-5.014</td></tr>
<tr><td>3.28</td><td>150.038</td><td>0.038</td></tr>
<tr><td>3.29</td><td>155.16</td><td>5.16</td></tr>
<tr><td>3.3</td><td>160.354</td><td>10.354</td></tr>
<tr><td>3.31</td><td>165.62</td><td>15.62</td></tr>
<tr><td>3.32</td><td>170.958</td><td>20.958</td></tr>
<tr><td>3.33</td><td>176.369</td><td>26.369</td></tr>
<tr><td>3.34</td><td>181.854</td><td>31.854</td></tr>
<tr><td>3.35</td><td>187.414</td><td>37.414</td></tr>
<tr><td>3.4</td><td>216.354</td><td>66.354</td></tr>
<tr><td>3.5</td><td>280.219</td><td>130.219</td></tr>
<tr><td>3.6</td><td>352.662</td><td>202.662</td></tr>
<tr><td>3.7</td><td>434.44</td><td>284.44</td></tr>
<tr><td>3.75</td><td>479.077</td><td>329.077</td></tr>
<tr><td>3.8</td><td>526.352</td><td>376.352</td></tr>
</table></td></tr>
</table>

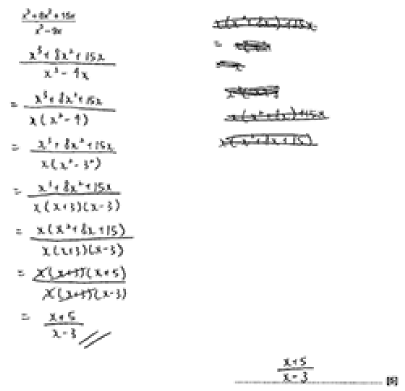
					for **M1** or **M2** has not been credited in part **(a)** 3.9 | 629.242 | 479.242 A correct narrower range scores **0** unless accompanied by the relevant correct calculations. Calculations in support of x = 3 or x = 4 need not be repeated from part **(a)** **<u>Examiner's Comments</u>** Part (a) says that 3 < p < 4, so even if the candidate could not show this for themselves, they could still attempt (b). To find a smaller interval, candidates needed to evaluate y for one value of x within that interval and then interpret the answer as a new interval. For example, x = 3.5 evaluates to 130 and so a smaller interval is 3 < p < 3.5, or x = 3.1 evaluates to $^-$81 and so another smaller interval is 3.1 < p < 4. Part marks were available, with M1 for substituting an appropriate value of x and M1 for the correct evaluation. However, many candidates either gained full marks or no marks.
			Total	**6**	
137			$\frac{x+5}{x-3}$	5	**M4** for $\frac{x(x+3)(x+5)}{x(x+3)(x-3)}$ or $\frac{(x+3)(x+5)}{(x+3)(x-3)}$ OR **M2** for [x](x + 3)(x + 5) or **M1** for [x](x(x + 5)+3(x + 5)) or [x](x(x + 3) + 5(x + 3)) or for [x](x + a)(x + b) where a + b = 8 or ab = 15 and **M1** for [x](x + 3)(x – 3) or $\frac{x(x^2+8x+15)}{x(x^2-9)}$ or $\frac{x^2+8x+15}{x^2-9}$ For **M2** and **M1** marks, if written as a quotient, condone [x] not being consistently present in both or cancelled out from both Also award **M2** and **M1** marks for factorising without first factorising [x].

or for $x^2 + 8x + 15$ and $x^2 - 9$ or any other partially factorised form of the numerator or denominator	eg. $(x^2 + 3x)(x + 5)$ earns **M2**

Examiner's Comments

Some candidates gained full marks, but most gained none. Part marks were given depending on the progress made in the factorising of the numerator and the denominator, plus any correct simplifications.

Exemplar 3



The order in which the factorisations and simplifications take place is sometimes interchangeable. Many candidates performed more than one step at a time, but sometimes introduced an error; this can make it difficult to credit an intermediate step that may have taken place and is then subsequently spoilt. This exemplar shows very clearly, line-by-line, what each step is.

On the penultimate line of working, the candidate gives an expression that is M4 on the mark scheme, but progress leading to this should be checked for any errors that sometimes cancel themselves out. That is not the case here.

First the candidate deals with the denominator, taking x out as a factor and then they factorise the difference of two squares (M1). They then factorise the numerator (M2). The numerator and denominator have been factorised correctly and

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td colspan="2">presented as a whole expression, so M4 is given. Finally, they simplify this expression correctly and stop. Some candidates however incorrectly cancelled x at the end to finish with $\frac{5}{3}$.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>5</td><td colspan="2"></td></tr>
<tr><td>138</td><td></td><td></td><td>[0].7 oe with correct working</td><td>5</td>
<td><u>By Equation:</u>
M3 for 5k + 21 and 10(5 – 1.5)k oe

or

M1 for 5k + 21
M1 for (5 – 1.5)k or 3.5k

AND

M1FT for 30k = 21

If 0 or 1 scored, instead award
SC2 for answer [0].7 with no working or insufficient working
If 0 scored, instead award

SC1 for $-\frac{140}{31}$ or –4.516… to –4.52 as final answer

<u>By Trials</u>:
M4 for 5k + 21 and either 10(5 – 1.5)k oe or (5 – 1.5)k oe both correctly evaluated with k = 0.7

or

M3 for 5k + 21 and either 10(5 – 1.5)k oe or (5 – 1.5)k oe both correctly evaluated in one trial with consistent k</td>
<td>“correct working” requires evidence of at least M3

5k + 21 [M1] = 26k [isw, but ruled out of M3 and M1FT if 26k used]
5 – 1.5k = 3.5k [M1 bod]

FT their linear equation in the form ak + b = ck

SC1 is from ×10 of wrong function***

<table>
<tr><th>k</th><th>5k+21</th><th>10(5–1.5)k</th><th>(5–1.5)k</th></tr>
<tr><td>0.5</td><td>23.5</td><td>17.5</td><td>1.75</td></tr>
<tr><td>0.6</td><td>24</td><td>21</td><td>2.1</td></tr>
<tr><td>0.7</td><td>24.5</td><td>24.5</td><td>2.45</td></tr>
<tr><td>0.8</td><td>25</td><td>28</td><td>2.8</td></tr>
<tr><td>0.9</td><td>25.5</td><td>31.5</td><td>3.15</td></tr>
<tr><td>1</td><td>26</td><td>35</td><td>3.5</td></tr>
<tr><td>2</td><td>31</td><td>70</td><td>7</td></tr>
</table></td></tr>
</table>

<table>
<tr>
<td></td><td></td><td></td><td></td><td></td>
<td>or
M1 for $5k + 21$ correctly evaluated in one trial
M1 for either $10(5 – 1.5)k$ oe or $(5 – 1.5)k$ oe correctly evaluated in one trial

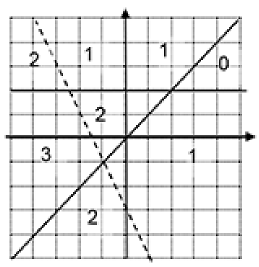
SC award marks as above</td>
<td><table><tr><td>3</td><td>36</td><td>105</td><td>10.5</td></tr><tr><td>4</td><td>41</td><td>140</td><td>14</td></tr><tr><td>5</td><td>46</td><td>175</td><td>17.5</td></tr><tr><td>10</td><td>71</td><td>350</td><td>35</td></tr></table></td>
</tr>
<tr>
<td></td><td></td><td></td><td></td><td></td>
<td colspan="2">

<u>Examiner’s Comments</u>

Some basic algebraic errors were shown in responses to this question.
Function A leads to $5k + 21$, but it was common for this to be incorrectly simplified to $26k$ in subsequent working.
Function B leads to $3.5k$, but it was common for this to be treated as $5 − 1.5k$, or as $50 − 15k$ after multiplying by 10.

It was anticipated that candidates would set up and solve the equation $5k + 21 = 35k$. Instead, it was common for trial values of k to be substituted into Function A and Function B. This was usually unsuccessful in reaching the correct answer of $k = 0.7$ as many candidates only trialled integer values. Some credit was given depending on correct evaluations and whether the values of k used in the two functions were consistent.

Other candidates tried setting up simultaneous equations, such as $5k + 21 = 10B$ and $3.5k = A/10$, but generally abandoned this at $147 = 70B – A$ or sooner. If the left-hand side of these equations were correct, these candidates could still gain M1 M1.

</td>
</tr>
<tr>
<td></td><td></td><td></td><td>**Total**</td><td>**5**</td><td colspan="2"></td>
</tr>
<tr>
<td>139</td><td></td><td></td>
<td>$y = 2$ ruled and $y = –2x –3$ broken line and correct region indicated

</td>
<td>6</td>
<td>**B1** for $y = 2$ ruled

B2 for $y = –2x –3$ broken line

or</td>
<td>Penalise one mark only for good

freehand lines

Additional lines treat as choice</td>
</tr>
</table>

					B1 for $y = –2x –3$ solid line AND **B1** for *R* on correct side of $y = x$ **B1** for *R* on correct side of $y = 2$ **B1** for *R* on correct side of *their* $y = –2x – 3$	Length of line should be fit for purpose to identify *their* region See marks on diagram for the final **B3** marks provided all lines drawn correctly For region, FT *their* $y = –2x – 3$ provided line with negative gradient only but no FT for $y = 2$ if incorrect Condone shading in or out of region provided R is clearly identified
					Examiner's Comments Few candidates gave a fully correct response for the region. Others were able to draw two correct lines and identify the correct region, but did not draw $y = {}^-2x – 3$ as a broken line. Most candidates struggled to draw $y = {}^-2x – 3$, but were able to draw y = 2. Many were given partial marks for identifying a region that satisfied at least one of the lines. Examiners allowed a follow-through mark for the region if the line $y = {}^-2x – 3$ had been drawn incorrectly, provided it was a ruled line with a negative gradient. **Assessment for learning** Before drawing a boundary line, candidates should consider whether it is included in the required region or not. Lines should always be ruled and where the line is not included in the region, it should be drawn as a ruled broken line.	
			Total	**6**		
140			Translation $\binom{-3}{-14}$	4		

					B3 for translation $\binom{-3}{k}$ or translation $\binom{k}{-14}$ OR **M2** for [y =] $(x + 3)^2 - 5 - 3^2$ or better or **M1** for [y =] $(x + 3)^2$ seen **B1** for translation If more than one transformation given then **M2** maximum **<u>Examiner's Comments</u>** This proved to be challenging for almost all candidates. Many omitted this part. Some candidates completed the square and then linked it to the coordinates of the turning point of $y = x^2 + 6x - 5$ before giving a correct transformation. Some others recognised the transformation and gave the answer translation, but without any algebraic work to establish the vector required.
			Total	**4**	
141			115	4	**M1** for $4x - 150 = 2(x + 20)$ **oe** **M1** for $4x - 150 = 2x + 40$ FT *their* 4 term linear equation with brackets **M1** for $x = 95$ FT *their* 4 term linear equation FT linear eqn with more than 4 terms but not fewer, must have at least two terms in x **<u>Examiner's Comments</u>** A few candidates were able to set up a correct equation, solve it to find the value of x and then use this to find the size of angle BCD. Many set up an incorrect equation, for example $x + 20 = 4x - 150$ or $x + 20 + 4x - 150 = 360$. A follow-through mark was available for solving an incorrect equation of equivalent difficulty to the

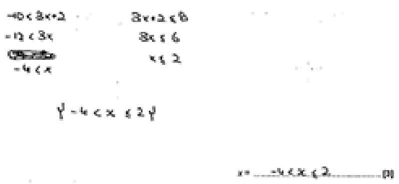
					correct equation. This mark was given to a small number of candidates.
			Total	**4**	
142			$a = 11$ $b = -6$	3	**B2** for $a - 3 = 8$ or $7 - b = 13$ or better or **M1** for $x^2 + ax + 7 = 3x + b$ **oe** **B2** implied by one correct value e.g. $0 = 3x + b - x^2 - ax - 7$ **<u>Examiner's Comments</u>** Only the highest performing candidates had success on this question. Some were given partial marks for stating that $x^2 + ax + 7 = 3x + b$ would lead to the given equation. Most others that attempted the question tried to find the solutions of the equation $x^2 + 8x + 13 = 0$.
			Total	**3**	
143	a		243	1	**<u>Examiner's Comments</u>** Those that recognised the term-to-term relationship of multiply by 3 gave the correct response. A few candidates tried to look for differences between the terms using difference trees and gave incorrect responses.
	b		0.37 0.46 2.12	3	**B1** for 0.46 **B1** for 2.12 **B1FT** for 0.83 – *their* 0.46 *their* 0.46 < 0.83 **<u>Examiner's Comments</u>** This was very well answered. Any of the few errors made in finding the terms were in the arithmetic and not in the understanding of the pattern of the sequence.
			Total	**4**	

144	a		3	1	**Examiner's Comments** Few gave the correct value of 3. An answer of 5 was common and ⁻17 was also seen.
	b		Correct curve	3	**B2FT** for 7 or 8 correct plots or **B1FT** for 5 or 6 correct plots Use overlay as a guide Mark curve first accuracy ± 1mm, ½ small sq Condone slight feathering Condone ruled segment between $x = -5$ and $x = -4.5$ only If curve incorrect then mark plots accuracy ± 1mm If no plot, curve implies plot **Examiner's Comments** Few candidates gave a fully correct curve. Many were given partial marks for correctly plotting their points. The plots at (⁻4.5, ⁻10.1), (⁻3, ⁻9) and (⁻2, ⁻8) were those most commonly plotted incorrectly, where candidates were not able to correctly interpret the vertical scale of the graph.
	c		–1 cao	1	**Examiner's Comments** This part proved challenging and there were a range of incorrect values given. To be successful, candidates needed to look for the 'highest' horizontal line through an integer on the y-axis that crossed the curve once only.

			Total	**5**	
145	a		$12a^7$ final answer	2	**B1** for answer ka^7 or $12a^k$ or for correct answer seen then spoiled **Examiner's Comments** Almost all candidates answered this correctly.
	b		$4x(x – 3)$ final answer	2	**B1** for answer $4(x^2 – 3x)$ or $x(4x – 12)$ or $2x\ (2x – 6)$ or for correct answer seen then spoiled Condone omission of final bracket for 2 marks or **B1** **Examiner's Comments** Most candidates gave a correct fully factorised expression. Some gave a partial factorisation such as $2x(2x − 6)$ and were given partial marks. **Misconception** Where expressions can be factorised by removing common factors, always remove the highest common factor from the terms to make sure the expression is factorised 'fully'.
			Total	**4**	
146	a		1 10	1 1FT	**FT** from *their* 1 **Examiner's Comments** This question is aimed at the higher grades and there were only a few correct responses. The common errors were $u_2 = 2 \times {}^-2 = {}^-4$ with $u_3 = 3 \times {}^-2 = {}^-6$ and $u_2 = 3 + 7 = 10$ with $u_3 = 3 \times 10 + 7 = 37$ which did score follow through credit.

	b		[*a* =] 3 [*b* =] –5	3	**B2** for [*a* =] 3 or **B1** for [*b* =] —5 or **M1** for second difference +6 or for a correct pair of simultaneous equations — e.g. $a + b = -2$ and $4a + b = 7$ **<u>Examiner's Comments</u>** Most candidates did not attempt this part, but most of those who did were able to work out the second difference of 6 and from that, they calculated the value of *a* to be half of 6 which is 3. A few were able to work out the value of *b*.
			Total	**5**	
147			$2x^2 - 6x - 5x - 24 + 3$ [= 0] or better $(2x + 3)(x - 7)$ —1.5 oe 7	M1 M2 B1	e.g. $2x^2 - 11x - 21$ [= 0] **M1** for two brackets giving two correct terms **FT** *their* brackets **<u>Examiner's Comments</u>** Many candidates attempted this question, but they needed to rearrange it first to combine all the terms on one side which many did not do correctly. Some of those who managed to do this correctly then used the 'quadratic formula' to solve it, despite the demand of the question which asks for the method of factorisation to be used. Some candidates attempted to factorise just the left-hand side of the equation, $2x^2 - 6x - 24$, which does not factorise. **The question states that a certain method must be used.** This question states that the method of factorisation must be used to solve the equation which means that this method must be used in order to get full marks.
			Total	**4**	
148			625 with no extras	3	

					M1 for $\frac{x^{-\frac{1}{6}} \times x^{\frac{3}{4}}}{x^{\frac{1}{3}}} = 5$ or better **M1** for $-\frac{1}{6}+\frac{3}{4}-\frac{1}{3}=\frac{1}{4}$ or better e.g. $x^{\frac{1}{4}}=5$ Alternative method : **M1** for $x^{\frac{1}{3}-\frac{3}{4}}$ or $x^{\frac{-5}{12}}$ or $x^{\frac{-1}{6}+\frac{3}{4}}$ or $x^{\frac{7}{12}}$ and **M1** for $x^{\frac{-1}{6}-their\frac{-5}{12}}$ or $x^{\frac{7}{12}-\frac{1}{3}}$ or $x^{\frac{3}{12}}$ or $x^{\frac{1}{4}}$ could be $x^{\frac{5}{12}}$ or $x^{\frac{-1}{4}}$ depends on which side of the equation **<u>Examiner's Comments</u>** The candidates were required to know and apply the laws of indices to be able to answer this question and most of them could not do this. The best attempts used the law on the right-hand side to get $x^{\frac{1}{3}} \div x^{\frac{3}{4}} = x^{-\frac{5}{12}}$ and a few were able to obtain the correct answer from the use of one or more of these laws.
			Total	**3**	
149			−3 −2 −1 0 1 2	3	**B2** for 5 correct and none incorrect or 6 correct and 1 incorrect OR **M1** for −10 – 2 < 3x or better **M1** for 3x ≤ 8 – 2 or better If **0** scored **SC1** for x = − 4 and x = 2 e.g. $\frac{-12}{3} < x$ or –4 < x e.g. $x \le \frac{6}{3}$ or x ≤ 2 **<u>Examiner's Comments</u>** Most candidates struggled to answer this question, not spotting what was required even though questions of this type have been set previously. Many treated the inequality as one

					unit which made the problem more difficult. The best attempts split the single inequality into two inequalities −10 < 3*x* + 2 and 3*x* + 2 ≤ 8, then they solved each one separately. Some of those who solved these inequalities omitted 0 as a solution. **Assessment for learning** These inequalities are best solved by writing as two separate inequalities first and solving them separately. Exemplar 1  The inequality can be solved as one statement or, as here, it can be split into two statements and solved separately. In this response the candidate needs to check the question demand to see that they need to find the integers that satisfy both of these inequalities.
			Total	**3**	
150			Expanding the brackets gives −*x* oe (*x* − 4)(*x* + 5)	1 1	Accept any correct response, look for answers in the working space (see appendix) Expanding brackets gives − *x* **1** The signs are the wrong way round (condone inverted) **1** The minus sign is on the wrong one **1** They are the wrong factors **0** The answer is (*x* − 4)(*x* + 5) **0** The answer is 4 or – 5 **0** **<u>Examiner's Comments</u>** The most common reason given was that the brackets lead to -*x* rather than +*x* and many gave the correct pair of brackets. The most

					common error was from those who thought the 4 and 5 should be 1 and 20 giving $(x + 1)(x - 20)$ as their solution. There were a few who did not describe the error, but they just wrote out the incorrect line without comment.
			Total	**2**	