Algebra

1	**9 (a) (i)**	–2.5 oe	2	**M1** for $5(w + 1) = 3w$
	(ii)	–3 or 1	2	**B1 B1** (If 0, **SC1** for $y + 1 = \pm 2$)
	(iii)	9.5 oe	B3	**M2** for $5x + 5 - 3x + 6 = 2 \times 15$ Condone one slip (sign or numerical) on left hand side **or M1** for $\frac{5(x+1)}{15} - \frac{3(x-2)}{15}$ or better, condoning one sign or numerical slip.
	(b) (i)	$(u - 10)(u + 1)$	2	**SC1** for $(u + a)(u + b)$ where $ab = -10$ or $a + b = -9$
	(ii)	–1, 10	1**ft**	Only **ft B2** or **SC1** in **(i)** but can recover to correct answer only if new working or if **(i)** not attempted
	(c) (i)	$\frac{(x+1)(x+2)}{2} = x^2$ oe	M1	
		$((x+1)(x+2) =) x^2 + x + 2x + 2$	B1	Allow $3x$ for $x + 2x$
		$x^2 + x + 2x + 2 = 2x^2$		
		$x^2 - 3x - 2 = 0$	E1	Established without any omissions or errors
	(ii)	$\frac{-(-3) \pm \sqrt{(-3)^2 - 4(1)(-2)}}{2(1)}$	2	**B1** for $\sqrt{(-3)^2 - 4(1)(-2)}$ or better seen anywhere. If in form $\frac{p + \sqrt{q}}{r}$ or $\frac{p - \sqrt{q}}{r}$ then **B1** for $-(-3)$ **and** $2(1)$ or better Brackets and full line may be implied later
		–0.56, 3.56	2	**B1 B1** **SC1** for –0.6 or –0.562 to –0.561 **and** 3.6 or 3.561 to 3.562
	(iii)	12.7 or 12.67 to 12.69 ft	1**ft**	**ft** their positive x squared
2	**8 (a)**	$(p + q)^2 - 5$ oe final answer	2	**SC1** for $(p + q)^2$ oe seen
	(b)	$6x + 9(x - 3) = 51$ or better	B3	**B2 for** $6x + 9(x - 3)$ or **B1** for $6x$ or $9(x - 3)$
		5.2(0) final answer	B1	5.2(0) ww is **B1** only
	(c)	$a + c = 52$ oe	B1	Condone consistent use of other variables
		$3a + 2c = 139$ oe	B1	or **M3** for $3a + 2(52 - a) = 139$ or $3(52 - c) + 2c = 139$ o.e.
		Correctly eliminating a or c.	M1	Allow one numerical slip.
		35	A1	If A0**, SC1** for 17, 35
		17	A1	

3	**9 (a)**	$8w + 2j = 12$ $12w + 18j = 45$ Correctly eliminating one variable Water 1.05, Juice 1.8(0)	5	**B1** condone consistent use of other variables **B1** **M1** allow one numerical slip **A1 A1** If A0**, SC1** for 1.80, 1.05
	(b) (i)	$\frac{2}{y} + \frac{4}{y-4} = \frac{40}{60}$ oe	M2	**M2** If M0, **SC1** for $\frac{2}{y}$ or $\frac{4}{y-4}$
		$\frac{2\times3(y-4)}{3y(y-4)} + \frac{3\times4y}{3y(y-4)} = \frac{2y(y-4)}{3y(y-4)}$ oe or better $6(y-4) + 12y = 2y(y-4)$ oe $6y - 24 + 12y = 2y^2 - 8y$ oe $0 = 2y^2 - 26y + 24$ $y^2 - 13y + 12 = 0$	E2	**E2** Correct conclusion reached without any errors or omissions including at least 3 intermediate steps. **or E1** if any one slip, error or omission that is recovered or correct with only two steps.
	(ii)	$(y-1)(y-12)$	2	**SC1** for $(y+a)(y+b)$ where $ab = 12$ or $a + b = -13$
	(iii)	1, 12 ft	1**ft**	Only **ft SC1** but can recover to correct answer with new working or if **(ii)** not attempted
	(iv)	8 ft	1**ft**	**ft** a positive root –4 if positive answer
	(c)	$\frac{-(-1) \pm \sqrt{(-1)^2 - 4(1)(-4)}}{2(1)}$	2	**B1** for $\sqrt{(-1)^2 - 4(1)(-4)}$ or better If in form $\frac{p+\sqrt{q}}{r}$ or $\frac{p-\sqrt{q}}{r}$ then **B1** for –(–1) and 2(1) or better Brackets and full line may be implied later
		–1.56, 2.56	2	**B1 B1** If B0, **SC1** for –1.6 or –1.562 to –1.561 **and** 2.6 or 2.561 to 2.562
4	**3**	**(a)** $72 - 2x$ oe seen $x(72 - 2x) = 72x - 2x^2$	M1 E1	No errors or omissions
		(b) $2x(36 - x)$ or $-2x(x - 36)$	2	isw solutions **B1** for answers $2(36x - x^2)$ or $x(72 - 2x)$ or correct answer spoiled by incorrect simplification
		(c) 630, 640, 70	3	**B1** for each correct value
		(d) 8 correct plots	P3ft C1	ft for their values ft **P2** for 6 or 7 correct plots ft **P1** for 4 or 5 correct plots Curve of **correct shape** through minimum of 7 of their points No ruled sections
		(e) (i) 7.5 to 8.5 27.5 to 28.5 **(ii)** 641 to 660	2 1	**B1** for either value correct
		(f) 41	2	**M1** for 500 ÷ 12 soi by 41.6… to 42

5	**5**	**(a)** **(i)**	$x^2 + (x + 7)^2 = 17^2$ oe	B1	Must be seen
			$x^2 + x^2 + 7x + 7x + 49 = 17^2$ or better	B1	
			$2x^2 + 14x - 240 = 0$		Must be shown – correct 3 terms
			$x^2 + 7x - 120 = 0$	E1	With no errors seen
		(ii)	$(x + 15)(x - 8)$	2	**M1** for $(x + a)(x + b)$ where a and b are integers and $a \times b = -120$ or $a + b = 7$ Ignore solutions after factors given
		(iii)	–15 and 8	1ft	Correct or ft dep on at least **M1** in **(ii)**
		(iv)	15	1ft	Correct or ft their positive root from **(ii)** + 7 dep on a positive and negative root given
		(b) **(i)**	$3x(2x - 1) = (2x + 3)^2$ oe	M1	e.g. $6x^2 - 3x = 4x^2 + 12x + 9$ must see equation before simplification
			$4x^2 + 6x + 6x + 9$ or better seen	B1	Indep
			$6x^2 - 3x = 4x^2 + 12x + 9$ oe $2x^2 - 15x - 9 = 0$	E1	With no errors seen and both sets of brackets expanded
		(ii)	$\frac{(--)15 \pm \sqrt{((-)15)^2 - 4(2)(-9)}}{2(2)}$ oe	1 1	In square root **B1** for $((-)15)^2 - 4(2)(-9)$ or better (297) If in form $\frac{p + \sqrt{q}}{r}$ or $\frac{p - \sqrt{q}}{r}$, **B1** for $-(-15)$ and $2(2)$ or better
		(iii)	8.06 and -0.56 cao 76.5 (76.46 to 76.48)	1, 1 1ft	**SC1** for –0.6 or –0.558… and 8.1 or 8.058… ft 8 times a positive root to **(b)(ii)** add 12
6	**3**	**(a)**	$5x^2 - x$ or $x(5x - 1)$	2	**M1** for $x^2 + 3x$ or $4x^2 - 4x$ correct
		(b)	$27x^9$	2	**B1** for 27 or for x^9
		(c) **(i)**	$7x^7(1 + 2x^7)$	2	**M1** for any correct partially factorised expression or $7x^7(1 + ...)$
		(ii)	$(y + w)(x + 2a)$	2	**M1** for $x(y + w) + 2a(y + w)$ or $y(x + 2a) + w(x + 2a)$
		(iii)	$(2x + 7)(2x - 7)$	1	
		(d)	$\frac{-5 \pm \sqrt{5^2 - 4(2)(1)}}{2(2)}$ oe	2	In square root **B1** for $5^2 - 4(2)(1)$ or better (17) If in form $\frac{p + \sqrt{q}}{r}$ or $\frac{p - \sqrt{q}}{r}$ **B1** for $p = -5$ and $r = 2(2)$
			–2.28 –0.22	1 1	**SC1** for –2.3 or –2.281 to –2.280 and –0.2 or –0.220 to –0.219

7	**3 (a)**	3 www	3	M1 for $p = \frac{k}{(m+1)}$ oe A1 for $k = 36$ or M2 for $4 \times 9 = p \times 12$ oe
	(b)	**(i)** $(x + 5)(x – 5)$	1	
		(ii) $\frac{(2x+1)}{(x-5)}$ final answer	3	B2 for factors $(2x+1)(x+5)$ or SC2 for final answer $\frac{x+\frac{1}{2}}{x-5}$ (B1 for $(2x+a)(x+b)$ where $ab = 5$ or $2b + a = 11$ or SC1 for $(x+\frac{1}{2})(x+5)$)
	(c)	$x < 7$ oe final answer	3	M2 for $8x$ * 56 where * is inequality or = sign (B1 for $5x – 20$ or $36 – 3x$)
8	**5 (a)**	2, 3, 4, 5	3	M2 for $1 < n \leq 5$ seen (M1 for $1 < n$ or $n \leq 5$) Allow $2 \leq n < 6$ in M2 or M1 case If 0, B2 for 3 correct with no extras or 4 correct with 1 extra.
	(b)	**(i)** $2x(x + 5y)$	2	B1 for $x(2x +10y)$ or $2(x^2 + 5xy)$
		(ii) $3(a – 2b)(a + 2b)$	3	B2 for $(3a – 6b)(a + 2b)$ or $(a – 2b)(3a + 6b)$ or correct answer seen in working or B1 for $3(a^2 – 4b^2)$ If B0, SC1 for $a^2 – b^2 = (a – 2b)(a + 2b)$
	(c)	**(i)** ½ $x(x + 17) = 84$ or $x(x+17) = 2 \times 84$	M1	Condone ½ $x \times x + 17 = 84$ but only for M mark No errors or omission of brackets anywhere
		Correct proof of $x^2 + 17x – 168 = 0$	E1	
		(ii) $(x – 7)(x + 24)$	2	SC1 for $(x + a)(x + b)$ where a and b are integers and $a + b = 17$ or $ab = – 168$
		(iii) 7 and –24 ft	1**ft**	Correct or ft from their factors if quadratic
	(d)	– 3 www 3	3	B2 for $15 – 6 = x – 4x$ oe or better M1 for $15 – x = 2(3 – 2x)$ or better or $7½ – x/2 = 3 – 2x$
	(e)	$\sqrt{(-5)^2 – 4 \times 2 \times -6}$	B1	($\sqrt{73}$)
		$p =$ – –5 and $r = 2 \times 2$	B1	Dependent on $\frac{p+\sqrt{q}}{r}$ or $\frac{p-\sqrt{q}}{r}$ or $\left(x-\frac{5}{4}\right)^2$ B1 $\sqrt{3+\frac{25}{16}}$ B1
		3.39, –0.89 final answers	B1B1	SC1 for 3.4 or 3.386… or 3.39 seen and – 0.9 or – 0.886… or – 0.89 seen

9	**3 (a)**	$(x + 5)^2 - 2x^2 = 1$ oe	M1	Equiv means equation in the three parts, allowing $(x + 5)^2$ expanded
		$(x + 5)^2 = x^2 + 10x + 25$ or $x^2 + 5x + 5x + 25$	B1	
		$x^2 + 10x + 25 - 2x^2 = 1$ $0 = x^2 - 10x - 24$	E1	For final line reached without any errors or omissions after any previous line with $(x + 5)^2$ expanded
	(b)	12	3	M2 for $(x - 12)(x + 2)$ or full correct expression from formula. Allow SC1 for $(x + a)(x + b)$ and $ab = -24$ or $a + b = -10$ then SC1 **ft** (dependent on quadratic factors or two roots from formula) for correct selection of +ve root, if only one +ve. Answer of 12 and –2 scores M2 only
	(c)	53.1 to 53.2 www 3	3	M2 for $2 \times \tan^{-1}(\frac{1}{2})$ o.e. i.e. any **complete** method or M1 for $\tan = \frac{1}{2}$ o.e. i.e. any correct method leading to any angle in diagram (expressions can be implicit and bod which angle is being worked out) (Implied by 26.56 to 26.57 or 26.6, 63.43 to 63.44 or 63.4, 126.8 to 126.9) 53 or 127 without working score 0
10	**2** **(a)**	0, 1, 2, 3	**3**	Additional values count as errors **B2** for one error/omission or **B1** for two errors/ omissions After **B0**, **M2** for $-1 < x \leq 3.5$ seen, allow 7/2 for 3.5 or **M1** for $-1 < x$ or $x \leq 3.5$ or $x = -1$ **and** $x = 3.5$ Allow **M2** for $0 \leq x < 4$ or **M1** for $x \geq 0$ or $x < 4$
	(b)	$\frac{x-2}{x-5}$ www final answer	**4**	**M3** for $\frac{(x+5)(x-2)}{(x+5)(x-5)}$. or **M2** for $(x + 5)(x - 2)$ seen or **M1** for $(x + a)(x + b)$ where $ab = -10$ or $a + b = 3$ and **M1** for $(x + 5)(x - 5)$ seen
	(c)	**(i)** $5(x + 1) + 2(x - 3) = 3(x + 1)(x - 3)$ oe	**M1**	Allow if still over common denominator
		$x^2 - 3x + x - 3$ or better seen	**B1**	Allow $x^2 - 2x - 3$ seen or $3x^2 - 9x + 3x - 9$ or better seen
		$3x^2 - 13x - 8 = 0$	**E1**	With no errors seen and brackets correctly expanded on both sides
		(ii) $\frac{-(-13) \pm \sqrt{(-13)^2 - 4(3)(-8)}}{2(3)}$	**B1** **B1**	In square root **B1** for $(-13)^2 - 4(3)(-8)$ or better (265) If in form $\frac{p+\sqrt{q}}{r}$ or $\frac{p-\sqrt{q}}{r}$, **B1** for – (–13) and 2(3) or better
		4.88 and –0.55 cao	**B1B1**	**SC1** for 4.88 and – 0.55 seen or – 0.5 and 4.9 or – 0.546… and 4.879 to 4.880

11	5	**(a)**	63.45 or 63.5 cso	**4**	**M1** for 10, 30, 45, 55, 65, 75, 85, 95 At least 6 correct mid-values soi and **M1** for $\sum fx$ $(6 \times 10 + 12 \times 30 + 20 \times 45 + \ldots 5 \times 95)$ (12690) where x is in the correct interval allow one further slip and **M1** for their $\sum fx \div 200$ dep on second **M1**
		(b)	**(i)** 75 117 195 200	**B2**	**B1** for 2 or 3 correct
			(ii) 8 correct points plotted	**P3ft**	**P2ft** for 6 or 7 **P1ft** for 4 or 5
			Curve (or polygon) correct through 8 points	**C1ft**	ft their increasing curve only if at least **B1** in **(b)(i)**. Ignore $t = 0$ to 20
		(c)	**(i)** 65 to 67	**B1ft**	Or ft their curve at cf = 100
			(ii) 52 to 55	**B1**	
			(iii) 21 to 24	**B1**	
			(iv) 44 to 52	**B1**	Must be integer
			(v) Integer value of 200 – reading at 45 secs	**2ft**	**B1ft** for integer value of reading at 45 secs
12	6	**(a) (i)**	$(4x-7)(2x-1)=1$	**M1**	or $(4x-7)(2x-1)-1=0$ only
			$8x^2-14x-4x+7$	**B1**	allow $-18x$ and/or $+6=0$ or $=-6$
			$4x^2-9x+3=0$	**E1**	at least one more line e.g. $8x^2-18x+6=0$ with no errors or omissions seen
		(ii)	$(x=)\ \dfrac{-(-9)\pm\sqrt{(-9)^2-4(4)(3)}}{2\times4}$	**B2**	**B1** for $\sqrt{(-9)^2-4(4)(3)}$ or better seen $(\sqrt{33})$ **B1** for $p=-(-9)$ and $r=2\times4$ or better as long as in the form $\dfrac{p+or-\sqrt{q}}{r}$
			$(x=)$ 0.41, 1.84 cao	**B1,B1**	After B0B0, **SC1** for 0.4 or 0.406(929...) and 1.8 or 1.843(070...)
		(iii)	0.36 or 0.3720 to 0.3724 or 0.37	**B1ft**	ft their value to give positive $(4x-7)$
		(b) (i)	$(x-4)(x+4)$	**B1**	
		(ii)	$(2x+3)(x+4)+(x+40)=2(x^2-16)$ oe	**M2**	fractions cleared or could all still be over (x^2-16) or $(2x+3)(x^2-16)+(x+40)(x-4)=2(x-4)(x^2-16)$
			$2x^2+8x+3x+12$ or $2x^3+3x^2-32x-48$	**B1**	Condone sign slips
			$x=-7$ www 4	**A1**	

13	6 (a)	$(x =)$ 64 www 3	3	**B2** for $x + 2x + x = 360 - 114 + 10$ or better or **M1** for $x + 2x + 114 + x - 10 = 360$
	(b) (i)	-1 n^2 oe $5n$ oe $n^2 + 5n$ oe	1 1 1 1	
	(ii)	20	2	**M1** for their $n^2 + 5n = 500$ or 20 **and** 25 seen
	(c)	**Final answer** $\frac{x-4}{2x-1}$ cao www 4	4	**B1** for $(x-4)(x+4)$ **B2** for $(2x-1)(x+4)$ or **SC1** for $(2x+a)(x+b)$ where either $a + 2b = 7$ or $ab = -4$
14	10 (a) (i)	$8x^6y^9$ **final answer**	2	**B1** for any two of 8, x^6, y^9 in a single term in answer
	(ii)	$\frac{x^2}{3}$ oe but not $\frac{1}{3x^{-2}}$ oe **final answer**	3	**B2** for $\frac{3}{x^2}$ or $3x^{-2}$ or $\frac{1}{3x^{-2}}$ as answer or **B1** for $\frac{x^6}{27}$ oe as answer or $\frac{1}{\sqrt[3]{\frac{27}{x^6}}}$ seen or **SC1** for 3 or x^2 or x^{-2} seen in answer
	(b)	$6x^2 + 11xy - 10y^2$ **final answer**	3	**B2** for 3 of $6x^2 - 4xy + 15xy - 10y^2$ ($11xy$ implies 2 terms) or **B1** for 2 of $6x^2 - 4xy + 15xy - 10y^2$
	(c) (i)	$\frac{V - \pi r^3}{2\pi r^2}$ or $\frac{V}{2\pi r^2} - \frac{r}{2}$ oe but not triple fractions **final answer**	2	**M1** for correct subtraction or correct division by $2\pi r^2$ **seen**
	(ii)	$\frac{V^2}{3}$ **final answer**	2	**B1** for $V^2 = 3h$ or $\frac{V}{\sqrt{3}} = \sqrt{h}$ or $h = \left(\frac{V}{\sqrt{3}}\right)^2$
	(d)	$\frac{5x}{12}$ **final answer**	2	**B1** for 2 of $\frac{6x}{12}$, $\frac{20x}{12}$, $\frac{-21x}{12}$ oe implied by $\frac{10x}{24}$ ie 2 with common denominator = at least 6

15	**12 (a)**	$10x + 4y = 10.7$ oe $8x + 6y = 10.1$ oe	**1** **1**	
		Multiplying or dividing equation(s) by number(s) suitable for elimination	**M1**	Allow one arithmetic error. If substitution, correctly making one variable the subject of one equation.
		Elimination of one variable	**M1**	Allow one arithmetic error. If substitution method then M is for the actual substitution.
		$x = 0.85$ cao $y = 0.55$ cao	**A1** **A1**	**SC1** for correct fractions After **M0**, **SC2** for **both** correct answers
				If working in cents, likely mark is 0 for equations, **M2** for method, **A2** if answers converted to dollars, **A1** if left in cents
	(b)	$\dfrac{--5 \pm \sqrt{(-5)^2 - 4.2.-8}}{2.2}$	**B2**	**B1** for $\sqrt{(-5)^2 - 4.2.-8}$ $(\sqrt{89})$ **B1** for $\dfrac{p+\sqrt{\ }}{r}$ or $\dfrac{p-\sqrt{\ }}{r}$ with $p = --5$ or 5 **and** $r = 2 \times 2$ or 4
				Completing the square **B1** for $\left(x - \dfrac{5}{4}\right)^2$ **and** **B1** for $\sqrt{4 + \dfrac{25}{16}}$
		3.61 or –1.11 **final answer**	**B1B1**	After B0 B0 for answers, **SC1** for 3.6 or 3.608… **and** – 1.1 or – 1.108 or 3.61 and –1.11 seen **Correct answers without working score max 2**
16	**10 (a)**	1.3[0]	**3**	**M2** for $(31.7[0] - 7) \div (12 + 7)$ or better Or **M1** for $12x + 7(x + 1) = 31.7[0]$ or better or $31.7[0] - 7$ or better)
	(b) (i)	$\dfrac{36}{y} - \dfrac{36}{y+1} = 25$ oe	**M2**	**SC1** for $\dfrac{36}{y}$ oe or $\dfrac{36}{y+1}$ oe seen
		$36(y+1) - 36y = 25y(y+1)$ oe $36y + 36 - 36y = 25y^2 + 25y$ oe		Accept both all over $y(y + 1)$ Must see at least one of these lines before E mark
		$25y^2 + 25y - 36 = 0$	**E1**	Final line reached without any errors or omissions
	(ii)	$(5y + 9)(5y - 4)$	**2**	Accept $(25y - 20)(y + 1.8)$ oe **SC1** for $(5y + m)(5y + n)$ where $mn = -36$ or $m + n = 5$
	(iii)	–1.8 oe, 0.8 oe	**1ft**	ft only **SC1** from (b)(ii)
	(iv)	2.6[0]	**1ft**	ft 2 × positive root from (b)(iii) +1 Dep on pos and neg root in (b)(iii)

17	4	**(a) (i)** 2.5 or $\frac{5}{2}$	**2**	**M1** for one correct step collected i.e $6x = k$ or $ax = 15$ or for $4x + 2x = 8 + 7$
		(ii) 13	**2**	**M1** for $x - 7 = 2 \times 3$ or better
		(b) (i) $27x^3y^{12}$ final answer	**2**	**B1** for 2 correct elements
		(ii) $4a^3b^{[1]}$ final answer	**2**	**B1** for 2 correct elements
		(iii) $\frac{x+1}{x+8}$ www final answer	**4**	**M2** for $(x - 8)(x + 1)$ seen or **SC1** for $(x + a)(x + b)$ where $a + b = -7$ or $ab = -8$ **and B1** for $(x + 8)(x - 8)$ seen
18	3	**(a) (i)** $2(2x + 1)(x - 5)$ final answer	**3**	**B1** for $2(2x^2 - 9x - 5)$ and **B1** for $(2x + 1)(x - 5)$ or **SC2** for expansion of brackets gives 3 correct terms e.g. $(2x + 1)(2x - 10)$ or $(4x + 2)(x - 5)$ or **SC1** for expansion of brackets gives 2 correct terms e.g. $(2x - 1)(2x + 10)$ or $(4x - 2)(x - 4)$
		(ii) $-1/2$oe , 5	**1ft**	Correct or ft their 2 brackets
		(b) $\frac{[--]7 \pm \sqrt{([-]7)^2 - 4(2)(-10)}}{2(2)}$	**B2**	**B1** for $\sqrt{([-]7)^2 - 4(2)(-10)}$ $[= \sqrt{129}\ ]$ If in form $\frac{p+\sqrt{q}}{r}$ or $\frac{p-\sqrt{q}}{r}$, **B1** for $--7$ and $2(2)$ or better
		-1.09 , 4.59 final answers	**B1B1**	If **B0**, **SC1** for -1.1 and 4.6 as final answers or $-1.089..$ and $4.589..$ as final answers or -1.09 and 4.59 seen
		(c) $\frac{-10}{(3x-1)(x-2)}$ or $\frac{-10}{3x^2 - 7x + 2}$ as final answer	**3**	**M1** for $6(x - 2) - 2(3x - 1)$ or better. Allow recovery after missing bracket[s] and **B1** for $(3x - 1)(x - 2)$ as common denominator seen (may be as two fractions)

19	5	**(a)** 0.57	**B4**	Condone use of other variables **M1** for $2w+3l=3.6$ oe **and M1** for $l=w+0.25$ oe **A1** for correct $aw=b$ or $cl=d$ **or M2** for $2w+3(w+0.25)=3.6$ oe or $2(l-0.25)+3l=3.6$ oe or **M1** for $w+0.25$ or $l-0.25$ seen **A1** for $2w+3w=3.6-0.75$ or better or $2l+3l=3.6+0.5$ or better $l=0.82$ implies **M2A1** trial & error scores **B4 or zero** accept answer 57 if written **57 cents** **after M0, SC3** if answer 57
		(b) (i) $\frac{5}{x}+\frac{6}{x+2}=1$ oe	**M2**	e.g. $\left(1-\frac{5}{x}\right)(x+2)=6$ **M1** for $\frac{5}{x}$ seen or $\frac{6}{x+2}$ seen or $xy=5$ **and** $(x+2)Y=6$ oe or $xy=5$ **and** $(x+2)(1-y)=6$ oe
		$5(x+2)+6x=x(x+2)$ oe	**A1**	e.g. $(x-5)(x+2)=6x$ Allow $5x+10+6x=x^2+2x$ and allow **all** over correct denominator but must see this line
		$5x+10+6x=x^2+2x$ oe $0=x^2-9x-10$	**E1**	One correctly expanded line seen No errors or omissions
		(ii) $(x-10)(x+1)$	**2**	**SC1** for $(x+a)(x+b)$ where $ab=-10$ or $a+b=-9$
		(iii) 21	**2ft**	ft a positive x into $2(x+\frac{5}{x})$ **M1** for 0.5 seen or 5 / *their* positive root
		(c) (i) $(2x+3)^2=(x+3)^2+5^2$ oe	**M1**	
		$4x^2+6x+6x+9=$ $x^2+3x+3x+9+25$ oe $3x^2+6x-25=0$	**B1** **B1** **E1**	for $4x^2+6x+6x+9$ or $4x^2+12x+9$ for $x^2+3x+3x+9$ or x^2+6x+9 No errors or omissions
		(ii) $\frac{-6\pm\sqrt{6^2-4(3)(-25)}}{2(3)}$	**B2**	**B1** for $\sqrt{6^2-4(3)(-25)}$ or better seen If in form $\frac{p+\sqrt{q}}{r}$ or $\frac{p-\sqrt{q}}{r}$ oe **B1** for $p=-6$ and $r=2(3)$ or better
		-4.06, 2.06 final answer	**B2**	**B1 B1** After B0 B0 **SC1** for -4.1 **and** 2.1 or $-4.055\ldots$ **and** 2.055... or -4.06 and 2.06 seen
		(iii) 12.63 to 12.65 or 12.6 or 12.7	**2ft**	ft (a positive $x+3$) × 2.5 **SC1** for 0.5 × *their* positive value × 5 written

20	**5**	**(a)**	$\frac{27}{x}$ final answer	**1**	
		(b)	$\frac{25}{x-2}$ final answer	**1**	
		(c)	$\frac{25}{x-2}-4=\frac{27}{x}$ oe	**M1**	**FT** *their* (b) – 4 = *their* (a) oe must be eqn in x
			$25x-4x(x-2)=27(x-2)$ oe	**M1**	**FT** $\frac{25}{x-2}+4=\frac{27}{x}$ oe **only** for 2nd and 3rd M mark If all on one side then condone omission of '= 0'
			$4x^2+27x-25x-8x-54[=0]$ oe	**M1dep**	Dep on 2nd M1 Must see brackets expanded before this award and terms on one side of eqn
			$2x^2-3x-27=0$ without error seen	**A1**	Must see $4x^2-6x-54=0$ first
		(d)	$-3,\ 4.5$	**3**	**B2** for $(2x-9)(x+3)$ **or SC1** for $(2x+a)(x+b)$ where a and b are integers and $a+2b=-3$ or $ab=-27$
		(e)	6 cao	**1**	
21	**10**	**(a)**	**(i)** final answer $\frac{25-8x}{20}$	**2**	**M1** for $\frac{5\times5-4\times2x}{5\times4}$ or better seen
			(ii) final answer $\frac{2x^2+5x+9}{3(x+3)}$	**3**	**B1** for $2x^2+6x-x-3$ soi **and B1** for denom $3(x+3)$ or $3x+9$ seen
		(b)	$x=\frac{2}{3}$ oe or 0.667 or 0.6666 to 0.6667 $y=-3$	**3**	**M1** for correct method to eliminate one variable **A1** for $x=\frac{2}{3}$ oe or 0.667 or 0.6666 to 0.6667 or $y=-3$
		(c)	final answer $\frac{7}{2x+3}$ www	**4**	**B1** for $7(x+3)$ in numerator and **B2** for $(2x+3)(x+3)$ in denominator or **SC1** for $(2x+a)(x+b)$ where a and b are integers and $a+2b=9$ or $ab=9$ After **B1** scored, **SC1** for final answer $\frac{7}{2(x+1.5)}$ *or* $\frac{3.5}{x+1.5}$

22	10	(a)	(i)	4.5 or 4½	3	**M2** for a complete correct method **or M1** for one correct step at any stage.
			(ii)	$(x - 6)(x - 1)$	M2	**M1** for $(x + a)(x + b)$ where $ab = 6$ **or** $a + b = -7$
				1, 6	A1FT	**FT** their brackets **dep** on **M1** earned After **M0** scored **SC1** for 1, 6 as answer
			(iii)	6	4	**B1** for $2(3x - 2) + x + 2 = 4\times10$ oe **and B1** for correct multiplication of a bracket **and M1** for correct rearrangement of their linear equation without brackets to $ax = b + c + d$ or better
		(b)		$a = 1/3$ oe, $b = 1/2$ oe	6	**B1** for any one of $1 = a + b + 1/6$ oe $5 = 8a + 4b + 2/6$ oe $14 = 27a + 9b + 3/6$ oe $30 = 64a + 16b + 4/6$ oe Or any other correct equation **and B1** for another of the above equations **and M1** for equating one coefficient or correct rearrangement to give a or b as subject **and M1** for subtracting to eliminate a or b or correct substitution for *their* a or their b **A1** for $a = 1/3$ oe or $b = 1/2$ oe
23	8	(a)		$\sqrt{(-11)^2 - 4(8)(-11)}$ or better	**B1**	Seen anywhere or for $\left(x - \frac{11}{16}\right)^2$
				$p = -(-11)$, $r = 2(8)$ or better	**B1**	Must be in the form $\frac{p + \sqrt{q}}{r}$ or $\frac{p - \sqrt{q}}{r}$ or **B1** for $\sqrt{\frac{11}{8} + \left(\frac{11}{16}\right)^2} + \frac{11}{16}$
				– 0.67, 2.05 final answers	**B1B1**	**SC1** for – 0.7 or – 0.672 to – 0.671 **and** 2.0 or 2.046 to 2.047 or answers 0.67 **and** – 2.05
		(b)		132	**3**	**M1** for $y = k\sqrt{x}$ oe or $\sqrt{x} = ky$ oe **A1** for k = 6 oe or better or for k = 0.1666 to 0.167 [k = 6 implies M1A1] oe
		(c)		20 with supporting algebraic working	**6**	**B2** for $\frac{x}{2.5} + \frac{x - 14.5}{0.5} = 19$ oe or **B1** for $\frac{x}{2.5}$ or $\frac{x - 14.5}{.5}$ **M1dep on B2** for first completed correct move to clear both fractions **M1** for second completed correct move to collect terms in x to a single term **M1** for third completed correct move to collect numeric term[s] leading to $ax = b$ **SC1** for 20 with no algebraic working

24	3		**(a)** $\frac{4x-7}{10}$ final answer nfww	**3**	**M2** for $\frac{5(2x-1)-2(3x+1)}{2\times5}$ or $\frac{5(2x-1)}{5\times2}-\frac{2(3x+1)}{5\times2}$ **or M1** for attempt to convert to common denominator of 10 or multiple of 10 with one error in numerator
			(b) $x^2 + 9$ final answer nfww	**4**	**B3** for $4x^2 - 6x - 6x + 9 - 3x^2 + 12x$ or correct answer given and then spoilt **or B1** for $4x^2 - 6x - 6x + 9$ seen **and B1** for $-3x^2 + 12x$ or $-(3x^2 - 12x)$ seen
			(c) **(i)** $(2x - 1)(x + 3)$ isw solving	**2**	**M1** for $(2x + a)(x + b)$ where $ab = -3$ or $2b + a = 5$ with integers a and b
			(ii) $\frac{2x-1}{2(x-3)}$ or $\frac{2x-1}{2x-6}$ final answer nfww	**3**	**M2** for $2(x + 3)(x - 3)$ or $(2x - 6)(x + 3)$ or $(2x + 6)(x - 3)$ seen **or M1** for $2(x^2 - 9)$ seen
25	8	**(a)**	$\frac{2(s-ut)}{t^2}$ oe nfww	**3**	**M1** for a correct rearrangement to isolate the a term and **M1** for a correct multiplication by 2 and **M1** for a correct division by t^2
		(b)	36.75 cao	**3**	**M2** for $15.5 + 2.5 \times 8.5$ **B1** for two of 15.5, 2.5, 8.5 seen
		(c) **(i)**	$\frac{16}{5}$ or better [3.2]	**1**	
		(ii)	11.2	**4**	**M2** for ½(25 + 10)16 (= 280) or **M1** for appreciation of distance from area and **M1** for *their* 280 ÷ 25 (dep on M1)
26	10	**(a)**	$\frac{x}{x+3}$ cao	**3**	**B1** for $(x + 3)(x - 3)$ **B1** for $x(x - 3)$
		(b)	$\frac{3}{2}$ and -5	**7**	**M2** for $15(x + 1) - 20x = 2x(x + 1)$ or **M1** for multiplication by one denominator only or $\frac{15(x+1)-20x}{x(x+1)}$ and **B2** for $2x^2 + 7x - 15$ [= 0] or **B1** for $15x + 15 - 20x$ or $2x^2 + 2x$ and **M2** for $(2x - 3)(x + 5)$ or *their* correct factors or formula or **M1** for $(2x + a)(x + b)$ where $ab = -15$ or $a + 2b = 7$ **A1** for $x = \frac{3}{2}$ and -5

27	8 (a) (i)	$\frac{600}{x}$	1	Not $x = \frac{600}{x}$
	(ii)	$\frac{600}{x+1}$	1	Not $x = \frac{600}{x+1}$
	(b) (i)	$\frac{600}{x} - \frac{600}{x+1} = 20$ oe	M1FT	**FT** *their* (a)(i) – *their* (a)(ii) = 20 oe If **M0, SC1FT** for *their*(a)(ii) – *their* (a)(i) = 20 oe
		$600(x+1) - 600x = 20x(x+1)$ or better	A1	May still be over common denominator and can be implied by third line. Allow recovery if bracket omitted
		$600x + 600 - 600x = 20x^2 + 20x$ $0 = 20x^2 + 20x - 600$ $x^2 + x - 30 = 0$	A1	**Dep on M1A1** and conclusion reached with at least one of the interim lines and without any errors or omissions
28	8 (a) (i)	$7 \times 2 + (2x-3)(x+4) = 2(x+4)$	M1	Allow if bracket[s] omitted but recovers
		$2x^2 + 8x - 3x - 12$ or better seen	B1	
		$2x^2 + 3x - 6 = 0$	A1	with no errors seen and brackets correctly expanded on both sides and no omission of brackets
	(ii)	$\sqrt{(3)^2 - 4(2(-6))}$ or better	B1	or $\left(x + \frac{3}{4}\right)^2$
		$p = -3$ and $r = 2(2)$	B1	Must see $\frac{p+\sqrt{q}}{r}$ or $\frac{p-\sqrt{q}}{r}$ or both Or $-\frac{3}{4}$ + or – $\sqrt{\frac{57}{16}}$
		1.14 and – 2.64 cao	B1B1	**SC1** for 1.1 and – 2.6 final answer or 1.137 and – 2.637 final answer or 1.14 and – 2.64 seen in working or for -1.14 and 2.64 as final ans
	(b)	$\pi \times x^2 + \pi \times x \times 3x$	M2	or **M1** for $\pi \times x \times 3x$
		$4[\pi]x^2 = [\pi]r^2$	M1	**Dep on M2**
		$2x = r$	A1	with no errors seen

29	2	(a)	$[\pm]\sqrt{v^2 + 2as}$ final answer	2	**M1** for correct first step, i.e. $u^2 = v^2 + 2as$
		(b) (i)	$\frac{60}{x} + \frac{45}{x+4} = 6$ oe	**M2**	**B1** for either $\frac{60}{x}$ or $\frac{45}{x+4}$ seen
			$60(x + 4) + 45x = 6x(x + 4)$ or better	**M1**	**Dep** on **M2**
			$60x + 240 + 45x = 6x^2 + 24x$ oe $0 = 2x^2 - 27x - 80$	**A1**	$[6x^2 - 81x - 240 = 0]$ Dep on **M3** and brackets expanded and with no errors or omissions throughout
		(ii)	16 final answer	3	**M2** for $(x - 16)(2x + 5)$ [= 0] or **M1** for partial factorisation e.g. $x(2x + 5) - 16(2x + 5)$ or **SC1** for $(x + a)(2x + b)$[= 0] where $ab = -80$ or $2a + b = -27$ or **B2** for $\frac{--27 + or - \sqrt{(-27)^2 - 4.2.-80}}{2.2}$ or $[-]\sqrt{40 + \left(\frac{27}{4}\right)^2} + \frac{27}{4}$ or **B1** for $\frac{--27 + or - \sqrt{q}}{2.2}$ or $\sqrt{(-27)^2 - 4.2.-80}$ or $\left(x - \frac{27}{4}\right)^2$
		(c) (i)	0.75×20 [=15]	1	
		(ii)	150 cao	4	**M3** for $90 + T = 1800 \times 2 \div 15$ oe or $T - 110 = (1800 - (90 \times 15) - (20 \times 15 \div 2)) \times 2 \div 15$ oe or $t = (1800 - (90 \times 15) - (20 \times 15 \div 2)) \times 2 \div 15$ oe [$t = 40$] or **M2** for ½ $(90 + T) \times 15 = 1800$ oe or ½ $(T - 110) \times 15 + 90 \times 15 + ½ (20 \times 15) = 1800$ oe or $1800 - ½ \times 20 \times 15 - 90 \times 15$ oe [300 for area of 'end' triangle] or **M1** for method for area of triangle or rectangle or trapezium soi
		(d)	10 cao nfww	3	**M2** for $22.5 \div 2.25$ or **M1** for 21.5 to $22.5 \div 2.25$ to 2.75 or **B1** for 22.5 or 2.25 seen

30	4	(a)	(i)	$11 - x$ final answer	2	**M1** for $8x - 4 - 9x + 15$ or **B1** for final answer $11 - kx$ or $k - x$
			(ii)	$6x^2 - xy - 12y^2$ final answer	3	**M2** for $6x^2 + 8xy - 9xy - 12y^2$ [= 0] or for final answer with **one** error in a **coefficient** (includes sign) but otherwise correct or **M1** for any two of $6x^2$, $8xy$, $-9xy$, $-12y^2$
		(b)		$x(x^2 - 5)$ final answer	1	Condone $x(x - \sqrt{5})(x + \sqrt{5})$ as final answer
		(c)		$x \geqslant 4$ or $4 \leqslant x$ final answer nfww	3	**B2** for 4 with no/incorrect inequality or equals sign as answer or **M2** for $8x + 4 \leqslant 15x - 24$ or better or **M1** for $4(2x + 1) \leqslant 3(5x - 8)$
		(d)	(i)	$p = 4.5$ oe $q = 8.25$ oe	3	**B2** for one correct answer or for $(x - 4.5)^2 - 8.25$ oe seen or **M1** for $(x - 4.5)^2$ oe seen or $x^2 - px - px + p^2$ seen and **M1** for $p^2 - q = 12$ or $2p = 9$
			(ii)	-8.25 oe	1FT	**FT** – *their q*
			(iii)	$x = 4.5$ oe	1FT	**FT** x = *their p*
31	2	(a)		$x > 0.5$ oe **final answer nfww**	3	**B2 nfww** for 0.5 with no/incorrect inequality or equals sign as answer or **M2** for $7x + 15x > 6 + 5$ or better or $-6 - 5 > -7x - 15x$ or better or **M1** for $6 - 15x$ seen
		(b)	(i)	$(p - 2)(q + 4)$ **final answer**	2	**M1** for $q(p - 2) + 4(p - 2)$ or $p(q + 4) - 2(q + 4)$
			(ii)	$(3p - 5)(3p + 5)$ **final answer**	1	
		(c)		$(5x - 9)(x + 2)$	M2	**M1** partial factorisation, e.g. $x(5x - 9) + 2(5x - 9)$ or **SC1** for $(5x + a)(x + b)$ where $ab = -18$ or $a + 5b = 1$
				$\frac{9}{5}$ oe and -2 **final answer**	B1	

32	6	(a)	(i)	$\frac{x^8}{3}$ final answer	1	
			(ii)	$15x^7y^3$ final answer	2	**M1** for 2 elements correct
			(iii)	$16x^8$ final answer	2	**M1** for $16x^k$ or kx^8
		(b)		$\sqrt{([-]7)^2 - 4.3 - 12}$ or better and	**B1**	or for $\left(x - \frac{7}{6}\right)^2$
				$p = [--]7$ and $r = 2(3)$ oe	**B1**	Must see $\frac{p + \sqrt{q}}{r}$ or $\frac{p - \sqrt{q}}{r}$ or both or for $\frac{7}{6} \pm \sqrt{4 + \left(\frac{7}{6}\right)^2}$
				3.48, –1.15 cao	**B1B1**	After **B0**, **SC1** for answer 3.5 and –1.1 or 3.482… and –1.149 to –1.148 seen or for 3.48, –1.15 seen or for answer –3.48 and 1.15
		(c)		$\frac{x+5}{x^2}$ or $\frac{1}{x} + \frac{5}{x^2}$ final answer nfww	3	**B1** for $(x + 5)(x – 5)$ and **B1** for $x^2(x – 5)$
33	10	(a)	(i)	$5x + 14$ final answer	2	**M1** for $5x + k$ or $kx + 14$
			(ii)	14.2	3	**M1** for $5x = 32 – 14$ **FT** *their* expression in **(a)(i)** **A1FT** for $x = 3.6$
		(b)		$8a – 3b + 14 = 32.5$ or better	**B1**	$8a – 3b = 18.5$
				$5a + 4b + 13.5 = 39.75$ or better	**B1**	$5a + 4b = 26.25$
				Equates coefficients of either a or b $40a – 15b = 92.5$ $40a + 32b = 210$ or $32a – 12b = 74$ $15a + 12b = 78.75$	**M1**	or rearranges one of *their* equations to make a or b the subject e.g. $a = \frac{3b + 18.5}{8}$
				Adds or subtracts to eliminate $47b = 117.5$ $47a = 152.75$	**M1**	**Dep** on previous method or correctly substitutes into the second equation e.g. $\frac{5(3b + 18.5)}{8} + 4b = 26.25$
				$[a =] 3.25$	**A1**	After **M0** scored
				$[b =] 2.5$	**A1**	**SC1** for 2 correct values with no working or for two values that satisfy one of their original equations

34	8	(a)	$5x = 75$ or $5x + 48 = 123$	B2	**M1** for $x + (x + 12) + 3(x + 12) = 123$ oe
			15	B1	
		(b)	6, 7	3	**B2** for answer of 6 or 7 OR **M1** for $t < 8$ **M1** for $t \geqslant \frac{37}{7}$ OR **SC2** for final answer of 5, 6, 7 or 6, 7, 8 or **SC1** for final answer of 5, 6, 7, 8
		(c)	**(i)** 1.8 oe	3	**M1** for $21 - x = 4(x + 3)$ or better **B1** for $[\pm]5x = k$ or $kx = [\pm]9$
			(ii) $\sqrt{7^2 - 4 \times 3 \times (-5)}$ or better nfww	B1	or for $\left(x + \frac{7}{6}\right)^2$
			and $\frac{-7 + \sqrt{q}}{2(3)}$ or $\frac{-7 - \sqrt{q}}{2(3)}$ oe	B1	or for $-\frac{7}{6} \pm \sqrt{\frac{5}{3} + \left(\frac{7}{6}\right)^2}$
			-2.91 and 0.57 final ans cao	B1B1	**SC1** for 0.6 or 0.573… **and** -2.9 or -2.907 or -2.906… or -0.57 and 2.91 or 0.57 and -2.91 seen in working
35	11	(a)	$\frac{At}{t + r}$ final answer oe nfww	4	**B1** for $t(A - x) = xr$ or $tA - tx = xr$ or $A = \frac{xr}{t} + x$ **M1** for correctly completing multiplication by t (eliminating any bracket) and x terms isolated **M1** for correct factorisation **M1** dep for correct division
		(b)	$[a =]$ 64	3	**B1** for $2b = -16$ or $(x - 8)^2$
			$[b =]$ -8		**B1** for $a = (\text{their } b)^2$
					If **0** scored, **SC1** for $x^2 + 2bx + b^2$ soi
		(c)	$\frac{13x + 8}{(x - 4)(3x - 2)}$ final answer nfww	3	**B1** for $6(3x - 2) - 5(x - 4)$ or better seen **B1** for $(x - 4)(3x - 2)$ oe seen as denom or **SC2** for final answer $\frac{13x - 32}{(x - 4)(3x - 2)}$

36	3	(a)	(i)	$\frac{600}{x+20}$ final answer	1	
			(ii)	$\frac{600}{x} - \textit{their}\ \frac{600}{x+20} = 1.5$ oe	M1	
				$600(x+20) - 600x = 1.5x(x+20)$ or $\frac{600(x+20)-600x}{x(x+20)}$ [= *their* 1.5]	M1	Correctly clearing, or correctly collecting into a single fraction, two fractions both with algebraic denominators, one being $\frac{600}{x}$
				$600x + 12\,000 - 600x = 1.5x^2 + 30x$ [$0 = 1.5x^2 + 30x - 12\,000$]	M1	Dep on previous **M1**, correctly multiplying *their* brackets **and** clearing fraction
				$0 = x^2 + 20x - 8000$	A1	With no errors or omissions seen, dep on **M3**
		(b)		–100, 80	3	**M2** for $(x + 100)(x - 80)$ or **M1** for $(x + a)(x + b)$ where $ab = -8000$ or $a + b = 20$ OR **B1** for $\sqrt{20^2 - 4\times1\times(-8000)}$ or better and **B1** for $\frac{-20+\sqrt{q}}{2\times1}$ or $\frac{-20-\sqrt{q}}{2\times1}$
		(c)		6.67 or 6.666 to 6.667 oe	2FT	**FT** $\frac{12}{2(\textit{their}\ 80)+20}\times 100$ correctly evaluated to at least 3 sf **M1** for choosing and using *their* positive root

37	9	(a)		$4x - 3x^2$ or $x(4 - 3x)$ nfww final answer	3	**B2** for $3x^2 - 6x - 6x^2 + 10x$ or **M1** for $3x^2 - 6x$ or $-6x^2 + 10x$
		(b)	(i)	$(2 + y)(3w - 2x)$ oe final answer	2	**M1** for $3w(2 + y) - 2x(2 + y)$ or $2(3w - 2x) + y(3w - 2x)$
			(ii)	$(2x + 5y)(2x - 5y)$ final answer	2	**M1** for $(2x \pm 5y)(2x \pm 5y)$ or $(2x + ky)(2x - ky)$ or $(kx + 5y)(kx - 5y)$, $k \neq 0$ or $(2x + 5)(2x - 5)$ or $(2 + 5y)(2 - 5y)$
		(c)		$\frac{27x^6}{64}$ final answer	2	**B1** for 2 [out of 3] elements correct in the right form in final answer or final answer contains 27 and 64 and $x^{[-]6}$ or $\frac{3x^2}{4}$ seen or $\frac{729x^{12}}{4096}$ seen
		(d)	(i)	$2n$ is even and subtracting 1 gives an odd number	1	Must interpret the $2n$ as even or not odd and then the -1 oe
			(ii)	$2n + 1$ oe final answer	1	
			(iii)	*their*$(2n + 1)^2 - (2n - 1)^2$	M1	Could use alternate correct expressions for consecutive **odd** numbers. Allow method and accuracy marks if correct. Could reverse the algebraic terms *their*$(2n - 1)^2 - (2n + 1)^2$ leading to $-8n$. Allow method and accuracy marks if correct.
				$4n^2 + 4n + 1 - 4n^2 + 4n - 1$	M1	**Dep on M1** for expanding brackets in *their* expressions. If seen alone and completely correct then implies previous **M1** Allow $4n^2 + 4n + 1 - (4n^2 - 4n + 1)$
				$8n$	A1	With no errors seen. After **0** scored, allow **SC1** for two correctly evaluated numeric examples of subtracting consecutive odd squares isw

38	7	(a) (i)	331 or 331.1 to 331.2	2	**M1** for $\pi \times 6.2 \times 10.8 + \pi \times 6.2^2$
		(ii)	$\frac{A - \pi r^2}{\pi r}$ oe final answer	2	**M1** for correct re-arrangement isolating term in l **M1** for correct division by πr
		(b) (i)	4.39 or 4.390…	3	**M2** for $18 \div \left(\frac{10}{4} + \frac{8}{5}\right)$ or **M1** for $\frac{10}{4}$ or $\frac{8}{5}$
		(ii)	$x + x + 4$ oe	**B1**	Must be seen
			$\frac{x}{5}$ or $\frac{x+4}{10}$	**B1**	Must be seen
			$\frac{x + x + 4}{\frac{x}{5} + \frac{x+4}{10}} = 7$ oe	**M2**	or **M1** for evidence of total distance ÷ *their* total time
			12	**B1**	
		(c) (i)	16.5[0] final answer	3	**M2** for $19.8 \div \left(1 + \frac{20}{100}\right)$ oe or **M1** for evidence of (100 + 20)% associated with 19.8
		(ii)	$\frac{100x}{100 + y}$ final answer	3	**B2** for $\frac{x}{1 + \frac{y}{100}}$ or $\frac{x}{1 + 0.01y}$ oe or **B1** for $1 + \frac{y}{100}$ or $100 + y$ or $1 + 0.01y$ seen

39	8	(a)	$(x-5)(x+2)$ final answer	2	**B1** for $(x-5)(x+2)$ seen and then spoiled or **M1** for $(x+a)(x+b)$ where $a+b=-3$ or $ab=-10$ [a, b integers]
		(b)	(i) $x(x+2)+3(x+1)=3x(x+1)$ or $x^2+2x+3x+3=3x^2+3x$	M2	**M1** for $x(x+2)+3(x+1)$ or better seen Allow recovery of omitted brackets for M marks but not A mark
			$0=2x^2-2x-3$	A1	Brackets expanded correctly and/or no errors or omission of brackets seen
			(ii) $\dfrac{[-\!-]2\pm\sqrt{([-]2)^2-4(2)(-3)}}{2(2)}$ or $0.5\pm\sqrt{1.75}$	B2	**B1** for $\sqrt{([-]2)^2-4(2)(-3)}$ or $\sqrt{28}$ or $\sqrt{1.75}$ oe in completion of square **and B1** for in form $\dfrac{p+\sqrt{q}}{r}$ or $\dfrac{p-\sqrt{q}}{r}$ $p=-\!-2$ **and** $r=2(2)$ or better or $(x-0.5)^2$ oe in completion of square
			-0.823 and 1.823 final answer	B1 B1	If **B0B0** for answers, **SC1** for -0.82 or $-0.822\ldots$ and 1.82 or $1.822..$ as final answers or -0.823 and 1.823 seen or -1.823 and 0.823 as final answers
		(c)	$\dfrac{x^2+3x+3}{(x+2)(x+1)}$ or $\dfrac{x^2+3x+3}{x^2+3x+2}$ final answer nfww	4	**M1** for $(2x+3)(x+1)-x(x+2)$ oe isw **B1** for common denominator $=(x+2)(x+1)$ isw or x^2+3x+2 isw **B1** for $2x^2+2x+3x+3$ or better or $-x^2-2x$ or x^2+3x+3
40	7	(a)	83 nfww	4	**B3** for $17x=1411$ or $17x=14.11$ oe in form $ax=b$ or final answer of 0.83 or **B2** for $6x+11x-55=1356$ oe or $6x+11x-[0.]55=13[.]56$ or **M1** for $6x+11(x-[0.0]5)=13[.]56$
		(b)	$\dfrac{1}{3}$ oe nfww	4	**M1** for $y(y+3)$ oe or $\dfrac{1}{2}(2y+1)(y+1)$ oe and **B2** for $2y^2+6y=2y^2+2y+y+1$ oe or better or **B1** for $(2y+1)(y+1)=2y^2+2y+y+1$ soi

	(c)	25 nfww	**4**	**M1** for $\frac{4[.]80}{w-1}$ or $\frac{7[.]80}{2w-11}$ **M1** for $\frac{4[.]80}{w-1} = \frac{7[.]80}{2w-11}$ oe **M1** for $480(2w-11) = 780(w-1)$ oe or ALT **M1** for $n(w-1) = 4[.]80$ or $n(2w-11) = 7[.]80$ **M1** for $2wn - 11n = 7[.]80$ $2wn - 2n = 9[.]60$ oe **M1** for $9n = 180$ oe or better or ALT **M1** for $n(w-1) = 4[.]80$ or $n(2w-11) = 7[.]80$ **M1** for $\frac{4[.]80+n}{n} = \frac{7[.]80+11n}{2n}$ **M1** for $9n = 180$ oe or better
	(d)	**(i)** $\frac{1}{2}u(3u-2) = 2.5$ One further correct step leading to $3u^2 - 2u - 5 = 0$ with no errors	**M1** **A1**	First step must involve $\frac{1}{2}u(3u-2)$
		(ii) $(3u-5)(u+1)$	**2**	**SC1** for $(3u+a)(u+b)$ where $ab = -5$ or $a+3b = -2$ [a, b integers]
		(iii) 29.1 or 29.05…	**3**	**M2** for $\tan = \frac{their\ \frac{5}{3}}{3 \times their\ \frac{5}{3} - 2}$ or **M1** for substituting *their* positive value of u into [u and] $3u-2$

41	4	**(a)**	$(11y-m)(11y+m)$ final answer	**2**	**B1** for $11y$ seen
		(b)	$\frac{3x^2+5x-14}{(3x-5)(x-1)}$ final answer	**3**	**B1** for denom $(3x-5)(x-1)$ oe isw and **B1** for $3x^2+6x-5x-10$ soi
		(c)	$\frac{-2\pm\sqrt{2^2-4(3)(-7)}}{2\times3}$	**2**	**B1** for $\sqrt{2^2-4(3)(-7)}$ or better seen and if in form $\frac{p+or-\sqrt{q}}{r}$ **B1** for $p = -2$ **and** $r = 2\times3$
			-1.90 1.23 final answers	**1, 1**	**SC1** for -1.9, -1.896 or -1.897 and 1.2 or 1.230 or -1.23 and 1.90 final answers or -1.90 and 1.23 seen in working
		(d)	**(i)** $\frac{1}{2}(x+4+3x+2)(x+1)=15$	**M1**	Allow $\frac{1}{2}(4x+6)(x+1)=15$
			$4x^2+4x+6x+6 = 30$ or $2x^2+2x+3x+3 = 15$	**M1**	Dep on 1st **M1**
			$2x^2+5x-12=0$	**A1**	With no errors or omissions
			(ii) 1.5 or $\frac{3}{2}$, -4	**3**	**B2** for $(2x-3)(x+4)$ or $\frac{-5\pm\sqrt{5^2-4(2)(-12)}}{2\times2}$ **or SC1** for $(2x+a)(x+b)$ where a and b are integers and $a+2b=5$ or $ab=-12$ or $\sqrt{5^2-4(2)(-12)}$ or $\frac{p+or-\sqrt{q}}{r}$ where $p = -5$ and $r = 2\times2$
			(iii) 6.5 or $\frac{13}{2}$	**1FT**	FT $3\times$ *their* pos root from **(d)(ii)** $+2$

42	8	**(a)**	15 nfww	**3**	**M1** for $y = k\sqrt{(x+2)}$ oe **A1** for $k = 3$
		(b)	$\frac{x+6}{x-2}$ nfww final answer	**5**	**B2** for $(x+6)^2$ oe or **SC1** for $(x+a)(x+b)$ where $ab = 36$ or $a + b = 12$ or $x(x + 6) + 6(x + 6)$ **B2** for $(x-2)(x+6)$ or **SC1** for $(x+a)(x+b)$ where $ab = -12$ or $a + b = 4$ or $x(x + 6) - 2(x + 6)$ or $x(x - 2) + 6(x - 2)$
		(c)	$\frac{X}{W^2+1}$ nfww final answer	**5**	**M1** for $W^2 = \frac{X-a}{a}$ **or** $W\sqrt{a} = \sqrt{X-a}$ **M1** for next productive step **M1** for 2nd productive step **M1** for 3rd productive step **M1** for final step leading to $a =$
		(d)	$\frac{-7x-1}{x^2-1}$ or $\frac{-7x-1}{(x-1)(x+1)}$ final answer	**5**	**M1** for common denominator $(x-1)(x+1)$ isw **M1** for $(x-2)(x-1)-(x+3)(x+1)$ **B2** for $x^2-2x-x+2-(x^2+3x+x+3)$ oe or **B1** for either expansion

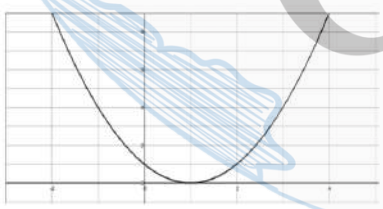
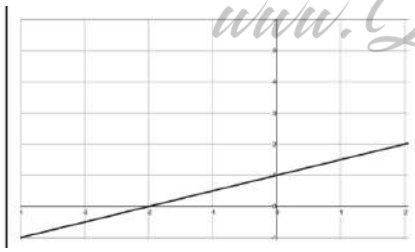
436	(a) (i)	$[y =]\ \frac{1}{2}(80-2x)$	M1	$40 - x$ is enough
		$A = their\frac{1}{2}(80-2x)\times x$ oe	M1	
		$A = 40x - x^2$ and $x^2 - 40x + A = 0$	A1	No errors or omissions
	(ii)	$(x-30)(x-10)$	B2	**B1** for $x(x-30) - 10(x-30)$ [= 0] or $x(x-10) - 30(x-10)$ [= 0] or **SC1** for $(x+a)(x+b)$ where $ab = 300$ or $a + b = -40$
		30, 10	B1	
	(iii)	$\sqrt{(-40)^2 - 4(1)(200)}$ or better	B1	or for $(x-20)^2$
		$p = --40$ and $r = 2(1)$	B1	Must see $\frac{p+\sqrt{q}}{r}$ or $\frac{p-\sqrt{q}}{r}$ or both or for $20 \pm \sqrt{200}$
		5.86 34.14	B1 B1	If B0, **SC1** for 5.9 or 5.857 to 5.858 **and** 34.1 or 34.14… or 5.86 **and** 34.14 seen in working or –5.86 **and** –34.14 as final answers
	(b) (i)	$\frac{200}{x} - \frac{200}{x+10}$	M2	or **M1** for $\frac{200}{x}$ or $\frac{200}{x+10}$ soi
		$\frac{200(x+10)-200x}{x(x+10)} = \frac{2000}{x(x+10)}$	A1	No errors or omissions
	(ii)	16 [min] 40 [s]	3	**B2** for $0.2\dot{7}$ or 0.278 or 0.2777 to 0.2778 or $\frac{5}{18}$ [h] oe or $16.\dot{6}$ or 16.7 or 16.66 to 16.67 or $\frac{50}{3}$ [min] or **M1** for $2000 \div 80(80+10)$ or $\frac{200}{80} - \frac{200}{90}$

44	2 (a)	(i)	5	1	
		(ii)	$\frac{1}{2}$ oe	1	
		(iii)	$\frac{5}{3}$ oe	2	**M1** for $2^{3x} = 2^5$ oe or better or **SC1** for either denominator or numerator of index correct in final answer
		(iv)	$-\frac{2}{3}$ oe	2	**M1** for $3^{3x} = 3^{-2}$ oe or better or $\left(\frac{1}{3}\right)^{-3x} = \left(\frac{1}{3}\right)^{2}$ or better or **SC1** for $\frac{2}{3}$ or any negative index
	(b)		$(y - 10)(y + 3)$ seen	B2	**B1** for $y(y - 10) + 3(y - 10)$ [= 0] or $y(y + 3) - 10(y + 3)$[= 0] or for $(y + a)(y + b)$ [= 0] where $ab = -30$ or $a + b = -7$ or for $y - 10$ [= 0] and $y + 3$ [= 0]
			10 and – 3 final answers	B1	
45	2 (a)		$x > \frac{12}{5}$ oe final answer	2	**B1** for $\frac{12}{5}$ oe in answer with incorrect or no sign or **M1** for one correct step e.g. $5x > 9 + 3$
	(b)	(i)	$(y - 6)(x + 3)$ final answer	2	**M1** for $y(x + 3) - 6(3 + x)$ or $x(y - 6) + 3(y - 6)$
		(ii)	$8(x + 3y)(x - 3y)$ final answer	3	**M2** for $2(2x + 6y)(2x - 6y)$ or $(8x + 24y)(x - 3y)$ or $(8x - 24y)(x + 3y)$ or $4(2x - 6y)(x + 3y)$ or $4(2x + 6y)(x - 3y)$ or $(4x - 12y)(2x + 6y)$ or $(4x + 12y)(2x - 6y)$ or **M1** for $8(x^2 - 9y^2)$ or $(x + 3y)(x - 3y)$
	(c)		$r = \frac{1}{p + 7}$ final answer nfww	4	**M1** removes fraction correctly **M1** collects terms in r **M1** removes r as a factor from their terms in r **M1dep** divides by bracket to leave r and denominator simplified

46 7	(a) (i)	$\frac{12}{x-1}-\frac{10}{x}=0.5$ oe	M2	**M1** for $\frac{12}{x-1}$ or $\frac{10}{x}$
		$12x - 10(x - 1) = 0.5x(x - 1)$ or better	M1	**FT** $\frac{10}{x}-\frac{12}{x-1}=0.5$ only
		Brackets expanded		
		$x^2 - 5x - 20 = 0$ with no errors or omissions seen	A1	Dep on **M3** and brackets expanded
	(ii)	$\sqrt{(-5)^2 - 4(1)(-20)}$ or better	B1	Seen anywhere or $(x-\frac{5}{2})^2$ oe
		$p = -(-5)$, $r = 2(1)$ or better	B1	Must be in the form $\frac{p+\sqrt{q}}{r}$ or $\frac{p-\sqrt{q}}{r}$ or for $\frac{5}{2}+\sqrt{\left(\frac{5}{2}\right)^2+20}$ or $\frac{5}{2}-\sqrt{\left(\frac{5}{2}\right)^2+20}$
		– 2.62, 7.62 final answers	B1B1	**SC1** for – 2.6 or – 2.623 to – 2.624 and 7.6 or 7.623 to 7.624 or –2.62 and 7.62 seen in working or answers 2.62 and – 7.62
	(iii)	1 [hr] 49 [mins]	2FT	**FT** 12 ÷ (*their* +ve root – 1) or 0.5 + 10 ÷ (*their* 7.62) in hrs and mins, rounded to nearest min **M1** for 12 ÷ (*their* +ve root – 1) or 0.5 + 10 ÷ (*their* 7.62)
	(b) (i)	2.5	1	
	(ii)	1312.5 final answer	3	**M2** for any complete correct method e.g 25 × 10 ÷ 2 + 45 × 25 + 5 × 25 ÷ 2 **M1** for any correct method for a relevant area under the graph
47	6(a)(i)	–7*x* + 55 final answer	2	**M1** for 8*x* + 20 or –15*x* + 35 or answer –7*x* + *k* or *k*x + 55
	6(a)(ii)	$x^2 - 14x + 49$ final answer	2	**M1** for 3 of $x^2 - 7x - 7x + 49$
	6(b)(i)	–18	3	**M1** for a correct first step ie correctly multiplying by 3 or correctly dividing by 2 or for correctly subtracting 5 **M1** for correctly reaching *ax* = *b* from *their* first step
	6(b)(ii)	15	3	**M2** for 6*x* – 4*x* = 21 + 9 oe or **M1** for 6*x* – 21 or correct division by 3 or for correctly reaching *ax* = *b* from *their* first step
	6(b)(iii)	5 and –5	3	**B2** for 5 or –5 or **M1** for [x^2 =] (74 + 1) ÷ 3 or better

48	3(a)	-2.75 or $-2\frac{3}{4}$	**2**	**M1** for $11x - 3x = -7 - 15$ or better
	3(b)(i)	$(x + 11)(x - 2)$ final answer	**2**	**M1** for $(x + a)(x + b)$ where $ab = -22$ or $a + b = 9$
	3(b)(ii)	-11 and 2 final answer	**1**	
	3(c)	$[x] = \frac{2a}{2-y}$ or $\frac{-2a}{y-2}$ nfww final answer	**4**	**M1** for clearing the x term in the denominator **M1** for correctly removing the bracket (expand or divide by 2) **M1** for factorising to obtain single x term **M1** for *their* factor and division Incorrect answer scores 3 out of 4 maximum
	3(d)	$\frac{x}{x+6}$ nfww final answer	**3**	**M1** for $x(x - 6)$ **M1** for $(x + 6)(x - 6)$
49	5(a)(i)	$(2n+m)(m-3)$ final answer	**2**	**M1** for $m(2n+m)-3(2n+m)$ or $2n(m-3)+m(m-3)$
	5(a)(ii)	$(2y-9)(2y+9)$ final answer	**1**	
	5(a)(iii)	$(t-4)(t-2)$ final answer	**2**	**B1** for $(t-4)(t-2)$ seen and spoiled or **M1** for $t(t-2)-4(t-2)$ or $t(t-4)-2(t-4)$ or $(t+a)(t+b)$ where $a + b = -6$ or $ab = +8$
	5(b)	$[x =]\frac{2m}{k+1}$	**4**	**M1** for $xk = 2m - x$ or $k = \frac{2m}{x} - 1$ **M1** for $xk + x = 2m$ or $k + 1 = \frac{2m}{x}$ **M1** for $x(k+1) = 2m$
	5(c)	correctly eliminating one variable	**M1**	
		$[x =]\ 6$	**A1**	
		$[y =]\ -2$	**A1**	If 0 scored **SC1** for 2 values satisfying one of the original equations or **SC1** if no working shown, but 2 correct answers given
	5(d)(i)	$3m - 4(m+4) = 6m(m+4)$	**M1**	or $\frac{3m-4(m+4)}{m(m+4)}[=6]$ oe
		$3m - 4m - 16 = 6m^2 + 24m$	**M1**	removes brackets correctly
		$6m^2 + 25m + 16 = 0$	**A1**	with no errors or omissions

	5(d)(ii)	$\frac{-25 \pm \sqrt{(25)^2 - 4(6)(16)}}{2 \times 6}$ or $\frac{-25}{12} \pm \sqrt{\left(\frac{25}{12}\right)^2 - \frac{16}{6}}$	**2**	**B1** for $\sqrt{(25)^2 - 4(6)(16)}$ or **B1** for $\left(m + \frac{25}{12}\right)^2$ and if in form $\frac{p + \sqrt{q}}{r}$ or $\frac{p - \sqrt{q}}{r}$ **B1** for $p = -25$ and $r = 2(6)$
		–0.79 and –3.38 final ans cao	**2**	**B1** for each **SC1** for –0.8 and –3.4 or for –0.78 and –3.37 or –0.789... and –3.377... or 0.79 and 3.38 or –0.79 and –3.38 seen in working
50	4(a)(i)	$243p^{10}$ final answer	**2**	**B1** for answer $243p^k$ or kp^{10} $(k \neq 0)$
	4(a)(ii)	$9xy^4$ final answer	**2**	**B1** for answer with two correct elements in correct form of expression
	4(a)(iii)	$\frac{m^2}{25}$ final answer	**1**	
	4(b)	10	**4**	**B2** for $x = 8$ or for [length of rectangle =] 31 or **M1** for $5x - 9 = 3x + 7$ oe or better **M1** for $\frac{310}{(3 \times \text{their}x + 7)}$ or $\frac{310}{(5 \times \text{their}x - 9)}$ Alt method using simultaneous eqns **M1** for $5xw - 9w = 310$ **and** $3xw + 7w = 310$ **M1** for equating coefficients of xw **M1** for subtraction to eliminate term in xw

51	6(a)	$x^2 + 4x - 21$ final answer	**2**	**B1** for three of $x^2, +7x, -3x, -21$
	6(b)(i)	$5q^2(3p^2 - 5q)$ final answer	**2**	**B1** for $5(3p^2q^2 - 5q^3)$ or $q^2(15p^2 - 25q)$ or $q(15p^2q - 25q^2)$ or $5q(3p^2q - 5q^2)$ or for correct answer seen
	6(b)(ii)	$(2g + 5k)(2f + 3h)$ final answer	**2**	**B1** for $2g(2f + 3h) + 5k(2f + 3h)$ or $2f(2g + 5k) + 3h(2g + 5k)$ or for correct answer seen
	6(b)(iii)	$(9k + m)(9k - m)$ final answer	**2**	**M1** for $(9 + m)(9 - m)$ or for correct answer seen
	6(c)	5.5	**4**	**M1** for $5 \times 3(x - 4) + x + 2 = 5 \times 6$ **M1** for $15x - 60 + x + 2 = 30$ **FT** *their* first step or $3x - 12 + \frac{x+2}{5} = 6$ If M0M0, **SC1** for $3x - 12 + x + 2 = 30$ oe **M1dep** for $16x = 88$ **FT** *their* previous steps
52	9(a)(i)	$(x+4)^2 - 25$	**2**	**B1** for $(x+k)^2 - 9 - (\text{their } k)^2$ or $(x+4)^2 - h$ or $k = 4$
	9(a)(ii)	$x + 4 = [\pm]\ 5$	**M1**	**FT** *their* **(a)(i)**
		–9 and 1	**A1**	
	9(b)	$[b =]\ 7$ $[c =]\ -3$	**3**	**B1** for $[b =]\ 7$ **M1** for $b^2 - 4c = 61$
	9(c)(i)(a)	Correct sketch 	**2**	**B2** for correct quadratic curve with min touching x-axis or **B1** for parabola vertex downwards
	9(c)(i)(b)	Correct sketch 	**2**	**B2** for correct straight line intersecting curve on y-axis or **B1** for straight line with positive gradient and positive y-intercept

53	8(a)	$ab(3a - b)$ final answer	**2**	**B1** for $a(3ab - b^2)$ or $b(3a^2 - ab)$ or $ab(3a - b)$ seen
	8(b)	$x > 7.5$ final answer	**2**	**B1** for $12+3 < 5x - 3x$ oe
	8(c)	$27x^6y^{12}$	**2**	**B1** for two of 27, x^6 and y^{12} correct
	8(d)	0.5 or $\frac{1}{2}$	**3**	**M2** for $4 = 6x + 2x$ or better or **M1** for $2(2 - x) = 6x$ oe
	8(e)	$2x^3 + 5x^2 - 23x + 10$ final answer	**3**	**B2** for correct expansion of three brackets unsimplified **B1** for correct expansion of two brackets with at least 3 terms correct
	8(f)(i)	$200\left(1+\frac{r}{100}\right)^2 = 206.46$ oe	**M1**	
		$1+\frac{2r}{100}+\frac{r^2}{100^2}$ oe	**M1**	
		$r^2 + 200r - 323 = 0$	**A1**	Correct solution reached with no errors or omissions seen If 0 scored, **SC1** for $200(n)^2 = 206.46$
	8(f)(ii)	$\frac{-200+\sqrt{200^2-4(1)(-323)}}{2\times1}$	**B2**	**B1** for $\sqrt{200^2-4(1)(-323)}$ or $(r+100)^2$ **B1** for $\frac{-200+\sqrt{q}}{2\times1}$ or $r = \sqrt{323+100^2} - 100$ OR **B2** for $100\left(\sqrt{\frac{206.46}{200}}-1\right)$ or **B1** for $\sqrt{\frac{206.46}{200}}$
		1.60 cao final answer	**B1**	