Mark Scheme

Q1.

Question		Working	Answer	Mark	Notes
	(a)	$m^2 - 8m + 5m - 40$		2	M1 for any 3 correct terms **or** for 4 out of 4 correct terms ignoring signs for $m^2 - 3m$ … **or** for …$- 3m - 40$
			$m^2 - 3m - 40$		A1
	(b)		$5y(1 + 4y)$	2	B2 If not B2 then award B1 for $5(y + 4y^2)$ **or** $y\,(5 + 20y)$ **or** $5y(a + 4y)$ where a is an integer and $a \neq 0$ **or** $5y(1 + by)$ where b is an integer and $b \neq 0$
	(c)		1	1	B1
	(d)	E.g. $6x - 15$ or $12x - 30$ oe		4	M1 for expansion of a correct bracket
		$2 \times 3(2x - 5) = 9 - x$ oe **or** $2(\text{'}6x - 15\text{'}) = 9 - x$ oe **or** $3(2x - 5) = \frac{9}{2} - \frac{x}{2}$ oe			M1 for removal of fraction or separating fraction (RHS) in an equation
		$12x + x = 9 + 30$ oe **or** $6x + \frac{x}{2} = \frac{9}{2} + 15$ oe			M1 ft (dep on 4 terms) for terms in x on one side of equation; number terms on the other
			3		A1 dep on at least M2 awarded
					Total 9 marks

(**Q07 4MA1/1H, Jan 2020**)

Q2.

Q	Working	Answer	Mark	Notes	
(a)	$20 - 5x\ (= 7 - 3x)$		3	M1	for expansion of bracket
	E.g. $20 - 7 = -3x + 5x$ or $-5x + 3x = 7 - 20$			M1	ft from a 4-term equation for a correct process of isolating terms in x on one side of the equation and numbers on the other side
		6.5 oe		A1	dep on M1 awarded and from correct working
(b)			2	M1	for any **correct** partial factorisation with at least 2 factors, one of which must be a letter **or** the correct common factor with no more than 1 error inside the bracket
		$8m^2g^3(2m + 3g^2)$		A1	
(c)(i)	$(y \pm 6)(y \pm 8)$		2	M1	
		$(y - 8)(y + 6)$		A1	
(c)(ii)		8, −6	1	B1	**must** ft from their factors in (c)(i)
					Total 8 marks

(**Q07 4MA1/1H, Nov 2020**)

Q3.

Q	Working	Answer	Mark	Notes	
a		g^{10}	1	B1	
b		k^7	1	B1	
c		$9c^2d^8$	2	B2	B1 for 2 out of 3 terms correct in a product
d	$4x > 2 - 7$ oe			M1	accept as an equation or with wrong inequality sign.
		$x > -1.25$	2	A1	oe allow $(-1.25, (+)\infty)$ Note: award M1A0 for an answer on the answer line of −1.25 with no sign or the incorrect sign eg $x = -1.25$, $x < -1.25$
					Total 6 marks

(**Q01 4MA1/2H, Nov 2020**)

Q4.

Q	Working	Answer	Mark	Notes
a		$4e^{10}$	2	B2 (B1 for $4e^{k}$ or ke^{10})
b	A correct first step eg $\frac{y^{-4}}{2^{-4}}$ or $\left(\frac{y^4}{16}\right)^{-1}$ or $\frac{y^{-4}}{0.0625}$ or $\left(\frac{2}{y}\right)^4$ or $\frac{16}{y^4}$ or $\left(\frac{1}{y/2}\right)^4$ or $\frac{1}{\left(y/2\right)^4}$			M1 or for $16y^{p}$ where $p \neq -4$
		$16y^{-4}$	2	A1
c	eg $12\times\frac{4x-2}{3}-12\times\frac{5-3x}{4}=12\times6$ or eg $4(4x-2)-3(5-3x)=12\times6$ or eg $\frac{4(4x-2)}{12}-\frac{3(5-3x)}{12}(=6)$ or eg $\frac{4(4x-2)-3(5-3x)}{12}(=6)$ oe			M1 for clear intention to multiply **all** terms by 12 or a multiple of 12 or to express LHS as two fractions over 12 or a multiple of 12 or as a single fraction with a denominator of 12 or a multiple of 12 (if expanded numerator, allow one sign error)
	eg $16x-8-15+9x=6\times12$			M1 expanding brackets and multiplying both sides by denominator with no more than one sign error
	eg $16x+9x=72+8+15$			M1 for correct rearrangement of a correct equation with terms in x isolated
		3.8	4	A1 oe, award full marks for a correct answer if at least M1 scored
				Total 8 marks

(**Q11 4MA1/2H, Nov 2020**)

Q5.

Q	Working	Answer	Mark	Notes
(a)	$6x^2 + 9x - 3x^2 - 5x$		2	M1 expansion with at least 3 correct terms (must see for example, $6x^2$ and not just $3x \times 2x$)(can assume that no sign in front of a number is a + if terms written in a list or table)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$3x^2 + 4x$		A1 or $4x + 3x^2$ or $x(3x + 4)$ or $x(4 + 3x)$
(b)	$p + d = at$ **or** $-at = -d - p$ **or** $\frac{p}{a} = \frac{at}{a} - \frac{d}{a}$ oe		2	M1 Correct first stage in rearrangement
	Working not required, so correct answer scores full marks	$t = \frac{p+d}{a}$		A1 oe eg $t = \frac{p}{a} + \frac{d}{a}$ or $t = \frac{-p-d}{-a}$ Must have "$t =$" either in working or on answer line
(c)	$w^2 \times w^n = w^{10}$ **or** $w^5 \times w^n = w^{13}$ **or** $w^5 \times w^{n-3} = w^{10}$ **or** $\frac{w^{5+n}}{w^3} = w^{10}$ **oe** **or** $5 + n - 3 = 10$ **or** $2 + n = 10$ **or** $5 + n = 13$		2	M1 A correct first stage simplifying at least one index in a correct equation **or** a clearly correct subsequent stage showing correct use of a rule of indices eg $w^5 \times w^n = w^{30}$ **and** $w^n = w^{30-5}$ **or** a correct equation using indices only
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	8		A1 accept w^8 (trial and error gains full marks if correct and no marks if incorrect unless a rule of indices is clearly shown)
				Total 6 marks

(**Q05 4MA1/1H, June 2021**)

Q6.

Q	Working	Answer	Mark	Notes
(a)	$6y(y-1)+5(y-1)$ or $y(6y+5)-1(6y+5)$		2	M1 for $(6y \pm 5)(y \pm 1)$ or $(6y \pm 1)(y \pm 5)$ or $(ay+5)(by-1)$ where $ab=6$ or $5b-a=-1$ or $(6y+p)(y+q)$ where $pq=-5$ or $6q+p=-1$ Condone use of a different letter to y
	Correct answer scores full marks (unless from obvious incorrect working)	$(6y+5)(y-1)$		A1 oe
(b)	$8w-fw=2f+3$ oe		3	M1 for multiplying by denominator and expanding in a correct equation
	$8w-3=2f+fw$ oe or $-2f-fw=3-8w$ oe			M1 for gathering terms in f on one side and other terms the other side in a correct equation ft their equation dep on 2 terms in f and two other terms
	Correct answer scores full marks (unless from obvious incorrect working)	$f=\frac{8w-3}{2+w}$		A1 oe accept $f=\frac{3-8w}{-2-w}$ oe
(c)	$4(x^2-2x)+7$ or $4\left(x^2-2x+\frac{7}{4}\right)$ oe		3	M1
	$4\left[(x-1)^2-1^2\right]+7$ oe or $4\left[(x-1)^2-1^2+\frac{7}{4}\right]$ oe			M1 for a complete method
	Correct answer scores full marks (unless from obvious incorrect working)	$4(x-1)^2+3$		A1 allow $a=4$, $b=-1$ and $c=3$
				Total 8 marks

(c) **ALT**	$ax^2+2bax+b^2a+c$		3	M1 for correctly expanding $a(x+b)^2+c$ to give $ax^2+2bax+b^2a+c$
	$2ba=-8$ and $b^2a+c=7$			M1 for a complete method (equating coefficients)
	Correct answer scores full marks (unless from obvious incorrect working)	$4(x-1)^2+3$		A1 allow $a=4$, $b=-1$ and $c=3$

(**Q17 4MA1/1H, Nov 2021**)

Q7.

Q	Working	Answer	Mark	Notes
(a)	$n^2-6n+4n-24$		2	M1 for any 3 correct terms **or** for 4 out of 4 correct terms ignoring signs **or** for n^2-2n … **or** for …$-2n-24$
		$n^2-2n-24$		A1 oe
(b)	$8x-12$ **or** $\frac{3}{4}x-\frac{5}{4}$ oe or $0.75x-1.25$ oe		3	M1 for correct multiplication by 4 **or** separate fractions on the RHS
	$8x-3x=-5+12$ oe or $5x=7$ oe **or** $2x-\frac{3}{4}x=-\frac{5}{4}+3$ or $2x-0.75x=-1.25-3$ oe			M1 ft (dep on 4 terms) for terms in x on one side of equation and number terms on the other
		$\frac{7}{5}$		A1 oe dep on M1 1.4 or $1\frac{2}{5}$ oe
				Total 5 marks

(**QU05 4MA1/1H, June 2022**)

Q8.

Q	Working	Answer	Mark	Notes
	$d=-2$		6	M1 for common difference
	$(S_n=)\frac{n}{2}[2(177)+(n-1)(-2)]$ or $(S_n=)\frac{n}{2}[354-2n+2]$ or $(S_n=)\frac{n}{2}[356-2n]$ oe			M1 for correctly substituting 177 and –2 into $(S_n=)\frac{n}{2}[2a+(n-1)d]$
	$\frac{n}{2}[2(177)+(n-1)(-2)]=(n-2)\times180$			M1 dep on M2 for equating S_n with $(n-2)\times180$
	E.g. $2n^2+4n-720=0$ or $n^2+2n-360=0$ oe Allow $n^2+2n=360$			A1 (dep on M3) writing a correct 3-term quadratic expression in form ax^2+bx+c $(=0)$ allow $ax^2+bx=c$
	E.g. $(x-18)(x+20)(=0)$ $x=\frac{-2\pm\sqrt{2^2-4\times1\times-360}}{2}$ e.g. $(x+1)^2-(1)^2=360$			M1 (dep on M2) for a complete method to solve their 3-term quadratic equation Allow one sign error and some simplification – allow as far as $\frac{-2\pm\sqrt{4+1440}}{2}$
		18		A1 dep on M3 for 18 only
				Total 6 marks

Q	Working	Answer	Mark	Notes
ALT	3, 5, 7,… **and** $d = 2$ or $a = 3$ **and** $d = 2$		6	M1 for identifying exterior angle sequence for at least 3 terms and $d = 2$ **or** first term and common difference
	$(S_n =)\frac{n}{2}[2(3)+(n-1)(2)]$ or $(S_n =)\frac{n}{2}[6+2n-2]$ or $(S_n =)\frac{n}{2}[4+2n]$ oe			M1 for correctly substituting 3 and 2 into $(S_n =)\frac{n}{2}[2a+(n-1)d]$
	$\frac{n}{2}[2(3)+(n-1)(2)]=360$			M1 dep on M2 for equating S_n with 360
	E.g. $2n^2+4n-720=0$ or $n^2+2n-360=0$ oe Allow $n^2+2n=360$			A1 (dep on M3) writing a correct 3-term quadratic expression in form $ax^2 + bx + c$ (= 0) allow $ax^2 + bx = c$
	E.g. $(x-18)(x+20)(=0)$ $x = \frac{-2\pm\sqrt{2^2-4\times1\times-360}}{2}$ e.g. $(x+1)^2-(1)^2=360$			M1 (dep on M2) for a complete method to solve their 3-term quadratic equation Allow one sign error and some simplification – allow as far as $\frac{-2\pm\sqrt{4+1440}}{2}$
		18		A1 dep on M3 for 18 only
				Total 6 marks

(**QU23 4MA1/1H, June 2022**)

Q9.

Q	Working	Answer	Mark	Notes
	eg $\begin{matrix}+7x+3y=3\\ 9x-3y=21\end{matrix}$ or $\begin{matrix}-21x+9y=9\\ 21x-7y=49\end{matrix}$ or eg $7x+3(3x-7)=3$ or $7\left(\frac{7+y}{3}\right)+3y=3$		3	M1 a correct method to eliminate x or y – multiplying one or both equations so that one variable can be eliminated (allow a total of one error in multiplication) **and** the correct operation to eliminate or for substitution of one variable into the other equation.
	If first M1 gained then they can substitute an incorrect value if from 'correct' method to gain this mark.			M1 dep on M1 for a correct method to calculate the value of other letter eg substitution or starting again with elimination
		$x=1.5$, $y=-2.5$		A1 oe dep on M1
				Total 3 marks

(**QU10 4MA1/2H, June 2022**)

Q10.

Q	Working	Answer	Mark	Notes
(i)	$(x\pm3)(x\pm8)$		2	M1 or $(x+a)(x+b)$ where $ab=-24$ **or** $a+b=5$
		$(x-3)(x+8)$		A1
(ii)		3, −8	1	B1ft Must ft from their answer to (i) ft from their incorrect factors in the form $(x+a)(x+b)$
				Total 3 marks

(**QU11 4MA1/2H, June 2022**)

Q11.

Q	Working	Answer	Mark	Notes
(a)		$3c^4+12c^3$	2	B2 for $3c^4+12c^3$ (B1 for $3c^4$ or $12c^3$)
(b)(i)			2	M1 for $(x\pm9)(x\pm1)$ or for $(x+a)(x+b)$ with $ab=-9$ or $a+b=8$
		$(x+9)(x-1)$		A1 for correct factors
(ii)		$-9, 1$	1	B1 ft dep on factorising in the form $(x+p)(x+q)$
				Total 5 marks

(**QU05 4MA1/1HR, June 2022**)

Q12.

Q	Working	Answer	Mark	Notes
(a)	eg $10p=3p-5$ **or** $p=\frac{3p}{10}-\frac{5}{10}$ oe eg $p=0.3p-0.5$		3	M1 for a correct first step – multiplying both sides by 10 correctly or writing the RHS as 2 terms each over 10 or each term as a decimal [must be in a correct equation]
	eg $10p-3p=-5$ **or** $7p=-5$ **or** $p-\frac{3p}{10}=-\frac{5}{10}$ **or** $0.7p=-0.5$			M1ft (ft a 3 term equation) for collecting terms in p on one side and number the other
		$-\frac{5}{7}$		A1 (dep on at least M1) for $-\frac{5}{7}$ oe, accept −0.71(4...) allow −0.7 if you have seen $-\frac{5}{7}$ or $-5\div7$
(b)		1	1	B1

(c)		$\frac{y^2}{2x}$	2	B2	for $\frac{y^2}{2x}$ oe eg $\frac{0.5y^2}{x}$, $0.5y^2x^{-1}$, $\frac{y^2x^{-1}}{2}$, $\frac{1}{2xy^{-2}}$ oe If not B2, award B1 for 2 of number, x, y correct eg $\frac{ky^2}{x}$ where $k \neq \frac{1}{2}$ **or** $\frac{y^2}{2x^m}$ where $m \neq 1$ **or** $0.5y^2$ **or** $\frac{y^p}{2x}$ where $p \neq 2$) **oe** [one term can be missing with 2 correct for B1]
(d)		$5cd^2(2c^2+3d^2)$	2	B2	for $5cd^2(2c^2+3d^2)$ B1 for a correct partial factorisation eg $5(2c^3d^2+3cd^4)$ or $cd^2(10c^2+15d^2)$ **or** $5d^2(2c^3+3cd^2)$ **or** $5c(2c^2d^2+3d^4)$ **or** $5cd(2c^2d+3d^3)$ etc **or** $5cd^2$(a 2 term expression with just one error)
					Total 8 marks

(**QU06 4MA1/2HR, June 2022**)

Q13.

Q	Working	Answer	Mark	Notes
(a)		2	1	B1
(b)		$8a^3$	2	B2 for $8a^3$ If not B2 then B1 for $8a^k$ where $k \neq 3$ or ka^3 where $k \neq 8$
(c)	$5x(3x+4) = 15x^2 + 20x$ **or** $5x(2x-1) = 10x^2 - 5x$ **or** $(3x+4)(2x-1) = 6x^2 - 3x + 8x - 4$ $(= 6x^2 + 5x - 4)$		3	M1 for a correct intention to multiply all 3 factors by multiplying 2 factors only, allow one error
	$(15x^2 + 20x)(2x-1) = 30x^3 - 15x^2 + 40x^2 - 20x$ oe $(10x^2 - 5x)(3x+4) = 30x^3 + 40x^2 - 15x^2 - 20x$ oe $5x(6x^2 + 5x - 4) = 30x^3 + 25x^2 - 20x$ oe			M1 (dep)ft for expanding by the third factor, allow one error (some may do the expansion in one stage and will get to $30x^3 - 15x^2 + 40x^2 - 20x$ without firstly expanding two factors – this gains M2, allow one error)
	$30x^3 + 25x^2 - 20x$ *Correct answer scores full marks (unless from obvious incorrect working)*			A1 isw correct factorisation ($30x^3 + 25x^2 - 20x$ must be seen previously to award 3 marks) eg $5(6x^3 + 5x^2 - 4x)$ $x(30x^2 + 25x - 20)$ $5x(6x^2 + 5x - 4)$ do not isw incorrect simplification eg $30x^3 + 25x^2 - 20x = 6x^3 + 5x^2 - 4x$ gets M2A0
				Total 6 marks

(**Q12 4MA1/2HR, Jan 2023**)

Q14.

Q	Working	Answer	Mark	Notes
(a)	$8x^2 + 20x - 6x^2 + 9x$	$2x^2 + 29x$	2	M1 3 correct terms or all 4 terms condoning incorrect signs
				A1
(b)	$y^5 \times y^n = y^{19}$ or $y^{-1} \times y^n = y^{13}$ or $5 + n - 6 = 13$	14	2	M1 Use of 1 rule of indices or a correct equation in n
				A1 Accept y^{14}
(c)(i)	$7t - 2t < 7 + 8$ oe eg $5t < 15$ oe	$t < 3$	2	M1 Terms in t on one side and number terms the other side – may be in an equation or the incorrect inequality sign or an answer of $t = 3$ or eg $t \geq 3$
				A1 Must be a correct inequality given as answer
(ii)		open circle at $t = 3$ and a line with an arrow to the left	1	B1ft Allow a line without an arrow if it reaches to at least −5, with an arrow it can be any length
				Total 7 marks

(**Q05 4MA1/2H, Jan 2021**)

Q15.

Q	Working	Answer	Mark	Notes
(a)	eg $20\times\frac{9a-7}{5}-20\times\frac{3a-7}{4}=20\times4.55\,(=91)$ or eg $4(9a-7)-5(3a-7)=20\times4.55$ or eg $\frac{4(9a-7)}{20}-\frac{5(3a-7)}{20}\,(=4.55)$ or eg $\frac{4(9a-7)-5(3a-7)}{20}\,(=4.55)$		3	M1 For clear intention to multiply all terms by 20 (or 4 × 5) or a multiple of 20 oe or to express LHS as two fractions over 20 (or 4 × 5) or a multiple of 20 oe or as a single fraction with a denominator of 20 (or 4 × 5) or a multiple of 20 oe if expanded numerator, allow one error
	eg $36a-28-15a+35=20\times4.55$ or $21a=84$ oe			M1 Expanding brackets and multiplying by denominator with no more than one sign error
		4		A1 dep on M1
(b)	$p^2=\frac{ac+8}{3+c}$		4	M1 for removing square root
	$3p^2+cp^2=ac+8$			M1 for multiplying by denominator and expanding in a correct equation
	$cp^2-ac=8-3p^2$ or $3p^2-8=ac-cp^2$			M1ft for gathering terms in c on one side and other terms the other side ft their equation dep on 2 terms in c and two other terms
		$c=\frac{8-3p^2}{p^2-a}$		A1 or $c=\frac{3p^2-8}{a-p^2}$
				Total 7 marks

(**Q14 4MA1/2H, Jan 2021**)

Q16.

Q	Working	Answer	Mark	Notes	
	$\left(\frac{9x^2-4}{3x^2-13x-10}=\right)\ \frac{(3x+2)(3x-2)}{(3x+2)(x-5)}$			M1 for either $(3x+2)(3x-2)$ **or** $(3x+2)(x-5)$	M2 for $\frac{9x^2-4}{(9x^2-4)(x-5)}=\frac{1}{(x-5)}$
	$\left(\frac{9x^2-4}{3x^2-13x-10}=\right)\ \frac{(3x+2)(3x-2)}{(3x+2)(x-5)}$			M1 for $(3x+2)(3x-2)$ **and** $(3x+2)(x-5)$	
	E.g. of denominators $(3x-2)(3x^2-13x-10)(x-1)$ **or** $(3x-2)(3x+2)(x-5)(x-1)$ **or** $9x^4-54x^3+41x^2+24x-20$ **or** $(3x+2)(x-5)(x-1)$ **or** $3x^3-16x^2+3x+10$ **or** $(3x-2)(x-5)(x-1)$ **or** $3x^3-20x^2+27x-10$ **or** $(x-5)(x-1)$ **or** x^2-6x+5			M1	(indep) ft their fractions for use of a correct common denominator for 2 fractions with **algebraic** denominators NB: fractions need not be simplified
	$\frac{x-1-7(x-5)}{(x-5)(x-1)}$ **or** $\frac{x-1-7x+35}{(x-5)(x-1)}$ **or** $\frac{x-1-7(x-5)}{x^2-6x+5}$ **or** $\frac{x-1-7x+35}{x^2-6x+5}$ oe			M1	for a **correct** fraction with a **correct quadratic** denominator – may or may not be expanded which leads to a correct answer
		$\frac{2(17-3x)}{(x-5)(x-1)}$	5	A1	accept $\frac{34-6x}{(x-5)(x-1)}$ oe; if denominator is expanded then it must be correct
					Total 5 marks

(**Q21 4MA1/1H, Nov 2020**)

Q17.

Question	Working	Answer	Mark	Notes
	e.g. $n^2-(n-1)^2$ or $(n+1)^2-n^2$		3	M1 for setting up a correct algebraic expression (any letter can be used)
	e.g. n^2-n^2+2n-1 or $n^2+2n+1-n^2$			M1 Correct expansion of brackets and correct signs or a correct result
		e.g. $2n-1$ is always odd		A1 dep on M2 for eg $2n-1$ or $2n+1$ or $-(2n+1)$ oe **and** a suitable conclusion SCB1 for eg $(2n)^2-(2n-1)^2$ or $(2n+1)^2-(2n)^2$ oe
				Total 3 marks

(**Q17 4MA1/2H, Jan 2020**)

Q18.

Q	Working	Answer	Mark	Notes
	eg $2n$, $2n+2$, $2n+4$ **or** $2n-2$, $2n$, $2n+2$ etc		3	M1 for 3 consecutive even numbers in algebraic form (any letter can be used)
	eg $(2n)^2+(2n+4)^2 (=4n^2+4n^2+16n+16$ $=8n^2+16n+16)$ **or** $2(2n+2)^2$ $(=2(4n^2+8n+4)$ $=8n^2+16n+8)$ **or** $2(2n+2)^2+8$ $(=2(4n^2+8n+4)+8$ $=8n^2+16n+16)$			M1 for the sum of the squares of the largest and smallest even numbers and adding or the square of the middle even number multiplied by 2 (no need to expand or simplify for this mark)
	eg $(2n)^2+(2n+4)^2=8n^2+16n+16$ and $2(2n+2)^2+8=8n^2+16n+16$ **or** $(2n)^2+(2n+4)^2=8n^2+16n+16$ and $2(2n+2)^2=8n^2+16n+8$ and $8n^2+16n+16-(8n^2+16n+8)=8$ **or** $(2n)^2+(2n+4)^2=8n^2+16n+16$ and $8n^2+16n+16=8n^2+16n+8+8$ $=2(2n+2)^2+8$ **or** $2(2n+2)^2+8=8n^2+16n+16$ and $8n^2+16n+16=4n^2+4n^2+16n+16$ $=(2n)^2+(2n+4)^2$ *Working required*	Correctly shown		A1 dep on M2 for use of algebra to show correct conclusion (SCB1 for eg $(p+4)^2+p^2$ or $2(p+2)^2$ or $2(p+2)^2+8$) (SCB2 for use of eg $(p+4)^2+p^2=2p^2+8p+16$ and $2(p+2)^2+8=2p^2+8p+16$ If the student shows this and also says "it is true for all numbers, so it must be true for even numbers" oe or defines p, $p+2$, $p+4$ as even numbers, then this would gain M2A1
				Total 3 marks

(**Q19 4MA1/2HR, Jan 2023**)

Q19.

Q	Working		Answer	Mark	Notes
	$a = 8 \;\; d = 7$			4	M1 can be implied
	$(S_{100} =)\frac{100}{2}(2\times 8+(100-1)\times 7)$ (= 35 450) **or** $(S_{49} =)\frac{49}{2}(2\times 8+(49-1)\times 7)$ (= 8624) **or** $(S_{50} =)\frac{50}{2}(2\times 8+(50-1)\times 7)$ (= 8975)				M1
	'35450' – '8624' **or** '35450' – '8975' + (8 + (50 – 1)×7)				M1
			26 826		A1
					Total 4 marks
	Alternative scheme				
	$(u_n =)\ 7n + 1$	$a = 8$ and $d = 7$		4	M1 can be implied
	$(u_{50} =)\ 7 \times 50 + 1$ (= 351) **or** $(u_{100} =)\ 7 \times 100 + 1$ (= 701)	$(u_{50} =)\ 8 + (50 - 1)\times 7$ (= 351)			M1
	$\frac{51}{2}('351'+'701')$	$\frac{51}{2}(2\times 351+(51-1)\times 7)$			M1
			26 826		A1
					Total 4 marks

(**Q24 4MA1/1H, Nov 2020**)

Q20.

Q	Working	Answer	Mark	Notes
	$a + d = 8.5$, $a + 4d = 13$ oe		5	M1 for at least 1 correct equation **or** for $d = 1.5$
	$a = 7$, $d = 1.5$			A1 both values correct
	$\frac{N}{2}(2\times 7+(N-1)1.5)=292$ (eg $3N^2 + 25N - 1168$ [= 0] **or** $1.5N^2 + 12.5N - 584$ [= 0])			M1 A correct equation for the total of the first N terms of the series with a and d substituted in. The mark can be gained by using **their** values of a and d even if no previous marks awarded.
	eg $(3N + 73)(N - 16)$ [=0] $[N=]\ \frac{-25\pm\sqrt{25^2-4\times 3\times -1168}}{2\times 3}$			M1 A correct method dep on the previous M1 for solving **their** 3 term quadratic equation using any correct method (allow one sign error and some simplification – allow as far as $\frac{-25\pm\sqrt{625+14016}}{6}$) oe (may be ± or just +) or if factorising, allow brackets which expanded give 2 out of 3 terms correct, or if completing the square allow as far as the stage $3((N+\frac{25}{6})^2-\frac{25^2}{6^2})-1168\ (=0)$
	Working required	16		A1 dep on M2
				Total 5 marks

(**Q23 4MA1/1H, June 2021**)

Q21.

Q	Working	Answer	Mark	Notes
	$\frac{12}{\sqrt{2}-1}\times\frac{\sqrt{2}+1}{\sqrt{2}+1}$ or $\frac{12}{\sqrt{2}-1}\times\frac{-\sqrt{2}-1}{-\sqrt{2}-1}$ **and** $4\sqrt{2}$ or $2\sqrt{8}$ or $\sqrt{32}$ oe		3	M1 for showing a correct method for rationalising the denominator **and** dealing with $\left(\sqrt{2}\right)^5$
	E.g. $12\sqrt{2}+12-4\sqrt{2}$ or $8\sqrt{2}+12$ $12\sqrt{2}+12-2\sqrt{8}$ or $12\sqrt{2}+12-\sqrt{32}$ oe			M1 dep expression must be in surd form
	E.g. $12\sqrt{2}(+12)-4\sqrt{2}=8\sqrt{2}(+12)=$ $2\sqrt{4^2\times2}(+12)=2\sqrt{32}(+12)$ or $12\sqrt{2}(+12)-2\sqrt{8}=6\sqrt{8}(+12)-2\sqrt{8}=4\sqrt{8}(+12)=$ $2\sqrt{4\times8}(+12)=2\sqrt{32}(+12)$ or $12\sqrt{2}(+12)-\sqrt{32}=3\sqrt{4^2\times2}(+12)-\sqrt{32}=$ $2\sqrt{32}(+12)$ oe Note $8\sqrt{2}=2\sqrt{4^2\times2}$ or $2\sqrt{16\times2}$ or $\sqrt{32\times4}$ or $\sqrt{64\times2}$ $12\sqrt{2}=3\sqrt{4^2\times2}$ or $3\sqrt{16\times2}$ or $\sqrt{32\times9}$	Shown		A1 dep on M2 for showing working to given answer (they may dismiss the +12 and just deal with the surd part for this stage)
				Total 3 marks

(**QU16 4MA1/1H, June 2022**)

Q22.

Q	Working	Answer	Mark	Notes
	$xy + 3y = 5 - 2x$ oe			M1 multiplying both sides by $(x + 3)$ and expanding the brackets correctly
	e.g. $xy + 2x = 5 - 3y$			M1 ft dep on 2 terms on left and $(5 - 2x)$ on right, for collecting all x terms on one side and non-x terms on the other side
	eg $x(y + 2) = 5 - 3y$			M1 ft, dep on 2 terms in x, for factorising for x
		$x=\frac{5-3y}{2+y}$	4	A1 oe allow $\frac{5-3y}{2+y}$ as answer so long as previously seen $x=\frac{5-3y}{2+y}$
				Total 4 marks

(**Q15 4MA1/2H, Nov 2020**)

Q23.

Q	Working	Answer	Mark	Notes
(a)	$2(x^2-6x)+3$ **or** $2(x^2-6x+\frac{3}{2})$		3	M1 **or** for one of a, b or c correct **OR** expanding $a(x^2+2bx+b^2)+c$
	$2\left[(x-3)^2-9\right]+3$ **or** $2\left[(x-3)^2-3^2+\frac{3}{2}\right]$ oe			M1 **or** for two of a, b or c correct **OR** $-12=2ab$ **or** $3=ab^2+c$
		$2(x-3)^2-15$		A1 accept $a=2$, $b=-3$, $c=-15$
(b)		$(-1,-15)$	2	B2ft eg accept [their $-b-4$] for the x-coordinate or [their c] for the y-coordinate (B1 ft for one correct coordinate)
				Total 5 marks

(**QU23 4MA1/1HR, June 2022**)

Q24.

Q	Working	Answer	Mark	Notes
	[g(x) =] $2(x-3)^2-5$		4	B2 for $a = 2$, $b = 3$ and $c = 5$ correct (stated or shown) (B1 for one of $a = 2$, $b = 3$ and $c = 5$ correct)
	stretch y direction scale factor 2 oe [ft their a] **or** translation $\begin{pmatrix}3\\-5\end{pmatrix}$ (ft correct use of their b and c) oe			M1 **Stretch** and a correct description of the stretch **or translation** and a correct description of the translation NB: must include the word translation (or translate) and stretch
		Correct transformations in correct order		A1 Stretch y direction scale factor 2 **followed by** translation $\begin{pmatrix}3\\-5\end{pmatrix}$ oe eg translation $\begin{pmatrix}3\\0\end{pmatrix}$, stretch SF2 in y direction followed by translation $\begin{pmatrix}0\\-5\end{pmatrix}$
				Total 4 marks
Alt	[g(x) =] $2(x-3)^2-5$		4	B2 for $a = 2$, $b = 3$ and $c = 5$ correct (stated or shown) (B1 for one of $a = 2$, $b = 3$ and $c = 5$ correct)
	translation $\begin{pmatrix}3\\-2.5\end{pmatrix}$ (ft correct use of their b and $0.5c$) oe **or** stretch y direction scale factor 2 (ft their a)			M1 A correct description of the stretch **or** the translation
		Correct transformations in correct order		A1 Translation $\begin{pmatrix}3\\-2.5\end{pmatrix}$ oe **followed by** stretch y direction scale factor 2
				Total 4 marks

(**Q22 4MA1/2H, June 2021**)

Q25.

Q	Working	Answer	Mark	Notes
a	$5-(x\pm q)^2+9$ oe **or** $p-(x-3)^2$ oe **or** $p-q^2+2qx-x^2$ and one of $2q=6$ **or** $p-q^2=5$			M1 may be seen in working eg $-[(x-3)^2-9-5]$ **or** expanding $p-(x-q)^2$ correctly and equating one of the coefficient of x or the constant term
		$14-(x-3)^2$	2	A1 fully correct SCB1 for $(x-3)^2-14$
b	e.g. $(x-3)^2=14-y$ [or $(y-3)^2=14-x$]			M1 correct steps to isolate their bracket ft from (a) dep on expression in form $\pm p\pm(x-q)^2$
	$x=3\pm\sqrt{14-y}$ [or $y=3\pm\sqrt{14-x}$]			M1 complete method to find y in terms of x or x in terms of y. Condone + for ± ft from (a) dep on expression in form $\pm p\pm(x-q)^2$
	$(f^{-1}(x)=)\ 3-\sqrt{14-x}$			M1 for the correct inverse
				M1 method to solve $0<3-\sqrt{14-x}$ or a lower bound of 5 clearly shown, eg $x>5$ as part of the answer
		$5<x\leq 14$	5	A1 cao
				Total 7 marks

(**Q21 4MA1/2H, Nov 2020**)

Q26.

Q	Working	Answer	Mark	Notes
(a)	$7-3(x^2-4x)$		3	M1 or for one of a, b or c correct
	$7-3[(x-2)^2-4]$			M1 or for two of a, b or c correct
		$19-3(x-2)^2$		A1
(b)		(2, 19)	1	B1 ft their expression
				Total 4 marks

(**Q20 4MA1/1H, Jan 2022**)

Q27.

Q	Working	Answer	Mark	Notes
	eg $\frac{(4x+3)(x-5)}{2x-1}\times\frac{(2x-1)(x-3)}{(x+5)(x-5)}$ **or** eg $\frac{(4x+3)(x-3)}{x+5}(+(29-4x))$		4	M2 for factorising at least 2 of the quadratics correctly – could be implied by 2 factors cancelled correctly (M1 for factorising at least 1 of the 3 quadratics correctly)
	eg $\frac{(4x+3)(x-3)+(29-4x)(x+5)}{x+5}$ oe **or** eg $\frac{4x^2-9x-9+145+9x-4x^2}{x+5}$ oe			M1 for writing the correct fractions over a common denominator of $(x+5)$ with or without brackets removed – need not be in simplest form. Could be written as 2 separate fractions.
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{136}{x+5}$		A1
				Total 4 marks

(**Q26 4MA1/2HR, Jan 2023**)

Q28.

Q	Working	Answer	Mark	Notes
	eg $\frac{20}{x^2-36}-\frac{2(x+6)}{x^2-36}$ oe **or** $\frac{20}{(x-6)(x+6)}-\frac{2(x+6)}{(x-6)(x+6)}$ oe **or** $\frac{20(x-6)}{(x^2-36)(x-6)}-\frac{2(x+6)(x-6)}{(x^2-36)(x-6)}$ **or** $\frac{20-2(x+6)}{(x^2-36)(4-x)}$ oe		3	M1 for writing the first two fractions with a common denominator (may be a single denominator) or multiplying both fractions by $\frac{1}{4-x}$ and writing over a common denominator
	eg $\frac{8-2x}{x^2-36}\times\frac{1}{4-x}$ **or** $\frac{8-2x}{(x-6)(x+6)}\times\frac{1}{4-x}$ **or** $\frac{20x-2x^2-48}{(x^2-36)(x-6)}\times\frac{1}{4-x}$ oe $\frac{8-2x}{(x^2-36)(4-x)}$ oe			M1 for simplifying first 2 fractions to a single fraction and expanding and simplifying numerator – must be correct, and showing intention to multiply by $\frac{1}{4-x}$ or expanding the numerator of the full solution and writing as a single fraction
		$\frac{2}{x^2-36}$		A1 oe eg $\frac{2}{(x-6)(x+6)}$
				Total 3 marks

(**QU23 4MA1/2HR, June 2022**)

Q29.

Q	Working		Answer	Mark	Notes
(a)	$g(2) = 7 \times 2 - 6\ (= 8)$ **or** $5(7 \times 2 - 6)^2 - 10(7 \times 2 - 6) + 7$			2	M1
	Working not required, so correct answer scores full marks		247		A1
(b)	eg $y = 5(x^2 - 2x) + 7$ **or** $y = 5(x^2 - 2x + \frac{7}{5})$ oe	eg $x = 5(y^2 - 2y) + 7$ **or** $x = 5(y^2 - 2y + \frac{7}{5})$		4	M1 **or** eg $\frac{y-7}{5} = x^2 - 2x$
	eg $y = 5[(x-1)^2 - 1^2] + 7$ **or** $y = 5\left((x-1)^2 - 1^2 + \frac{7}{5}\right)$ oe	eg $x = 5\left((y-1)^2 - 1^2\right) + 7$ **or** $x = 5\left((y-1)^2 - 1^2 + \frac{7}{5}\right)$ oe			M1 **or** eg $\frac{y-7}{5}$ $= (x-1)^2 - 1^2$
	$(x-1)^2 = \frac{y-2}{5}$ oe	$(y-1)^2 = \frac{x-2}{5}$ oe			M1 **or** eg $(x-1)^2 = \frac{y-7}{5} + 1$
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)		$1 + \sqrt{\frac{x-2}{5}}$		A1 Must be in terms of x, oe eg $1 + \sqrt{\frac{x-7}{5} + 1}$ (NB: $f^{-1}(x) =$ $1 \pm \sqrt{\frac{x-2}{5}}$ is 3 marks)
	Alternative for (b)				**Total 6 marks**
	Let $x = 5y^2 - 10y + 7$ [$\Leftrightarrow$] $5y^2 - 10y + (7 - x) = 0$ oe			4	M1
	$[y =] \frac{10 \pm \sqrt{100 - 20(7 - x)}}{10}$				M1
	$1 \pm \sqrt{\frac{x-2}{5}}$				M1
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)		$1 + \sqrt{\frac{x-2}{5}}$		A1 Must be in terms of x
					Total 6 marks

(**Q24 4MA1/1H, June 2021**)

Q30.

Q	Working	Answer	Mark	Notes
	eg $(fg(x) =)(2x+1)^2 - 4$		4	M1 for finding fg(x)
	eg $4x^2 + 4x - 3\ (> 0)$ or $4x^2 + 4x - 3 (= 0)$ **or** $(2x+1)^2 > 4$ or $(2x+1)^2 = 4$			M1 For a correct expansion and fg(x) written as a 3 term quadratic **or** a start to write quadratic in correct form for completing square
	$-\frac{3}{2}$ oe **(and)** $\frac{1}{2}$ oe			A1 for finding the two correct critical values (dep on previous M1) (values seen with any signs between)
		$x < -\frac{3}{2}$, $x > \frac{1}{2}$		A1 two fully correct inequalities, oe (dep on 2nd M1)
				Total 4 marks

(QU19 4MA1/2HR, June 2022)

Q31.

Q	Working	Answer	Mark	Notes
	$4 \times (5 - x)$ **or** $5 \times (2x - 1)$ **or** $20 - 4x$ **or** $10x - 5$ oe		4	M1 for setting up a correct algebraic expression for area A or area B (could be seen as part of an equation) (condone lack of brackets for multiplying if meaning is clear for this mark only)
	one from: $4(5 - x) = 20 - 4x$ or $2 \times 4(5 - x) = 40 - 8x$ or $0.5 \times 4(5 - x) = 10 - 2x$ oe **and** one from: $5(2x - 1) = 10x - 5$ or $2 \times 5(2x - 1) = 20x - 10$ or $0.5 \times 5(2x - 1) = 5x - 2.5$ oe			M1 for expanding 2 sets of brackets correctly (one for each shape) [allow ×2 or ÷2 for the wrong shape for this mark] Need not be in an equation at this stage.
	eg $10x + 8x = 40 + 5$ **or** $-5 - 40 = -10x - 8x$ **or** $18x = 45$ **or** $-45 = -18x$ **or** $4x + 5x = 20 + 2.5$ oe			M1 for a correct equation with terms in x on one side and number terms the other side
	Working required	2.5		A1 oe dep on M1
				Total 4 marks

(Q02 4MA1/2H, Nov 2021)

Q32.

Q	Working	Answer	Mark	Notes
(a)		8	1	B1
(b)		11	1	B1 accept x^{11}
(c)		$8k^6m^{12}$	2	B2 for all correct B1 for two correct from 8 or k^6 or m^{12}
				Total 4 marks

(QU09 4MA1/1H, June 2022)

Q33.

Q	Working	Answer	Mark	Notes
	$-q\left(x^2-\frac{12}{q}x\right)+q$ or $-q\left(x^2-\frac{12}{q}x-\frac{q}{q}\right)$ oe		4	M1 for a correct factorisation of the expression or $b=q$ (must be stated)
	$-q\left[\left(x-\frac{12}{2q}\right)^2 .....\right]$ oe or $-q\left[\left(x-\frac{6}{q}\right)^2 .....\right]$ oe			M1 for starting the correct process to complete the square
	E.g. $-q\left(x-\frac{6}{q}\right)^2+\frac{36}{q}+q$ oe or $-q\left(x-\frac{12}{2q}\right)^2+\frac{144q}{4q^2}+q$ oe			M1 for a complete process of completing the square. (Does not need to be simplified)
		$a=\frac{36}{q}+q$ $b=q$ $c=\frac{6}{q}$		A1 oe a and c must come from a correct process of completing the square. (Does not need to be simplified)
				Total 4 marks

Q	Working	Answer	Mark	Notes
ALT	$a - bx^2 + 2bcx - bc^2$ oe or $-bx^2 + 2bcx - bc^2 + a$ oe or $b = q$		4	M1 for correctly multiplying out $a - b(x - c)^2$
	$2bc = 12$ or $a - bc^2 = q$ oe			M1 for correctly equating coefficients
	$c = \frac{12}{2q}$ or $a = q\left(\frac{12}{2q}\right)^2 + q$ or $c = \frac{6}{q}$ or $a = q\left(\frac{6}{q}\right)^2 + q$			M1 for correctly finding a or c (Does not need to be simplified)
		$a = \frac{36}{q} + q$ $b = q$ $c = \frac{6}{q}$		A1 oe (Does not need to be simplified)
				Total 4 marks

(**QU24 4MA1/1H, June 2022**)

Q34.

Q	Working	Answer	Mark	Notes
(a)	$(5-x)(2x+3)=$ $10x+15-2x^2-3x\ (=-2x^2+7x+15)$ or $(5-x)(x+4)=$ $5x+20-x^2-4x\ (=-x^2+x+20)$ or $(2x+3)(x+4)=$ $2x^2+8x+3x+12\ (=2x^2+11x+12)$		3	M1 multiplying 2 factors only but do not award if they multiply eg $(5-x)(2x+3)$ **and** $(5-x)(x+4)$ as their method allow one error
	$(-2x^2+7x+15)(x+4)=$ $-2x^3-8x^2+7x^2+28x+15x+60$ or $(-x^2+x+20)(2x+3)=$ $-2x^3-3x^2+2x^2+3x+40x+60$ or $(2x^2+11x+12)(5-x)=$ $10x^2-2x^3+55x-11x^2+60-12x$			M1 (dep)ft for expanding by the third factor, allow one further error
		$-2x^3-x^2+43x+60$		A1 Dep on M1
	ALTERNATIVE			
	$10x^2+15x+40x+$ $60-2x^3-3x^2-8x^2-12x$		3	M2 for a complete expansion with 8 terms present, at least 4 of which must be correct (M1 for 4 correct terms from any number of terms)
		$-2x^3-x^2+43x+60$		A1

	Working	Answer	Mark	Notes
(b)	$g+7=\frac{c+3}{4+c}$ or $g(4+c)=c+3-7(4+c)$ or $g=\frac{c+3}{4+c}-\frac{7(4+c)}{4+c}$ $\left(=\frac{c+3-28-7c)}{4+c}\right)$		4	M1 Adding 7 to both sides as a first step or removing fraction correctly
	eg $4g+gc+28+7c=c+3$ or $4g+gc=c+3-28-7c$ oe			M1 removing fraction and expanding all brackets in an equation with no more than one error
	eg $gc+7c-c=3-28-4g$ or $28-3+4g=c-7c-gc$			M1ft ft dep on previous M1 - terms in c on one side and other terms on the other side in an equation
		$c=\frac{-(4g+25)}{g+6}$		A1 oe eg $c=\frac{25+4g}{-6-g}$ or $c=\frac{3-28-4g}{g+7-1}$ oe [if c = is missing allow full marks if seen in working otherwise 3 marks] (SCB2 for an answer of $c=\frac{-4-4g}{g-1}$ oe or $c=\frac{31-4g}{g-8}$ oe SCB1 in working for $4g+cg=c+3-7$ oe or $4g+cg-28-7c=c+3$ oe
				Total 7 marks

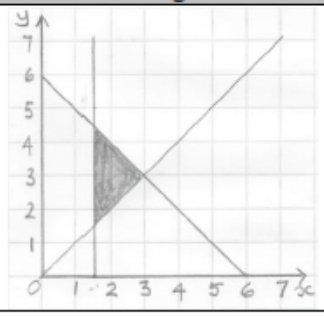
(**QU14 4MA1/2H, June 2022**)

Q35.

Q	Working	Answer	Mark	Notes
		$2x+y\le 6$ $2y\le 5x+1$ $3y+2x\ge 4$	3	B3 oe for all three correct (B2 oe for any two correct) (B1 oe for any one correct) $2x+y\le 6$ equivalent to $y\le -2x+6$ oe $2y\le 5x+1$ equivalent to $y\le 2.5x+0.5$ oe $3y+2x\ge 4$ equivalent to $y\ge -\frac{2}{3}x+\frac{4}{3}$ oe Allow the following inequalities $2x+y<6$ oe $2y<5x+1$ oe $3y+2x>4$ oe
				Total 3 marks

(**Q11 4MA1/1H, Jan 2023**)

Q36.

Q	Working	Answer	Mark	Notes
(a)(i)		Correct line	1	B1 For $x = 1.5$ drawn
(ii)		Correct line	1	B1 For $y = x$ drawn
(iii)		Correct line	1	B1 For $x + y = 6$ drawn
(b)		Correct region	1	B1 dep on B3 for correctly shading the region **R** accept unlabelled or unshaded if clear. Shading can be 'in' or 'out'.
				Total 4 marks

(**Q04 4MA1/2H, Jan 2021**)

Q37.

Q	Working	Answer	Mark	Notes
(a)	$(3x \pm 2y)(3x \pm 2y)$ or $(3x)^2 - (2y)^2$		2	M1
		$(3x+2y)(3x-2y)$		A1
(b)	$\frac{7(4x)}{32x} - \frac{8(x+3)}{32x}$ oe or $\frac{7(4x)}{8(4x)} - \frac{8(x+3)}{8(4x)}$ oe or $\frac{28x}{32x} - \frac{8(x+3)}{32x}$ oe or $\frac{28x}{32x} - \frac{8x+24}{32x}$ oe or $\frac{28x-8(x+3)}{32x}$ oe or $\frac{7x}{8x} - \frac{2(x+3)}{8x}$ oe or $\frac{7x-2(x+3)}{8x}$ oe		3	M1 for two correct fractions with common denominator **or** a single correct fraction
	$\frac{28x-8x-24}{32x}$ oe or $\frac{20x-24}{32x}$ oe or $\frac{7x-2x-6}{8x}$ oe or $\frac{20x}{32x} - \frac{24}{32x}$ oe or $\frac{28x}{32x} - \frac{8x}{32x} - \frac{24}{32x}$ oe			M1 for correct fraction(s) with bracket(s) expanded **and** dealing with the negative signs
		$\frac{5x-6}{8x}$		A1 or $\frac{-6+5x}{8x}$
				Total 5 marks

(**QU11 4MA1/1H, June 2022**)

Q38.

Q	Working	Answer	Mark	Notes
(a)	$5x(x+2)=5x^2+10x$ **or** $(x+2)(3x-4)=$ $3x^2-4x+6x-8$ $(=3x^2+2x-8)$ **or** $5x(3x-4)=15x^2-20x$		3	M1 for a correct intention to multiply all 3 factors by starting to multiply 2 factors only, allow one error
	eg $[(5x^2+10x)(3x-4)=]$ $15x^3-20x^2+30x^2-40x$ **or** $[5x(3x^2+2x-8)=]$ $15x^3+10x^2-40x$ **or** $[(x+2)(15x^2-20x)=]$ $15x^3-20x^2+30x^2-40x$			M1 (dep)ft for expanding by the third factor, allow one error (some may do the expansion in one stage and will get to $15x^3-20x^2+30x^2-40x$ without firstly expanding two factors, allow two errors)
		$15x^3+10x^2-40x$		A1 isw correct factorisation eg $5(3x^3+2x^2-8x)$ do not isw incorrect factorisation eg $15x^3+10x^2-40x=3x^3+2x^2-8x$

Q	Working	Answer	Mark	Notes
(b)	$\left(\frac{2w^2}{y^5}\right)^{-3}$ or $\left(\frac{y^{20}}{16w^8}\right)^{\frac{3}{4}}$ or $\left(\frac{4096w^{24}}{y^{60}}\right)^{-\frac{1}{4}}$		3	M1 for one of fourth rooting or reciprocating or cubing
	$\left(\frac{8w^6}{y^{15}}\right)^{-1}$ or $\frac{2^{-3}w^{-6}}{y^{-15}}$ or $\frac{\frac{1}{8}w^{-6}}{y^{-15}}$ or $\left(\frac{y^5}{2w^2}\right)^3$ or $\left(\frac{y^{60}}{4096w^{24}}\right)^{\frac{1}{4}}$ or $\frac{0.125y^{15}}{w^6}$ or $\frac{0.125w^{-6}}{y^{-15}}$ or $\frac{0.125}{y^{-15}w^6}$ oe			M1 for two of fourth rooting or reciprocating or cubing
		$\frac{y^{15}}{8w^6}$		A1 allow $\frac{y^{15}}{8w^6}$ or $\frac{y^{15}w^{-6}}{8}$ or $0.125y^{15}w^{-6}$ or $\frac{1}{8}y^{15}w^{-6}$ or $\frac{w^{-6}}{8y^{-15}}$ or $\frac{1}{8y^{-15}w^6}$

Q	Working	Answer	Mark	Notes
	ALTERNATIVE		3	M2 for 2 correct terms (M1 for 1 correct term)
		$\frac{y^{15}}{8w^6}$		A1 allow $\frac{y^{15}}{8w^6}$ or $\frac{y^{15}w^{-6}}{8}$ or $0.125y^{15}w^{-6}$ or $\frac{1}{8}y^{15}w^{-6}$ or $\frac{w^{-6}}{8y^{-15}}$ or $\frac{1}{8y^{-15}w^6}$
				Total 6 marks

(Q13 4MA1/1H, Jan 2022)

Q39.

Q	Working	Answer	Mark	Notes
	$3x(2x-5)=6x^2-15x$ **or**		3	M1 for multiplying $3x$ by $(2x-5)$ with **both** terms correct or
	$(2x-5)^2=4x^2-10x-10x+25$ **or**			for multiplying $(2x-5)$ by $(2x-5)$ with 3 out of 4 terms correct or
	$(2x-5)^2=4x^2-20x+25$			for multiplying $(2x-5)$ by $(2x-5)$ and getting $4x^2-20x\ldots$ **or** $\ldots-20x+25$ (not for $4x^2+25$)
	$(6x^2-15x)(2x-5)=$ $12x^3-30x^2-30x^2+75x$ oe **or**			M1ft (dep) for multiplying the product of $3x$ and $(2x-5)$ by $(2x-5)$ with 3 out of 4 terms correct or
	$(6x^2-15x)(2x-5)=$ $12x^3-60x^2+75x$ oe **or**			for multiplying the product of $3x$ and $(2x-5)$ by $(2x-5)$ and getting $12x^3-60x^2\ldots$ **or** $\ldots-60x^2+75x$
	$3x(4x^2-10x-10x+25)=$ $12x^3-30x^2-30x^2+75x$ oe **or**			for multiplying the product of $(2x-5)$ and $(2x-5)$ by $3x$ with 3 out of 4 terms correct or
	$3x(4x^2-20x+25)=$ $12x^3-60x^2+75x$			for multiplying the product of $(2x-5)$ and $(2x-5)$ by $3x$ with 2 out of 3 terms correct or
				Expansion in one stage will lead to $12x^3-30x^2-30x^2+75x$ without firstly expanding two factors – award M2 for 3 out of 4 terms correct M1 for 2 out of 4 terms correct
	Working required	$12x^3-60x^2+75x$		A1 dep on M1
				Total 3 marks

(**Q13 4MA1/1H, Jan 2023**)

Q40.

Q	Working	Answer	Mark	Notes
(a)	$2y-4y+8-y^2$		2	M1 for 3 correct terms **or** for 4 correct terms ignoring signs **or** $...-2y-y^2$ **or** $8-2y-...$
		$8-2y-y^2$		A1 Any order but simplified
(b)		$5b^3c(3b^2-7c^8)$	2	B2 fully correct **or** B1 for a correct partial factorisation with at least two terms outside the bracket eg $5b^3(3b^2c-7c^9)$ or $5c\,(3b^5-7b^3c^8)$ etc **or** the fully correct factor outside the bracket with a two term expression in terms of b and c inside the bracket eg $5b^3c(15b^2-c^8)$
				Total 4 marks

(**Q01 4MA1/2H, Jan 2022**)

Q41.

Q	Working	Answer	Mark	Notes
(a)	$(3x-1)(x+2)=3x^2+6x-x-2(=3x^2+5x-2)$ **or** $(3x-1)(3x+1)=9x^2+3x-3x-1(=9x^2-1)$ **or** $(x+2)(3x+1)=3x^2+x+6x+2(=3x^2+7x+2)$		3	M1 for a correct intention to multiply all 3 factors by multiplying 2 factors only, allow one error
	$[(3x^2+5x-2)(3x+1)=]\ 9x^3+15x^2-6x+3x^2+5x-2$ **or** $[(9x^2-1)(x+2)=]\ 9x^3+18x^2-x-2$ **or** $[(3x^2+7x+2)(3x-1)=]\ 9x^3+21x^2+6x-3x^2-7x-2$			M1 (dep)ft for expanding by the third factor, allow one error
		$9x^3+18x^2-x-2$		A1
	ALTERNATIVE			
	$9x^3+3x^2+18x^2+6x-3x^2-x-6x-2$		3	M2 for a complete expansion with 8 terms present, at least 4 of which must be correct
		$9x^3+18x^2-x-2$		A1

(b)	$\left(\frac{8xy^2}{2x^5}\right)^2$ **or** $\left(\frac{x^4}{4y^2}\right)^{-2}$ **or** $\left(\frac{4x^{10}}{64x^2y^4}\right)^{-1}$		3	M1	for one of reciprocating or simplifying or squaring
	$\left(\frac{4y^2}{x^4}\right)^2$ **or** $\left(\frac{x^8}{16y^4}\right)^{-1}$ **or** $\frac{64x^2y^4}{4x^{10}}$ **or** $\frac{\frac{1}{4}x^{-10}}{\frac{1}{64}x^{-2}y^{-4}}$			M1	for two of reciprocating or simplifying or squaring
		$\frac{16y^4}{x^8}$		A1	accept $16y^4x^{-8}$ or $\frac{16}{y^{-4}x^8}$ or $\frac{16x^{-8}}{y^{-4}}$ oe
	ALTERNATIVE				
			3	M2	for 2 correct terms (M1 for 1 correct term)
		$\frac{16y^4}{x^8}$		A1	accept $16y^4x^{-8}$ or $\frac{16}{y^{-4}x^8}$ or $\frac{16x^{-8}}{y^{-4}}$ oe
					Total 6 marks

(**QU16 4MA1/1HR, June 2022**)

Q42.

Q	Working	Answer	Mark	Notes
	$4x(3x+1) = 12x^2 + 4x$ **or** $4x(2x-3) = 8x^2 - 12x$ **or** $(3x+1)(2x-3) = 6x^2 - 9x + 2x - 3$ $(= 6x^2 - 7x - 3)$		3	M1 for expanding two of the three factors, allow one error
	$(12x^2 + 4x)(2x-3) = 24x^3 - 36x^2 + 8x^2 - 12x$ oe $(8x^2 - 12x)(3x+1) = 24x^3 + 8x^2 - 36x^2 - 12x$ oe $4x(6x^2 - 7x - 3) =$ eg $24x^3 - 28x^2$.... oe			M1 (dep)ft for expanding by the third factor, allow one error (some may do the expansion in one stage and will get to $24x^3 - 36x^2 + 8x^2 - 12x$ without firstly expanding two factors)
	Working required	$24x^3 - 28x^2 - 12x$		A1 dep on M1 isw correct factorisation eg $4(6x^3 - 7x^2 - 3x)$ $x(24x^2 - 28x - 12)$ $4x(6x^2 - 7x - 3)$ do not isw incorrect simplification eg $24x^3 - 28x^2 - 12x = 6x^3 - 7x^2 - 3x$ gets M2A0
				Total 3 marks

(**Q13 4MA1/1H, June 2021**)

Q43.

Q	Working	Answer	Mark	Notes
(a)			2	M1 for $4n + k$ ($k \neq -3$) or $4 \times n + k$ ($k \neq -3$) or $n \times 4 + k$ ($k \neq -3$) (k may be zero or absent)
		$4n - 3$		A1 oe e.g. $1 + (n - 1)4$ oe or $4 \times n - 3$ oe or $n \times 4 - 3$ oe NB: award full marks for eg $x = 4n - 3$ oe or $x = 4 \times n - 3$ oe or $x = n \times 4 - 3$ oe or nth term $= 4n - 3$ oe or nth term $= 4 \times n - 3$ oe or nth term $= n \times 4 - 3$ oe but only M1 for $n = 4n - 3$ oe
(b)		$6m + 5$	1	B1 for $3(2m) + 5$ oe or $6m + 5$ or $3 \times 2m + 5$ oe or $6 \times m + 5$ Allow $3(2n) + 5$ or $6n + 5$ oe
				Total 3 marks

(**QU01 4MA1/1H, June 2022**)

Q44.

Q	Working	Answer	Mark	Notes
	eg $\frac{2\times3\times3\times(3^{\frac{3}{2}})^{4n+6}}{2\times3\times3^{2(2n+8)}}$ or $\frac{3\times3^{\frac{3}{2}(4n+6)}}{3^{2(2n+8)}}$ $\sqrt{27}$ to be changed to a power of 3 and not $3\sqrt{3}$ unless recovered		3	M1 For **2** of: • writing 18 as 2×3^2 oe **and** 6 as 2×3 **OR** cancelling 6 & 18 fully • writing $\sqrt{27}$ as $3^{\frac{3}{2}}$ or $3\times3^{\frac{1}{2}}$ **OR** $\left(\sqrt{27}\right)^{4n+6}$ as $\left(3^3\right)^{2n+3}$ or 3^{6n+9} • writing 9 as 3^2 **OR** 9^{2n+8} as $3^{2(2n+8)}$ or 3^{4n+16}
	eg $\frac{3\times3^{6n+9}}{3^{4n+16}}$ or $\frac{3^{6n+10}}{3^{4n+16}}$ or $\frac{3\times3^{1.5(4n+6)}}{3^{2(2n+8)}}$ or $\frac{3^2\times3^{6n+9}}{3\times3^{4n+16}}$ or $\frac{3^{6n+11}}{3^{4n+17}}$ oe or eg $3^{6n+11} = 3^x \times 3^{4n+17}$ oe			M1 For a correct expression or equation using only powers of 3 (powers of 3 but not necessarily a single power)
		$2n - 6$		A1 oe eg $2(n - 3)$ dep on M1
				Total 3 marks

(**QU24 4MA1/2H, June 2022**)

Q45.

Q	Working	Answer	Mark	Notes
(a)		$5y^3(3y + 4u)$	2	B2 for $5y^3(3y + 4u)$ (B1 for $5y(3y^3 + 4uy^2)$ **or** $5y^2(3y^2 + 4uy)$ **or** $y^2(15y^2 + 20uy)$ **or** $y^3(15y + 20u)$ **or** $5y^3(\ldots)$ where there is only one mistake in the brackets)
(b)	$4\times(4-3x)=5-8x$ oe **or** $16-12x=5-8x$ oe **or** $4-3x=\frac{5}{4}-2x$ oe		3	M1 for removal of fraction in a correct equation
	e.g. $16-5=12x-8x$ **or** $11=4x$ oe **or** $4-\frac{5}{4}=3x-2x$			M1 for terms in x on one side **and** numbers on the other side in an equation, allow correct rearrangement of their equation in the form $ax + b = cx + d$
		2.75		A1 (dep on M1) oe e.g. $2\frac{3}{4}$ or $\frac{11}{4}$
				Total 5 marks

(**Q05 4MA1/1H, Jan 2021**)

Q46.

Q	Working	Answer	Mark	Notes
(a)	$(y\pm6)(y\pm8)$ or $y(y+6)-8(y+6)$ or $y(y-8)+6(y-8)$		2	M1 or for $(y \pm a)(y \pm b)$ where $ab = -48$ or $a + b = -2$
		$(y+6)(y-8)$		A1 oe Allow any letter for y
(b)		$x \leq 3$	1	B1 allow $3 \geq x$ Allow any letter for x
(c)	$6-14>12w-7w$ oe or $7w-12w>14-6$ oe		3	M1 Condone = rather than > or any other sign for this mark.
	$-8>5w$ or $-5w>8$ or $-w>\frac{8}{5}$ or $w>-\frac{8}{5}$ or $w=-\frac{8}{5}$ oe			M1 Condone = rather than > or any other sign for this mark.
	Correct answer scores full marks (unless from obvious incorrect working)	$w<-\frac{8}{5}$		A1 oe accept $-\frac{8}{5}>w$ Must have correct sign on answer line dep on M1 (sight of correct answer in working space and just $(w=)-\frac{8}{5}$ oe on answer line gains M2 only)
				Total 6 marks

(**Q10 4MA1/1H, Jan 2023**)

Q47.

Q	Working		Answer	Mark	Notes
(a)		$3c^2(6cd^2-7)$	2	B2	fully correct **or** B1 for a correct partial factorisation with at least two terms outside the bracket ie $3c(6c^2d^2-7c)$ or $c^2(18cd^2-21)$ **or** the fully correct factor outside the bracket with two terms inside the bracket and at most one mistake $3c^2(\ldots\ldots)$
(b) (i)	eg $(y\pm6)(y\pm3)$ or $y(y+3)-6(y+3)$ or $y(y-6)+3(y-6)$		2	M1	or $(y+a)(y+b)$ where $ab=-18$ **or** $a+b=-3$ or factorisation which expands to give 2 out of 3 correct terms
	[allow use of x rather than y]	$(y-6)(y+3)$		A1	
(ii)		6, −3	1	B1	ft must come from their factors in (b)(i)
					Total 5 marks

(b) As we have always done, (ii) must ft from (i)
If they do nothing in (i) and then factorise and give the solutions in (ii) can we give marks retrospectively – yes, as long as nothing in (i) – this could gain M1A1B1 (correct factorisation and correct solutions) or M1A0B1 (factorisation worthy of the method mark, but not correct and ft solutions from incorrect factorisation) or M0A0B1 (incorrect factorisation that is worthy of no marks and then answers which ft from their incorrect factorisation)
What do we do if they give the incorrect factorisation in (i) and then start again in (ii), showing the correct factors and give the correct answers from their factorisation in (ii) as answers? Award M0A0 in (i) and then B1 in (ii)
What do we do if nothing is done in (i) and then we see they have used the quadratic formula and got the answers from this in (ii)? No marks at all M0A0B0
What do we do if the student has got the correct factorisation in (i) and the correct answers in (ii) but also has the quadratic formula shown in (ii)? We award M1A1B1 – assuming that the quadratic formula is a check
What if they factorise and solve in part (i) with nothing in (ii)
M1A1B1 if fully correct or M1A0B1(allowable factorisation) or M0A0B1 (ft from incorrect factorisation that is not allowable)
What if they factorise in (i) and give the correct answers for (ii) in (i) and then a different answer for
the solution in (ii)
Award M1A1 in (i) and B0 in (ii)
What if they factorise correctly and then expand and give the original expression on the answer line – award full marks; the student knows how to factorise and is checking and gives their check as the answer.

(**Q08 4MA1/1HR, Jan 2023**)

Q48.

<table>
<tr><th>Q</th><th>Working</th><th>Answer</th><th>Mark</th><th colspan="2">Notes</th></tr>
<tr><td></td><td>$y=\frac{k}{\sqrt{x}}$ or $ky=\frac{1}{\sqrt{x}}$
or $\sqrt{x}=\frac{k}{y}$ oe</td><td></td><td>3</td><td>M1
(NB. Not for $y=\frac{1}{\sqrt{x}}$)
Constant of proportionality must be a symbol such as k (Allow c for k for this mark only)</td><td rowspan="2">M2 for $c^4=\frac{k}{\sqrt{c^2}}$
oe</td></tr>
<tr><td></td><td>$c^4=\frac{k}{\sqrt{c^2}}$ oe or
$k=c^4\times\sqrt{c^2}$ oe</td><td></td><td></td><td>M1 for substitution of x and y into a correct formula</td></tr>
<tr><td></td><td>Correct answer scores full marks (unless from obvious incorrect working)</td><td>$y=\frac{c^5}{\sqrt{x}}$</td><td></td><td colspan="2">A1 oe e.g $y=c^5\times\frac{1}{\sqrt{x}}$

Award 3 marks if answer is
$y=\frac{k}{\sqrt{x}}$ on the answer line and $k=c^5$ clearly given in the body of working of the script</td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="2">Total 3 marks</td></tr>
</table>

(**Q17 4MA1/1H, Jan 2023**)

Q49.

Q	Working	Answer	Mark	Notes
	For one of: $10^{4n}=(5\times 2)^{4n}$ **or** $5^{4n}\times 2^{4n}$ **or** oe $20^2=(5\times 2^2)^2$ **or** $5^2\times 2^4$ **or** $5^2\times 2^2\times 2^2$ **or** cancelling 5^2 on numerator with 20^2 to get 16 or 2^4		5	M1 for writing 10^{4n} correctly as a product of 5 and 2 to the power $4n$ oe **or** writing 20^2 correctly as a product of 5 and 2^2 to the power 2 oe **or** cancelling 5^2 on numerator with 20^2 to get 16 or 2^4
	for getting numerator to the stage (this scores M1M1) $2^{4n}\times 2^{3n^2-15n}\times 5^2$ oe eg $2^{3n^2-11n}\times 5^{-4n+4n+2}$ oe **or for two of** $10^{4n}=(5\times 2)^{4n}$ **or** $5^{4n}\times 2^{4n}$ **or** oe $20^2=(5\times 2^2)^2$ **or** $5^2\times 2^4$ **or** $5^2\times 2^2\times 2^2$ **or** cancelling 5^2 on numerator with 20^2 to get 16 or 2^4 or getting the numerator to the stage			M1
	$\frac{2^{4n}\times 2^{3n^2}\times 2^{-15n}}{2^4}$ [= 1 **or** 2^0] *or* $2^{4n}\times 2^{3n^2}\times 2^{-15n}=2^4$ oe			M1 For writing the equation in powers of 2 only
	$3n^2-11n-4$[= 0]			A1 Correct quadratic equation dep on M1
	working required	$-\frac{1}{3}$, 4		A1 Both answers required dep on M1
				Total 5 marks

(**Q26 4MA1/2H, Jan 2023**)

Q50.

Q	Working	Answer	Mark	Notes
	$2t+1+(n-1)3=14t-5$		4	M1 for the use of nth term $= a + (n-1)d$ to find n
	$(n=)4t-1$ or $(n=)-1+4t$			A1
	$(S_n=)\frac{"4t-1"}{2}[2(2t+1)+("4t-1"-1)3]$ or $(S_n=)\frac{"4t-1"}{2}[2t+1+14t-5]$ oe			M1 for the use of S_n formula (must be in terms of t) Allow their expression for n dep on M1
	Working required	$p=2$ $q=4$ $r=2$		A1 dep on M2 allow $(S_n=)2(4t-1)^2$ Values of p, q and r must come from correct working
				Total 4 marks

(**Q22 4MA1/1H, Jan 2023**)

Q51.

Q	Working	Answer	Mark	Notes
(a)		$16p^6q^8$	2	B2 for all three correct terms (B1 for 2 correct terms in a product of 3 terms or for $(4p^3q^4)^2$ or $(4096p^{18}q^{24})^{\frac{1}{3}}$)
(b)	eg $\frac{2\times10}{3x\times10}+\frac{4\times6}{5x\times6}-\frac{9\times3}{10x\times3}$ (= $\frac{20}{30x}+\frac{24}{30x}-\frac{27}{30x}$)		2	M1 for a common denominator for all 3 terms with at least 2 correct equivalent fractions (no need for signs) [NB: fraction can be done in 2 parts]
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{17}{30x}$		A1 or $\frac{17}{30}x^{-1}$
(c)	eg $4x(x-5)=4x^2-20x$ or $4x(2x+3)=8x^2+12x$ or $(x-5)(2x+3)=2x^2+3x-10x-15$ $=2x^2-7x-15$		3	M1 allow one error in the expansion of $4x(x-5)$ or $4x(2x+3)$ or $(x-5)(2x+3)$
	eg $(4x^2-20x)(2x+3)=8x^3+12x^2-40x^2-60x$ or $(8x^2+12x)(x-5)=8x^3+12x^2-40x^2-60x$ or $4x(2x^2+3x-10x-15)=8x^3+12x^2-40x^2-60x$ or $4x(2x^2-7x-15)=8x^3-28x^2-60x$			M1ft but dep on previous M1 for correctly expanding – allow one extra error or one omission.
	Working required	$8x^3-28x^2-60x$		A1 dep on M1 May be factorised if $8x^3-28x^2-60x$ seen
				Total 7 marks

(**Q12 4MA1/2H, Nov 2021**)

Q52.

Question	Working	Answer	Mark	Notes
(a)		x^7	1	B1
(b)	eg $7^8 \times 7^4 = 7^{12}$ or $7^8 \div 7^3 = 7^5$ or $7^5 \times 7^4$ or $7^4 \div 7^3 = 7$ or $7^8 \times 7$ or $7^{'12'} \div 7^3 = 7^{'12'-3}$		2	M1 for one correct step – must be written as a power of 7
		7^9		A1 for 7^9
				Total 3 marks

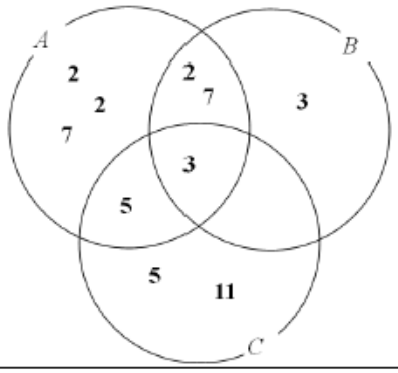
(**Q01 4MA1/2H, Jan 2020**)

Q53.

Q	Working	Answer	Mark	Notes
(a)		-0.5	1	B1 oe eg $-\frac{1}{2}, \frac{-1}{2}, \frac{1}{-2}, -1/2$
(b)	$(3x-5)y=2$ **or** $(3y-5)x=2$ **or** $3xy-5y=2$ **or** $3xy-5x=2$ oe or $3y-5=\frac{2}{x}$ **or** $3x-5=\frac{2}{y}$ oe		2	M1 remove denominator or get to the stage $3y-5=\frac{2}{x}$ or $3x-5=\frac{2}{y}$
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{2+5x}{3x}$		A1oe eg $\frac{2}{3x}+\frac{5}{3}$ or $\frac{\frac{2}{x}+5}{3}$ **must be in terms of x**
(c)	$5(x^2-4x)$..... **or** $5(x^2-4x$.....$)$ **or** $5(x-2)^2$...		3	M1
	$5\left[(x-2)^2-(-2)^2\right]$..... **or** $5\left[(x-2)^2-(-2)^2\right.$..... $\left.\right]$ **or** $5(x-2)^2-20$ ..... **or** $5\left[(x-2)^2+\frac{3}{5}\right]$			M1 $(-2)^2$ can be 2^2 or 4 or $\left(\pm\frac{4}{2}\right)^2$
	Correct answer scores full marks (unless from obvious incorrect working)	$5(x-2)^2+3$		A1
				Total 6 marks
Alternative mark scheme for c				
	$ax^2-2abx+ab^2+c$		3	M1 for multiplying out $a(x-b)^2+c$ to obtain $ax^2-2abx+ab^2+c$ oe

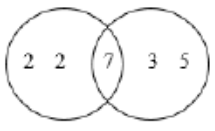
(**Q16 4MA1/1HR, Jan 2023**)

Q54.

Q	Working	Answer	Mark	Notes
(a)	$2\times2\times2\times5\times5$ **or** 2, 2, 2, 5, 5 **or** $2\times2\times3\times5\times7$ **or** 2, 2, 3, 5, 7 **or** eg 2 | **200** | **420** 2 | 100 | 210 5 | 50 | 105 | 10 | 21		2	M1 for one number written as a product of prime factors or prime factors listed – numbers may be at end of factor trees or on 'ladder diagrams' or in a table or in a Venn diagram **or** at least two factors for each (excluding 1, 200, 420)
	Correct answer scores full marks (unless from obvious incorrect working)	20		A1 or $2^2\times5$ oe
(b)			2	M1 for $2^m\times3^n\times5^p\times7^q\times11^r$ with at least three of $m = 3$, $n = 2$, $p = 2$, $q = 2$, $r = 1$ (all 5 terms should be seen) **or** omission of one term with others fully correct **OR** prime factors seen in a Venn diagram – if so must be fully correct
	Correct answer scores full marks (unless from obvious incorrect working)	$2^3\times3^2\times5^2\times7^2\times11$		A1 allow 970 200 oe
				Total 4 marks

(**Q07 4MA1/2HR, Jan 2023**)

Q55.

Question		Working	Answer	Mark	Notes
		28, 56, 84, 112… **and** 105, 210, 315, 420… **or** 2, 2, 7 **and** 3, 5, 7 **or**  **or** $\frac{28\times105}{7}$ **or** 2, 2, 3, 5, 7 oe		2	M1for any correct valid method e.g. for starting to list at least **four** multiples of each number **or** 2, 2, 7 **and** 3, 5, 7 seen (may be in a factor tree and ignore 1) **or** a fully correct Venn diagram
			420		A1 cao
					Total 2 marks

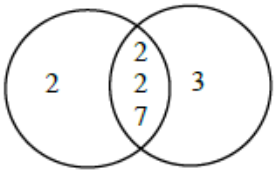
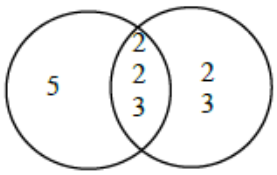
(**Q02 4MA1/1H, Jan 2020**)

Q56.

Q	Working	Answer	Mark	Notes
(a)		$3^2 \times 5 \times 7$	1	B1 accept $3 \times 3 \times 5 \times 7$ oe or 315
(b)		$3^{11} \times 5^7 \times 7^5$	2	B2 fully correct answer (allow $x = 11, y = 7, z = 5$) (B1 for an answer in the form $3^p \times 5^q \times 7^r$ where one or two of p, q or r are correct)
				Total 3 marks

(**QU12 4MA1/1HR, June 2022**)

Q57.

Q	Working	Answer	Mark	Notes
(a)	1, 2, 4, 7, 8, 14, 28, 56 **and** 1, 2, 3, 4, 6, 7, 12, 14, 21, 28, 42, 84 **or** 2 2 2 7 **and** 2 2 3 7 **or**  e.g. **28** | 56 | 84 | **2** | **3**		2	M1 for any correct valid method and no errors e.g. for starting to list at least **four** different factors of each number and no errors **or** 2 2 2 7 **and** 2 2 3 7 seen (may be in a factor tree or a ladder diagram and ignore 1) **or** a fully correct Venn diagram **or** other clear method, e.g, table
		28		A1 dep M1 accept $2^2 \times 7$ oe
(b)	60, 120, 180, 240… **and** 72, 144, 216, 288… **or** 2 2 3 5 **and** 2 2 2 3 3 **or**  **or** $\frac{60 \times 72}{12}$ **or** 2, 2, 2, 3, 3, 5 oe **2** | 60 | 72 **2** | 30 | 36 **3** | 15 | 18 **2** | **5** | 6 | | **3**		2	M1 for any correct valid method and no errors e.g. for starting to list at least **four** multiples of each number **or** 2 2 3 5 **and** 2 2 2 3 3 seen (may be in a factor tree or a ladder diagram and ignore 1) **or** a fully correct Venn diagram **or** other clear method, e.g, table
		360		A1 dep M1 accept $2^3 \times 3^2 \times 5$ oe
				Total 4 marks

(**QU03 4MA1/1H, June 2022**)

Q58.

Q	Working	Answer	Mark	Notes
(a)		9	1	B1 allow 3^9
(b)		21	1	B1 allow 5^{21}
(c)	$8+2-p=6$ oe eg $8+2=6+p$ or $7^{8+2-p}=7^6$ oe		2	M1 (or embedded eg $8+2=10$, $10-4=6$)
	Correct answer scores full marks (unless from obvious incorrect working)	4		A1 allow 7^4
				Total 4 marks

(**Q01 4MA1/2H, Nov 2021**)

Q59.

Q	Working	Answer	Mark	Notes
(a)	$2^{\frac{1}{2}}\times 2^4$ or eg $2\times(2^4)^2=(2^x)^2$ or $2^9=2^{2x}$		2	M1 for a correct expression in powers of 2 that is equivalent to 2^x eg $2^{\frac{1}{2}}\times 2^4$ or for showing $\sqrt{2}=2^{\frac{1}{2}}$ and $16=2^4$ or for writing the equation in powers of 2 eg $2\times(2^4)^2=(2^x)^2$ or $2^9=2^{2x}$
	Working required	$\frac{9}{2}$		A1 or 4.5 or 4½ dependent on M1
(b)	$\frac{11^{-30}}{11^4}$ or $-30-4=n$ or $-30=n+4$ oe		2	M1 For $(11^{-6})^5$ written as 11^{-30} in the equation or $(11^{-6})^5=11^{-30}$ shown in working or a correct equation with indices only (no marks for $3.914....\times 10^{-36}$)
	Working required	−34		A1 dep on M1 (as we have asked for working)
				Total 4 marks

(**Q11 4MA1/1H, June 2021**)

Q60.

Q	Working	Answer	Mark	Notes
	$2^{-4x} = 2^5$ or $-4x = 5$ or $-\frac{4}{5}x = 1$ oe		2	M1
	Correct answer scores full marks (unless from obvious incorrect working)	$-\frac{5}{4}$		A1 oe allow eg $\frac{5}{-4}$
				Total 2 marks

(Q12 4MA1/1HR, Jan 2023)

Q61.

Q	Working	Answer	Mark	Notes
(a)		a^{11}	1	B1
(b)		w^{12}	1	B1
(c)		$64x^{10}y^6$	2	B2 if not B2 then award B1 for 2 correct parts as part of a product eg $kx^{10}y^6$ where $k \neq 64$ or $64x^ky^6$ where $k \neq 10$ or $64x^{10}y^k$ where $k \neq 6$
(d)	$c + 8v = t^3$		2	M1
		$t = \sqrt[3]{c+8v}$		A1 oe SCB1 for an answer of $t = \frac{c+8v}{3}$ oe
				Total 6 marks

(Q01 4MA1/1H, Jan 2022)

Q62.

Q	Working	Answer	Mark	Notes
(a)		e^6	1	B1 cao
(b)	$x^2-3x+x-3$		2	M1 for any 3 correct terms **or** for 4 out of 4 correct terms ignoring signs **or** for $x^2-2x\ldots$ **or** for $\ldots-2x-3$
	Correct answer scores full marks (unless from obvious incorrect working)	x^2-2x-3		A1
				Total 3 marks

(**Q01 4MA1/1H, Nov 2021**)

Q63.

Q	Working	Answer	Mark	Notes
(a)		$-2, -1, 0, 1, 2$	2	B2 (B1 for 4 correct values and no incorrect values (eg -1, 0, 1, 2) **or** for 6 values with no more than one incorrect value (eg -2, -1, 0, 1, 2, 3))
(b)	$7t-2t\leq 31+3$ or $5t\leq 34$ or $-3-31\leq 2t-7t$ or $-34\leq -5t$ oe		2	M1 t terms on one side and numbers on the other. Condone = rather than $\leq$ or any other sign for this mark.
	Working required	$t\leq 6.8$		A1 oe (dep on M1) eg $t\leq\frac{34}{5}$ **or** $t\leq 6\frac{4}{5}$ or $6.8\geq t$ Must have correct sign on answer line (sight of correct answer in working space and just 6.8 oe on answer line gains M1 only)
				Total 4 marks

(**Q07 4MA1/1H, June 2021**)

Q64.

Q	Working	Answer	Mark	Notes
(i)	$-7+3 \leq 2x < 5+3$ oe or $\frac{-7}{2} \leq x - \frac{3}{2} < \frac{5}{2}$ oe or $-7+3 \leq 2x$ oe **and** $2x < 5+3$ oe or $(x =) -2$ or $(x =) 4$		3	M1 or one side of the inequality correct, i.e.. $x \geq -2$ oe or $x < 4$ Condone = rather than ≤ or < or any other sign for the M marks.
	$\frac{-7+3}{2} \leq x < \frac{5+3}{2}$ or $\frac{-7}{2} + \frac{3}{2} \leq x < \frac{5}{2} + \frac{3}{2}$ or $\frac{-7+3}{2} \leq x$ oe **and** $x < \frac{5+3}{2}$ or $(x =) -2$ and $(x =) 4$			M1
	Correct answer scores full marks (unless from obvious incorrect working)	$-2 \leq x < 4$		A1 allow $x \geq -2$ and $x < 4$ Allow $[-2, 4)$
(ii)			2	M1 ft for drawing a line from −2 to 4 or (indep) for a closed circle or [at −2 or (indep) for an open circle or) or [at 4 Only allow a follow through for a double ended inequality
		Correct diagram		A1 ft for correct diagram Only allow a follow through for a double ended inequality
				Total 5 marks

(**Q09 4MA1/1H, Nov 2021**)

Q65.

Q	Working	Answer	Mark	Notes
		$y \geq -3$ oe $x + y \leq 1$ oe $y \leq 2x + 2$ oe	3	B3 for all 3 correct inequalities (B2 for 2 correct inequalities B1 for 1 correct inequality) Allow < instead of ≤ and > instead of ≥
				Total 3 marks

(**Q13 4MA1/2H, Nov 2021**)

Q66.

Q	Working	Answer	Mark	Notes
(a)		$-3, -2, -1, 0, 1$	2	B2 for $-3, -2, -1, 0, 1$ If not B2 then award B1 for 4 correct values and no incorrect values (eg $-3, -2, -1, 0$) or for 6 values with no more than one incorrect value (eg $-4, -3, -2, -1, 0, 1$)
(b)		$x > -1$	1	B1 accept $-1 < x$
				Total 3 marks

(**Q03 4MA1/2HR, Jan 2023**)

Q67.

Q	Working	Answer	Mark	Notes
	$-4x \leq 11 - 3$ **or** $-4x \leq 8$ **or** $-x \leq 2$ **or** $3 - 11 \leq 4x$ **or** $-8 \leq 4x$		2	M1 allow equals sign or condone incorrect inequality sign for M1 only
		$x \geq -2$		A1 allow $-2 \leq x$ SCB1 for x and -2 with an incorrect sign between them or -2 as an answer
				Total 2 marks

(**QU09 4MA1/1HR, June 2022**)

Q68.

Q	Working	Answer	Mark	Notes	
(a)	$5x \leq 2+7$ **or** $5x \leq 9$ **or** $\frac{5x}{5} - \frac{7}{5} \leq \frac{2}{5}$ oe		2	M1	allow any sign instead of $\leq$ or for an answer of 1.8 oe or x and 1.8 oe with the incorrect sign
		$x \leq 1.8$		A1	oe
(b)(i)	$(y \pm 7)(y \pm 5)$		2	M1	for $(y \pm 7)(y \pm 5)$ or $(y + a)(y + b)$ where $ab = -35$ **or** $a + b = -2$
		$(y - 7)(y + 5)$		A1	isw if student goes on to solve the equation in this part
(ii)		7, −5	1	B1ft	answer must ft from their $(y + a)(y + b)$ in (b)(i). Award B0 for 7, −5 if no marks scored in (i)
					Total 5 marks

(**Q06 4MA1/1H, Jan 2022**)

Q69.

Q	Working	Answer	Mark	Notes	
	$y = (x-4)^2 - 4^2 \ (+5)$ oe **or** $x = (y-4)^2 - 4^2 \ (+5)$		3	M1	for a correct first step in order to complete the square
	$y = 4 \pm \sqrt{11+x}$ **or** $x = 4 \pm \sqrt{11+y}$			A1	allow $y = 4+\sqrt{11+x}$ **or** $x = 4+\sqrt{11+y}$
		$4-\sqrt{x+11}$		A1	oe
					Total 3 marks

ALT	$x^2 - 8x + (5 - y) = 0$ $(x =) \frac{8 \pm \sqrt{(-8)^2 - 4\times1\times(5-y)}}{2\times1}$ **or** $y^2 - 8y + (5 - x) = 0$ $(y =) \frac{8 \pm \sqrt{(-8)^2 - 4\times1\times(5-x)}}{2\times1}$		3	M1	for a correct first step in preparation for use of quadratic formula and substitution into the quadratic formula (allow one sign error)
	$y = 4 \pm \sqrt{11+x}$ **or** $x = 4 \pm \sqrt{11+y}$			A1	allow $y = 4+\sqrt{11+x}$ **or** $x = 4+\sqrt{11+y}$
		$4-\sqrt{x+11}$		A1	oe
					Total 3 marks

ALT	Using $ax^2+bx+c=a(x+p)^2+q$				
	$\left(p=\frac{b}{2a}\right)=\frac{-8}{2}(=-4)$ **and** $q=(4)^2-8(4)+5(=-11)$		3	M1	for finding p and q
	$y=4\pm\sqrt{11+x}$ **or** $x=4\pm\sqrt{11+y}$			A1	allow $y=4+\sqrt{11+x}$ **or** $x=4+\sqrt{11+y}$
		$4-\sqrt{x+11}$		A1	oe
					Total 3 marks

(**Q22 4MA1/1H, Jan 2021**)

Q70.

Question		Working	Answer	Mark	Notes
		$(fg(x)=)\ (x+3)^2-2(x+3)$ oe		5	M1 for substituting $g(x)$ into $f(x)$
		$(fg(x)=)\ x^2+4x+3$			A1 Allow y^2+4y+3
		$(x+2)^2-4+3$ **or** $(x+2)^2-1$ **or** $x^2+4x+(3-y)=0$ **or** $y^2+4y+(3-x)=0$			M1 ft (dep on M1) for correctly completing the square on their 3 term quadratic **or** Correctly setting up an equation
		$(x+2)^2=y+1$ **or** $(y+2)^2=x+1$ **or** $x=\frac{-4\pm\sqrt{16-4(3-y)}}{2}$ **or** $x=-2\pm\sqrt{1+y}$			M1 ft (dep on M2) for a correct rearrangement for their completed the square quadratic **or** correctly substituting into the quadratic formula Allow same equations with x and y swapped
			$-2+\sqrt{x+1}$		A1 oe
					Total 5 marks

(**Q21 4MA1/1H, Jan 2020**)

Q71.

Q	Working	Answer	Mark	Notes	
	$y=3\left(x^2-4x\right)+7$ **or** $y=3\left(x^2-4x+\frac{7}{3}\right)$ **or** $\frac{y-7}{3}=x^2-4x$ **or** $y=3(x-2)^2.....$		4	M1	for a correct equation for a first step to complete the square
	eg $y=3\left((x-2)^2-2^2\right)+7$ **or** $y=3\left((x-2)^2-2^2+\frac{7}{3}\right)$ **or** $y=3(x-2)^2-5$ **oe or**			M1	
	$(x-2)^2=\frac{y+5}{3}$ **oe** **eg** $(x-2)^2=\frac{y-7}{3}+4$ **or** $x-2=(\pm)\sqrt{\frac{y+5}{3}}$ **oe**			M1	
	Correct answer scores full marks (unless from obvious incorrect working)	$2-\sqrt{\frac{x+5}{3}}$		A1 oe	NB: note only negative square root. Must be in terms of x **any equivalent form**
	Note: Allow candidates to swap x and y when finding the inverse				**Total 4 marks**
Alt	$3x^2-12x+(7-y)=0$		4	M1	for a correct first step
	$(x=)\frac{12\pm\sqrt{144-12(7-y)}}{6}$			M1	
	$(x=)2\pm\sqrt{\frac{60+12y}{36}}$ **oe**			M1	
	Correct answer scores full marks (unless from obvious	$2-\sqrt{\frac{x+5}{3}}$		A1 oe	NB: note only negative square root. Must be in terms of x **any equivalent form**
					Total 4 marks

(**Q25 4MA1/2H, Jan 2023**)

Q72.

Q	Working	Answer	Mark	Notes
(a)	$(x-3)^2$ or $(3-x)^2$ or $(y-3)^2$ or $(3-y)^2$		4	M1
	14 or -14			M1 As part of an expression in x or y or an equation in x and y
	$3\pm\sqrt{14-x}$ or $3\pm\sqrt{14-y}$			M1 Can be $\pm$ or $-$ or $+$
		$3+\sqrt{14-x}$		A1 oe must be in x
alt (a)	Alternative method: $x^2-6x+(y-5)=0$ oe or $y^2-6y+(x-5)=0$ oe		4	M1 rearrange to form a quadratic in x or y terms can be in any order but must be in an equation equal to zero
	$y=\frac{6\pm\sqrt{36-4(x-5)}}{2}$ or $x=\frac{6\pm\sqrt{36-4(y-5)}}{2}$			M1 correct substitution into quadratic formula
	$3\pm\sqrt{14-x}$ or $3\pm\sqrt{14-y}$			M1 Can be $\pm$ or $-$ or $+$
		$3+\sqrt{14-x}$		A1 oe must be in x
(b)		$x \leqslant 14$	1	B1 oe **must** ft from part (a) dep on an answer in correct form
				Total 5 marks

(**Q25 4MA1/2H, Jan 2022**)

Q73.

Q	Working	Answer	Mark	Notes
	$F=\frac{k}{v^2}$ **or** $Fv^2=k$ oe		3	M1 (NB. Not for $F=\frac{1}{v^2}$) Constant of proportionality must be a symbol such as k — M2 for $6.5=\frac{k}{4^2}$ oe
	$6.5=\frac{k}{4^2}$ **or** $k=6.5\times4^2$ **or** $k=104$			M1 For substitution of F and v into a correct formula
		$F=\frac{104}{v^2}$		A1 Award 3 marks if $F=\frac{k}{v^2}$ is on the answer line and the value of $k=104$ is found
				Total 3 marks

(Q14 4MA1/1H, Nov 2020)

Q74.

Q	Working	Answer	Mark	Notes
(a)	$A = \frac{k}{r^2}$		3	M1 oe k can be any letter (must be a letter and not 1)
	$5 = \frac{k}{0.3^2}$ oe **or** $k = 0.45$ oe			M1 implies first M1 if you see this stage
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$A = \frac{0.45}{r^2}$		A1 oe with A as the subject eg $A = \frac{9}{20r^2}$ (allow $A = \frac{k}{r^2}$ where $k = 0.45$ oe) (SC if M0 scored then award B2 for $A \propto \frac{0.45}{r^2}$ oe)
(b)	$[A =] \frac{"0.45"}{(7.5A)^2}$ oe **or** $\frac{"0.45"}{56.25A^2}$ **or** $\frac{9}{20(7.5A)^2}$ oe		3	M1 ft from (a) dep on M2 in (a) ($[A =] \frac{"0.45"}{7.5A^2}$ is zero marks unless recovered later)
	$A^3 = \frac{"0.45"}{56.25}$ ($A^3 = \frac{1}{125}$ or 0.008 oe) or $125A^3 = 1$ oe			M1 ft their 0.45 dep on M2 in (a) Must include A^3
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	0.2		A1 oe
				Total 6 marks

(Q16 4MA1/2H, June 2021)

Q75.

Q	Working	Answer	Mark	Notes
	eg $40=\frac{k}{1.5^2}$ **or** $k=90$ **or** $\frac{C^2}{1.5^2}=\frac{40}{1000}(=0.04)$ **or** $(C^2=)1.5^2\times\frac{40}{1000}(=0.09)$ **or** $\frac{1.5^2}{C^2}=\frac{1000}{40}(=25)$ **or** $(C^2=)1.5^2\div\frac{1000}{40}(=0.09)$		3	M1
	eg $(C=)\sqrt{\frac{"90"}{1000}}$ oe **or** $(C=)\sqrt{1.5^2\times"0.04"}$ **or** $(C=)\sqrt{1.5^2\div"25"}$ **or** $(C=)\sqrt{"0.09"}$			M1
		0.3		A1 oe, allow ±0.3 oe or −0.3 oe
				Total 3 marks

(**Q15 4MA1/1H, Jan 2022**)

Q76.

Q	Working	Answer	Mark	Notes
	$2^2\times7$ or $2\times3\times7$ or $3^2\times7$ oe condone 1's in factor tree **or** showing at least 5 correct multiples across at least 2 lists (excluding 28, 42, 63) (28) 56, 84, 112, 140, 168, 196, 224, 252 (42) 84, 126, 168, 210, 252 (63) 126, 189, 252		3	M1 accept prime factors seen in factor tree **or** correct position in Venn diagram for at least one of the numbers given.
	$2^2\times7$ **and** $2\times3\times7$ **and** $3^2\times7$ **or** showing at least 9 correct multiples across all 3 lists (excluding 28, 42, 63)			M1 accept prime factors seen in factor tree **or** correct position in Venn diagram for all 3 of the numbers given.
		252		A1 or $2^2\times3^2\times7$ Dep on M1
alt	7 | **28** | **42** | **63** 2 | **4** | **6** | **9** 3 | **2** | **3** | **9** | **2** | **1** | **3** 7 | 28 | 42 | 63 2 | **4** | **6** | **9** 3 | **2** | **3** | **9** 2 | **2** | **1** | **3** 3 | **1** | **1** | **3** (1) | **1** | **1** | **1**		3	M1 For one correct row in table eg division by 7 gives 4, 6, 9 M1 Fully correct table – need only go as far as top table – we want to see prime factors along the side or prime factors along the sides and bottom (condone 1's)
		252		A1 or $2^2\times3^2\times7$ Dep on M1
				Total 3 marks

(**Q07 4MA1/2H, Jan 2022**)

Q77.

Q	Working	Answer	Mark	Notes
		$2^4\times3^2\times5^4\times11\times13$	2	B2 (B1 for 12 870 000 or correct unsimplified product or $2^m\times3^n\times5^p\times11\times13$ with at least 1 of m, n or p correct or for $2^4\times3^2\times5^4$)
				Total 2 marks

(**Q09 4MA1/2H, Jan 2021**)

Q78.

Q	Working	Answer	Mark	Notes
		$x\geq -1$	1	B1 oe condone > in place of ≥
		$y\geq x$	1	B1 oe condone > in place of ≥
		$x+2y\leq 8$	1	B1 oe condone < in place of ≤
				SCB1 if all inequalities reversed
				Total 3 marks

(**Q13 4MA1/2H, Jan 2022**)

Q79.

Question	Working		Answer	Mark	Notes
(a)	$2x > 4 - 7$ **or** $x + 3.5 > 2$			2	M1 For a correct first step allow $2x = 4 - 7$ or $x + 3.5 = 2$ or an answer of $x = -1.5$ or $x < -1.5$ or -1.5
			$x > -1.5$		A1 for $x > -1.5$ oe
(b)	$(x \pm 8)(x \pm 5)$	$\frac{-(-3) \pm \sqrt{(-3)^2 - 4\times1\times(-40)}}{2\times1}$ **or** $\frac{3 \pm \sqrt{9+160}}{2}$			M1 **or** $(x + a)(x + b)$ where $ab = -40$ **or** $a + b = -5$ **OR** correct substitution into quadratic formula (condone one sign error in a, b or c and missing brackets) (if + rather than ± shown then award M1 only unless recovered with answers)
	$(x - 8)(x + 5)$	$\frac{3 \pm \sqrt{169}}{2}$ **or** $\frac{3 \pm 13}{2}$			M1 $\frac{3 \pm \sqrt{169}}{2}$ **or** $\frac{3 \pm 13}{2}$
			8, −5	3	A1 dep on at least M1 for correct values
					Total 5 marks

(**Q07 4MA1/2H, Jan 2020**)

Q80.

Q	Working	Answer	Mark	Notes
	$(4^n =)(2^2)^n$ **or** $(4^n =)2^{2n}$ oe eg $2^k \div 2^{2n} = 2^x$ **or** $2^k = 4^{\frac{1}{2}k}$ **and** $2^x = 4^{\frac{1}{2}x}$ oe eg $\frac{4^{\frac{1}{2}k}}{4^n} = 4^{\frac{1}{2}x}$		2	M1 for writing 4^n as $\left(2^2\right)^n$ or 2^{2n} or for writing each term in terms of 4 ie $2^k = 4^{\frac{1}{2}k}$ **and** $2^x = 4^{\frac{1}{2}x}$ If these things are seen in working, award this mark even if followed by incorrect working – if not a choice of methods
		$k - 2n$		A1 allow 2^{k-2n}
				Total 2 marks

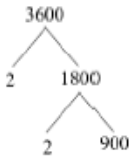
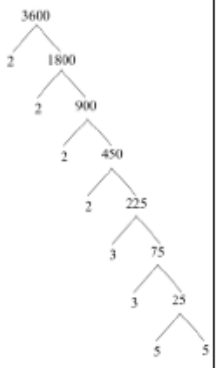
(**QU07 4MA1/2HR, June 2022**)

Q81.

Q	Working	Answer	Mark	Notes
		$91 - 6n$	2	B2 for a correct answer in any form eg $91 - 6 \times n$ or $-6n + 91$ or $85 + (n - 1)(-6)$ oe (B1 for $-6n + k$ oe (k may be zero or absent)) NB: award full marks for eg $x = 91 - 6n$ or nth term $= 91 - 6n$ but only B1 for $n = 91 - 6n$
				Total 2 marks

(**Q02 4MA1/1H, June 2021**)

Q82.

Q	Working	Answer	Mark	Notes
	E.g. $2 \times 2 \times 900$ or $2^2 \times 900$ or $2 \times 3 \times 600$ or $2 \times 5 \times 360$ or $3 \times 3 \times 400$ or $3^2 \times 400$ or $3 \times 5 \times 240$ or $5 \times 5 \times 144$ or $5^2 \times 144$ E.g. 2 | 3600 2 | 1800 | 900 E.g.  		3	M1 for at least 2 correct stages in prime factorisation which give 2 prime factors – may be in a factor tree or a table or listed eg 2, 2, 900 (see LHS for examples of the amount of work needed for the award of this mark, allow no more than one mistake ft in factor tree or table (eg one mistake with 2 prime factors ft: $3600 = 1800 \times 20 = 2 \times 900 \times 4 \times 5$ or $360 = 2 \times 2 \times 90$)
	E.g. $2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 5 \times 5$ E.g. 2 | 3600 2 | 1800 2 | 900 2 | 450 3 | 225 3 | 75 5 | 25 5 | 5 | (1) E.g.  			M1 for 2, 2, 2, 2, 3, 3, 5, 5 or 2^4 , 3^2 , 5^2 or $2^4 + 3^2 + 5^2$ (ignore 1s) (may be a fully correct factor tree or ladder)
	Working required	$2^4 \times 3^2 \times 5^2$		A1 dep on M2 can be any order (allow 2^4 . 3^2 . 5^2) (SCB1 for $3.6 \times 2^3 \times 5^3$)
				Total 3 marks

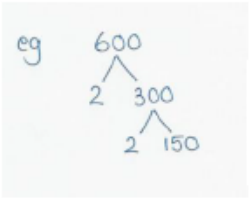
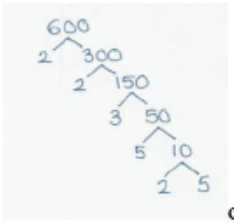
(**Q07 4MA1/1H, Nov 2021**)

Q83.

Q	Working	Answer		Mark	Notes
	$3^4 = \frac{3^x}{9^{3x}}$ or $81 = \frac{3^x}{(3^2)^{3x}}$	$9^2 = \frac{3^x}{9^{3x}}$ or $81 = \frac{(9^{0.5})^x}{9^{3x}}$			M1 replacing 81 with 3^4 or 9^{3x} with $(3^2)^{3x}$ (or 3^{6x}) or replacing 81 with 9^2 or 3^x with $(9^{0.5})^x$ (in an equation)
	eg $4 + 6x = x$ or $4 = x - 2(3x)$ oe	eg $2 = 0.5x - 3x$ oe			M1 a correct equation using powers
			−0.8	3	A1 oe, dep on at least M1
					Total 3 marks

(**Q12 4MA1/2H, Nov 2020**)

Q84.

Q	Working	Answer	Mark	Notes
	eg $2 \times 2 \times 150$ **or** $3 \times 5 \times 40$ **or** $2 \times 3 \times 100$ **or** $5^2 \times 24$ **or**  **or** eg | 2 | 600 | | 2 | 300 | | | 150 |		3	M1 for at least 2 correct stages in prime factorisation which give 2 prime factors – may be in a factor tree or a table or listed eg 2, 2, 150 (see LHS for examples of the amount of work needed for the award of this mark, allow no more than one mistake ft (eg one mistake with 2 prime factors ft: $600 = 200 \times 30 = 2 \times 100 \times 5 \times 6$)
	eg $2 \times 2 \times 2 \times 3 \times 5 \times 5$  oe | 2 | 600 | | 2 | 300 | | 2 | 150 | | 3 | 75 | | 5 | 25 | | 5 | 5 | | | [1] | oe			M1 for 2, 2, 2, 3, 5, 5 (ignore 1s) (may be a fully correct factor tree or ladder)
	Working required. *NB: answer must be given as a product of powers of prime factors*	$2^3 \times 3 \times 5$		A1 dep on M2 can be any order (allow $2^3 \cdot 3 \cdot 5^2$)
				Total 3 marks

(**Q01 4MA1/2H, June 2021**)

Q85.

Q	Working	Answer	Mark	Notes
	eg $2n$, $2n+2$, $2n+4$ **or** $2n-2$, $2n$, $2n+2$ etc		3	M1 3 consecutive even numbers in algebraic form (any letter can be used)
	eg $(2n+4)^2-(2n)^2$ $(=4n^2+8n+8n+16-4n^2$ $(=16n+16)$) **or** $(2n+2)^2-(2n-2)^2$ $(=4n^2+4n+4n+4-(4n^2-4n-4n+4)$ $(=16n))$			M1 for squaring the largest and smallest even numbers and subtracting (no need to expand or simplify for this mark)
	eg $8(2n+2)=16n+16$ **or** eg $16n+16=8(2n+2)$ **or** eg $16n=8(2n)$ **or** eg $8n+8n=8(n+n)$ **or** eg $\frac{16n+16}{2n+2}=8$	Correctly shown		A1 dep on M2 for use of algebra to show correct conclusion (SCB1 for eg $(p+4)^2-p^2$) (SCB2 for use of eg $(p+4)^2-p^2=8p+16=8(p+2)$ If the student shows this and also says "it is true for all numbers, so it must be true for even numbers" oe then this would gain M2A1
	Alternative			**Total 3 marks**
	eg a, b, c are consecutive even numbers where $a<b<c$ **and** one of $b=\frac{a+c}{2}$ **or** $a+c=2b$ **or** $c-a=4$ oe		3	M1 3 numbers defined as consecutive even numbers with one correct equation, writing one term in terms of one or more of the others or $c-a=4$
	eg a, b, c are consecutive even numbers where $a<b<c$ **and** all of $b=\frac{a+c}{2}$ **and** $a+c=2b$ **and** $c-a=4$ oe			M1 3 numbers defined as consecutive even numbers with three correct equations that involve all letters in some place
	Now $c^2-a^2=(c-a)(c+a)$ $=4\times 2b=8b$	Correctly shown		A1 dep on M2 for use of algebra to show correct conclusion
				Total 3 marks

(**Q17 4MA1/1H, June 2021**)

Q86.

Q	Working	Answer	Mark	Notes
	eg $(2n+1)^2+(2n-1)^2$ or $(2n+1)^2+(2n+3)^2$ oe		3	M1 for setting up a correct algebraic expression (any letter can be used) must have intention to add (may come after expanding)
	Eg $4n^2+4n+1+4n^2-4n+1$ **or** $8n^2+2$ **or** $4n^2+4n+1+4n^2+12n+9$ **or** $8n^2+16n+10$ oe			M1 correct expansion of brackets and correct signs or a correct result.
	eg $8\times n^2+2$ $\frac{8n^2+16n+10}{8}=n^2+2n+\frac{10}{8}$ which shows a remainder of 2 or $10-8=2$ or $\frac{8n^2+16n+10}{8}=n^2+2n+1$ remainder 2 oe $\frac{8n^2+16n+10}{8}=n^2+2n+1+\frac{2}{8}$ oe $8(n^2+2n+1)+2$ oe	shown clearly		A1 conclusion dep on M2 for eg $8n^2+2$ **and** a suitable conclusion (may be shown as a calculation/in numbers). The conclusion must be an intention to show that the result is a multiple of 8 and there is 2 remaining.
				Total 3 marks

(**Q18 4MA1/2H, Jan 2022**)

Q87.

Q	Working	Answer	Mark	Notes
(a)	$P=\frac{k}{y^2}$		3	M1 oe (the constant term, k, can be any other letter apart from a or P or y)
	eg $a=\frac{k}{4^2}$ **or** $k=16a$			M1 oe
	Correct answer scores full marks (unless from obvious incorrect working)	$P=\frac{16a}{y^2}$		A1 oe eg $P=16ay^{-2}$ or $P=\frac{4^2a}{y^2}$
(b)	$\sqrt{"\frac{16a}{4a}"}=c\sqrt{a}$ oe eg $\frac{16a}{4a}=c^2a$ or $4a=\frac{16a}{c^2a}$ **or** $4a\times c^2a=16a$ **oe** **or** (when $P=4a$) $y^2=\frac{16a}{4a}$ **or** $y^2=4$ **or** $y=\sqrt{\frac{16a}{4a}}(=2)$ oe		3	M1 ft a correct formula involving the constant term (c used here) and a **or** ft for an expression or value of y^2 or y given for when $P=4a$
	$c=\sqrt{\frac{4}{a}}$ **or** $c=\frac{\pm2}{\sqrt{a}}$ **or** $c=\frac{\pm2\sqrt{a}}{a}$ oe allow the constant term squared eg $c^2=\frac{16a}{4a^2}\left(=\frac{4}{a}\right)$			M1 (implies previous M1) a correct value, in terms of a, for the constant term or the constant term squared – need not be simplified
	Correct answer scores full marks (unless from obvious incorrect working)	$P=\frac{4a^2}{x}$		A1 oe eg $P=\frac{\frac{16a}{4x}}{a}$ or $P=\frac{16a^2}{4x}$
				Total 6 marks

(**Q19 4MA1/1HR, Jan 2023**)

Q88.

Q	Working	Answer	Mark	Notes	
	$(2x+3)(x-1) < 75$		5	B1	For writing the correct inequality sign with a correct calculation or correct value – this could be initially or saying that $x < 6$ at the end
	$2x^2 + x - 78 < 0$			M1	rearranged to form correct quadratic < 0 (allow $= 0$ or other incorrect inequality sign) oe
	$(x-6)(2x+13)\ (< 0)$ **or** $x = \frac{-1 \pm \sqrt{(1)^2 - (4 \times 2 \times -78)}}{2 \times 2}$ **or** $2\left(x + \frac{1}{4}\right)^2 - 2\left(\frac{1}{4}\right)^2 - 78 = 0$			M1	first step to find critical values from the correct quadratic
		$x = 6$		A1	$x = 6$ identified as critical value, ignore -6.5 if given
		$1 < x < 6$		A1	correct inequality
					Total 5 marks

(**Q22 4MA1/2H, Jan 2022**)

Q89.

Q	Working	Answer	Mark	Notes	
	$(3x+2)(2x-4) < 3x + 27$oe eg $6x^2 - 8x - 8 < 3x + 27$			M1	condone incorrect symbol
	eg $6x^2 - 11x - 35 < 0$			M1	expanding and rearranging to get a correct 3 term quadratic, condone incorrect symbol
	$(2x-7)(3x+5)\ (= 0)$ or $\frac{11 \pm \sqrt{(-11)^2 - 4 \times 6 \times (-35)}}{2 \times 6}$			M1	first step to find the critical values dep on M1 for solving their 3 term quadratic using any correct method (allow one sign error and some simplification – allow as far as the equivalent of $\frac{11 \pm \sqrt{121+840}}{12}$) or if factorising, allow brackets which expanded give 2 out of 3 terms correct)
	$-\frac{5}{3}, \frac{7}{2}$			A1	oe the positive critical value only or both critical values (if both they must be correct)
		$2 < x < \frac{7}{2}$	5	A1	accept $2 \leq x < \frac{7}{2}$ may be seen as two separate inequalities $x > 2$ $(x \geq 2)$ **and** $x < \frac{7}{2}$
					Total 5 marks

(**Q17 4MA1/2H, Nov 2020**)

Q90.

Question	Working	Answer	Mark	Notes
	$\frac{4(2x-3)-3(2x-5)}{(2x-5)(2x-3)}$ or $\frac{8x-12-6x+15}{(2x-5)(2x-3)}$ oe		4	M1 Writing 1st fraction as a fraction over a common denominator (can be 2 separate fractions)
	$x(3-2x)(3+2x)$ or $(3x-1)(2x-5)$			M1 Complete factorisation of numerator or denominator of 2nd fraction
	$\frac{2x+3}{(2x-5)(2x-3)} \times \frac{(3x-1)(2x-5)}{x(3-2x)(3+2x)}$			M1 may be partially simplified
		$\frac{3x-1}{x(2x-3)(3-2x)}$		A1 e.g. $\frac{3x-1}{x(2x-3)(3-2x)}$ or $\frac{1-3x}{x(2x-3)^2}$ or $\frac{3x-1}{x(12x-9-4x^2)}$ or $\frac{3x-1}{(12x^2-9x-4x^3)}$ oe isw for incorrect denominator expansion
				Total 4 marks

(**Q24 4MA1/2H, Jan 2020**)

Q91.

Q	Working	Answer	Mark	Notes
	$\frac{6}{3-\sqrt{7}}\times\frac{3+\sqrt{7}}{3+\sqrt{7}}$ or $\frac{6}{3-\sqrt{7}}\times\frac{-3-\sqrt{7}}{-3-\sqrt{7}}$			M1
	$\frac{6(3+\sqrt{7})}{3^2-7}$ or $\frac{6(3+\sqrt{7})}{2}$ or $\frac{6(-3-\sqrt{7})}{-3^2+7}$ or $\frac{6(-3-\sqrt{7})}{-2}$			M1 (numerator may be expanded or denominator may be 4 terms which need to be all correct)
		$9+3\sqrt{7}$	3	A1 dep on M2 for $9+3\sqrt{7}$ or $3(3+\sqrt{7})$ from correct working
				Total 3 marks

(**Q19 4MA1/1H, Nov 2020**)

Q92.

Question	Working	Answer	Mark	Notes
	$y^2=\frac{x+1}{x-4}$		4	M1 for squaring
	$y^2(x-4)=x+1$ or $y^2x-4y^2=x+1$			M1 for removing the fraction
	$y^2x-x=4y^2+1$ or $-4y^2-1=x-y^2x$ or $x(y^2-1)=4y^2+1$ or $-4y^2-1=x(1-y^2)$			M1 for expanding the bracket **and** rearranging for x so that the terms in x are on one side of the correct equation
		$x=\frac{4y^2+1}{y^2-1}$		A1 for $x=\frac{4y^2+1}{y^2-1}$ or $x=\frac{-4y^2-1}{1-y^2}$ (need to see $x=$ somewhere)
				Total 4 marks

(**Q16 4MA1/2H, Jan 2020**)

Q93.

Question	Working	Answer	Mark	Notes
	$\frac{18}{\sqrt{7}+1}\times\frac{\sqrt{7}-1}{\sqrt{7}-1}$		3	M1 for $\frac{18}{\sqrt{7}+1}\times\frac{\sqrt{7}-1}{\sqrt{7}-1}$
	eg $\frac{18(\sqrt{7}-1)}{7-1}$			M1 Dep on M1 for a correct numerator **and** multiplying out the denominator to $7-1$ or 6
	$3\sqrt{7}-3$	$3\sqrt{7}-3$		A1 Dep on M2 Allow $3(\sqrt{7}-1)$
				Total 3 marks

(**Q20 4MA1/2H, Jan 2020**)

Q94.

Q	Working	Answer	Mark	Notes
	$(S_{20}=)10[2A+19\times11]=10170$ oe (where A is the $u_{(k-19)}$ th term)		5	M1
	$A=\left(\frac{10170}{10}-19\times11\right)\div2\,(=404)$			M1
	$8+(P-1)11=$"404" oe (where P is the number of terms from 20 to the end)			M1 M2 for $8+11\times(k-20)$ ="404"
	$P=\frac{\text{"404"}-8+11}{11}\,(=37)$			M1
	Working required	56		A1 dep on M1
	ALTERNATIVE METHOD			
	$(S_k=)\frac{k}{2}[2\times8+(k-1)11]$ **or** $(S_{k-20}=)\frac{(k-20)}{2}[2\times8+(k-21)11]$ **or** $(u_{k-19}=)8+11(k-20)$ **or** $(u_k=)8+11(k-1)$ *(allow use of letter other than k)*		5	M1 for S_k **or** S_{k-20} **or** u_k or u_{k-19} ***a* and *d* must be substituted correctly**
	$(S_k=)\frac{k}{2}[2\times8+(k-1)11]$ **and** $(S_{k-20}=)\frac{(k-20)}{2}[2\times8+(k-21)11]$ **or** $(u_{k-19}=)8+11(k-20)$ **and** $(u_k=)8+11(k-1)$			M1 For correct expressions for both S_k and S_{k-20} or u_k and u_{k-19}
	$10170=\frac{k}{2}[\text{"16"}+(k-1)11]-\frac{(k-20)}{2}[\text{"16"}+(k-21)11]$ oe or $10170=\frac{20}{2}([8+11(k-20)+[8+11(k-1)])$ oe			M1
	eg $10170=160+\frac{11}{2}[40k-420]$ oe eg $440k=24640$ or $2240=40k$ oe			M1 Expanding to obtain a linear equation **and** collecting terms in k
	Working required	56		A1 dep on M1
				Total 5 marks

(Q24 4MA1/1HR, Jan 2023)

Q95.

Q	Working	Answer	Mark	Notes
	$\frac{2n}{2}\left[2a+(2n-1)d\right]$ oe		4	M1 for a correct expression for S_{2n}
	$\frac{2n}{2}\left[2a+(2n-1)d\right]=4\times\frac{n}{2}\left[2a+(n-1)d\right]$ oe			M1 dep on M1 for setting up a correct equation for $S_{2n}=4\times S_n$
	$2a-d=4a-2d$ oe			M1 for a correct linear expression in a and d
		$\frac{d}{2}$		A1 (dep on M2) for $\frac{d}{2}$ oe
				Total 4 marks

(Q24 4MA1/1H, Jan 2021)

Q96.

Q	Working	Answer	Mark	Notes
(a)	eg $6\times2.4+5\times3.5$		2	M1
		31.9		A1 oe
(b)	$(W=)$ $5.9n$ **or** $(W=)$ $5.9(n-1)+2.4$ **or** $(W=)$ $2.4n+3.5(n-1)$		2	M1 for $2.4n+3.5n$ or $5.9n$ seen
		$5.9n-3.5$		A1 oe but must be in simplest form eg $-3.5+5.9n$
				Total 4 marks

(QU02 4MA1/1HR, June 2022)

Q97.

Q	Working	Answer	Mark	Notes
	$\frac{3k}{4}-k$ or $\frac{k}{2}-\frac{3k}{4}$ or $\frac{k}{4}-\frac{k}{2}(=-\frac{k}{4})$ or $\frac{90+2k-k}{14}=(\frac{90+k}{14})$		5	M1 for finding the common difference (d) in terms of k
	eg $90+2k=k+(15-1)'\left(\frac{3k}{4}-k\right)'$ oe or $'\frac{3k}{4}-k'='\frac{90+k}{14}'$ oe			M1 dep equating 2 different expressions in terms of k using their value(s) of d in terms of k (or from working using k) or other correct method to find k
	$k=-20$			A1
	$\frac{30}{2}\left[2('-20')+(30-1)\left(\frac{-'-20'}{4}\right)\right]$ oe			M1 dep on previous M1 for correctly substituting, into $(S_n=)\frac{30}{2}\left[2k+(30-1)d\right]$ or $\frac{30}{2}(k+l)$ where $l=k+29d$ all values to be numerical
	Correct answer scores full marks (unless from obvious incorrect working)	1575		A1
				Total 5 marks

(**Q20 4MA1/2H, Nov 2021**)

Q98.

Q	Working	Answer	Mark	Notes
	$(Sm=)\frac{m}{2}(2a+(m-1)d)=39$ oe **or** $(S_2m=)\frac{2m}{2}(2a+(2m-1)d)=320$ oe		5	M1 one correct equation for S_m or S_{2m} (condone consistent use of n instead of m)
	$(Sm=)\frac{m}{2}(2a+(m-1)d)=39$ oe **and** $(S_2m=)\frac{2m}{2}(2a+(2m-1)d)=320$ oe			M1 both equations correct
	eliminate to get $dm^2=242$ oe			M1
	$242=2\times11\times11$ or $242=2\times121$ oe			M1
		$d=2$ $m=11$		A1 Dep on M2 Both correct
				Total 5 marks

(**Q26 4MA1/2H, Jan 2022**)

Q99.

Q	Working	Answer	Mark	Notes	
	$(S_{10} =)\frac{10}{2}(2a+9d)$ **or** $(S_5 =)\frac{5}{2}(2a+4d)$ oe **or** $a+7d=45$		5	M1	for a correct expression for the sum of the first 10 terms (S_{10}) or the first 5 terms (S_5) **or** a correct equation for the 8^{th} term Take 9 as their 10 – 1 and 4 as their 5 – 1 and 7 as their 8 – 1
	$\frac{10}{2}(2a+9d)=4\times\frac{5}{2}(2a+4d)$ oe			M1	for a correct equation relating S_{10} and S_5
	eg $d=2a$ oe **or** $a=\frac{d}{2}$ oe **or** $a+7d=45$ oe **and** eg $10a-5d=0$ oe **or** eg $\frac{10}{2}(2(45-7d)+9d)=$ $4\times\frac{5}{2}(2(45-7d)+4d)$ oe **or** $5d=10(45-7d)$ oe			M1	(dep on M1) for d in terms of a, or vice-versa (must be correct) **or** for $a+7d=45$ oe **and** correctly reducing the equation relating S_{10} and S_5 to an equation with one term in a and one term in d eg $10a-5d=0$ oe **or** substituting a correct expression into their correct equation to obtain an equation in just d
	eg $a+7(2a)=45$ **or** $d=6$ **or** eg $70a-35d=0$ $5a+35d=225$ + $(75a=225)$ or $10a-5d=0$ $10a+70d=450$ – $(-75d=-450)$			M1	(dep on M2) for a correct equation in just a **or** for $d=6$ **or** for a correct method to eliminate a or d: coefficients of a or d the same **and** correct operation to eliminate selected variable (condone 1 arithmetical error)
		3		A1	Dep on M3
					Total 5 marks

(**QU25 4MA1/1HR, June 2022**)

Q100.

Q	Working	Answer	Mark	Notes
		$\frac{4y^5}{3x^2}$	3	B3 Accept $\frac{4}{3}x^{-2}y^5$ or $\frac{4x^{-2}y^5}{3}$ or $1.\dot{3}x^{-2}y^5$ oe NB: Must see 4 and 3 and not $16^{\frac{1}{2}}$ or $9^{\frac{1}{2}}$ or $16^{-\frac{1}{2}}$ or $9^{-\frac{1}{2}}$ (allow use of 1.3[33..])
				If not B3 then B2 for 2 of: correct fraction ($\frac{4}{3}$ or $1.\dot{3}$)(allow use of 1.3[33..]) or x term correct (x^2 on denominator or x^{-2} on numerator) or y term correct (y^5 on numerator or y^{-5} on denominator)
				If not B2 then **B1** for 1 of : correct fraction **or** x term correct **or** y term correct **or** for one of applying negative power to at least 3 out of 4 of $9, x^4, 16, y^{10}$ **or** applying square root to at least 3 out of 4 of $9, x^4, 16, y^{10}$ eg at least 3 of the 4 parts of $\frac{16y^{10}}{9x^4}$ **or** $\frac{16x^{-4}}{9y^{-10}}$ **or** $\frac{\frac{1}{9}x^{-4}}{\frac{1}{16}y^{-10}}$ **or** $\frac{3x^2}{4y^5}$ oe
				Total 3 marks

(**Q14 4MA1/2H, June 2021**)

Q101.

Q	Working	Answer	Mark	Notes	
	(definition of part: there are 3 parts: one part is the number, one part the letter t and one part the letter w Definition of terms: there are 6 terms: 2 number terms, 2 terms in t and 2 terms in w)		3	M1 indep	Fully correct cancellation of any two parts of their fraction at any stage of working
				M1 indep	correctly apply the negative power to the whole of their bracket (all parts or all terms) **or** correctly square all parts or terms of their bracket **or** correctly apply the negative power AND square of at least two parts (maybe 4 terms) of their bracket
		$4t^4w^2$		A1	Allow $(2t^2w)^2$ after the correct answer
	ALTERNATIVE				
		$4t^4w^2$	3	M2	2 correct terms (M1 for 1 correct term)
				A1	Allow $(2t^2w)^2$ after the correct answer
					Total 3 marks

(**Q11 4MA1/2H, Jan 2021**)

Q102.

Q	Working	Answer	Mark	Notes	
(a)		$16x^{12}y^{20}$	2	B2	B1 for an answer in the form ax^ny^m with 2 correct from $a = 16$, $n = 12$, $m = 20$
(b)(i)	$(x \pm 9)(x \pm 4)$		2	M1	for $(x \pm 9)(x \pm 4)$ **or** for $(x + a)(x + b)$ where $ab = -36$ or $a + b = 5$
		$(x + 9)(x - 4)$		A1	
(ii)		$-9, 4$	1	B1	ft from (b)(i)
					Total 5 marks

(**Q09 4MA1/1H, Jan 2021**)

Q103.

Q	Working	Answer	Mark	Notes
(a)	$\frac{4(x+1)-3(x-2)}{(x-2)(x+1)}$ or $\frac{4(x+1)}{(x-2)(x+1)}-\frac{3(x-2)}{(x-2)(x+1)}$		3	M1 for expressing both fractions correctly with a common denominator.
	$\frac{4x+4-3x+6}{(x-2)(x+1)}$ or $\frac{4x+4-3x+6}{x^2-x-2}$			M1 for removing brackets in a single fraction with a correct denominator. Allow denominator to be expanded. Allow one error in the expansion of the numerator.
		$\frac{x+10}{(x-2)(x+1)}$		A1 accept $\frac{x+10}{x^2-x-2}$ oe
(b)	$2x(x-5)=2x^2-10x$ or $2x(x-3)=2x^2-6x$ or $(x-5)(x-3)=x^2-5x-3x+15\left(=x^2-8x+15\right)$		3	M1 for multiplying $2x$ by a bracket with both terms correct or the 2 brackets with at least 3 out of 4 terms correct or at least 2 out of 3 terms correct
	$\left(2x^2-10x\right)(x-3)=2x^3-6x^2-10x^2+30x$ or $\left(2x^2-6x\right)(x-5)=2x^3-10x^2-6x^2+30x$ or $2x(x^2-5x-3x+15)=2x^3-10x^2-6x^2+30x$ or $2x\left(x^2-8x+15\right)=2x^3-16x^2+30x$			M1 (dep) for multiplying the product of $2x$ and the 1st bracket (ft from the 1st stage) by the 2nd bracket and getting at least 3 out of 4 terms correct or multiplying the product of the 2 brackets (ft from the 1st stage) by the $2x$, and getting at least 3 out of 4 or 2 out of 3 terms correct
		$2x^3-16x^2+30x$		A1
				Total 6 marks

(**Q12 4MA1/1H, Jan 2021**)

Q104.

Q	Working		Answer	Mark	Notes
	$(1-2y)^2-9y-(1-2y)=2y^2-12$	$x^2-9\left(\frac{1-x}{2}\right)-x=2\left(\frac{1-x}{2}\right)^2-12$		5	M1 substitution of linear equation into quadratic
	e.g. $2y^2-11y+12(=0)$ oe allow $2y^2-11y=-12$ oe	e.g. $x^2+9x+14(=0)$ oe allow $x^2+9x=-14$ oe			A1 (dep on M1) writing the correct quadratic expression in the form $ax^2+bx+c\ (=0)$ allow $ax^2+bx=c$
	e.g. $(2y-3)(y-4)(=0)$ $(y=)\frac{11\pm\sqrt{(-11)^2-4\times2\times12}}{2\times2}$ e.g. $2\left[\left(y-\frac{11}{4}\right)^2-\left(\frac{11}{4}\right)^2\right]=-12$ oe	e.g. $(x+7)(x+2)(=0)$ $(x=)\frac{-9\pm\sqrt{9^2-4\times1\times14}}{2}$ e.g. $\left(x+\frac{9}{2}\right)^2-\left(\frac{9}{2}\right)^2=-14$			M1 (dep on M1) for a complete method to solve their 3-term quadratic equation (allow one sign error and some simplification – allow as far as $\frac{11\pm\sqrt{121-72}}{4}$ or $\frac{-9\pm\sqrt{81-56}}{2}$)
	$y=\frac{3}{2}$ oe and $y=4$	$x=-7$ and $x=-2$			A1 (dep on M1) both x-values or both y-values
			$x=-2$, $y=\frac{3}{2}$ oe and $x=-7$, $y=4$		A1 (dep on first M1) must be paired correctly
					Total 5 marks

(**Q19 4MA1/1H, Jan 2021**)

Q105.

Q	Working		Answer	Mark	Notes
	$y = x - 3$	$x = y + 3$		6	B1 for correct rearrangement of linear equation
	eg $3x^2 - (x-3)^2 + x(x-3) = 9$	eg $3(3+y)^2 - y^2 + y(3+y) = 9$			M1 substitution of their linear equation into quadratic in x or y alone(even if B0 scored)
	eg $3x^2 + 3x - 18\ (= 0)$ **or** $x^2 + x - 6\ (= 0)$	eg $3y^2 + 21y + 18\ (= 0)$ **or** $y^2 + 7y + 6\ (= 0)$			M1ft from their substitution (dep on previous M1) for a complete correct method to get a 3-term or 2-term quadratic expression in the form $ax^2 + bx\ (+ c)\ (= 0)$ [allow $ax^2 + bx = c$]
	eg $(x-2)(x+3)\ (= 0)$ $x = \frac{-1 \pm \sqrt{1^2 - 4\times1\times-6}}{2\times1}$ eg $\left(x - \frac{1}{2}\right)^2 - \left(\frac{1}{2}\right)^2 = 6$	eg $(y+1)(y+6)\ (= 0)$ $y = \frac{-7 \pm \sqrt{7^2 - 4\times1\times6}}{2\times1}$ eg $\left(y - \frac{7}{2}\right)^2 - \left(\frac{7}{2}\right)^2 = -6$			M1 (dep on M1) for a complete method to solve their 3-term or 2- term quadratic equation $(ax^2 + bx\ (+ c) = 0)$ – correct factorisation or substitution into formula or completing square (allow one sign error and some simplification – allow as far as $\frac{-1 \pm \sqrt{1+24}}{2}$ or $\frac{-7 \pm \sqrt{49-24}}{2}$) or for seeing $x = 2, x = -3$ **or** $y = -1, y = -6$
	$x = -3, x = 2$ **and** $y = -1,\ y = -6$ or one correct midpoint coordinate ie $x = -\frac{1}{2}$ **or** $y = -\frac{7}{2}$				A1 (dep on M2) for $x = 2, x = -3$ **and** $y = -1, y = -6$ **or** one correct midpoint ie $x = -\frac{1}{2}$ or $y = -\frac{7}{2}$
	Working required		$\left(-\frac{1}{2}, -\frac{7}{2}\right)$		A1 (dep on M2) oe
					Total 6 marks

(**Q19 4MA1/2H, Nov 2021**)

Q106.

Q	Working		Answer	Mark	Notes
	$3x^2+(2x-3)^2-x(2x-3)=5$	$3\left(\frac{y+3}{2}\right)^2+y^2-y\left(\frac{y+3}{2}\right)=5$		5	M1 Correct substitution of x for y (or y for x)
	$5x^2-9x+4(=0)$ oe **or** $5x^2-9x=-4$	$5y^2+12y+7(=0)$ oe **or** $5y^2+12y=-7$			M1 for a correct equation in the form $ax^2+bx+c\ (=0)$ oe **or** $ax^2+bx=-c$
	$(5x-4)(x-1)(=0)$ or $(x=)\frac{9\pm\sqrt{(-9)^2-4\times5\times4}}{2\times5}$ or $5\left[\left(x-\frac{9}{10}\right)^2-\left(\frac{9}{10}\right)^2\right]+4(=0)$ [leading to x values of 0.8 and 1]	$(5y+7)(y+1)(=0)$ or $(y=)\frac{-12\pm\sqrt{12^2-4\times5\times7}}{2\times5}$ or $5\left[\left(y+\frac{6}{5}\right)^2-\left(\frac{6}{5}\right)^2\right]+7(=0)$ [leading to y values of -1.4 and -1]			M1ft dep on M1 for solving their quadratic equation using any correct method - if factorising, allow brackets which expanded give 2 out of 3 terms correct (if using formula or completing the square allow one sign error and some simplification – allow as far as $\frac{9\pm\sqrt{81-80}}{10}$ oe **or** $\frac{-12\pm\sqrt{144-140}}{10}$ oe **or** $5\left(x-\frac{9}{10}\right)^2-\frac{1}{20}$ oe **or** $5\left(y+\frac{6}{5}\right)^2-\frac{1}{5}$ oe
	$(y=)\ 2\times\text{“0.8”}-3$ **and** $2\times\text{“1”}-3$	$(x=)\ \frac{\text{“}-1.4\text{”}+3}{2}$ **and** $\frac{\text{“}-1\text{”}+3}{2}$			M1 dep on previous M1
			$x=0.8$ & $y=-1.4$ / $x=1$ & $y=-1$		A1 oe, for both solutions dep on M2
					Total 5 marks

(**Q19 4MA1/1H, Jan 2022**)

Q107.

Q	Working	Answer	Mark	Notes
	eg $4x + 8y = 60$ or $3x + 6y = 45$ $-\ 4x - 6y = 4$ $+\ 4x - 6y = 4$ $(14y = 56)$ $(7x = 49)$ eg $4x - 6\left(\frac{15 - x}{2}\right) = 4$ or $4(15 - 2y) - 6y = 4$ oe		3	M1 Correct method to eliminate x or y: coefficients of x or y the same **and** correct operator to eliminate selected variable (condone any one arithmetic error in multiplication) **or** correctly writing x or y in terms of the other variable and correctly substituting.
	eg $x + 2 \times 4 = 15$ or $7 + 2 \times y = 15$			M1 dep correct method to find second variable using their value from a correct method to find first variable or for repeating above method to find second variable.
	Working required	$x = 7$, $y = 4$		A1 dep on M1
				Total 3 marks

(**Q06 4MA1/1HR, Jan 2023**)

Q108.

Q	Working		Answer	Mark	Notes
	Elimination E.g. $21x-6y=102$ $21x+35y=-21$ $(-41y=123)$ or $35x-10y=170$ $6x+10y=-6$ $(41x=164)$	**Substitution** E.g. $3\left(\frac{34+2y}{7}\right)+5y=-3$ or $3x+5\left(\frac{7x-34}{2}\right)=-3$ or $7\left(\frac{-3-5y}{3}\right)-2y=34$ or $7x-2\left(\frac{-3-3x}{5}\right)=34$		4	M1 for a correct method to eliminate x or y: coefficients of x or y the same **and** correct operation to eliminate selected variable (condone 1 arithmetical error) **or** for correctly writing x or y in terms of the other variable and correctly substituting
					A1 dep on M1 for $x=4$ or $y=-3$
	E.g. $7x-2\times-3=34$				M1 dep on M1 for substitution of found variable **or** repeating the steps in first M1 for the second variable
			$x=4$ $y=-3$		A1 cao A correct answer without working scores no marks
					Total 4 marks

(**Q12 4MA1/1H, Nov 2020**)

Q109.

Q	Working		Answer	Mark	Notes
	$3y(2y+1)-y^2=8$ **or** $x=\frac{8+y^2}{3y} \rightarrow \frac{8+y^2}{3y}-2y=1$ **or** $\_3xy-y^2=8$ $3xy-3y\times 2y=3y\times 1$ oe	$3x\left(\frac{x-1}{2}\right)-\left(\frac{x-1}{2}\right)^2=8$ oe			M1 correct first step eg substitution by eg $x=1+2y$ or $y=\frac{x-1}{2}$ to get an equation in a single variable **or** writing 2nd equation with x the subject and substituting into 1st **or** multiplying 2nd equation by $3y$ and subtracting from 1st oe
	eg $5y^2+3y-8\ (=0)$	eg $5x^2-4x-33\ (=0)$			A1 for a correct simplified quadratic
	$(5y+8)(y-1)\ (=0)$ or $\frac{-3\pm\sqrt{3^2-4\times 5\times(-8)}}{2\times 5}$	$(5x+11)(x-3)\ (=0)$ or $\frac{4\pm\sqrt{(-4)^2-4\times 5\times(-33)}}{2\times 5}$			M1ft dep on M1 for solving their 3 term quadratic equation using any correct method (allow one sign error and some simplification – allow as far as $\frac{-3\pm\sqrt{9+160}}{10}$) or if factorising, allow brackets which expanded give 2 out of 3 terms correct)
	$y=-\frac{8}{5}$ and $y=1$ (both)	$x=-\frac{11}{5}$ and $x=3$ (both)		5	A1 dep on first M1
			$x=-\frac{11}{5}, y=-\frac{8}{5}$ $x=3, y=1$		A1 oe dep on first M1 Must be paired correctly
					Total 5 marks

(**Q16 4MA1/2H, Nov 2020**)

Q110.

Q	Working	Answer	Mark	Notes
	eg $6x + 10y = 6.2$ _ $6x + 3y = 3.75$ $7y = 2.45$ eg $30x + 15y = 18.75$_ $9x + 15y = 9.3$ $21x = 9.45$ **or** eg $6\left(\frac{3.1-5y}{3}\right)+3y=3.75$		3	M1 for correct method to eliminate one variable – multiplying one or both equations so the coefficient of x or y is the same in both (condone one arithmetic error), with the intention to subtract all 3 terms to eliminate one variable (intention to subtract is clearly showing a minus sign or subtracting 2 or 3 out of 3 terms) **or** isolating x or y in one equation and substituting into the other
	eg. $6 \times$ "0.45" $+ 3y = 3.75$ or $3 \times$ "0.45" $+ 5y = 3.1$ **or** $3x + 5 \times$ "0.35" $= 3.1$ or $6x + 3 \times$ "0.35" $= 3.75$			M1 dep. Substitute found value into one equation **or** correct method to eliminate second unknown.
		$x = 0.45$ oe $y = 0.35$ oe		A1 dep M1
				Total 3 marks

(**Q10 4MA1/2H, Jan 2022**)

Q111.

Q	Working		Answer	Mark	Notes
	eg $5x + 4y = -2$ $+ 8x - 4y = 17.6$ $(13x = 15.6)$ eg $[x = \frac{4.4 + y}{2}]$ oe $5\left(\frac{4.4 + y}{2}\right) + 4y = -2$ oe	eg $10x + 8y = -4$ $- 10x - 5y = 22$ $(13y = -26)$ eg $[y = 2x - 4.4]$ oe $5x + 4(2x - 4.4) = -2$ oe		3	M1 multiplication of one or both equation(s) with correct operation selected (allow one arithmetic error) (if + or − is not shown then assume it is the operation that at least 2 of the 3 terms have been calculated for) **or** correct rearrangement of one equation with substitution into second
	eg $5 \times$ "1.2" $+ 4y = -2$ **or** $2 \times$ "1.2" $- y = 4.4$	eg $5x + 4 \times$ "−2" $= 4.4$ **or** $2x -$ "−2" $= 4.4$			M1 (dep on previous M1 but not on a correct first value) correct method to find second unknown – this could be a correct substitution into one of the equations given or calculated or starting again with the same style of working as for the first method mark
	Working required		$x = 1.2$ $y = -2$		A1 oe eg $x = \frac{6}{5}$ for both solutions dependent on first M1
					Total 3 marks

(**Q07 4MA1/2H, Jan 2023**)

Q112.

Q	Working		Answer	Mark	Notes
	$x^2+(7-2x)^2=34$	$\left(\frac{7-y}{2}\right)^2+y^2=34$		5 M1	substitution of linear equation into quadratic
	$5x^2-28x+15[=0]$ oe	$5y^2-14y-87[=0]$ oe			M1 dep on previous M1 for multiplying out and collecting terms, forming a three term quadratic in any form of $ax^2+bx+c\ (=0)$ **where at least 2 coefficients** (a or b or c) **are correct** and all are non-zero
	$(5x-3)(x-5)\ [=0]$ or $\frac{-(-28)\pm\sqrt{(-28)^2-4\times5\times15}}{2\times5}$ or $5[(x-\frac{28}{10})^2-\frac{784}{100}]+15=0$ oe or $x=0.6$ **and** $x=5$ (allow incorrect labels for x/y)	$(5y-29)(y+3)\ [=0]$ or $\frac{-(-14)\pm\sqrt{(-14)^2-4\times5\times(-87)}}{2\times5}$ or $5[(y-\frac{14}{10})^2-\frac{196}{100}]-87=0$ oe or $y=5.8$ **and** $y=-3$ (allow incorrect labels for x/y)			M1ft dep on M1 for solving *their* 3 term quadratic equation using any correct method (if factorising, allow brackets which expanded give 2 out of 3 terms correct) (if using formula allow one sign error and some simplification – allow as far as $\frac{28\pm\sqrt{784-300}}{10}$ or $\frac{14\pm\sqrt{196+1740}}{10}$) (if completing the square allow as far as shown) or **correct values for x or correct values for y dep on correct quadratic**
	eg $y=7-2\times5$ and $y=7-2\times0.6$ (correct labels for x/y)	eg $5.8=7-2x$ and $-3=7-2x$ (correct labels for x/y)			M1ft dep on previous M1 for substituting **their** 2 found values of x or y in a suitable equation **or** correct values for the other variable
	Working must be shown		$x=0.6$, $y=5.8$ $x=5$, $y=-3$	A1	dep on M1 and **the correct quadratic** (allow coordinates) must be paired correctly

(**Q20 4MA1/2H, Jan 2023**)

Q113.

Q	Working	Answer	Mark	Notes
	eg $2(-3-2x)^2+x^2=-6x+42$	eg $2y^2+\left(\frac{-3-y}{2}\right)^2=-6\left(\frac{-3-y}{2}\right)+42$	5	M1 substitution of $y=\pm3\pm2x$ (or $x=\frac{\pm3\pm y}{2}$) into $2y^2+x^2=-6x+42$ to obtain an equation in x only (or y only)
	eg $9x^2+30x-24(=0)$ **or** $3x^2+10x-8(=0)$ allow eg $3x^2+10x=8$	eg $\frac{9}{4}y^2-\frac{3}{2}y-\frac{195}{4}(=0)$ **or** $9y^2-6y-195(=0)$ **or** $3y^2-2y-65(=0)$ allow eg $3y^2-2y=65$		M1 ft (dep on previous M1) for multiplying out and collecting terms, forming a three term quadratic in any form of $ax^2+bx+c\ (=0)$ where at least 2 coefficients (a or b or c) are correct
	eg $(3x-2)(x+4)(=0)$ **or** $\frac{-10\pm\sqrt{10^2-4\times3\times-8}}{2\times3}$ **or** $3\left[\left(x+\frac{5}{3}\right)^2-\left(\frac{5}{3}\right)^2\right]=8$ oe (should give $(x=)\frac{2}{3}, -4$)	eg $(3y+13)(y-5)(=0)$ **or** $\frac{2\pm\sqrt{(-2)^2-4\times3\times-65}}{2\times3}$ **or** $3\left[\left(y-\frac{1}{3}\right)^2-\left(\frac{1}{3}\right)^2\right]=65$ oe (should give $(y=)-\frac{13}{3}, 5$)		M1 ft (dep on M1) method to solve **their** 3 term quadratic using any correct method (allow one sign error and some simplification – allow as far as eg $\frac{-10\pm\sqrt{100+96}}{6}$ **or** $\frac{2\pm\sqrt{4+780}}{6}$) **or** if factorising allow brackets which expanded give 2 out of 3 terms correct) **or** correct values for x (allow 0.66(6…) or 0.67) **or** correct values for y (allow −4.33(3…))
	eg $2\left("\frac{2}{3}"\right)+y=-3$ **and** $2("-4")+y=-3$	eg $2x+"-\frac{13}{3}"=-3$ **and** $2x+"5"=-3$		M1 (dep on previous M1) for substituting **their** 2 found values of x or y in a suitable equation (use 2dp or better for substitution) **or** fully correct values for the other variable (correct labels for x / y)
	Working required	$x=-4, y=5$ and $x=\frac{2}{3}, y=-\frac{13}{3}$		A1 oe (dep on M1) and a correct quadratic (allow coordinates) allow $x=0.66(6\ldots)$ or 0.67, $y=-4.33(3\ldots)$, $x=-4, y=5$
				Total 5 marks

(**Q22 4MA1/2HR, Jan 2023**)

Q114.

Q	Working		Answer	Mark	Notes
	Elimination eg $9x-15y=75$ $20x+15y=70$ + $(29x=145)$ or $12x-20y=100$ $12x+9y=42$ − $(-29y=58)$	**Substitution** eg $4\left(\frac{25+5y}{3}\right)+3y=14$ or $4x+3\left(\frac{25-3x}{-5}\right)=14$ or $3\left(\frac{14-3y}{4}\right)-5y=25$ or $3x-5\left(\frac{14-4x}{3}\right)=25$		4	M1 for a correct method to eliminate x or y: coefficients of x or y the same **and** correct operation to eliminate selected variable (condone 1 arithmetical error) **or** for correctly writing x or y in terms of the other variable and correctly substituting
					A1 dep on M1 for $x = 5$ **or** $y = -2$
	eg $3x - 5 \times$ "-2" $= 25$ **or** $4x + 3 \times$ "-2" $= 14$ **or** $3 \times$ "5" $- 5y = 25$ **or** $4 \times$ "5" $+ 3y = 14$				M1 dep on M1 for substitution of found variable **or** repeating the steps in first M1 for the second variable
			$x = 5$ $y = -2$		A1 cao, dep on M1 a correct answer without working scores no marks
					Total 4 marks

(**QU14 4MA1/1HR, June 2022**)

Q115.

Q	Working		Answer	Mark	Notes
	$(3+2y)^2-y^2+2(3+2y)=10$	$x^2-\left(\frac{x-3}{2}\right)^2+2x=10$		5 M1	for using correct substitution of a linear equation into the quadratic – all terms shown correctly
	eg $3y^2+16y+5(=0)$	eg $3x^2+14x-49(=0)$ $3x^2+14x=49$		A1	for a correct 3 term quadratic
	eg $(3y+1)(y+5)(=0)$ **or** $\frac{-16\pm\sqrt{16^2-4\times3\times5}}{2\times3}$ **or** $3\left[\left(y+\frac{8}{3}\right)^2-\left(\frac{8}{3}\right)^2\right]+5=0$ (should give $(y=)-\frac{1}{3}, -5$)	eg $(3x-7)(x+7)(=0)$ **or** $\frac{-14\pm\sqrt{14^2-4\times3\times(-49)}}{2\times3}$ **or** $3\left[\left(x+\frac{7}{3}\right)^2-\left(\frac{7}{3}\right)^2\right]-49=0$ (should give $(x=)\frac{7}{3}, -7$)		M1	dep on M1 method to solve **their** 3 term quadratic using any correct method (allow one sign error and some simplification – allow as far as eg $\frac{-16\pm\sqrt{256-60}}{6}$ **or** $\frac{-14\pm\sqrt{196+588}}{6}$ or if factorising allow brackets which expanded give 2 out of 3 terms correct) **or** correct values for x **or** correct values for y
	eg $x=3+2\times-5$ and $x=3+2\times-\frac{1}{3}$	eg $\frac{7}{3}-2\times y=3$ $-7-2\times y=3$		M1ft	dep on previous M1 for substituting **their** 2 found values of x or y in a suitable equation (use 2dp or better for substitution) **or** fully correct values for the other variable (correct labels for x / y)
			$x=\frac{7}{3}, y=-\frac{1}{3}$ $x=-7, y=-5$	A1	dep on M1 (allow coordinates) must be paired correctly allow $x=-7, y=-5$ $x=2.33(3\ldots), y=-0.33(3\ldots)$
					Total 5 marks

(**QU21 4MA1/2HR, June 2022**)

Q116.

Question	Working	Answer	Mark	Notes
	$x^2+(x+2)^2-2(x+2)=24$		5 M1	for substituting linear equation into the quadratic equation
	$2x^2+2x-24$ (=0) or x^2+x-12 (=0) or $2x^2+2x=24$ or $x^2+x=12$		A1	for a correct equation in the form $ax^2+bx+c=0$ or $ax^2+bx=-c$
	$(x+4)(x-3)$ (= 0) or $x=\frac{-1\pm\sqrt{1^2-(4\times1\times-12)}}{2\times1}$ or $\left(x-\frac{1}{2}\right)^2-\left(\frac{1}{2}\right)^2-12=0$		M1ft	dep on M1 for solving their quadratic equation using any correct method (allow one sign error and some simplification – allow as far as $\frac{-1\pm\sqrt{1+48}}{2}$) or if factorising, allow brackets which expanded give 2 out of 3 terms correct)
	$x=-4$ and $x=3$		A1	for both x values dep on M1
	(−4, −2) and (3, 5)	(−4, −2) and (3, 5)	A1	for both solutions dep on M1

Question	Working	Answer	Mark	Notes	
Alternative mark scheme					
	$(y-2)^2+y^2-2y=24$		5	M1	for substituting linear equation into the quadratic equation
	$2y^2-6y-20$ (=0) or $y^2-3y-10$ (=0) $2y^2-6y=20$ or $y^2-3y=10$			A1	for a correct equation in the form $ay^2+by+c=0$ or $ay^2+by=-c$
	$(y-5)(y+2)=0$ or $y=\frac{--3\pm\sqrt{(-3)^2-(4\times1\times-10)}}{2\times1}$ or $\left(y-\frac{3}{2}\right)^2-\left(\frac{3}{2}\right)^2-10=0$			M1ft	dep on M1 for solving their quadratic equation using any correct method (allow one sign error and some simplification – allow as far as $\frac{3\pm\sqrt{9+40}}{2}$) or if factorising, allow brackets which expanded give 2 out of 3 terms correct
	$y=5$ and $y=-2$			A1	for both y values dep on M1
	(–4, –2) and (3, 5)	(–4, –2) and (3, 5)		A1	for both solutions dep on M1
					Total 5 marks

(**Q22 4MA1/2H, Jan 2020**)

Q117.

Q	Working		Answer	Mark	Notes
	eg $10a + 4c = 20$ $+ \ 2a - 4c = 7$ eg $[c = \frac{10-5a}{2}]$ oe $2a - 4\left(\frac{10-5a}{2}\right) = 7$ oe	eg $10a + 4c = 20$ $- \ 10a - 20c = 35$ eg $[a = \frac{7+4c}{2}]$ oe $5\left(\frac{7+4c}{2}\right) + 2c = 10$ oe		3	M1 multiplication of one or both equation(s) with correct operation selected (allow one arithmetic error) (if + or − is not shown then assume it is the operation that at least 2 of the 3 terms have been calculated for) **or** correct rearrangement of one equation with substitution into second
	eg $5 \times$ "2.25" $+ 2c = 10$ **or** $2 \times$ "2.25" $- 4c = 7$	eg $5a + 2 \times$ "−0.625" $= 10$ **or** $2a - 4 \times$ "−0.625" $= 7$			M1 (dep on previous M1 but not on a correct first value) correct method to find second unknown – this could be a correct substitution into one of the equations given or calculated or starting again with the same style of working as for the first method mark
	Working required		$a = 2.25$ $c = -0.625$		A1 oe eg $a = \frac{9}{4}$, $c = -\frac{5}{8}$ for both solutions dependent on first M1
					Total 3 marks

(**Q08 4MA1/2H, June 2021**)

Q118.

Q	Working		Answer	Mark	Notes
	$x^2+(3-2x)^2=18$	$\left(\frac{3-y}{2}\right)^2+y^2=18$		5	M1 substitution of linear equation into quadratic
	$5x^2-12x-9[=0]$ oe	$5y^2-6y-63[=0]$ oe			M1 simplified to a correct 3 term quadratic
	$(5x+3)(x-3)$ [= 0] $\frac{-(-12)\pm\sqrt{(-12)^2-4\times5\times(-9)}}{2\times5}$ $5[(x-\frac{12}{10})^2-\frac{144}{100}]-9=0$ oe	$(5y-21)(y+3)$ [= 0] $\frac{-(-6)\pm\sqrt{(-6)^2-4\times5\times(-63)}}{2\times5}$ $5[(y-\frac{6}{10})^2-\frac{36}{100}]-63=0$ oe			M1ft dep on M1 for solving *their* 3 term quadratic equation using any correct method (if factorising, allow brackets which expanded give 2 out of 3 terms correct) (if using formula allow one sign error and some simplification – allow as far as $\frac{12\pm\sqrt{144+180}}{10}$ or $\frac{6\pm\sqrt{36+1260}}{10}$) (if completing the square allow as far as shown)
			$x=-0.6$ **and** $x=3$ **OR** $y=4.2$ **and** $y=-3$		A1 oe dep on M2 for both x-values **OR** both y-values
	Working must be shown		$x=-0.6$, $y=4.2$ $x=3$, $y=-3$		A1 oe dep on M2 (must be clearly shown as correct pairs), accept answers given as coordinates
					Total 5 marks

(**Q19 4MA1/2H, June 2021**)

Q119.

Q	Working	Answer	Mark	Notes
	$6-12x$ or $2-4x=\frac{5}{3}-\frac{8}{3}x$		3	M1 for expansion of bracket on the LHS or dividing the RHS by 3 with two terms
	$6-5=12x-8x$ or $1=4x$ or $-12x+8x=5-6$ oe or $-4x=-1$ or $\frac{8}{3}x-4x=\frac{5}{3}-2$ oe or $2-\frac{5}{3}=-\frac{8}{3}x+4x$ oe			M1 ft (dep on 4 terms) for terms in x on one side of equation; number terms on the other
	Working required	$\frac{1}{4}$		A1 oe dep on M1 awarded
				Total 3 marks

(**Q02 4MA1/1H, Jan 2023**)

Q120.

Q	Working	Answer	Mark	Notes
	eg $20\times\frac{x+3}{4}-20\times\frac{7-x}{5}$ $=20\times4.3$ or eg $5(x+3)-4(7-x)=20\times4.3$ or eg $\frac{5(x+3)}{20}-\frac{4(7-x)}{20}(=4.3)$ or eg $\frac{5(x+3)-4(7-x)}{20}(=4.3)$		3	M1 For clear intention to multiply all terms by 20 (or 4×5) or a multiple of 20 oe or to express LHS as two fractions over 20 (or 4×5) or a multiple of 20 oe or as a single fraction with a denominator of 20 (or 4×5) or a multiple of 20 oe if expanded numerator, allow one error
	eg $5x+15-28+4x=4.3\times20$ oe eg $9x-13=86$ eg $9x=99$			M1 Expanding brackets and multiplying by denominator with no more than one error in total from multiplying out brackets [we must see 4.3×20 or 86 accurately]
	Working required	11		A1 dep on M1
				Total 3 marks

(**Q13 4MA1/2H, Jan 2023**)

Q121.

Q	Working	Answer	Mark	Notes
(i)	$(x \pm 6)(x \pm 4)$		2	M1 or $(x + a)(x + b)$ where $ab = -24$ **or** $a + b = 2$
	Working not required, so correct answer scores full marks	$(x + 6)(x - 4)$		A1
(ii)	*Answer must come from the factors in (i) as the questions says 'Hence solve…'*	$-6, 4$	1	B1 **Must** follow through from their factors in (i), so even if the answers 8 and −6 are given, the mark can only be awarded if it follows from the factorisation in (i) (dep on 2 factors)
				Total 3 marks
				NB: Some students may show the whole of their working in the space for (i) or (ii). Please award the marks for (i) and (ii) so long as there is no ambiguity.

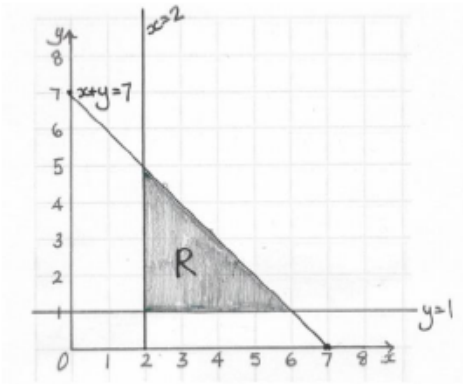
(**Q09 4MA1/2H, June 2021**)

Q122.

Q	Working	Answer	Mark	Notes
	$(6x - 5)(x + 7)(=0)$ **or** $\frac{-37 \pm \sqrt{37^2 - 4\times6\times-35}}{2\times6}$ $6\left[\left(x+\frac{37}{12}\right)^2 - \left(\frac{37}{12}\right)^2\right]$ … oe		3	M1 A correct method to solve the quadratic equation $6x^2 + 37x - 35(= 0)$ using any correct method (if factorising, allow brackets which expanded give 2 out of 3 terms correct) (if using formula allow one sign error in substitution and some simplification – allow as far as $\frac{-37 \pm \sqrt{1369 + 840}}{12}$) or completing the square as far as shown on left
	$\frac{5}{6}$ oe **and** -7			A1 dep on M1 correct critical values (allow 0.83…)
	Working must be seen for both accuracy marks as asked for in question	$-7 \le x \le \frac{5}{6}$		A1 dep on M1 oe eg $-7 \le x \le 0.83\ldots$, $\left[-7, \frac{5}{6}\right]$ Accept $x \le \frac{5}{6}$, $x \ge -7$
				Total 3 marks

(**Q22 4MA1/2H, Jan 2023**)

Q123.

Q	Working	Answer	Mark	Notes
(a)(i) (ii) (iii)	 Line length 2cm + but shaded area must be enclosed for the mark in (b)		3	B1 $y = 1$ drawn B1 $x = 2$ drawn B1 $x + y = 7$ drawn Allow dashed lines or solid lines for graphs **condone lack of labels if unambiguous**
(b)			1	B1 correct region indicated – shaded in or out – labelled **R** or clear intention to be the required region (ft only for one vertical line, one horizontal line and one line with a negative gradient)
				Total 4 marks

(**QU02 4MA1/2H, June 2022**)

Q124.

Q	Working	Answer	Mark	Notes
	e.g. $40+8\sqrt{x}-5\sqrt{x}-\sqrt{x}\sqrt{x}$ **or** $40+8\sqrt{x}-5\sqrt{x}-\left(\sqrt{x}\right)^2$ **or** $40+8\sqrt{x}-5\sqrt{x}-x$ **or** $40+3\sqrt{x}-x$		3	M1 for a correct expansion with at least 3 out of 4 terms correct oe or all 3 terms correct
		$x = 19$		A1 (dep on M1) for $x = 19$
		$y = 3$		B1 for $y = 3$
				Total 3 marks

(**Q18 4MA1/1H, Jan 2021**)

Q125.

Q	Working	Answer	Mark	Notes
	$\left(\frac{8}{\sqrt{5}-1}\right)\times\frac{\sqrt{5}+1}{\sqrt{5}+1}$ **or** $\frac{8\left(\sqrt{5}+1\right)}{4}$ **or** $\frac{8\sqrt{5}+8}{4}$ oe		3	M1 for rationalising the denominator – award for seeing intention to multiply by $\frac{\sqrt{5}+1}{\sqrt{5}+1}$ **or** $\frac{-\sqrt{5}-1}{-\sqrt{5}-1}$
	Working required	$2\sqrt{5}+2$		A1 from correct working
		$\sqrt{20}+2$		B1ft for $k\sqrt{5}+c=\sqrt{5k^2}+c$ where $5k^2$ is a single integer Accept $a=20$ and $b=2$
				Total 3 marks

(**Q17 4MA1/2H, Nov 2021**)

Q126.

Q	Working	Answer	Mark	Notes
	$\sqrt{3}x-x=6+2\sqrt{3}$ oe or $x-x\sqrt{3}=-6-2\sqrt{3}$ (allow $-2\sqrt{9}$ or $-2(\sqrt{3})^2$ for -6 or $2\sqrt{9}$ or $2(\sqrt{3})^2$ for 6)		4	M1 expanding bracket and collecting terms. Condone one error
	$(x=)\ \frac{6+2\sqrt{3}}{\sqrt{3}-1}$ oe eg $\frac{-6-2\sqrt{3}}{1-\sqrt{3}}$			A1 oe must be a correct fraction with irrational numerator and denominator
	$(x=)\ \frac{(6+2\sqrt{3})}{(\sqrt{3}-1)}\times\frac{(\sqrt{3}+1)}{(\sqrt{3}+1)}$ or $\frac{(6+2\sqrt{3})(\sqrt{3}+1)}{2}$ oe or $\frac{\left(6+2\sqrt{3}\right)}{\left(-1+\sqrt{3}\right)}\times\frac{\left(-1-\sqrt{3}\right)}{\left(-1-\sqrt{3}\right)}$ oe or $\frac{\left(-6-2\sqrt{3}\right)\left(1+\sqrt{3}\right)}{\left(1-\sqrt{3}\right)\left(1+\sqrt{3}\right)}$ oe			M1 (indep) Multiplying the numerator and denominator of their fraction by $\sqrt{3}+1$ oe or showing 2 or -2 as the denominator and multiplying the numerator by $\sqrt{3}+1$ oe or rationalising **their** denominator, so long as it is of the form $p+q\sqrt{3}$ where p and q are non zero integers (condone missing brackets provided meaning is clear)
	Working required	$6+4\sqrt{3}$		A1 dep on M1A1M1 with no errors seen
				Total 4 marks

(**Q18 4MA1/1HR, Jan 2023**)

Q127.

Q	Working		Answer	Mark	Notes
	$(\sqrt{2}-1)^2=2-\sqrt{2}-\sqrt{2}+1\left(=3-2\sqrt{2}\right)$	$\frac{(3+\sqrt{8})}{(\sqrt{2}-1)^2}\times\frac{(\sqrt{2}+1)^2}{(\sqrt{2}+1)^2}$		4 M1	expand the denominator (accept $2-2\sqrt{2}+1$ - must see expansion) **OR** method to rationalise using $(\sqrt{2}+1)^2$
	$\frac{\left(3+\sqrt{8}\right)}{"\left(3-2\sqrt{2}\right)"}\times\frac{\left(3+2\sqrt{2}\right)}{\left(3+2\sqrt{2}\right)}$	$(\sqrt{2}-1)^2=$ $2-\sqrt{2}-\sqrt{2}+1$ $\left(=3-2\sqrt{2}\right)$ **or** $(\sqrt{2}+1)^2=$ $2+\sqrt{2}+\sqrt{2}+1$ $\left(=3+2\sqrt{2}\right)$ **or** $(\sqrt{2}-1)(\sqrt{2}+1)=$ $2-\sqrt{2}+\sqrt{2}-1(=1)$			M1 oe ft $3-2\sqrt{2}$ method to rationalise **OR** expansion of $(\sqrt{2}-1)^2$ (accept $2-2\sqrt{2}+1$) **or** $(\sqrt{2}+1)^2$ (accept $2+2\sqrt{2}+1$) **or** $(\sqrt{2}-1)(\sqrt{2}+1)$
	eg $\frac{9+6\sqrt{2}+3\sqrt{8}+8}{9-6\sqrt{2}+6\sqrt{2}-8}$ **or** $\frac{9+12\sqrt{2}+8}{9-8}$ **or** $\frac{9+6\sqrt{2}+3\sqrt{8}+8}{1}$ **or** $\frac{9+12\sqrt{2}+8}{1}$				M1 dep on 2nd M1 correct expansion of brackets
			$17+\sqrt{288}$		A1 or $p=17$, $q=288$ answer from fully correct working with intermediate steps of working seen
					Total 4 marks

(**QU21 4MA1/1HR, June 2022**)

Q128.

Q	Working	Answer	Mark	Notes
	eg $\frac{\sqrt{12}}{\sqrt{3}+2}\times\frac{\sqrt{3}-2}{\sqrt{3}-2}$		3	M1 rationalise denominator – award for seeing multiplication by $\frac{\sqrt{3}-2}{\sqrt{3}-2}$ or $\frac{-\sqrt{3}+2}{-\sqrt{3}+2}$
	eg $\frac{\left(\sqrt{36}-2\sqrt{12}\right)}{3-4}$ or $\frac{6-2\sqrt{12}}{-1}$ or $\frac{6-4\sqrt{3}}{-1}$ or $-6+4\sqrt{3}$ or $-6+2\sqrt{12}$			M1 dep M1 correctly simplifying numerator and denominator. (denominator could be $3-4$ or -1)
		$-6+\sqrt{48}$		A1 dep M2 must be in correct form (including $\sqrt{48}$) allow $a=-6$ and $b=48$
				Total 3 marks

(**Q17 4MA1/2H, Jan 2022**)

Q129.

Question		Working	Answer	Mark	Notes
	(a)	$6\times6+6\times2\sqrt{12}+6\times2\sqrt{12}+\left(2\times\sqrt{12}\right)^2$ or $36+12\sqrt{12}+12\sqrt{12}+4\sqrt{12}\sqrt{12}$ or $36+12\sqrt{12}+12\sqrt{12}+(4\times12)$ or $36+24\sqrt{3}+24\sqrt{3}+48$ or $36+2\times24\sqrt{3}+48$ or $36+6\times2\times2\sqrt{12}+48$		3	M1 for correct expansion of brackets showing **four** terms (need not be simplified) **or** for the use of $(a+b)^2=a^2+2ab+b^2$ **or** for showing or stating $\sqrt{12}=2\sqrt{3}$ oe
		$84+48\sqrt{3}$			M1 (dep on M1)
			Shown		A1 for fully correct working leading to given expression

Question		Working	Answer	Mark	Notes
	(b)	E.g. $\left(\frac{3a^4}{t^5}\right)^{-2}$ or $\left(\frac{t^{15}}{27a^{12}}\right)^{\frac{2}{3}}$ or $\left(\frac{729a^{24}}{t^{30}}\right)^{-\frac{1}{3}}$		3	M1 for one of cube rooting or inverting or squaring or $\frac{ka^{-8}}{t^{-10}}$ where k is an integer $\neq 0$
		E.g. $\left(\frac{9a^8}{t^{10}}\right)^{-1}$ or $\frac{3^{-2}a^{-8}}{t^{-10}}$ or $\frac{\frac{1}{9}a^{-8}}{t^{-10}}$ or $\left(\frac{t^5}{3a^4}\right)^2$ or $\left(\frac{t^{30}}{729a^{24}}\right)^{\frac{1}{3}}$ or $\frac{a^{-8}}{9t^{-10}}$			M1 for two of cube rooting or inverting or squaring or $\frac{t^{10}}{ka^8}$ where k is an integer $\neq 0$
			$\frac{t^{10}}{9a^8}$		A1 Allow $\frac{t^{10}a^{-8}}{9}$ or $\frac{1}{9}t^{10}a^{-8}$
					Total 6 marks

(**Q17 4MA1/1H, Jan 2020**)

Q130.

Q	Working	Answer	Mark	Notes
(a)		1	1	B1
(b)		$27a^6b^{12}$	2	B2 (B1 for 2 of 3 parts in a product)
(c)		$7x^2y^2(2y^2+3x)$	2	B2 B1 for a correct factorisation with at least 2 factors outside (eg $7x$, x^2, xy, etc) eg $7x(2xy^4+3x^2y^2)$ eg $x^2y^2(14y^2+21x)$ or for the correct common factor with just one mistake inside the bracket eg $7x^2y^2(2y+3x)$ which is missing the squared on the y term
(d)	$y=mx+4$ where $m\neq 0$ oe (eg $y=2x+4$) **or** $y=-2x+c$ or $y+2x=c$ oe **or** $-2x+4$ or $f(x)=-2x+4$ oe		2	M1
	Correct answer scores full marks (unless from obvious incorrect working)	$y=-2x+4$		A1 oe eg $y+2x=4$
				Total 7 marks

(**Q09 4MA1/2H, Jan 2023**)

Q131.

Q	Working	Answer	Mark	Notes
(a)		$\frac{9}{10}$	1	B1 oe
(b)		-6	1	B1
				Total 2 marks

(**Q12 4MA1/1H, Jan 2023**)

Q132.

Q	Working	Answer	Mark	Notes
	$\frac{(5x-8)(5x+8)}{(5x+2)(x-3)} \times \frac{(x-5)(x-3)}{5x+8}$ or eg $\frac{(5x-8)(x-5)}{(5x+2)}(-(x-7))$		4	M2 For factorising at least 2 of the quadratics correctly – could be implied by 2 factors cancelled correctly (M1 For factorising at least 1 of the 3 quadratics correctly)
	$\frac{(5x-8)(x-5)-(x-7)(5x+2)}{5x+2}$ oe or $\frac{5x^2-25x-8x+40-(5x^2-35x+2x-14)}{5x+2}$ oe or $\frac{(25x^2-64)(x^2-8x+15)-(x-7)(5x^2-13x-6)(5x+8)}{(5x^2-13x-6)(5x+8)}$ oe or $\frac{(5x-8)(x^2-8x+15)-(x-7)(5x+2)(x-3)}{(5x+2)(x-3)}$ oe or $\frac{(25x^2-64)(x-5)-(x-7)(5x+2)(5x+8)}{(5x+2)(5x+8)}$ oe			M1 (indep (ft if M2 awarded)) For writing the fractions over a common denominator with or without brackets removed – need not be in simplest form Could be written as 2 separate fractions over a common denominator
		$\frac{54}{5x+2}$		A1 dep on M3
				Total 4 marks

(**Q21 4MA1/2H, Jan 2021**)

Q133.

Q	Working	Answer	Mark	Notes
	$[x=]\ \dfrac{5}{9\left(\dfrac{5}{5a-2}\right)+5}$ oe **or** $y=\dfrac{5}{9x}-\dfrac{5}{9}$ oe		4	M1 A correct substitution for y **or** writing y in terms of x
	$[x=]\ \dfrac{5(5a-2)}{45+5(5a-2)}$ oe **or** $(5-5x)(5a-2)=45x$ oe **or** $9x=\dfrac{5(45a-18)}{35+25a}$ oe			M1 Multiplying each term in the numerator and denominator by $(5a-2)$ to eliminate the fraction in the denominator **or** equating y's and getting rid of fractions as far as shown on left **or** single fraction in terms of a
	$[x=]\ \dfrac{25a-10}{35+25a}$ oe **or** $[x=]\ \dfrac{5(5a-2)}{5(7+5a)}$			M1 A correct fraction not in simplest form with all brackets expanded **or** numerator and denominator factorised with the same common factor taken out
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$x=\dfrac{5a-2}{7+5a}$		A1 Correctly simplified $x=$ needed for the answer, or $x=$ previously seen in working with correct simplified expression Do not isw if students have tried to do some incorrect cancelling eg $x=\dfrac{5a-2}{7+5a}=\dfrac{-2}{7}$ gets M3A0
				Total 4 marks

(**Q21 4MA1/1H, June 2021**)

Q134.

Q	Working	Answer	Mark	Notes
(a)		1	1	B1
(b)(i)	$(x\pm4)(x\pm9)(=0)$		2	M1 or $(x+a)(x+b)$ where $ab=-36$ **or** $a+b=-5$
	Correct answer scores full marks (unless from obvious incorrect working)	$(x+4)(x-9)$		A1 (isw if they also solve the equation in this part)
(ii)	*Answers must ft from (b)(i)*	-4 and 9	1	B1 ft Answer **must** ft from their $(x+p)(x+q)$ in (b)(i) Award B0 for -4 and 9 if no marks scored in (i)
				Total 4 marks

(**Q08 4MA1/2H, Nov 2021**)