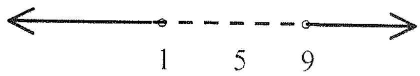
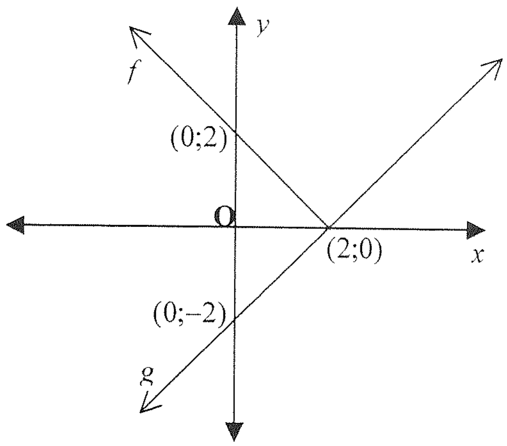
1.1				
	1.1.1	$5x(x-2)=2$ $5x^2-10x-2=0$ $\Delta=10^2-4(5)(-2)$ $=140$ which is not a perfect square $\therefore$ roots not rational. **OR** $5x(x-2)=2$ $5x^2-10x-2=0$ $x=\frac{-(-10)\pm\sqrt{140}}{10}$ but 140 is not a perfect square / $\sqrt{140}$ is irrational $\therefore$ roots not rational	(4)	✓Standard form [must have an equation, else penalty of 1 mark – **only in this question**] ✓Use of Δ ✓Value of Δ ✓"not a perfect square" ✓Standard form ✓x in surd form ✓✓" but 140 is not a perfect square / $\sqrt{140}$ is irrational" [CA if wrong Δ] **Note**: If candidate calculates x as 2,18 or - 0,18 and then concludes roots not rational, then award only 2 out of 4 marks [the first 2 marks] .
	1.1.2	$x=\frac{-(-10)\pm\sqrt{140}}{10}$ $x=2{,}18$ or $-0{,}18$ **OR** Answers only **OR** $5x(x-2)=2$ $5x^2-10x-2=0$ $\therefore x^2-2x+1=\frac{2}{5}+1$ $\therefore (x-1)^2=1{,}4$ $\therefore x=1+\sqrt{1{,}4}$, $x=1-\sqrt{1{,}4}$ $x=2{,}18$ or $x=-0{,}18$	(4)	✓Choice of formula ✓Substitution in formula ✓✓Each value of x 2 marks per solution ✓Standard form ✓Completing the square ✓✓Each value of x **Note**: penalise max of 1 mark for incorrect rounding off **in this question only**.

1.2				
	1.2.1	$(2x-5)^2 - 49x^2 = 0$ $(2x-5)^2 = 49x^2$ $2x - 5 = 7x$ or $2x - 5 = -7x$ $-5x = 5$ or $9x = 5$ $x = -1$ or $x = \frac{5}{9}$ **OR** $(2x-5)^2 - 49x^2 = 0$ $(2x-5+7x)(2x-5-7x) = 0$ $-5x = 5$ or $9x = 5$ $x = -1$ or $x = \frac{5}{9}$ **OR** $(2x-5)^2 - 49x^2 = 0$ $4x^2 - 20x + 25 - 49x^2 = 0$ $45x^2 + 20x - 25 = 0$ $9x^2 + 4x - 5 = 0$ $(x+1)(9x-5) = 0$ $x = -1$ or $x = \frac{5}{9}$	(4)	✓✓Each equation after taking square roots on each side ✓✓Each solution ✓Factorizing ✓Breaking into 2 equations ✓✓Each solution ✓Squaring ✓Standard form ✓Factorizing ✓Both solutions
	1.2.2	$\lvert x-5\rvert > \lvert 4-8\rvert$ $\lvert x-5\rvert > 4$ $x - 5 < -4$ or $x - 5 > 4$ $x < 1$ or $x > 9$ **OR** $\lvert x-5\rvert > 4 \Rightarrow$ distance from x to 5 is at least 4  $\therefore x < 1$ or $x > 9$ **OR** $x^2 - 10x + 25 > 16$ $x^2 - 10x + 9 > 0$ $(x-9)(x-1) > 0$ $x < 1$ or $x > 9$	(5)	✓value as 4 ✓ alternatives ✓ $x < 1$ ✓or ✓$x > 9$ ✓value as 4 ✓interpretation ✓ $x < 1$ ✓or ✓$x > 9$ ANSWER ONLY : FULL MARKS ✓Squaring ✓Factorising ✓ $x < 1$ ✓or ✓$x > 9$ **Note**: If get $\lvert x-5\rvert > -4$ Max of 2 / 5 for what follows: $x \in R$ or squaring etc.

	1.2.3	$\frac{3x}{x-3} \geq 4$ $\frac{3x}{x-3} - 4 \geq 0$ $\frac{3x-4x+12}{x-3} \geq 0$ $\frac{-x+12}{x-3} \geq 0$ $\frac{x-12}{x-3} \leq 0$ $x > 3$ *and* $x \leq 12$ OR $3 < x \leq 12$	(6)	✓4 to LHS ✓common denominator ✓simplifying [a variety of methods can be used as steps to the solution] ✓$x > 3$ ✓and ✓ $x \leq 12$ OR✓✓✓$3 < x \leq 12$
		OR $\frac{3(x-3)+9}{x-3} \geq 4$ $3 + \frac{9}{x-3} \geq 4$ $\frac{9}{x-3} \geq 1$ $\therefore x-3 > 0$ *and* $\frac{x-3}{9} \leq 1$ $\therefore x > 3$ *and* $x \leq 12$ OR $3 < x \leq 12$		✓simplify LHS to $3 + \frac{9}{x-3} \geq 4$ ✓simplify inequality to $\frac{9}{x-3} \geq 1$ ✓deduce $\frac{x-3}{9} \leq 1$ or $9 \geq x-3$ ✓$x > 3$ ✓and ✓ $x \leq 12$ OR✓✓✓$3 < x \leq 12$
		OR if error: $3x \geq 4x - 12$ $x \leq 12$		Max. 2 / 6 for last line

1.3				
	1.3.1	$(x+4)(y+4)-xy=208$ $xy+4x+4y+16-xy=208$ $4x+4y=192$ $x+y=48$ **OR** $(x+4)(y+4)=748$ $xy+4x+4y+16=748$ $540+4x+4y+16=748$ $4x+4y=192$ $x+y=48$ **OR** $2(x+4)+2(x+4)+2.2y=208$ OR $2(y+4)+2(y+4)+2.2x=208$ $4x+4y=192$ $x+y=48$	(3)	✓ $(x+4)(y+4)$ ✓ correctly completing equation ✓multiplying ✓ $(x+4)(y+4)$ ✓ correctly completing equation ✓multiplying and substituting for xy ✓✓setting up equation ✓multiplying
	1.3.2	$xy=540$ $x(48-x)=540$ $x^2-48x+540=0$ $(x-30)(x-18)=0$ or $x=\frac{48\pm\sqrt{48^2-4.540}}{2}$ $x=30$ or 18 $x=18 \quad (x<y)$ $y=48-18=30$ **OR** $xy=540$ $x(48-x)=540$ $=(18)(30)$ $\therefore x=18$ *and* $y=30$	(6)	✓formulating equation ✓substitution ✓standard form ✓factorising or subst in formula ✓value of x [**must make choice**] ✓value of y ✓formulating equation ✓substitution ✓observation✓540 = (18)(30) ✓value of x ✓value of y

		OR $xy = 540$ $(48 - y)y = 540$ $y^2 - 48y + 540 = 0$ $(y-30)(y-18) = 0$ or $y = \frac{48 \pm \sqrt{48^2 - 4.540}}{2}$ $y = 30$ or 18 $y = 30 \quad (x < y)$ $x = 48 - 30 = 18$		✓formulating equation ✓substitution ✓standard form ✓factorising or subst in formula ✓value of y [**must make choice**] ✓value of x
			[32]	

2.1				
	2.1.1		(6)	Graph of f ✓shape ✓vertex (2 ; 0) ✓y-intercept graph of g ✓straight line ✓shape coinciding with f for $x \geq 2$ ✓ y-intercept **Note:** If graph of f has vertex at (-2 ; 0): award 2 / 3 for graph of f and 2 / 3 for graph of g. If graph of f has vertex at (0 ; -2): award 2 / 3 for graph of f and 3 /3 for graph of g.
	2.1.2	$x \geq 2$	(2)	✓✓answer **Note**: CA applies. If graph of f has vertex at (-2 ; 0): ✓✓ no solutions. If graph of f has vertex at (0 ; -2): ✓✓ $x \geq 0$.
	2.1.3	$y = -\|x-2\|$ OR $-y = \|x-2\|$	(2)	✓✓answer

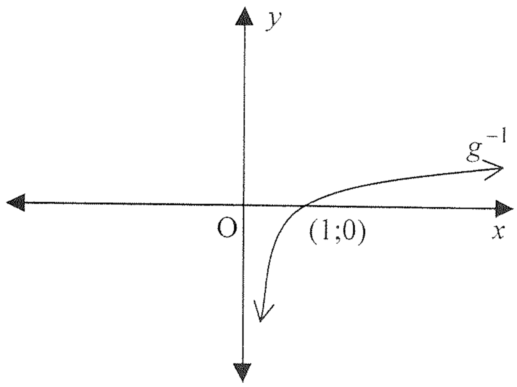
2.2	2.2.1	$y = -x^2 - 6x - 4$ $-y = x^2 + 6x + 4$ $-y = x^2 + 6x + 3^2 - 9 + 4$ $-y = (x+3)^2 - 5$ $y = -(x+3)^2 + 5$	(4)	✓making co-efficient of x^2 positive ✓completing square ✓writing with perfect square ✓answer
		OR $y = -x^2 - 6x - 4$ $y = -[x^2 + 6x + 4]$ $y = -[x^2 + 6x + 3^2 - 9 + 4]$ $y = -[(x+3)^2 - 5]$ $y = -(x+3)^2 + 5$		✓making co-efficient of x^2 positive ✓completing square ✓writing with perfect square ✓answer
		OR $x = \frac{-b}{2a} = \frac{6}{-2} = -3$ At turn pt. $y = 5$ $y = -(x+3)^2 + 5$		✓substitution in formula ✓x-coordinate of turn.pt. ✓y-coordinate of turn.pt. ✓answer
		OR $\frac{dy}{dx} = -2x - 6 = 0$ $x = -3$ $y = 5$ $y = -(x+3)^2 + 5$		✓derivative = 0 ✓x-coordinate of turn.pt. ✓y-coordinate of turn.pt. ✓answer
		OR $y = -(x-p)^2 + q$ $y = -x^2 + 2px - p^2 + q = -6x^2 - 6x - 4$ $\therefore 2p = -6$ $p = -3$ $-p^2 + q = -4$ $q = 5$ $\therefore y = -(x+3)^2 + 5$		✓multiplying ✓value of p ✓value of q ✓answer **Note:** CA appplies

	2.2.2	$(x+3)^2 \geq 0$ $\therefore -(x+3)^2 \leq 0$ $\therefore -(x+3)^2 + 5 \leq 5$ $\therefore f(x) \leq 5$ **OR** Turning point is $(-3;5)$ From graph: $f(x)$ has maximum value of 5 OR range of f is $y \leq 5$ $\therefore f(x) \leq 5$	(2)	✓perfect square ≥ 0 ✓award for second or third line ✓identifying turn pt. ✓deduction from graph
	2.2.3	y-intercept is (0 ; -4) $-9 < -4 - k < 0$ $-4 < k < 5$	(5)	✓y-intercept ✓✓each endpoint ["<" must be correct each time] ✓✓resultant answer **Answer only: full marks.** **Note:** CA must apply
	2.2.4	$-x^2 - 6x - 4 - t = 0$ $\Delta = 36 - 4(-1)(-4-t)$ $= 20 - 4t$ which is a perfect square for $t = 1;\ 4$ or 5 **OR** $t = -(x+3)^2 + 5$ $\therefore (x+3)^2 = 5 - t$ *and* $5 - t$ *is a perf. square only for* $t = 1;\ 4$ *or* 5 OR $t = -(x+3)^2 + 5$ $5 - 0^2 = 5\ ;\ 5 - 1^2 = 4\ ;\ 5 - 2^2 = 1$ $\therefore t = 1;\ 4$ *or* 5 **OR** Answer only	(5)	✓substitution in Δ ✓simplifying ✓✓✓each value of t ✓use of this form ✓perfect square as subject ✓✓✓ each value of t ✓ $f(x) = t$ ✓✓✓✓values of t : penalize 2 per error or omission. ✓✓✓✓✓ full marks less 2 per error or omission

2.3		$r = 3$ $\sqrt{2k} = 3$ $2k = 9$ $k = 4,5$	(5)	✓value of r ✓using $\sqrt{2k}$ (distance formula) ✓ $\sqrt{2k} = 3$ ✓squaring ✓answer
		OR $y = x$ so $x = \sqrt{9 - x^2}$ and $x^2 = k$ $x^2 = 9 - x^2$ $2x^2 = 9$ $x^2 = 4,5$ $\therefore k = 4,5$		✓✓ substitution in each equation ✓squaring ✓ value of x^2 ✓ value of k
		OR $\frac{k}{x} = \sqrt{9 - x^2}$ $\frac{k^2}{x^2} = 9 - x^2$ $x^4 - 9x^2 + k^2 = 0$ $\Delta = 0$ $81 - 4k^2 = 0$ $k = 4,5$		✓ substitution ✓standard form ✓$\Delta = 0$ ✓ extracting Δ ✓ answer
			[31]	

3.1	$p(x)=2x^3+x^2-2m^2x-3m$ $p(-3)=0$ $\therefore\ 2(-3)^3+(-3)^2-2m^2(-3)-3m=0$ $6m^2-3m-45=0$ $2m^2-m-15=0$ $(2m+5)(m-3)=0$ $m=-\frac{5}{2}$ or $m=3$ $p(3)=0$ $\therefore\ 2(3)^3+(3)^2-2m^2(3)-3m=0$ $-6m^2-3m+63=0$ $2m^2+m-21=0$ $(2m+7)(m-3)=0$ $m=-\frac{7}{2}$ or $m=3$ Both are factors for m = 3.	(9)	✓ use theorem correctly ✓ substitution ✓ standard form ✓ both values ✓ correct use of theorem ✓ substitution ✓ standard form ✓ both values ✓ answer
	OR $p(x)=2x^3+x^2-2m^2x-3m$ $p(-3)=0$ $\therefore\ 2(-3)^3+(-3)^2-2m^2(-3)-3m=0$ $6m^2-3m-45=0$ $2m^2-m-15=0$ .....(1) $p(3)=0$ $\therefore\ 2(3)^3+(3)^2-2m^2(3)-3m=0$ $-6m^2-3m+63=0$ $2m^2+m-21=0$ ......(2) (2)-(1): $2m-6=0$ $m=3$ OR (1)+(2): $4m^2-36=0$ $m=-3$ or 3		✓ use theorem correctly ✓ substitution ✓ standard form ✓ use theorem correctly ✓ substitution ✓ standard form ✓✓simultaneous solution ✓value of m ✓✓simultaneous solution need to also determine unique solution $m=3$ to get last mark
	OR $(x+3)$ and $(x-3)$ are factors $\therefore x^2-9$ is a factor $\therefore p(x)=(x^2-9)(2x+\frac{1}{3}m)=2x^3+\frac{1}{3}mx^2-18x-3m$ $\therefore \frac{1}{3}m=1$ and $-2m^2=-18$ $\therefore m=3$ $m=3$ or -3 $\therefore m=3$		✓✓✓✓for deduction of x^2-9 as factor ✓$2x$ ✓$\frac{1}{3}m$ ✓✓for $\frac{1}{3}m=1$ **or** for $-2m^2=-18$ ✓final solution $m=3$

	OR $p(x) = (x^2 - 9)(2x+1) + 18x - 2m^2x + 9 - 3m$ $= (x^2-9)(2x+1) + [2(9-m^2)x + 3(3-m)] = 0$ In the square bracket lives a linear function which is zero for TWO values of x ($x = 3$ *and* $x = -3$) Therefore it must be identically zero. So $3 - m = 0$ *AND* $9 - m^2 = 0$. This only happens for $m = 3$ **OR** In $p(x)$ replace x^2 by 9 and simplify $18x + 9 - 2m^2x - 3m = 0$ $3(m-3) + 2(m^2-9)x = 0$ $(m-3)[2(m+3)x+3] = 0$ $2(m+3)x + 3$ *is a linear function* therefore only zero for **one** value of x $\therefore m - 3$ *must be* $= 0$ $\therefore m = 3$		✓✓writing in this form ✓✓grouping inside [ ] ✓✓deduction ✓✓each equation ✓answer ✓method ✓substitution ✓✓grouping ✓factorising ✓✓deduction ✓conclusion ✓answer
3.2	$p(x) = 2x^3 + x^2 - 18x - 9$ $= (x^2-9)(2x+1)$ OR $(x+3)(2x^2-5x-3)$ OR $(x-3)(2x^2+7x+3)$ $= (x-3)(x+3)(2x+1)$	(3)	✓✓ two factors ✓ third factor
		[12]	

4.1				
	4.1.1	P(0 ; 1)	(1)	✓answer
	4.1.2	$1< a <5$	(3)	✓$1 < a$ ✓✓$a < 5$
	4.1.3		(3)	✓ shape ✓indicates x- intercept ✓ y-axis as asymptote
	4.1.4	$0 < x < 1$	(2)	✓ $0 < x$ ✓ $x < 1$
4.2				
	4.2.1	$\frac{15.5^{p-1}+5^{p+1}}{2^{-p}}$ $=\frac{5^p(15.5^{-1}+5)}{2^{-p}}$ $=\frac{5^p(8)}{2^{-p}}$ $=5^p.2^p.8$ $=8.10^p$ $=8M$ **OR** $\frac{15.5^{p-1}+5^{p+1}}{2^{-p}}$ $=2^p(15.5^{-1}.5^p+5.5^p)$ $=3\times10^p+5\times10^p$ $=8\times10^p$ $=8M$	(5)	✓taking out common factor ✓simplifying bracket ✓index law applied ✓further index law applied ✓ **realizing that $10^p = M$** ✓multiplying by 2^p ✓index law $5^{p-1}=5^p.5^{-1}$ ✓$15\times5^{-1}=3$ ✓index law $2^p\times5^p=10^p$ ✓**realizing that $10^p = M$**

	4.2.2	$\log 2.\log_2 5.\log_{25} M$ $= \log 2.\dfrac{\log 5}{\log 2}.\dfrac{\log M}{\log 25}$ $= \log 2.\dfrac{\log 5}{\log 2}.\dfrac{\log M}{2\log 5}$ $= \frac{1}{2}\log M$ $= \frac{1}{2}p$ OR $\log 2.\log_2 5.\log_{25} M$ $= \log 2.\log_2 5.\log_{25} 10^p$ $= \log 2.\log_2 5.p\log_{25} 10$ $= p\log 5.\log_{25} 10$ $= p\log_{25} 5$ $= \frac{1}{2}p$	(4)	✓✓each application of change of base law ✓application of further log law ✓simplification ✓ $\log_{25} 10^p = p\log_{25} 10$ ✓ $\log 2.\log_2 5 = \log 5$ ✓ $\log 5.\log_{25} 10 = \log_{25} 5$ ✓ $\log_{25} 5 = \frac{1}{2}$
4.3				
	4.3.1	$\sqrt{3}x^{\frac{3}{4}} - \sqrt{24} = 0$ $x^{\frac{3}{4}} = \sqrt{8}$ $x = (\sqrt{8})^{\frac{4}{3}}$ $x = (2^{\frac{3}{2}})^{\frac{4}{3}}$ $x = 2^2$ $x = 4$ [may not use calculator for last 2 marks]	(4)	✓ $x^{\frac{3}{4}}$ as subject ✓raising to power ✓ $\sqrt{8}$ as power of 2 ✓answer[accept 2^2 or 4]
	4.3.2	$2^{2x+1} - 2^x = 3$ $2.2^{2x} - 2^x = 3$ $2.2^{2x} - 2^x - 3 = 0$ $(2^x + 1)(2.2^x - 3) = 0$ $2^x = -1$ no solution or $2^x = 1{,}5$ $x\log 2 = \log 1{,}5$ $x = \dfrac{\log 1{,}5}{\log 2} = 0{,}58$ **OR** let $2^x = k$ $\therefore 2k^2 - k - 3 = 0$ $(k+1)(2k-3) = 0$	(7)	✓standard form ✓factorising ✓no solution one alternative ✓other alternative ✓use of logs ✓x as subject ✓answer
			[29]	

5.1		$S_n = a+[a+d]+[a+2d]+...+[a+(n-1)d]$ $S_n = [a+(n-1)d]+[a+(n-2)d]+...+a$ $2S_n = [2a+(n-1)d]+[2a+(n-1)d]+...to\ n\ terms$ $2S_n = n[2a+(n-1)d]$ $S_n = \frac{n}{2}[2a+(n-1)d]$ **OR** $S_n = a+[a+d]+[a+2d]+...+T_n$ $S_n = T_n+[T_n-d]+[T_n-2d]+...+a$ $2S_n = [a+T_n]+[a+T_n]+...to\ n\ terms$ $2S_n = n[a+T_n]$ $S_n = \frac{n}{2}[a+T_n]$ $but\ T_n = a+(n-1)d$ $\therefore S_n = \frac{n}{2}[2a+(n-1)d]$ **OR** $1+2+3+...+(n-1) = \frac{1}{2}(n-1)n$ $S_n = na+d[1+2+3+...+(n-1)]$ $= na+\frac{1}{2}dn(n-1)$ $= \frac{n}{2}[2a+(n-1)d]$	(4)	✓expansion ✓reverse order ✓addition ✓RHS as product ✓expansion ✓reverse order ✓addition ✓RHS as product ✓statement ✓substitution ✓substitution **max: 3 for this alternative.**

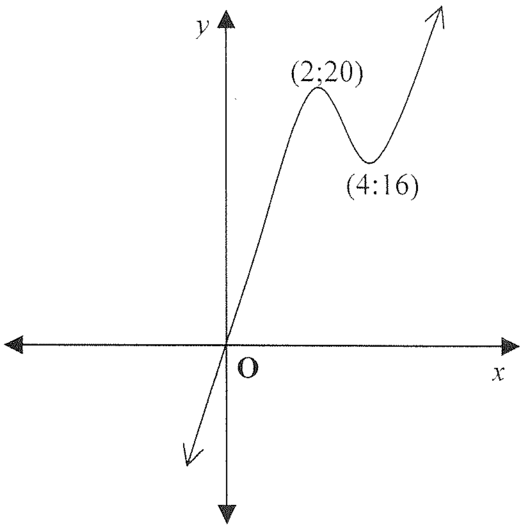
5.2		5+6+7+ ... is an arithmetic series with $a = 5$ and $d = 1$ 2200 m needs 110 shuttles $S_n = \frac{n}{2}[2a + (n-1)d]$ $110 = \frac{n}{2}[2.5 + (n-1).1]$ $n^2 + 9n - 220 = 0$ $(n+20)(n-11) = 0$ or $n = \frac{-9 \pm \sqrt{9^2 - 4.(-220)}}{2}$ or $n(n+9) = 220 = 11 \times 20$ $n = 11$ minutes **OR** $100 + 120 + 140 + ... = \frac{n}{2}[200 + (n-1)20] = 2200$ $n^2 + 9n - 220 = 0$ $(n-11)(n+20) = 0$ OR $n(n+9) = 220 = 11 \times 20$ or $n = \frac{-9 \pm \sqrt{9^2 - 4(-220)}}{2}$ n = 11 minutes	(6)	✓recognising Arithmetic sequence ✓number of shuttles needed ✓substitution in correct formula [first 3 marks for formulating equation] ✓standard form ✓factorising or subst in formula ✓answer ✓recognising Arithmetic sequence ✓ $S_n = 2200$ ✓substitution in correct formula [first 3 marks for formulating equation] ✓standard form ✓factorising or subst in formula ✓answer **Notes:** Answer only 3 / 6 Answer with evidence of understanding 6 / 6 Wrong formula: max. of 2 / 6

5.3				
	5.3.1	$\frac{m}{m+2} = \frac{2m-3}{m}$ $m^2 = 2m^2 + m - 6$ $m^2 + m - 6 = 0$ $(m+3)(m-2) = 0$ $m = -3$ or $m = 2$	(5)	✓setting up equation ✓simplification ✓standard form ✓factorising ✓values for m
	5.3.2	*if* $m = 2$ $r = \frac{2}{2+2} = \frac{1}{2}$ $\therefore$ converges for $m = 2$ **OR** *if* $m = -3$ $r = \frac{-3}{-3+2} = 3 \Rightarrow$ series diverges $\therefore$ must converge for $m = 2$	(3)	✓✓ testing for r [1 of these marks is for knowing convergence needs $-1 < r < 1$] ✓answer ✓✓ testing for r [1 of these marks is for knowing convergence needs $-1 < r < 1$] ✓answer **Note**: CA applies Answer only: 1 / 3
	5.3.3	4; 2; 1	(2)	✓4 ✓2 and 1 [if m wrong can get max of 1 mark for method]
	5.3.4	$S_\infty = \frac{a}{1-r}$ $= \frac{4}{1-\frac{1}{2}}$ $= 8$	(2)	✓choice of formula ✓answer **Note**: CA applies **provided** series is convergent, otherwise max. of 1 / 2
5.4		$\frac{1(3^n - 1)}{3-1} > 100\,000$ $3^n > 200001$ $n > \frac{\log 200001}{\log 3} \approx 11{,}1$ $\therefore n \geq 12$ so 12 terms	(6)	✓ use of correct formula ✓substitution in formula ✓setting up inequality **or** equation ✓3^n as subject ✓use of logs ✓answer **Note:** Trial and error methods acceptable

5.5		$T_4 = S_4 - S_3$ $= 4^3 - 3^3$ $= 37$	(4)	✓method ✓✓values of S_4 *and* S_3 ✓answer
			[32]	

6.1				**Note**: Penalise max of 1 mark for wrong notation in whole Q6
	6.1.1	Tangent to curve at P	(2)	✓tangent ✓P
	6.1.2	$f(x+h) = \frac{1}{2}(x+h)^2 + x + h$ $= \frac{1}{2}x^2 + xh + \frac{1}{2}h^2 + x + h$ $f(x+h) - f(x) = xh + \frac{1}{2}h^2 + h$ $m = \dfrac{xh + \frac{1}{2}h^2 + h}{h}$ $= x + \frac{1}{2}h + 1$ Accept: $f(x+h) = \frac{1}{2}(x+h)^2 + x + h$ $f(x+h) - f(x) = \frac{1}{2}(x+h)^2 + x + h - (\frac{1}{2}x^2 + x)$ $m = \dfrac{\frac{1}{2}(x+h)^2 + x + h - (\frac{1}{2}x^2 + x)}{h}$	(4)	✓substitution ✓simplification ✓subtraction ✓answer ✓✓substitution ✓subtraction ✓answer
	6.1.3	$\lim\limits_{h \to 0} \dfrac{f(x+h) - f(x)}{h} = \lim\limits_{h \to 0} (x + \frac{1}{2}h + 1)$ $= x + 1$	(2)	✓substitution of answer to Question 6.1.2 for quotient ✓answer CA applies
	6.1.4	$f'(x) = x + 1$ $f'(1) + f'(2) = 2 + 3 = 5$ but $f'(3) = 4$ $\therefore$ Not equal	(4)	✓derivative ✓value of sum of derivatives ✓value of derivative of sum ✓Not equal
6.2	6.2.1	$g(x) = \dfrac{-2x}{\sqrt{x}} - x^{10} = -2x^{\frac{1}{2}} - x^{10}$ $g'(x) = -x^{-\frac{1}{2}} - 10x^9$ [Accept: $g'(x) = \frac{1}{2} \times (-2x^{-\frac{1}{2}}) - 10x^9$]	(3)	✓simplification of g ✓✓ each term in derivative of g

	6.2.2	$h(x)=(x^5+5x^{-1})(x^5-5x^{-1})=x^{10}-25x^{-2}$ $h'(x)=10x^9+50x^{-3}$ [accept: $10x^9-2(-25)x^{-3}$]	(3)	✓✓simplification of h ✓ derivative of h
	6.2.3	$\frac{d}{dx}[2g(x)+h(x)]=2g'(x)+h'(x)$ $=-2x^{-\frac{1}{2}}-20x^9+10x^9+50x^{-3}$ $=-2x^{-\frac{1}{2}}-10x^9+50x^{-3}$ [Accept: $2(-2\times\frac{1}{2}x^{-\frac{1}{2}}-10x^9)+10x^9+50x^{-3}$] **OR** $\frac{d}{dx}[2g(x)+h(x)]$ $=\frac{d}{dx}[2(-2x^{\frac{1}{2}}-x^{10})+x^{10}-25x^{-2}]$ $=\frac{d}{dx}[-4x^{\frac{1}{2}}-x^{10}-25x^{-2}]$ $=-2x^{-\frac{1}{2}}-10x^9+50x^{-3}$	(4)	✓✓✓applying differentiation laws ✓ substitution ✓substitution ✓simplification ✓✓answer [1st and last term]
			[22]	

7.1				
	7.1.1	$5^3 - 9.5^2 + 24.5 = 20$ $\therefore$ P is on the graph	(2)	✓substitution ✓"=20"
	7.1.2	$f(x) = x^3 - 9x^2 + 24x$ $f'(x) = 3x^2 - 18x + 24$ at turning point $f'(x) = 0$ $3x^2 - 18x + 24 = 0$ $x^2 - 6x + 8 = 0$ $(x-4)(x-2) = 0$ $x = 4$ or $x = 2$ $y = 16$ or $y = 20$ turning points: (4 ; 16) and (2 ; 20)	(6)	✓differentiation ✓derivative equal to 0 ✓factorising ✓values of x ✓✓values of y
	7.1.3		(5)	✓✓shape ✓through origin ✓✓each turning point **Note**: CA from7.1.2 applies with each turning point.
	7.1.4	(a) max. is 20 (b) occurs at $x = 2$ and $x = 5$ (c) min. is 0	(1) (3) (1)	✓answer ✓ 2 ✓✓ 5 ✓answer **Note**: CA applies according to candidate's graph.
7.2				
		$C'(x) = 5 + 0{,}003x^2$ $C'(100) = 5 + 0{,}003(100)^2$ $= 35$ rand/shirt	(4)	✓derivative ✓substitution ✓answer ✓units