2004 MATHEMATICS HG PAPER 1

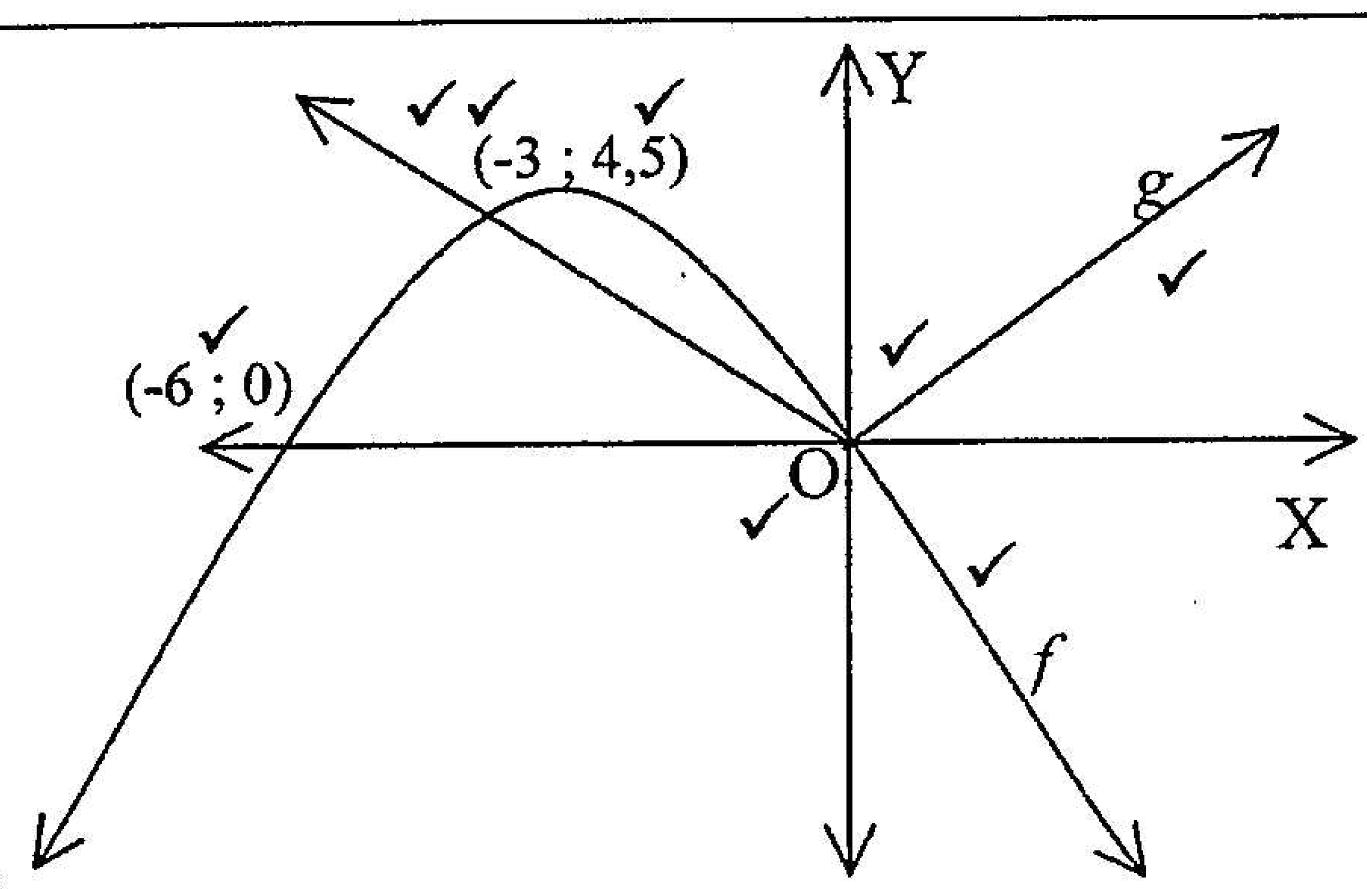
1.1				
	1.1.1	$\sqrt{x+6}=x$ $\therefore x+6=x^2$ ✓ $\therefore x^2-x-6=0$ ✓ $\therefore (x+2)(x-3)=0$ ✓ $\therefore x=-2$ or $x=3$ ✓ Check: $\sqrt{4}\neq -2$ $\sqrt{3+6}=3$ $\therefore x=3$ ✓	(5)	Squaring both sides Standard form Factoring x-values answer $x=3$ **NB: Answer only max.: $\frac{2}{5}$**
	1.1.2	$x=y-5$ ✓ **OR** $y+1=x+6$ $3=y-5$ $\therefore y=8$ ✓	(2)	Relationship between x and y Resultant y value **NB: Answer only: $\frac{2}{2}$** **solves from scratch max.: $\frac{1}{2}$**
1.2				
	1.2.1	$x=0$ ✓ or $x=8$ ✓	(2)	Answers only **If both answers incorrect 1 method mark for either** $\pm(4-x)=4$ **or** $(4-x)^2=16$ **If inequality is used : $\frac{1}{2}$**
	1.2.2	$\frac{4}{x-3}\leq 1$ $\therefore \frac{4}{x-3}-1\leq 0$ ✓ $\therefore \frac{4-x+3}{x-3}\leq 0$ ✓ $\therefore \frac{-x+7}{x-3}\leq 0$ ✓ $\therefore x<3$ ✓ or ✓ $x\geq 7$ ✓	(6)	Transfer constant Common denominator Simplifying numerator <3 ✓ or ✓ ≥ 7 ✓
		If $x>3$ [or $x-3>0$] then $4\leq x-3$ **2 marks or zero** $\therefore x\geq 7$ ✓ If $x<3$ then $x<3$ ✓ **2 marks or zero** $\therefore x<3$ or $x\geq 7$ **NB.: If just gives $4\leq x-3$, $\therefore$ $x\geq 7$ only gets 1 of 6 marks** **If** $\frac{-x+1}{x-3}<0$ $\therefore$ $x\leq 1$ **or** $x>3$ **max.:** $\frac{5}{6}$ **If** $\frac{x-7}{x-3}\leq 0$ $\therefore$ $3<x\leq 7$ **max.:** $\frac{4}{6}$ **If** $3>x\geq 7$ **max.:** $\frac{4}{6}$		

	1.2.3	$\frac{4}{(x-3)^2} < 1$ $\therefore 4 < (x-3)^2$ ✓ $\therefore x^2 - 6x + 5 > 0$ ✓ $(x-5)(x-1) > 0$ ✓ ✓ ✓ $x < 1$ or $x > 5$ **ALTERNATIVE** $\therefore 4 < (x-3)^2$ ✓ $x - 3 < -2$ ✓or $x - 3 > 2$ ✓ $x < 1$ ✓or $x > 5$ ✓	(5)	Multiplying standard form factors each case of solution **Don't penalize for omitting OR [-1 for AND]** multiplying each case (square root) each case of solution
		ALTERNATIVE $\frac{4}{(x-3)^2} - 1 < 0$ $\frac{4-(x-3)^2}{(x-3)^2} < 0$ $\frac{4-x^2+6x-9}{(x-3)^2} < 0$ $\frac{-x^2+6x-5}{(x-3)^2} < 0$ $\frac{x^2-6x+5}{(x-3)^2} > 0$ $(x-5)(x-1) > 0$ $x < 1$ or $x > 5$		✓ transpose 1 **If $1 > x > 5$ max.: $\frac{4}{5}$** ✓ simplification ✓ factors ✓✓ each case of solution

1.3				
	1.3.1	$3x^2 + kx - k = 3x$ $\therefore 3x^2 + (k-3)x - k = 0$ ✓ $\Delta = b^2 - 4ac$ $\Delta = (k-3)^2 + 12k$ ✓ $= k^2 - 6k + 9 + 12k$ ✓ $= k^2 + 6k + 9$ $= (k+3)^2$ ✓ perfect square $\therefore$ roots rational.	(4)	Standard form **[If $\Delta = 0$: - 1]** Substituting into delta Expansion Expressing as perfect square **[Wrong conclusion: –1]**
		$3x^2 + kx - k - 3x = 0$ $3x(x-1) + k(x-1) = 0$ $(x-1)(3x+k) = 0$ $\therefore x = 1$ or $x = -\frac{k}{3}$ both of which are rational		✓✓ take out common factor ✓ factorise ✓ values of x

	1.3.2	Equal roots $\Rightarrow \Delta = 0$ ✓ $\therefore k = -3$ ✓ $3x^2 - 6x + 3 = 0$ ✓ OR $x = \frac{-b}{2a}$ $\therefore (x-1)^2 = 0$ ✓ $= \frac{-(k-3)}{6}$ $\therefore x = 1$ ✓ $= 1$	(5)	Deduction that $\Delta = 0$ Value of k Substitution Factorizing Solution **[For incorrect value of k : max.: $\frac{2}{5}$]**
		$x = 1$ (full marks) follows from 2[nd] alternative **OR** $-\frac{k}{3} = 1$✓ $\therefore$ $k = -3$✓ $\therefore$ $x = 1$ ✓✓✓		

1.4				
	1.4.1	$\frac{50}{x+31}$ ✓	(1)	
	1.4.2	$\frac{10}{x} + \frac{50}{x+31} = 2$ ✓✓ $\therefore 10x + 310 + 50x = 2x^2 + 62x$ ✓✓ $\therefore 2x^2 + 2x - 310 = 0$ ✓ $\therefore x^2 + x - 155 = 0$ $\therefore x = \frac{-1 + \sqrt{1+620}}{2}$ ✓ $\therefore x = 11{,}96$ km/h ✓	(7)	Making equation **[Wrong equation: zero]** Multiplying LHS; RHS Standard form Substitution in formula Solution **[For – ve speed : - 1]**
		$(x+31)\left(2 - \frac{10}{x}\right) = 50$ ✓✓ $\therefore$ $2x - 10 + 62 - \frac{310}{x} = 50$ ✓✓ $2x^2 + 2x - 310 = 0$ ✓ $x = \frac{-1 + \sqrt{1+620}}{2}$ ✓ $x = 11{,}96$ km/h ✓		
			[37]	

2.1				
	2.1.1	(0 ; 0) ✓ (-6 ; 0) ✓	(2)	1 per x-value **[don't penalise for no co-ordinates]**
	2.1.2 2.1.4		(6) (2)	f: shape ✓ (-6 ; 0) ✓ (0 ; 0) ✓ ✓ turning pt x-coord ✓✓ y-coord ✓ **[No sketch max.: $\frac{2}{6}$]** g: shape ✓ turning point ✓

	2.1.3	$k=-\frac{1}{2}x(x+6)$ ✓ $0<k<4{,}5$ ✓✓	(3)	dividing by 2 solution : both marks or none Answer only **Full Marks** **[Note CA from TP in 2.1.2]**
	2.1.5	From 2.1.4, graphs intersect on arm of absolute value graph for which $y=-x$ $-x=-\frac{1}{2}x(x+6)$ ✓✓ $\therefore -2x=-x^2-6x$ $\therefore x^2+4x=0$ ✓ $\therefore x(x+4)=0$ $\therefore x=0$ or $x=-4$ ✓ ✓ $\therefore y=0$ or $y=4$ ✓	(6)	realizing only need 1 case that it is $y=-x$ substitution ✓✓ simplifying ✓ ✓ ✓ ✓ (0 ; 0) (-4 ; 4) [If (0 ; 0) only: 1 mark]
		$-\frac{1}{2}x(x+6)=x$ $2x=-x^2-6x$ $x^2+8x=0$ ✓ $x(x+8)=0$ $x=0$ or $x=-8$ (0 ; 0) ✓ or $(-8;-8)$ ✓✓		Max.: $\frac{4}{6}$
		$-\frac{1}{2}x(x+6)=\lvert x\rvert$ ✓ $\frac{x^2}{4}(x+6)^2=x^2$ ✓ etc. $x=0$ or 4 ✓✓		Max.: $\frac{4}{6}$
	2.1.6	$-4<x<0$ ✓✓ **OR** $-4<x$ and $x<0$ ✓✓	(2)	-1 if $\leq$ is used -1 if **and** is omitted CA applies from 2.1.5 or graph

2.2				
	2.2.1	r = 4 ✓ $\therefore y=\sqrt{16-x^2}$ ✓ [$x^2+y^2=16;\ y\geq 0$]	(2)	value of r ✓ correct form of equation ✓
		A(0 ; 4)✓ $\therefore$ $r=4$ and $y=\sqrt{r^2-x^2}$ ✓		**NB.: Answer only full marks**
	2.2.2	$x=2y+4$ ✓ $\therefore y=\frac{1}{2}x-2$ ✓ or $y=\frac{x-4}{2}$	(2)	interchanging x and y $y=\ldots$. form ✓
	2.2.3	$h^{-1}(4)=0$ ✓	(1)	**This Answer** or **CA from 2.2.2**
			[26]	

3				
3.1		$R=p(\frac{1}{2})$ ✓ $=16(\frac{1}{2})^3-4(\frac{1}{2})^2+8$ ✓ $=9$	(2)	Application of theorem Substitution **If long division the quotient is** $(8x^2+2x+1)$ **and rem. is 9:** $\frac{2}{2}$

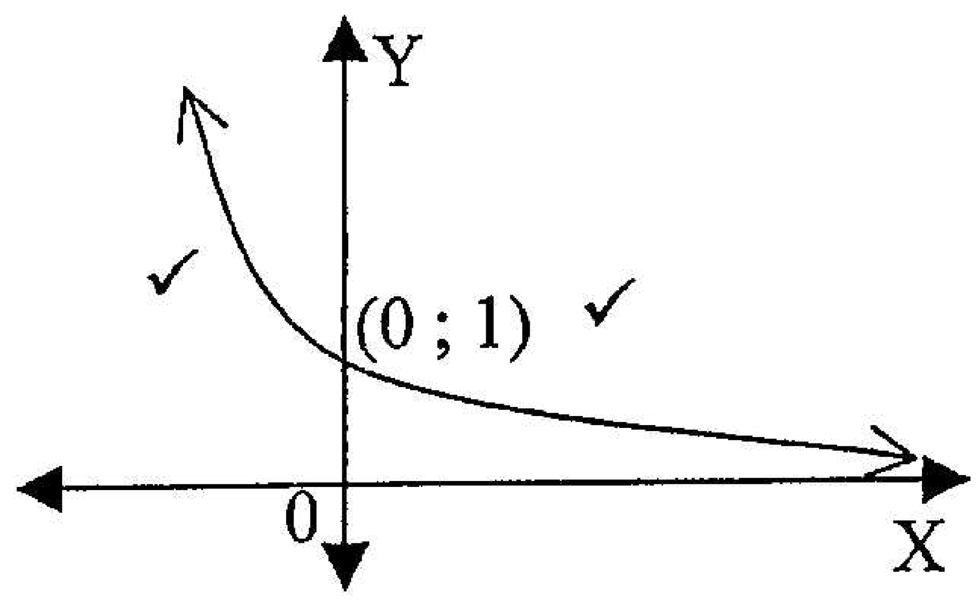
3.1	$\begin{array}{r} 8x^2+2x+1 \\ 2x-1\overline{)16x^3-4x^2\quad+8} \\ \underline{16x^3-8x^2} \\ 4x^2\quad+8 \\ \underline{4x^2-2x} \\ 2x+8 \\ \underline{2x-1} \\ 9 \end{array}$ ✓✓			
3.2		$Q(-1)$ is the remainder ✓ $p(-1)=(-2-1)Q(-1)+9$ ✓ ✓ $-16-4+8=-3Q(-1)+9$ $Q(-1)=7$ ✓ **ALTERNATIVE:** ✓ $p(x)=(2x-1)(8x^2+2x+1)+9$ (by long division) $\therefore Q(x)=8x^2+2x+1$ ✓ $Q(-1)=8(-1)^2+2(-1)+1$ ✓ $=7$ ✓	(4)	Application of theorem Substitution calculating $p(-1)$ answer value division deduction substitution answer value
	$\begin{array}{r} 8x-6 \\ x+1\overline{)8x^2+2x+1} \\ \underline{8x^2+8x} \\ -6x+1 \\ \underline{-6x-6} \\ 7 \end{array}$			
3.3		$16x^3-4x^2+8=(2x-1)Q(x)+9$ ✓ $16x^3-4x^2-1=(2x-1).Q(x)$ $16x^3-4x^2-1=(2x-1)(8x^2+2x+1)$ ✓ ✓ **ALTERNATIVE:** $16x^3-4x^2+8=(2x-1)(8x^2+2x+1)+9$ ✓ $16x^3-4x^2-1=(2x-1)(8x^2+2x+1)$ ✓ ✓	(3)	✓ substitution ✓ $8x^2$ *and* 1 ✓ $2x$
			[9]	

4.1		Let $\log_a M = x$ ✓ $\therefore\ a^x = M$ ✓ $\therefore\ \log_b a^x = \log_b M$ ✓ $\therefore\ \therefore\ x.\log_b a = \log_b M$ ✓ $\therefore\ x = \dfrac{\log_b M}{\log_b a}$ $\therefore\ \log_a M = \dfrac{\log_b M}{\log_b a}$	(4)	Changing to index form Taking $\log_b$ on both sides Application of log law Making x the subject

	Alternate 1 $\log_a M = x$ $\log_b M = y$ ✓ $\log_b a = z$ $M = a^x = b^y$ ✓ $a = b^z$ $\therefore\ (b^z)^x = b^y$ ✓ $xz = y$ $x = \frac{y}{z}$ ✓ $\log_a M = \frac{\log_b M}{\log_b a}$		
	Alternate 2 $\log_a M = x$ $\log_b M = y$ ✓ $\log_b a = z$ $M = a^x = b^y$ ✓ $b = a^{\frac{x}{y}}$ ✓ $\therefore\ \log_a b = \frac{x}{y}$ ✓ $= \frac{\log_a M}{\log_b M}$		

4.2				
	4.2.1	$y = 2^n$	(1)	answer only
	4.2.2	$\log_8 4y = \dfrac{\log_2 4y}{\log_2 8}$ ✓ $= \dfrac{\log_2 4 + \log_2 y}{\log_2 8}$ ✓ $= \dfrac{2+n}{3}$ ✓✓ OR $\log_8 4y = \log_8 4 + \log_8 y$ ✓ $= \dfrac{\log_2 4}{\log_2 8} + \dfrac{\log_2 y}{\log_2 8}$ ✓ $= \frac{2}{3} + \frac{n}{3}$ ✓✓ OR let $k = \log_8 4y$, then $4y = 8^k$ ✓ $\therefore y = 2^{3k-2}$ ✓ $\therefore \log_2 y = 3k - 2$ ✓ $\therefore n = 3k - 2$ $\therefore k = \dfrac{n+2}{3}$ ✓ OR $y = 2^n$ $4y = 4.2^n = 2^{n+2}$ ✓ $\log_8 4y = \log_8 2^{n+2}$ ✓ $= \dfrac{(n+2)\log 2}{\log 8}$ $= \dfrac{(n+2)\log 2}{3\log 2}$ ✓ $= \dfrac{n+2}{3}$ ✓	(4)	Use of change of base law Use of "product" law $\log_2 4 = 2$ ✓ $\log_2 8 = 3$ ✓
	4.2.3	$50^{n+1} = 50.50^n$ ✓ $= 50.5^{2n}.2^n$ ✓ $= 50x^2y$ ✓✓	(4)	Expanding 50^{n+1} Expanding 50^n Value of 5^{2n} ; value of 2^n
		$50^{n+1} = (2 \times 5^2)^{n+1}$ $= 2^{n+1} \times 5^{2n+2}$ $= 2 \times 2^n \times 25 \times (5^n)^2$ $= 50x^2y$		✓ ✓ ✓ ✓

4.3				
	4.3.1	$3^{x-1}+3^{x+1}=\sqrt{300}$ $\therefore\ 3^{x-1}(1+3^2)=\sqrt{300}$ ✓ $\therefore\ 3^{x-1}(10)=10\sqrt{3}$ ✓✓ $\therefore\ 3^{x-1}=\sqrt{3}$ ✓ $\therefore\ 3^{x-1}=3^{\frac{1}{2}}$ ✓✓ $\therefore\ x=1{,}5$ or $\frac{3}{2}$ **OR** $3^x(3^{-1}+3)=\sqrt{300}$ ✓ $3^x\left(\frac{10}{3}\right)=10\sqrt{3}$ ✓✓ $3^x=3\sqrt{3}$ ✓ $3^x=3^{1,5}$ ✓ $x=1{,}5$ ✓ or $\frac{3}{2}$	(6)	Taking out 3^{x-1} Simplifying; simplified surd Division $\sqrt{3}$ as power of 3 answer value Taking out 3^x
	4.3.2	$\log_{\frac{1}{2}} x+\log_{\frac{1}{2}}(x+1)\geq -1$ $\therefore\ \log_{\frac{1}{2}} x(x+1)\geq -1$ ✓ $\therefore\ x(x+1)\leq\left(\frac{1}{2}\right)^{-1}$ ✓✓ $\therefore\ x^2+x\leq 2$ ✓ $\therefore\ x^2+x-2\leq 0$ $\therefore\ (x+2)(x-1)\leq 0$ ✓ $\therefore\ -2\leq x\leq 1$ ✓✓ but $x>0$ and $x+1>0$ ✓ $\therefore 0<x\leq 1$ ✓	(9)	Application of log law Change to index form Changed inequality sign Simplification factorising $-2\leq x$ ✓ and $x\leq 1$ ✓ $x>0$ ✓ conclusion ✓
		$\log_{\frac{1}{2}} x(x+1)\geq -1$ ✓ $x(x+1)\geq\left(\frac{1}{2}\right)^{-1}$ $x(x+1)\geq 2$ ✓ CA $x^2+x-2\geq 0$ ✓ $(x+2)(x-1)\geq 0$ ✓ $x\leq -2$ or $x\geq 1$ ✓✓ But $x>0$ ✓ $\therefore\ x\geq 1$ ✓		Max.: $\frac{8}{9}$
		$\log_{\frac{1}{2}} x+\log_{\frac{1}{2}}(x+1)\geq -1$ $\log_{\frac{1}{2}}\frac{x}{x+1}\geq -\log_{\frac{1}{2}}\frac{1}{2}$ $\frac{x}{x+1}\leq 2$ ✓ but $x+1>0$ (by definition) ✓ $\therefore\ x\leq 2(x+1)$ $-x\leq 2$ $\therefore\ x\geq -2$ ✓ and $x>0$ $\therefore x>0$ ✓		Max.: $\frac{4}{9}$

4.4				
	4.4.1		(2)	✓Shape ✓ intercept
	4.4.2	Range = $\{y / y > 0, y \in R\}$ **or** $y > 0$✓✓ $(0;\infty)$	(2)	**Realizing range as set of y values : 1 mark**
4.5		$\frac{1}{2} = 3^{-0,07d}$ ✓ $\therefore \log\frac{1}{2} = \log 3^{-0,07d}$ $\therefore \log\frac{1}{2} = -0,07d\log 3$ ✓ $\therefore d = \dfrac{\log\frac{1}{2}}{-0,07\log 3}$ ✓ $\therefore \approx 9,01\text{ m}$ ✓	(4)	substitution Application of log law Making d the subject Solution **[wrong rounding off –1]**
			[36]	

5.1		$5 ; x ; y$ is an AP $\therefore x - 5 = y - x$ ✓ $\therefore y = 2x - 5$..........(1) ✓ $x ; y ; 81$ is a GP $\therefore \dfrac{y}{x} = \dfrac{81}{y}$ ✓ $\therefore y^2 = 81x$...........(2) ✓ Subst (1) in (2): $(2x-5)^2 = 81x$ ✓ $\therefore 4x^2 - 20x + 25 = 81x$ $\therefore 4x^2 - 101x + 25 = 0$ ✓ $\therefore (4x-1)(x-25) = 0$ ✓ $\therefore x = 25$ ✓ $\therefore y = 2(25) - 5 = 45$ ✓	(9)	Setting up equation Making y the subject Setting up equation Multiplying substitution simplifying factorizing integral x-value corresponding y-value
5.2		$S_n = 100a$✓ $l = 9a$ ✓ $S_n = \dfrac{n}{2}[a + l]$ ✓ $\dfrac{n}{2}[a + 9a] = 100a$ ✓ $\therefore 5an = 100a$ ✓ $\therefore n = 20$ ✓	(6)	S_n and l in terms of a Selection of appropriate formula Substitution Multiplication Answer value for n
5.3				
	5.3.1	$r = \frac{1}{5}$ ✓ so $-1 < r < 1$ ✓ **OR** $\|r\| < 1$	(2)	✓ Finding r ✓ r in interval needed for convergence

	5.3.2	$S_\infty = \frac{a}{1-r}$ ✓ $S_\infty = \frac{2.5^5}{1-\frac{1}{5}}$ ✓ $= 7812,5$ ✓ accept $\frac{1}{2}.5^6$	(3)	formula substitution answer **[CA check value of *r* in 5.3.1]** **If $\lvert r \rvert > 1$ max.: $\frac{1}{3}$**
	5.3.3	$S_n = \frac{a(1-r^n)}{1-r}$ ✓ $S_8 = \frac{2.5^5\left(1-\left(\frac{1}{5}\right)^8\right)}{1-\frac{1}{5}}$ ✓ $= 7812,48$ ✓✓	(4)	use of correct formula correct substitution into formula answer and correct rounding **[CA check value of *r* in 5.3.1]**
	5.3.4	$\sum_{n=9}^{\infty} 2.5^{6-n} = \sum_{n=1}^{\infty} 2.5^{6-n} - \sum_{n=1}^{8} 2.5^{6-n}$ ✓ $= 7812,5 - 7812,48$ $= 0,02$ ✓ **OR** $\frac{2.5^{-3}}{1-\frac{1}{5}} = 0,02$ ✓	(2)	interpretation answer **Answer only: full marks** **for alternative $\frac{1}{2}$**
			[26]	

6.1				
	6.1.1	$x = \frac{1}{2}$ ✓	(1)	Answer only
	6.1.2	1,501 ✓	(1)	Answer only
	6.1.3	1,5 ✓✓	(2)	Answer only for 2 marks
		$\lim_{x\to 0,5} \frac{(x+1)(2x-1)}{2x-1} = 1,5$ ✓✓		1 mark factorizing 1 mark answer
6.2	6.2.1	$f'(x) = \lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$ ✓ $f'(x) = \lim_{h\to 0} \frac{(x+h)^3 - x^3}{h}$ ✓ $= \lim_{h\to 0} \frac{x^3+3x^2h+3xh^2+h^3-x^3}{h}$ ✓ $= \lim_{h\to 0} \frac{3x^2h+3xh^2+h^3}{h}$ $= \lim_{h\to 0} \frac{h(3x^2+3xh+h^2)}{h}$ ✓ $= \lim_{h\to 0}(3x^2+3xh+h^2)$ ✓ $= 3x^2$ ✓	(6)	formula Substitution Cubing [if $(x+h)^3 = x^3 + h^3$ the max for question is 2/6] Common factor simplification Correct limit found For incorrect notation minus 1 If omit lim in notation max of 3

		$f'(x) = \lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$ ✓ $f'(x) = \lim_{h\to 0} \frac{(x+h)^3 - x^3}{h}$ ✓ $f'(x) = \lim_{h\to 0} \frac{(x+h-x)((x+h)^2+(x+h)x+x^2)}{h}$ ✓ $= \lim_{h\to 0} \frac{h(3x^2+3xh+h^2)}{h}$ ✓ $= \lim_{h\to 0}(3x^2+3xh+h^2)$ ✓ $= 3x^2$ ✓		
	6.2.2	$f'(2) = 12$	(1)	answer only. Note CA from 6.2.1
6.3		$y = x^{\frac{3}{2}} - x^{\frac{-1}{2}}$ ✓ ✓ $\frac{dy}{dx} = \frac{3}{2}x^{\frac{1}{2}} + \frac{1}{2}x^{-\frac{3}{2}}$ ✓ ✓ Accept for full marks: $\frac{2x\sqrt{x} - (x^2-1)\left(\frac{1}{2}x^{-\frac{1}{2}}\right)}{x}$	(4)	Each term as a power of x Derivative of each term **If** $\frac{x^2-1}{x}$ **max 2/4** **If differentiate top and bottom separately max 1 of 4**
6.4		$\frac{d}{dx}[f(x)+3.g(x)] = f'(x)+3.g'(x)$ $= 3x^2 + 3x$ ✓ ✓	(2)	**Answer only full marks**
6.5		$f(2) = g(2) = 5(2)+1 = 11$ ✓ ✓ $f'(2) = 5$ ✓ $f(2) + f'(2) = 16$ ✓	(4)	✓ value of $f(2)$ ✓ value of $g(2)$ ✓ value of $f'(2)$ ✓ answer
			[21]	

7.1				
	7.1.1	$x^3 - x^2 - 8x + 12 = 0$ $\therefore\ (x-2)(x^2+x-6) = 0$ ✓ ✓ ✓ $\therefore\ (x-2)(x+3)(x-2) = 0$ ✓ $\therefore\ x = -3$ ✓ $\therefore$ A(-3 ; 0) OR $(x^2-4x+4)(x+3) = 0$ ✓ ✓ ✓✓ $\therefore\ x = -3$ ✓ $\therefore$ A(-3 ; 0) OR by "trial and error" $f(-3) = (-3)^3 - (-3)^2 - 8(-3) + 12$ ✓ ✓ $= 0$ ✓ $\therefore\ x = -3$ is x-intercept, A(-3 ; 0) ✓✓	(5)	identification of (x-2) as a factor ✓ -6 and x^2 in trinomial ✓ x in trinomial ✓ further factorizing ✓ x-value at A ✓ identification of $(x-2)^2$ as factor ✓✓ (x + 3) as other factor ✓✓ x-value at A ✓ considering f(-3) ✓ substitution ✓ 0 as result ✓ x-value at A ✓✓ **Answer only 5 of 5**
	7.1.2	At B, $\frac{dy}{dx} = 0$ ✓ $\therefore\ 3x^2 - 2x - 8 = 0$ ✓ $\therefore\ (3x+4)(x-2) = 0$ ✓ $\therefore\ x = -\frac{4}{3}$ ✓	(4)	derivative = 0 finding derivative factorising x-value at B
	7.1.3	$x < -\frac{4}{3}$ ✓✓ $x > 2$ ✓	(3)	CA from 7.1.2
	7.1.4	One ✓✓	(2)	Answer only
7.2				
	7.2.1	when $t = 0,\ L = 28$ ✓ when $t = 3,\ L = 26$ ✓ avg rate $= \frac{26-28}{3-0}$ ✓ $=$ -0,67 m/hour or $-\frac{2}{3}$ ✓	(4)	Value of L Value of L method Answer[don't penalize for units]
	7.2.2	$\frac{dL}{dt} = -\frac{2}{9}t - \frac{3}{27}t^2$ ✓ when $t = 2$, rate $= -\frac{2}{9}(2) - \frac{3}{27}(2)^2$ ✓ $=$ -0,89 m/h or $-\frac{8}{9}$ m/h ✓	(3)	Finding derivative Substitution Answer [don't penalize for units]

7.3				
	7.3.1	$m = 4 - x^2$ ✓	(1)	answer only
	7.3.2	$A = 2x(4 - x^2)$ ✓ ✓ $= 8x - 2x^3$	(2)	length = $2x$ taking product [no CA]
	7.3.3	For max. $\frac{dA}{dx} = 0$ ✓ $8 - 6x^2 = 0$ ✓ $x^2 = \frac{4}{3}$ $x = \frac{2}{\sqrt{3}}$ ✓ $A = \frac{4}{\sqrt{3}}\left(4 - \frac{4}{3}\right) = \frac{32}{3\sqrt{3}}$ ✓✓ or 6,16 square units or $\frac{32\sqrt{3}}{9}$ square units	(5) **[29]**	derivative = 0 finding derivative correctly value of x ($x > 0$) substitution into formula for A answer

8.1		$y \leq 400$ ✓ or $0 \leq y \leq 400$ $x \leq 300$ ✓or $0 \leq x \leq 300$ $x + y \leq 500$ ✓ $y \geq \frac{1}{2}x$ ✓ **or** $x \leq 2y$ ✓	(5)	
8.2		See graph paper 1 mark for each intercept of $x + y = 500$ 1 mark for $y = 400$	(3)	
8.3		See graph paper. Shading correct region.	(2)	**All or zero.**
8.4		$P = 3x + 2y$ ✓✓	(2)	**All or zero**
8.5		See graph: 1 mark for gradient of search line 1 mark for through (300 ; 200)	(2)	Mark according to candidate's 8.4 **If line through correct point full marks**
8.6		300 hamburgers ✓ ; 200 chicken burgers ✓	(2)	Mark according to candidate's 8.5
			[16]	

QUESTION 8

EXAMINATION NUMBER

CENTRE NUMBER