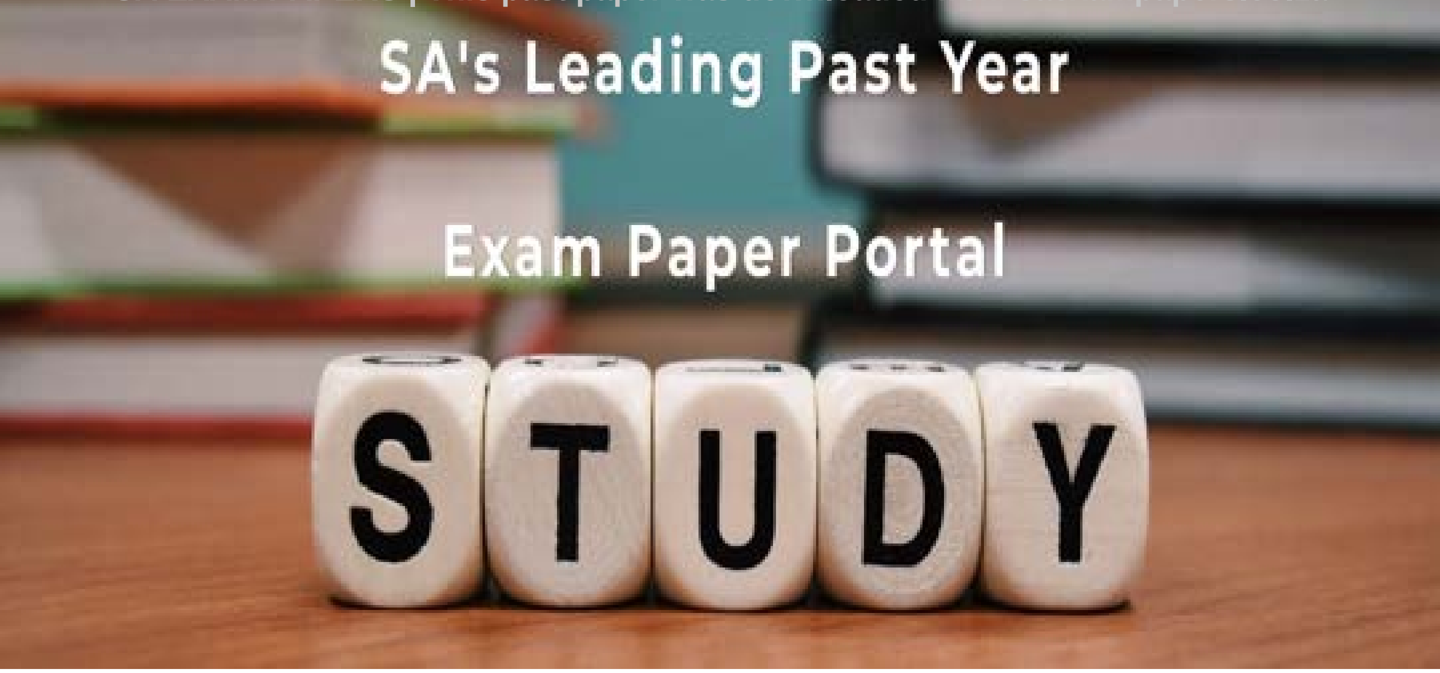

SA's Leading Past Year
Exam Paper Portal
STUDY

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

JUNE EXAMINATION
GRADE 12

2025

MARKING GUIDELINES

MATHEMATHICS (MATHS)

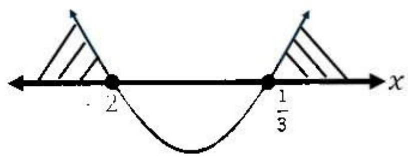
PAPER 1

22 pages

GENERAL NOTES

1. Consistent accuracy applies in this marking guideline.
2. If a learner answers the same question twice, but does not cancel one of the answers, **ONLY** consider the first attempt.
3. If a learner cancels the answer but does not make a second attempt, consider the cancelled attempt.
4. If a learner provided an answer not mentioned in this memorandum, first check/prove it before disqualifying their attempt. Please check through all **OPTIONS** provided in this marking guideline.

QUESTION 1			
1.1.1	$x(x+4)=0$ $x=0\ or\ x=-4$ ANSWER ONLY $\frac{1}{2}$	✓ factors ✓ both answers values of x	(2)
1.1.2	$2x^2-3x-\frac{1}{2}=0$ $x=\frac{-(-3)\pm\sqrt{(-3)^2-4(2)(-\frac{1}{2})}}{2(2)}$ $x=\frac{3\pm\sqrt{13}}{4}$ $x=1{,}65$ or $x=-0{,}15$ OR $4x^2-6x-1=0$ $x=\frac{-(-6)\pm\sqrt{(-6)^2-4(4)(-1)}}{2(4)}$ $x=\frac{6\pm\sqrt{52}}{8}$ $x=1{,}65$ or $x=-0{,}15$ ANSWER ONLY $\frac{2}{4}$ Penalize 1 mark for rounding	✓ standard form ✓ substitution ✓ 1,65 ✓ $-0{,}15$	(4)

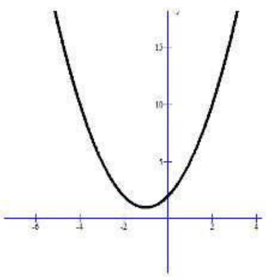
1.1.3	$3x^2 + 5x - 2 \geq 0$ $(3x - 1)(x + 2) = 0$ Critical Values $x = \frac{1}{3}$ and $x = -2$ $x \leq -2$ *or* $x \geq \frac{1}{3}$ 	✓ standard form ✓ factors ✓ critical values ✓ answers	(4)

1.1.4	$2^{2x} + 2^x - 6 = 0$ Let $k = 2^x$ $k^2 + k - 6 = 0$ $(k+3)(k-2) = 0$ $k \neq -3$ or $k = 2$ $2^x = 2$ $x = 1$ **OR/OF** **ANSWER ONLY $\frac{1}{3}$** $(2^x + 3)(2^x - 2) = 0$ $2^x \neq -3$ or $2^x = 2$ $x = 1$	✓ factors ✓ rejection ✓ answer **OR/OF** ✓ factors ✓ rejection ✓ answer	(3)
1.1.5	$x^2 - 2x + 3 + \frac{2}{x^2 - 2x} = 0$ $k = x^2 - 2x$ $k + 3 + \frac{2}{k} = 0$ $k(k+3) + 2 = 0$ $k^2 + 3k + 2 = 0$ $(k+1)(k+2) = 0$ $k = -2$ or $k = -1$ $x^2 - 2x = -1$ $x^2 - 2x + 1 = 0$ $(x-1)^2 = 0$ $x = 1$ $x^2 - 2x + 2 = 0$ $\Delta = b^2 - 4ac$ $= (-2)^2 - 4(1)(2)$ $\Delta = -4$ (Discriminant < 0)	✓ k-method ✓ factors ✓ discriminant ✓ answer	(4)

1.1.6	$(\sqrt{x+5})^2 = (x-1)^2$ $x + 5 = x^2 - 2x + 1$ $x^2 - 3x - 4 = 0$ $(x-4)(x+1) = 0$ $x \neq -1$ or $x = 4$	✓ squiring both sides ✓standard form ✓ factors ✓ answer/selection	(4)
1.2	$x + 2y = 5$ $And\ 2y^2 - xy - 4x^2 = 8$ From equation 1 $x = 5 - 2y \ldots\ldots(3)$ Substitute (3) into (2) $2y^2 - xy - 4x^2 = 8$ $2y^2 - y(5-2y) - 4(5-2y)^2 - 8 = 0$ $2y^2 - 5y + 2y^2 - 100 + 80y - 16y^2 - 8 = 0$ $-12y^2 + 75y - 108 = 0$ $\frac{-12y^2}{-3} + \frac{75y}{-3}\ \frac{-108}{-3} = 0$ $4y^2 - 25y + 36 = 0$ $(4y-9)(y-4 = 0$ $y = \frac{9}{4}$ or $y = 4$ When $y = \frac{9}{4}$ $x = 5 - 2y$ $x = 5 - 2(\frac{9}{4})$ $x = \frac{1}{2}$ When $y = 4$ $x = 5 - 2y$ $x = 5 - 2(4)$ $x = -3$	✓ $x = 5 - 2y$ equation 3 ✓ substitution of equation 3 into Equation 2 ✓ standard form ✓ factors ✓ both y-values ✓ Both x-values	(6)

1.3	$6x^2 - 4kx + 6 = 0$ $\Delta = b^2 - 4ac$ $\Delta = (-4k)^2 - (4)(6)(6)$ $= 16k^2 - 144$ $16k^2 - 144 = 0$ $\frac{16k^2}{16} = \frac{144}{16}$ $k^2 = 9$ $k = \pm\sqrt{9}$ $k = \pm 3$ Therefore, the values of k for which the roots are real and equal are as follows: $k = 3$ or $k = -3$	✓ correct use a formula of Δ ✓ simplification ✓ answers (only $k = 3$ this mark is not awarded)	(3)
			[30]

QUESTION 2			
2.1.1	$16 ; 23$	✓ 16 ✓ 23	(2)
2.1.2	$S_n = \frac{n}{2}[2a + (n-1)d]$ $S_n = \frac{n}{2}[2(-5) + (n-1)7]$ $S_n = \frac{n}{2}(-10 + 7n - 7)$ $S_n = \frac{n}{2}(7n - 17)$	✓ substitution for a ✓ substitution for d ✓ simplification	(3)
2.2.1	$x \qquad 3x-5 \qquad 4x-3 \qquad 5x+1$ $2x-5 \qquad x+2 \qquad x+4$ $-x+7 \qquad 2$ $-x + 7 = 2$ $\therefore x = 5$	✓ first difference ✓ second difference ✓ 5	(3)
2.2.2	$2a = 2$ $\qquad$ $3(1) + b = 5$ $\therefore a = 1$ $\qquad$ $\therefore \text{b} = 5 - 3 = 2$ $1 + 2 + c = 5$ $\therefore c = 5 - 3 = 2$ $\text{T}_n = n^2 + 2n + 2$ $= n^2 + 2n + 1 + 1$ $= (n+1)^2 + 1$ Conclusion: $(n+1)^2$ is always positive for all $n \geq 1$ and adding 1 will make the result remain positive.	✓ $a = 1$ ✓ b $= 2$ ✓ c $= 2$ ✓ $(n+1)^2 + 1$ ✓ explanation	(5)

	OR $2a = 2$ $\quad\quad\quad$ $3(1) + b = 5$ $\therefore a = 1$ $\quad\quad\quad$ $\therefore \text{b} = 5 - 3 = 2$ $1 + 2 + c = 5$ $\therefore c = 5 - 3 = 2$ $\text{T}_n = n^2 + 2n + 2$ $n \in N$ therefor T_n will be positive for all n values OR $2a = 2$ $\quad\quad\quad$ $3(1) + b = 5$ $\therefore a = 1$ $\quad\quad\quad$ $\therefore \textbf{b} = \mathbf{5} - 3 = 2$ $1 + 2 + c = 5$ $\therefore c = 5 - 3 = 2$ $\text{T}_n = n^2 + 2n + 2$  All term will be positive for all values of n	✓ $a = 1$ ✓ $\text{b} = 2$ ✓ $\text{c} = 2$ ✓ $n \in N$ ✓ explanation ✓ $a = 1$ ✓ $\text{b} = 2$ ✓ $\text{c} = 2$ ✓ ✓ Graphical explanation	

2.3.1	$r=\dfrac{\frac{3}{4}(p-3)^2}{\frac{1}{2}(p-3)}=\dfrac{3(p-3)}{2}$ For convergence: $-1<r<1\,;r\neq 0$ $-1<\dfrac{3(p-3)}{2}<1$ $-2<3(p-3)<2$ $-2<3p-9<2$ $7<3p<11$ $\dfrac{7}{3}<p<\dfrac{11}{3};\ p\neq 3$	✓ r, in terms of p ✓ substitution into convergence formula ✓ simplification ✓ $\frac{7}{3}<p<\frac{11}{3}$	(4)
2.3.2	$S_\infty=\dfrac{a}{1-r}$ $1=\dfrac{\frac{1}{2}(p-3)}{1-\left(\frac{3(p-3)}{2}\right)}$ $\left(1-\dfrac{3p-9}{2}\right)=\dfrac{1}{2}(p-3)$ $\dfrac{11-3p}{2}=\dfrac{p-3}{2}$ $4p=14$ $p=\dfrac{14}{4}=\dfrac{7}{2}$	✓ substitution into the correct formula ✓ simplification ✓ $\dfrac{7}{2}$	(3)
			[20]

QUESTION 3			
3.1	$\sum_{k=2}^{n} 2(3^{k-1}) = 59\,046$. $6 + 18 + 54 + \cdots + 2(3^{n-1}) = 59\,046$ $r = \frac{18}{6} = 3$ Number of terms $(n-2)+1 = n-1$ $S_n = \frac{a(r^n - 1)}{r-1}; r \neq 1$ $S_{n-1} = \frac{6(3^{n-1} - 1)}{3-1}$ $\frac{6(3^{n-1} - 1)}{3-1} = 59\,046$ $3(3^{n-1} - 1) = 59\,046$ $3^{n-1} - 1 = 19\,682$ $3^{n-1} = 19\,683$ $3^{n-1} = 3^9$ $n - 1 = 9$ $\therefore n = 10$ **OR** $\sum_{k=2}^{n} 2(3^{k-1}) = 59\,046$. $6 + 18 + 54 + \cdots + 2(3^{n-1}) = 59\,046$ $r = \frac{18}{6} = 3$ Number of terms $(n-2)+1 = n-1$ Let the number of terms be k $S_n = \frac{a(r^n - 1)}{r-1}; r \neq 1$ $S_k = \frac{6(3^k - 1)}{3-1}$ $\frac{6(3^k - 1)}{3-1} = 59\,046$ $3(3^k - 1) = 59\,046$ $3^k - 1 = 19\,682$ $3^k = 19\,683$ $3^k = 3^9$ $k = 9$ $\therefore n - 1 = 9$ $\Rightarrow n = 10$	✓ $r = 3$ ✓ $n - 1$ ✓ substitution ✓ simplification to $3^{n-1} = 19\,683$ ✓ 10 **OR** ✓ $r = 3$ ✓ $n - 1$ ✓ substitution ✓ simplification to $3^k = 19\,683$ ✓ 10 If $k = 9$ max $\frac{4}{5}$	(5)

3.2.1	6p	✓ 6p	(1)
3.2.2	Pythagoras' Theorem $h^2 = (12p)^2 - (6p)^2$ $h^2 = 144p^2 - 36p^2$ $h^2 = 108p^2$ $\therefore h = 6\sqrt{3}p$ units **OR** $\sin 60° = \frac{h}{12p}$ $h = 12p.\frac{\sqrt{3}}{2}$ $\therefore h = 6\sqrt{3}p$ units	✓ Pythagoras' Theorem ✓ $6\sqrt{3}p$ ✓ trig ratio ✓ $6\sqrt{3}p$	(2) **OR** (2)
3.2.3	Area of the first triangle $= \frac{1}{2}(12p)(6\sqrt{3}p) = 36\sqrt{3}p^2$ Area of the second triangle $= \frac{1}{2}(6p)(3\sqrt{3}p) = 9\sqrt{3}p^2$ Area of the third triangle $= \frac{1}{2}(3p).\frac{1}{2}(3\sqrt{3}p) = \frac{9\sqrt{3}p^2}{4}$ $36\sqrt{3}p^2 + 9\sqrt{3}p^2 + \frac{9\sqrt{3}p^2}{4} \ldots$ Geometric pattern $r = \frac{9\sqrt{3}p^2}{36\sqrt{3}p^2} = \frac{1}{4}$ $S_\infty = \frac{a}{1-r}; r \neq 1$ $S_\infty = \frac{36\sqrt{3}p^2}{1-\frac{1}{4}} = 48\sqrt{3}p^2$	✓ $36\sqrt{3}p^2$ ✓ $9\sqrt{3}p^2$ ✓ $\frac{9\sqrt{3}p^2}{4}$ ✓ $\frac{1}{4}$ ✓ substitution into correct formula	

	OR Area of the first triangle $=\frac{1}{2}(12p)(6\sqrt{3}p)=36\sqrt{3}p^2$ Ratio of corresponding sides of consecutive triangles= $1:2$ Ratio of areas of consecutive triangles= $1:4$ $\therefore\ r=\frac{1}{4}$ $S_\infty=\dfrac{a}{1-r};r\neq 1$ $S_\infty=\dfrac{36\sqrt{3}p^2}{1-\frac{1}{4}}=48\sqrt{3}p^2$ **OR** **Use area rule.** Area of the first triangle $=\frac{1}{2}(12p)(12p)\sin 60°$ $=36\sqrt{3}p^2$ Area of the second triangle $=\frac{1}{2}(6p)(6p)\sin 60°$ $=9\sqrt{3}p^2$ Area of the third triangle $=\frac{1}{2}(3p)(3p)\sin 60°$ $=\dfrac{9\sqrt{3}p^2}{4}$ $36\sqrt{3}p^2+9\sqrt{3}p^2+\dfrac{9\sqrt{3}p^2}{4}\ldots$ Geometric pattern $r=\dfrac{9\sqrt{3}p^2}{36\sqrt{3}p^2}=\dfrac{1}{4}$ $S_\infty=\dfrac{a}{1-r};r\neq 1$ $S_\infty=\dfrac{36\sqrt{3}p^2}{1-\frac{1}{4}}=48\sqrt{3}p^2$	**OR** ✓ $36\sqrt{3}p^2$ ✓ $1:2$ ✓ $1:4$ ✓ $\frac{1}{4}$ ✓ substitution into correct formula **OR** ✓ $36\sqrt{3}p^2$ ✓ $9\sqrt{3}p^2$ ✓ $\dfrac{9\sqrt{3}p^2}{4}$ ✓ $\frac{1}{4}$ ✓ substitution into correct formula	**(5)**
			[13]

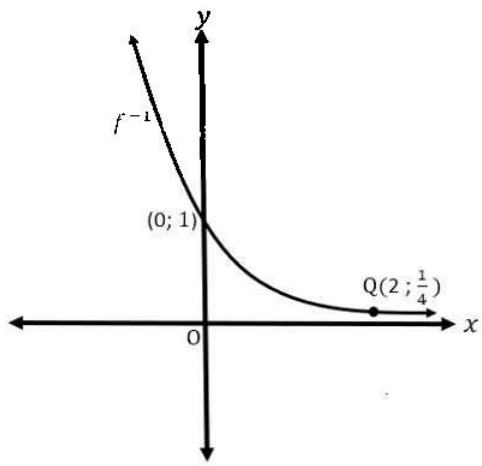
QUESTION 4			
4.1	$(0\,;\frac{15}{2})$ Penalize if NOT in coordinate form	✓ $(0\,;\frac{15}{2})$	(1)
4.2	$x^2 + 2x = 0$ $x(x+2) = 0$ $x = 0$ or $x = -2$ $C(-2\,;0)$ DO NOT penalize if not in coordinate form	✓ factorization ✓ $C(-2\,;0)$	(2)
4.3.1	$x = \frac{-b}{2a}$ $x = \frac{-2}{2(1)} = -1$ $\therefore p = -1$ **OR** $P = \frac{0+(-2)}{2} = -1$ **OR** $g(x) = (x+1)^2 - 1$ $x = -1$ $\therefore p = -1$	✓ $p = -1$	(1)
4.3.2	$g(-1) = (-1)^2 + 2(-1) = -1$ $y_E = -1$ $\therefore \mathrm{DE} = 8 - (-1) = 9$ units	✓ $y_E = -1$ ✓ 9	(2)

4.4	$f(x) = a(x+p)^2 + q$ $f(x) = a(x+1)^2 + 8$ Use F$(0\ ;\ \frac{15}{2})$ $a(0+1)^2 + 8 = \frac{15}{2}$ $a + 8 = \frac{15}{2}$ $\therefore a = -\frac{1}{2}$ $f(x) = -\frac{1}{2}(x+1)^2 + 8$ $f(x) = -\frac{1}{2}(x^2 + 2x + 1) + 8$ $f(x) = -\frac{1}{2}x^2 - x - \frac{1}{2} + 8$ $f(x) = -\frac{1}{2}x^2 - x + \frac{15}{2}$ $\therefore b = -1$	✓ substitution of p and q using point D(1 ; 8) ✓ substitution of x and y using point F$(0\ ;\ \frac{15}{2})$ ✓ simplification leading to $a = -\frac{1}{2}$ ✓ simplification leading to $b = -1$	(4)

4.5	$-\frac{1}{2}x^2 - x - \frac{15}{2} = x^2 + 2x$ $\frac{3}{2}x^2 + 3x - \frac{15}{2} = 0$ $x^2 + 2x - 5 = 0$ $x = \frac{-2 \pm \sqrt{2^2 - 4(1)(-5)}}{2(1)}$ $x = \frac{-2 \pm \sqrt{24}}{2}$ $x = 1.45\ or\ x = -3.45$ $g(1.45) = (1.45)^2 + 2(1.45) = 5.00$ $g(-3.45) = (-3.45)^2 + 2(-3.45) = 5.00$ $\therefore y = 5$ **OR** $f(1.45) = -\frac{1}{2}(1.45)^2 - 1.45 - \frac{15}{2} = 5.00$ $f(-3.45) = -\frac{1}{2}(-3.45)^2 - (-3.45) - \frac{15}{2} =$ 5.00 $\therefore y = 5$	✓ equating f and g ✓ standard equation ✓ x-values ✓ y-values ✓ $y = 5$	(5)
			[15]

QUESTION 5

5.1.1	$y = \log_a x$ $2 = \log_a \frac{1}{4}$ $a^2 = \frac{1}{4}$ $a = \pm\sqrt{\frac{1}{4}}$ $a = \pm\frac{1}{2}$ $\therefore a = \frac{1}{2}$	✓ substitution ✓ $a = \frac{1}{2}$	(2)

5.1.2	$y = \log_{\frac{1}{2}} x$ $x = \log_{\frac{1}{2}} y$ $y = \left(\frac{1}{2}\right)^x$ ANSWER ONLY FULL MARKS	✓ swopping of variables ✓ $y = \left(\frac{1}{2}\right)^x$	(2)
5.2		✓ shape ✓ y-intercept ✓ any other correct point on the graph	(3)
5.3	$\log_{\frac{1}{2}} x > -5$ $x < \left(\frac{1}{2}\right)^{-5}$ $x < 32$; but $x > 0$ $\therefore 0 < x < 32$ ANSWER ONLY FULL MARKS	✓ $x < \left(\frac{1}{2}\right)^{-5}$ ✓ $x < 32$ accept: Critical value $x = 32$ ✓ $0 < x < 32$	(3)
			[10]

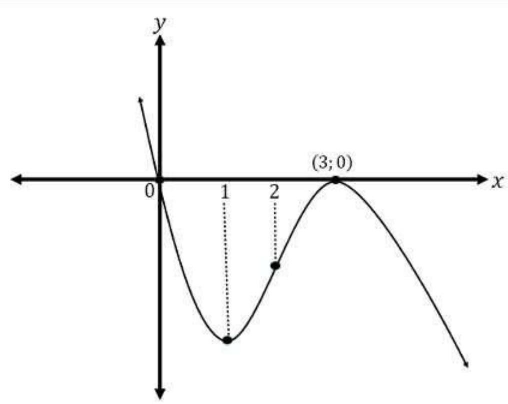
QUESTION 6			
6.1.1	$y = -x + k$ $-1 = -(-4) + k$ $-1 = 4 + k$ $k = -5$	✓ substitution ✓ $k = -5$	(2)
6.1.2	$p = 4$ $q = -1$ $y = \dfrac{a}{x+4} - 1$ Use A $(-8; 0)$ $0 = \dfrac{a}{-8+4} - 1$ $0 = \dfrac{a}{-4} - 1$ $1 = \dfrac{a}{-4}$ $\therefore a = -4$ $f(x) = -\dfrac{-4}{x+4} - 1$	✓ $p = 4$ ✓ q= -1 ✓ substitution ✓ $a = -4$	(4)
6.2	$-\dfrac{-4}{x+4} - 1 \geq -x - 5$ $\dfrac{-4}{x+4} \geq -x - 4$ $(x+4)^2 \geq 4$ Critical values: $(x+4)^2 = 4$ $x + 4 = \pm 2$ $x = -2$ and $x = -6$ $-6 \leq x < -4$ or $x \geq -2$	✓ inequality/ equate ✓ simplification ✓ critical values ✓ $-6 \leq x < -4$ ✓ $x \geq -2$	(5)

6.3	$\frac{-4}{x+4} - 1 = x + t$ $-4 - 1(x+4) = x(x+4) + t(x+4)$ $-4 - x - 4 = x^2 + 4x + tx + 4t$ $x^2 + (5+t)x + 8 + 4t = 0$ $b^2 - 4ac = 0$ $(5+t)^2 - 4(1)(8+4t) = 0$ $t^2 + 10t + 25 - 32 - 16t = 0$ $t^2 - 6t - 7 = 0$ $(t-7)(t+1) = 0$ $t = 7$ or $t = -1$	✓ Equating ✓ $x^2 + (5+t)x + 8 + 4t = 0$ ✓ Substitution into discriminant ✓ $t^2 - 6t - 7 = 0$ ✓ Factors/ Method ✓ Values of t	(6)
			[17]

QUESTION 7			
7.1	$f(x)=\frac{3}{x}$ $f^{/}(x)=\lim\limits_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim\limits_{h\to 0}\frac{\left(\frac{3}{x+h}\right)-\left(\frac{3}{x}\right)}{h}$ $=\lim\limits_{h\to 0}\frac{\left(\frac{3x-3(x+h)}{x(x+h)}\right)}{h}$ $=\lim\limits_{h\to 0}\frac{\left(\frac{3x-3x-3h}{x(x+h)}\right)}{h}$ $=\lim\limits_{h\to 0}\left[\frac{-3h}{x(x+h)}\times\frac{1}{h}\right]$ $=\lim\limits_{h\to 0}\left[\frac{-3}{x(x+h)}\right]$ $=\frac{-3}{x^2}$	✓ $\left(\frac{3}{x+h}\right)$ ✓ simplification of numerator to $-3h$ ✓ denominator $x(x+h)$ ✓ $\frac{-3h}{x(x+h)}\times\frac{1}{h}$ ✓ $\frac{-3}{x^2}$ ANSWER ONLY $\frac{0}{5}$ Penalize for notation 1 mark Only penalize notation in 7.1	(5)
7.2.1	$D_x\left[\frac{\sqrt[3]{x^2}-x^{-\frac{3}{2}}}{\sqrt{x}}\right]$ $D_x\left[\frac{x^{\frac{2}{3}}-x^{-\frac{3}{2}}}{x^{\frac{1}{2}}}\right]$ $D_x\left[x^{-\frac{1}{2}}\left(x^{\frac{2}{3}}-x^{-\frac{3}{2}}\right)\right]$ $D_x\left[x^{\frac{1}{6}}-x^{-2}\right]$ $\frac{1}{6}x^{-\frac{5}{6}}+2x^{-3}$	✓ changing both radicals to exponents. ✓ $x^{\frac{1}{6}}-x^{-2}$ ✓ $\frac{1}{6}x^{\frac{-5}{6}}$ ✓ $2x^{-3}$	(4)

7.2.2	$\frac{dy}{dx}$ if $xy - y = x^2 - 1$ $y = \frac{(x^2-1)}{(x-1)}$ $y = \frac{(x-1)(x+1)}{(x-1)}$ $y = x + 1$ $\therefore \frac{dy}{dx} = 1$	✓ $y = \frac{(x^2-1)}{(x-1)}$ ✓ $y = x + 1$ ✓ 1	(3)
7.3.1	$f(x) = ax^3 + bx^2$ The gradient of the tangent at $x = 1$ is 12. $f^{/}(x) = 3ax^2 + 2bx$ $f^{/}(1) = 3a(1)^2 + 2b(1)$ $12 = 3a + 2b$ Use point (1; 5) $5 = a(1)^2 + b(1)$ $5 = a + b$ Solving simultaneously: $b = 6 - \frac{3a}{2}$…………... (1) $b = 5 - a$ …………... (2) $6 - \frac{3a}{2} = 5 - a$ $10 - 2a = 12 - 3a$ $3a - 2a = 2$ $\therefore a = 2$ $\Rightarrow b = 5 - 2 = 3$	✓ $f^{/}(x) = 3ax^2 + 2bx$ ✓ $3a + 2b = 12$ ✓ $a + b = 5$ ✓ Simplifying to $a = 2$ ✓ Simplifying to $b = 3$	(5)

7.3.2	$f(x) = 2x^3 + 3x^2$ $f'(x) = 6x^2 + 6x$ $6x^2 + 6x = 0$ $x^2 + x = 0$ $x(x+1) = 0$ $\therefore x = 0$ or $x = -1$ $f(0) = 2(0)^3 + 3(0)^2 = 0$ $f(-1) = 2(-1)^3 + 3(-1)^2 = 1$ The coordinates are $(0{,}0)$ *and* $(-1{,}1)$	✓ $f'(x)$ ✓ equating to 0 ✓ x-values ✓ $(0{,}0)$ ✓ $(-1{,}1)$	(5)
			[22]

QUESTION 8			
8.1.1	The graph has a local maximum when $x = 3$ **OR** The graph is concave down.	✓✓ local maximum **OR** ✓✓ concave down	(2) (2)
8.1.2		✓ intercepts ✓ turning points ✓ point of inflection ✓ Shape	(4)

8.1.3	$x < 0$ $1 < x < 3$	✓ $x < 0$ ✓✓ $1 < x < 3$	(3)
8.2	$f(x) = a(x)(x-3)^2$ $-40 = a(5)(5-3)^2$ $-40 = 20a$ $\therefore a = -2$ $f(x) = -2(x)(x-3)^2$ $f(x) = -2x(x^2 - 6x + 9)$ $f(x) = -2x^3 + 12x^2 - 18x$ **OR** $f(x) = px^3 + qx + rx$ $f^/(x) = 3px^2 + 2qx + r$ At turning the point; $f^/(x) = 0$ $3px^2 + 2qx + r = 0$ $x^2 + \frac{2q}{3p}x + \frac{r}{3p} = 0$	✓ substitution of $(5;\ -40)$ ✓ -2 ✓ 12 ✓ -18	

	The graph has turning points at $x = 1$ and $x = 3$ $\therefore a(x-1)(x-3) = 0$ $(x-1)(x-3) = 0$ $x^2 - 4x + 3 = 0$ $\Rightarrow \frac{2q}{3p} = -4$ $q = -6p$ and $\frac{r}{3p} = 3$ $r = 9p$ **OR** $f''(x) = 6px + 2q$ $f''(2) = 12p + 2q$ $12p + 2q = 0$ $q = -6p$ But $f(5) = -40$ $\therefore 125p + 25q + 5r = -40$ $125p + 25(-6p) + 5(9p) = -40$ $20p = -40$ $p = -2$ $q = -6(-2) = 12$ $r = 9(-2) = -18$ $f(x) = -2x^3 + 12x^2 - 18x$ **OR** $f'(x) = 3px^2 + 2qx + r$ $f'(1) = 3p + 2q + r$ $3p + 2q + r = 0$ ……..Equation 1 $f'(3) = 27p + 6q + r$ $27p + 6q + r = 0$…….Equation 2 $f(5) = -40$ $\therefore 125p + 25q + 5r = -40$ $25p + 5q + r = -8$ ….Equation 3 From the three equations, eliminate r to get $22p + 3q = -8$ and $2p + q = 8$	**OR** ✓ Substitution of $(5;\ -40)$ ✓ -2 ✓ 12 ✓ -18 **OR** ✓ method ✓ -2 ✓ 12 ✓ -18	

	$q = 8 - 2p$ $22p + 3(8 - 2p) = -8$ $22p + 24 - 6p = -8$ $16p = -32$ $p = -2$ $q = 8 - 2(-2) = 12$ $3p + 2q + r = 0$ $3(-2) + 2(12) + r = 0$ $18 + r = 0$ $r = -18$		**(4)**
			[13]

QUESTION 9			
9.1.	$V = lbh$ $2\,160\,000 = x^2h$ $\therefore h = \dfrac{2\,160\,000}{x^2}$	✓ substitution ✓ $\dfrac{2\,160\,000}{x^2}$	(2)
9.2	$Surface\ area\ = 3x^2 + x^2 + 4xh$ $= 4x^2 + 4x\left(\frac{2\,160\,000}{x^2}\right)$ $A(x) = 4x^2 + \dfrac{8\,640\,000}{x}$	✓ $4x^2$ ✓ $4xh$ ✓ substitution of h	(3)
9.3	$A(x) = 4x^2 + 8\,640\,000x^{-1}$ $A'(x) = 8x - 8\,640\,000x^{-2}$ $= 8x - \dfrac{8\,640\,000}{x^2}$ $S'(x) = 0$ $8x - \dfrac{8\,640\,000}{x^2} = 0$ $8x^3 = 8\,640\,000$ $x^3 = 1\,080\,000$ $x = \sqrt[3]{1\,080\,000} = 102{,}6cm$ $\therefore h = \dfrac{2\,160\,000}{(102.6)^2} = 205{,}19cm$	✓ $8x - 8\,640\,000x^{-2}$ ✓ equating $A'(x)$ to 0. ✓ simplification ✓ $102{,}6cm$ ✓ $205{,}19cm$	(5)
			[10]

TOTAL: 150