



PREPARATORY EXAMINATION

2018

MARKING GUIDELINES

10611	MATHEMATICS (PAPER 1)
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14 pages

**GAUTENG DEPARTMENT OF EDUCATION
PREPARATORY EXAMINATION**

**MATHEMATICS
(Paper 1)**

MARKING GUIDELINES

	QUESTION 1	
1.1		
1.1.1	$x^2 - x - 30 = 0$ $(x - 6)(x + 5) = 0$ $x = 6 \text{ or } x = -5$	✓ correct factors ✓ both answers correct (2)
1.1.2	$3x^2 - 8x - 4 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $x = \frac{-(-8) \pm \sqrt{(-8)^2 - 4(3)(-4)}}{2(3)}$ $x = 3,10 \text{ or } x = -0,43$	✓ standard form ✓ correct subst. in the correct formula ✓ $x = 3,10$ ✓ $x = -0,43$ Penalise for incorrect rounding off here only (4)
1.1.3	$\sqrt{5 - x} - x = 1$ $\sqrt{5 - x} = 1 + x$ $(\sqrt{5 - x})^2 = (1 + x)^2$ $x^2 + 3x - 4 = 0$ $(x + 4)(x - 1) = 0$ $x = -4 \text{ or } x = 1$ NA	✓ isolate square root ✓ square both sides ✓ standard form ✓ both answers correct ✓ choose correct answer (5)
1.1.4	$\frac{6x^2 - 3x}{3} \leq 3x^2$ $2x^2 - x \leq 3x^2$ $2x^2 - 3x^2 - x \leq 0$ $-x^2 - x \leq 0$ $-x(x + 1) \leq 0$ $x \geq 0 \text{ or } x \leq -1$ OR	✓ simplify ✓ standard form ✓ correct factors ✓ critical values ✓ correct inequalities

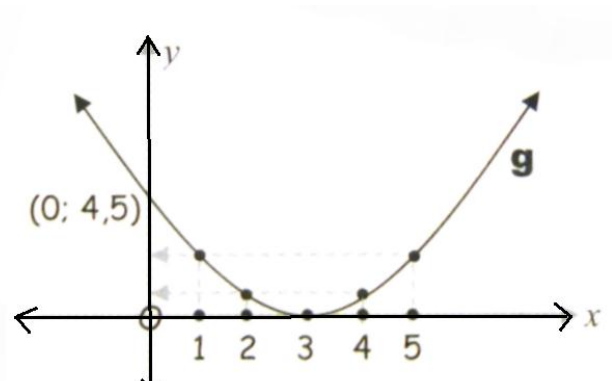
	$\frac{6x^2 - 3x}{3} \leq 3x^2$ $6x^2 - 3x \leq 9x^2$ $6x^2 - 9x^2 - 3x \leq 0$ $-3x^2 - 3x \leq 0$ $3x(x+1) \geq 0$ $x \geq 0 \text{ or } x \leq -1$	✓simplify ✓standard form ✓correct factors ✓critical values ✓correct inequalities (5)
1.1.5	$2x^2 + 7\sqrt{2x} = 2$ $2^2 \cdot 2^x + 7 \cdot 2^{\frac{x}{2}} - 2 = 0$ $4 \cdot 2^x + 7 \cdot 2^{\frac{x}{2}} - 2 = 0$ $(4 \cdot 2^{\frac{x}{2}} - 1)(2^{\frac{x}{2}} + 2) = 0$ $2^{\frac{x}{2}} = \frac{1}{4} \quad \text{or} \quad 2^{\frac{x}{2}} = -2$ $2^{\frac{x}{2}} = 2^{-2} \quad \text{NA}$ $\frac{x}{2} = -2$ $x = -4$	✓standard form ✓factors ✓ $2^{\frac{x}{2}} = 2^{-2}$ ✓NA ✓ $x = -4$ (5)
1.2	$6x^2 + 2px - 3x - p = 0$ $6x^2 + x(2p - 3) - p = 0$ $\Delta = b^2 - 4ac$ $\Delta = (2p - 3)^2 - 4(6)(-p)$ $= 4p^2 + 12p + 9$ $= (2p + 3)^2$ $\Delta = \text{perfect square}$ $\therefore \text{rational roots}$	✓coefficient of x ✓correct substitution in correct formula ✓factors ✓ $\therefore \Delta = \text{perfect square}$ (conclusion) (4)
[25]		

	QUESTION 2	
2.1	$T_n = a + (n-1)d$ $-239 = 6 + (n-1)(-5)$ $-239 = 6 - 5n + 5$ $250 = 5n$ $n = 50$	$\checkmark T_n = -239$ $\checkmark d = -5$ $\checkmark$ answer (3)
2.2	$T_3 = ar^2 = 18 \dots \textcircled{1}$ $T_5 = ar^4 = 162 \dots \textcircled{2}$ $\textcircled{2} \div \textcircled{1}: \quad r^2 = 9 \quad (r < 0)$ $r = -3$ $ar^2 = 18$ $a(9) = 18$ $a = 2$ $S_n = \frac{a(r^n - 1)}{r - 1}$ $S_7 = \frac{2((-3)^7 - 1)}{-3 - 1}$ $= \frac{2(-2187 - 1)}{-4}$ $= 1094$	$\checkmark$ eq① $\checkmark$ eq② $\checkmark r = -3$ $\checkmark a = 2$ $\checkmark$ correct substitution in correct formula $\checkmark$ answer (6)
2.3	3; x ; 11; 21; 35 $x - 3$; $11 - x$; 10; 14 $-2x = 4 - 14$ $-2x = -10$ $x = 5$	$\checkmark$ first difference d_1 $\checkmark$ equating second difference $\checkmark$ answer (3)

2.4	$S_8 : S_4 = 97:81$ $\frac{S_8}{S_4} = \frac{97}{81}$ $\frac{a(1-r^8)}{1-r} \div \frac{a(1-r^4)}{1-r} = \frac{97}{81}$ $\frac{a(1-r^8)}{1-r} \times \frac{1-r}{a(1-r^4)} = \frac{97}{81}$ $\frac{(1-r^8)}{(1-r^4)} = \frac{97}{81}$ $\frac{(1-r^4)(1+r^4)}{(1-r^4)} = \frac{97}{81}$ $1+r^4 = \frac{97}{81}$ $r^4 = \frac{16}{81}$ $r^4 = \left(\frac{2}{3}\right)^4$ $r = \left(\frac{2}{3}\right)$ $\therefore r = \left(\frac{2}{3}\right)$ First three terms: 9; 6; 4	$\checkmark$ $\frac{a(1-r^8)}{1-r} \div \frac{a(1-r^4)}{1-r} = \frac{97}{81}$ $\checkmark$ simplify $\frac{(1-r^8)}{(1-r^4)} = \frac{97}{81}$ $\checkmark$ factors $\checkmark r^4 = \left(\frac{2}{3}\right)^4$ $\checkmark r = \left(\frac{2}{3}\right)$ $\checkmark$ first three terms (6)
2.5.1	$2(p-5) + 2(p-5)^2 + 2(p-5)^3 + \dots$ $r = p-5$ Convergent: $-1 < r < 1$ $-1 < p-5 < 1$ $4 < p < 6$	$\checkmark r = p-5$ $\checkmark -1 < p-5 < 1$ $\checkmark 4 < p < 6$ (3)
2.5.2	$S_\infty = \frac{a}{1-r}$ $= \frac{-1}{1-(-\frac{1}{2})}$ $= -\frac{2}{3}$	$\checkmark$ substitute $a = -1$ $\checkmark r = -\frac{1}{2}$ $\checkmark$ answer (3)
		[24]

QUESTION 3		
3.1	$A = P(1-i)^n$ $100\,000 = 134\,000(1-0,068)^n$ $\frac{50}{67} = (0,932)^n$ $n = \log_{0,932}\left(\frac{50}{67}\right)$ $n = 4,16 \text{ years}$	✓ correct formula ✓ correct substitution ✓ $n = \log_{0,932}\left(\frac{50}{67}\right)$ ✓ answer (4)
3.2.1	$A = P(1+i)^n$ $A = 150\,000\left(1 + \frac{0,1525}{12}\right)^2$ $= R153\,836,73$ $P = \frac{x[1 - (1+i)^{-n}]}{i}$ $153\,836,73 = \frac{x\left[1 - \left(1 + \frac{0,1525}{12}\right)^{-24}\right]}{\frac{0,1525}{12}}$ $x = R7\,477,31$ ∴ The monthly payments are R7 477,31 per month	✓ $n = 2$ ✓ $i = \frac{0,1525}{12}$ ✓ correct formula and substitute for P ✓ $n = -24$ ✓ answer (5)
3.2.2	$P = \frac{x[1 - (1+i)^{-n}]}{i}$ $7\,477,31 = \frac{x\left[1 - \left(1 + \frac{0,1525}{12}\right)^{-6}\right]}{\frac{0,1525}{12}}$ $= R42\,934,09$ OR	✓ substitute in correct formula ✓ $i = \frac{0,1525}{12}$ ✓ $n = -6$ ✓ answer

	$F = \frac{x[(1+i)^n - 1]}{i}$ $F = \frac{7\,477,31 \left[\left(1 + \frac{0,1525}{12} \right)^{18} - 1 \right]}{\frac{0,1525}{12}}$ $F = R150\,164,35$ $A = P(1+i)^n$ $A = 153\,836,73 \left(1 + \frac{0,1525}{12} \right)^{18}$ $A = R193\,098,52$ $\therefore$ The outstanding balance is R42 934,17	✓ $n = -18$ ✓ $i = \frac{0,1525}{12}$ ✓ $153\,836,73 \left(1 + \frac{0,1525}{12} \right)^{18}$ ✓ answer (4)
		[13]
	QUESTION 4	
4.1	$y = -8$	✓ answer (1)
4.2	$f(x) = 0$ $2^x - 8 = 0$ At P : $2^x = 8$ $2^x = 2^3$ $x = 3$ P(3 ; 0) $x = 0$ At D: $f(x) = 2^0 - 8$ $= 1 - 8$ $= -7$ D(0 ; -7)	✓ $2^x = 2^3$ ✓ P(3;0) ✓ $2^0 = 1$ ✓ answer D(0; - 7) (4)
4.3	$h(x) = f(2x) + 8$ $= 2^{2x} - 8 + 8$ $= 2^{2x}$ $h(x) = 2^{2x}$ OR $h(x) = 4^x$	✓ substitution ✓ answer (2)
4.4	$y = 4^x$ $h^{-1} : x = 4^y$ $y = \log_4 x$ OR	✓ interchange x and y ✓ answer

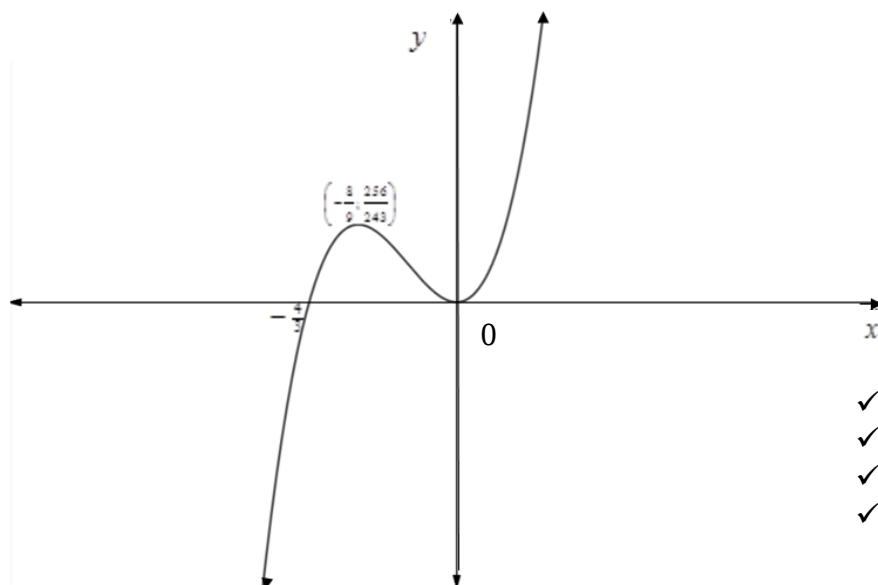
	$x = 2^{2y}$ $2y = \log_2 x$ $y = \frac{1}{2} \log_2 x$ $\log_2 \sqrt{x}$	✓ interchange x and y ✓ answer (2)
4.5	$y \in R$ OR $y \in (-\infty; \infty)$	✓ answer (1)
4.6	$y = a(x - p)^2 + q$ $y = a(x - 3)^2$ $4,5 = a(0 - 3)^2$ $\frac{1}{2} = a$ $y = \frac{1}{2}(x^2 - 6x + 9)$ OR $y = \frac{1}{2}(x - 3)^2$ OR $y = \frac{1}{2}x^2 - 3x + 4,5$	✓ substitution of points D and P ✓ value of a ✓ equation (in any form) (3)
4.7	By symmetry: $g(1) = g(5)$ and $g(2) = g(4)$ $\sum_{k=0}^3 g(k) - \sum_{k=4}^5 g(k)$ $= [g(0) + g(1) + g(2) + g(3)] - [g(4) + g(5)]$ $= g(0) + [g(1) - g(5)] + [g(2) - g(4)] + g(3)$ $= 4,5 + 0 + 0 + 0$ $= 4,5$ 	✓ correct deduction ✓ expansion ✓ answer (3)

4.8	Any upwards translation will result in non-real roots.	✓ answer (1)
		[17]
	QUESTION 5	
5.1	$x = -2$ or $x = 4$	✓ $x = -2$ ✓ $x = 4$ (2)
5.2	$x < -2$ or $-2 < x \leq 6$ OR $x \leq 6; x \neq -2$	✓ $x < -2$ ✓ $-2 < x \leq 6$ OR ✓ $x \leq 6$ ✓ $x \neq -2$ (2)
5.3	$-2 \leq x \leq 2$	✓ correct critical values ✓ correct inequalities (2)
		[6]
	QUESTION 6	
6.1	$g(x) = \frac{1}{4}x^2$	✓ answer (1)
6.2	$h(x) = \frac{1}{4}(x)^2 - 2$	✓ answer (1)
6.3	$y \geq -2$ OR $y \in [-2; \infty)$	✓ answer (correct inequality / bracket) (1)
		[3]
	QUESTION 7	
7.1	$x = 2$	✓ answer (1)
7.2	Translation of 2 units to the right and 3 units downwards.	✓ 2 units right ✓ 3 units down (2)
7.3	$x \in R; x \neq 3$	✓ answer (1)
7.4	$y = x + c$ $0 = 2 + c$ $-2 = c$ $y = x - 2$	✓ correct gradient (m=1) ✓ substitution C(2 ; 0) ✓ equation (3)
		[7]

QUESTION 8		
8.1	$f(x+h) = 1 - 3(x+h)^2$ $= 1 - 3(x^2 + 2xh + h^2)$ $= 1 - 3x^2 - 6xh - 3h^2$ $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \rightarrow 0} \frac{1 - 3x^2 - 6xh - 3h^2 - (1 - 3x^2)}{h}$ $= \lim_{h \rightarrow 0} \frac{1 - 3x^2 - 6xh - 3h^2 - 1 + 3x^2}{h}$ $= \lim_{h \rightarrow 0} \frac{-6xh - 3h^2}{h}$ $= \lim_{h \rightarrow 0} \frac{h(-6x - 3h)}{h}$ $= -6x$	$\checkmark f(x+h) =$ $1 - 3x^2 - 6xh - 3h^2$ $\checkmark$ correct substitution into correct formula $\checkmark$ simplify $(-6xh - 3h^2)$ $\checkmark$ common factor h $\checkmark -6x$ (5)
8.2	$f'(2) = -6(2)$ $= -12$	$\checkmark$ substitute $x = 2$ $\checkmark$ answer (2)
		[7]
QUESTION 9		
In this question, penalise learners ONCE for incorrect notation.		
9.1.	$\frac{d}{dt} [(t-2)(t+3)]$ $= \frac{d}{dt} [t^2 + t - 6]$ $= 2t + 1$	$\checkmark$ correct quadratic expression $\checkmark 2t$ $\checkmark 1$ (3)
9.2	$D_x \left[\frac{5x^3 - 4}{x} \right]$ $= D_x \left[5x^2 - \frac{4}{x} \right]$ $= D_x [5x^2 - 4x^{-1}]$ $= 10x + 4x^{-2}$	$\checkmark$ simplification $\checkmark 10x$ $\checkmark 4x^{-2}$ (3)
		[6]

QUESTION 10		
10.1	$f(x) = ax^3 + bx^2$ $7 = a + b \dots\dots\dots(1)$ $f'(x) = 3ax^2 + 2bx$ $17 = 3a(1)^2 + 6(1)$ $17 = 3a + 2b \dots\dots(2)$ from (1) $b = 7 - a$ Substitute in (2) $3a + 2(7 - a) = 17$ $3a + 14 - 2a = 17$ $a = 3$ $b = 4$ OR $f(x) = ax^3 + bx^2$ $7 = a + b$ $f'(x) = 3ax^2 + 2bx$ $17 = 3a(1)^2 + 6(1)$ $17 = 3a + 2b$ from (1) $a = 7 - b$ Substitute in (2) $3(7 - b) + 2b = 17$ $21 - 3b + 2b = 17$ $-b = -4$ $b = 4$ $a = 3$	 ✓ $7 = a + b$ ✓ derivative ✓ $17 = 3a + 2b$ ✓ $b = 7 - a$ ✓ $a = 3$ (must show calculation) ✓ $b = 4$ (must show calculation) ✓ $7 = a + b$ ✓ derivative ✓ $17 = 3a + 2b$ ✓ $a = 7 - b$ ✓ $b = 4$ (must show calculation) ✓ $a = 3$ (must show calculation) (6)
10.2	$f(x) = 3x^3 + 4x^2$ $f'(x) = 9x^2 + 8x$ $9x^2 + 8x = 17$ $9x^2 + 8x - 17 = 0$ $(9x + 17)(x - 1) = 0$ $x = -\frac{17}{9}$ or $x = 1$ $y = 3\left(-\frac{17}{9}\right)^3 + 4\left(-\frac{17}{9}\right)^2$ $= -5,95$ The other point is $(-1,89; -5,95)$	 ✓ derivative ✓ equate to 17 ✓ standard form ✓ factors ✓ x-value ✓ y-value (6)

10.3



- ✓ shape
- ✓ x-intercepts
- ✓ y-intercept
- ✓ turning points

OR

 x – intercepts

$$0 = 3x^3 + 4x^2$$

$$0 = x^2(3x + 4)$$

$$x = 0 \quad \text{or} \quad x = -\frac{4}{3}$$

 y – intercepts: $(0; 0)$

Turning point

$$0 = 9x^2 + 8x$$

$$x(9x + 8) = 0$$

$$x = 0 \quad \text{or} \quad x = -\frac{8}{9}$$

$$y = 3\left(-\frac{8}{9}\right) + 4\left(-\frac{8}{9}\right)^2$$

$$= \frac{256}{243} \quad \text{or} \quad 1,05$$

$$(0;0) \quad \text{or} \quad \left(-\frac{8}{9}; \frac{256}{243}\right)$$

(If no sketch – award 3 marks for correct calculations)✓ x -intercepts✓ y -intercepts

✓ turning points

(4)

10.4

$$f(x) = 3x^3 + 4x^2$$

$$f'(x) = 9x^2 + 8x$$

$$f''(x) = 18x + 8$$

$$18x + 8 > 0$$

$$x > -\frac{8}{18}$$

OR

$$x > -\frac{4}{9}$$

✓ $f''(x) = 18x + 8$ ✓ $18x + 8 > 0$

✓ answer

(3)

[19]

	QUESTION 11	
11.1	$s(t) = 6000 - 600t - 0,2t^3 + 2 \times 10^{-3}t^5$ $s'(t) = -600 - 0,6t^2 + 10^{-2}t^4$ $s'(0) = -600 - 0,6(0)^2 + 10^{-2}(0)^4$ $s'(0) = -600$ Thus meteorite is approaching at 600 m/s	✓ derivative ✓ substitute with 0 ✓ answer (600 m/s) (3)
11.2	$s(t) = 6000 - 600t - 0,2t^3 + 2 \times 10^{-3}t^5$ $s(10) = 6000 - 600(10) - 0,2(10)^3 + 2 \times 10^{-3}(10)^5$ $= 0$ The meteor will be 0 m away from the planet, thus hitting it.	✓ substitution ✓ answer (2)
11.3	$s''(t) = -1,2t + 4 \times 10^{-2}t^3$ $s''(5) = -1,2(5) + 4 \times 10^{-2}(5)^3$ $= -1 \text{ m/s}^2$	✓ second derivative ✓ substitution ✓ answer (3)
		[8]
	QUESTION 12	
12.1	No. $P(A \cap B) \neq 0$ OR $P(A \cap B) = 0,1596$	✓ No ✓ $P(A \cap B) \neq 0$ OR ✓ $P(A \cap B) = 0,1596$ (2)
12.2	$P(A \cup B) = P(A) + P(B) - P(A \cap B)$ $= 0,38 + 0,42 - 0,16$ $= 0,64$	✓ substitution ✓ answer (2)
12.3	$n(S) = \frac{456}{0,38}$ $= 1\,200$	✓ substitution ✓ answer (2)
12.4	$n(C') = 1\,200(0,72)$ $= 864$	✓ substitution ✓ answer (2)
		[8]

	QUESTION 13	
13.1	$P(E) = \frac{n(E)}{n(S)}$ $= \frac{3!}{5!}$ $= \frac{1}{20}$ $= 0,05$	✓3! ✓5! ✓ answer (3)
13.2	Children 7! Grandparents 2! Parents $2! \times 2! \times 2! \times 3! = 48$ Number of arrangements $7! \times 2! \times 48$ $= 483\,840$	✓7! ✓2! ✓48 ✓ answer (4)
		[7]
		TOTAL: 150