education
Department:
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NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS P1

NOVEMBER 2008

MEMORANDUM

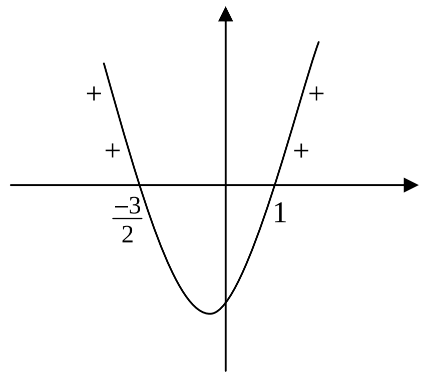
MARKS: 150

This memorandum consists of 23 pages.

- **Continued Accuracy will apply as a general rule.**
- **If a candidate does a question twice and does not delete either, only mark the FIRST attempt.**
- **If a candidate does a question, crosses it out and does not re-do it, mark the deleted attempt.**

QUESTION 1

1.1.1	$x^2 = 5x - 4$ $x^2 - 5x + 4 = 0$ $(x-4)(x-1) = 0$ $x = 4$ or $x = 1$	– 1 for not equal to zero in this question only. If = 0 appears once in this question then full marks	✓ standard form = 0 ✓ factorisation ✓ both answers (3) **OR** By the formula ✓ standard form = 0 ✓ substitution ✓ both answers
1.1.2	$x(3-x) = -3$ $3x - x^2 = -3$ $x^2 - 3x - 3 = 0$ $x = \frac{3 \pm \sqrt{(-3)^2 - 4(1)(-3)}}{2(1)}$ $x = \frac{3 \pm \sqrt{21}}{2}$ $x = 3{,}79$ or $x = -0{,}79$ OR $x(3-x) = -3$ $3x - x^2 = -3$ $-x^2 + 3x + 3 = 0$ $x = \frac{-3 \pm \sqrt{(3)^2 - 4(-1)(3)}}{2(-1)}$ $x = \frac{-3 \pm \sqrt{21}}{-2}$ $x = 3{,}79$ or $x = -0{,}79$	– 1 for inaccurate rounding off for both answers. – 1 for inaccurate rounding off for both answers.	✓ simplification ✓ standard form ✓ substitution into formula ✓✓ answers (5) ✓ simplification ✓ standard form ✓ substitution into formula ✓✓ answers (5) Note: If negative discriminant: max 2 / 5

1.1.3	$3 - x < 2x^2$ $-2x^2 - x + 3 < 0$ $2x^2 + x - 3 > 0$ $(2x+3)(x-1) > 0$ $x < -\frac{3}{2}$ or $x > 1$ OR $x \in (-\infty; -\frac{3}{2}) \cup (1; \infty)$  	✓ standard form ✓ factorisation ✓ OR / ∪ ✓ $x < -\frac{3}{2}$ ✓ $x > 1$ (5)
	OR	
	$3 - x < 2x^2$ $0 < 2x^2 + x - 3$ $0 < (2x+3)(x-1)$ $x < -\frac{3}{2}$ or $x > 1$	✓ standard form ✓ factorisation ✓ OR / ∪ ✓ $x < -\frac{3}{2}$ ✓ $x > 1$ (5)
	Note: 4 / 5 Inaccurate inequality in the beginning 2 / 5 If final answer does not have inequality signs (ie. question has been changed to an equation) 4 / 5 If the candidate has used AND or ∩ instead of OR or ∪ If Answer is $(2x+3)(x-1) > 0$ $-\frac{3}{2} < x < 1$ then: 2 / 5	

1.2	$y=3-2x$ $x^2+(3-2x)+x=(3-2x)^2$ $x^2+3-2x+x=9-12x+4x^2$ $3x^2-11x+6=0$ $(3x-2)(x-3)=0$ $x=\frac{2}{3}$ or $x=3$ $\therefore y=\frac{5}{3}$ $\therefore y=-3$ **OR**	✓ $y=3-2x$ ✓ substitution ✓ simplification of $(3-2x)^2$ ✓ standard form ✓ factorisation ✓ both x values ✓✓ y values (8)
	$x=\frac{3-y}{2}$ $\left(\frac{3-y}{2}\right)^2+y+\frac{3-y}{2}=y^2$ $\frac{9-6y+y^2}{4}+y+\frac{3-y}{2}=y^2$ $9-6y+y^2+4y+6-2y=4y^2$ $0=3y^2+4y-15$ $0=(3y-5)(y+3)$ $y=\frac{5}{3}$ or $y=-3$ $\therefore x=\frac{2}{3}$ $\therefore x=3$ **OR** $y=3-2x$ $x^2-y^2+x+y=0$ $(x+y)(x-y)+(x+y)=0$ $(x+y)(x-y+1)=0$ $y=-x$ $3-2x=-x$ $x=3$ $y=-3$ **or** $y=x+1$ $3-2x=x+1$ $x=\frac{2}{3}$ $y=\frac{5}{3}$ **OR**	✓ $x=\frac{3-y}{2}$ ✓ substitution ✓ simplification of $\left(\frac{3-y}{2}\right)^2$ ✓ standard form ✓ factorisation ✓ both y values ✓✓ x values (8) ✓ $y=3-2x$ ✓ common factor ✓ common bracket ✓ $y=-x$ ✓ $3-2x=-x$ ✓ both x-values ✓✓ y-values (8)

	$x=\frac{3-y}{2}$ $x^2-y^2+x+y=0$ $(x+y)(x-y)+(x+y)=0$ $(x+y)(x-y+1)=0$ $y=-x$ **or** $y=x+1$ $y=-\frac{3-y}{2}$; $y=\frac{3-y}{2}+1$ $2y=-3+y$; $2y=3-y+2$ $y=-3$; $3y=5$ $x=3$; $y=\frac{5}{3}$ $x=\frac{2}{3}$	✓ $x=\frac{3-y}{2}$ ✓ common factor ✓ common bracket ✓ $y=-x$ ✓ $y=-\frac{3-y}{2}$ ✓ both y-values ✓✓ x-values (8)
1.3	$\frac{x^2-4}{x-2}=\frac{(x+2)(x-2)}{(x-2)}=x+2$ Therefore when x = 999 999 999 999, the value is 999 999 999 999 +2 = 1 000 000 000 001. OR $\frac{x^2-4}{x-2}=\frac{(x+2)(x-2)}{(x-2)}=x+2$ 999 999 999 999 = $10^{12}-1$ x + 2 = 999 999 999 999 + 2 = $10^{12}+1$	✓ factorisation ✓ simplification ✓ answer (3) Note: If candidate has substituted directly, 0/3 (answer would be 1×10^{12} by substitution) Answer only: 2 / 3 Correct answer but incorrect mathematics 0 / 3
1.4	$\frac{x^4+1}{x^4}=1+\frac{1}{x^4}>1$ since $\frac{1}{x^4}>0$ $\therefore \frac{x^4+1}{x^4}$ can never be equal to ½ **OR** $2x^4+2=x^4$ $\frac{1}{x^4}=-\frac{1}{2}$ Which has no real solution since $\frac{1}{x^4}>0$ for all $x\in R-\{0\}$ **OR**	✓ inequality ✓ conclusion (2) ✓ equation ✓ conclusion (2)

	$2x^4+2=x^4$ $x^4+2=0$ $x^4+0x^2+2=0$ $b^2-4ac=0-4(1)(2)$ $=-8$ <0 $\therefore$ no real roots	✓ calculation ✓ $\Delta<0$ or $\Delta=-8$ (2)
	$2x^4+2=x^4$ $\therefore x^4=-2$ Which has no real solution since $x^4\geq 0$ for all $x\in R$	✓ equation ✓ conclusion (2) **[26]**

QUESTION 2

2.1.1	$\frac{1}{16}$; 13	✓✓ answers (2)
2.1.2	$\left(\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+...to\ 25\ terms\right)$ $\quad(4+7+10+13+...to\ 25\ terms)$ $\frac{a(r^n-1)}{r-1}$ $\quad = \frac{n}{2}[2a+(n-1)d]$ $=\frac{\frac{1}{2}\left(\left(\frac{1}{2}\right)^{25}-1\right)}{\frac{1}{2}-1}$ $\quad = \frac{25}{2}[2(4)+24(3)]$ = 0,9999999 $\quad$ = 1 000 $S_{50}=1001{,}00$ **OR** $S_{50}=$ 25 terms of 1st sequence + 25 terms of 2nd sequence $S_{50}=\left(\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+...to\ 25\ terms\right)+(4+7+10+13+...to\ 25\ terms)$ $S_{50}=\frac{\frac{1}{2}\left(\left(\frac{1}{2}\right)^{25}-1\right)}{\frac{1}{2}-1}+\frac{25}{2}[2(4)+24(3)]$ $S_{50}=0{,}999999...+1000$ $S_{50}=1001{,}00$	✓ formula for geometric series ✓ $\frac{\frac{1}{2}\left(\left(\frac{1}{2}\right)^{25}-1\right)}{\frac{1}{2}-1}$ ✓ answer for geometric series ✓ formula for linear series ✓ $\frac{25}{2}[2(4)+24(3)]$ ✓ 1000 ✓ answer (7) Note: If used 50 terms in each series: max 5/7 (answer then is 3876) Answer only: 6 / 7 Write out series and then correct answer: full marks Write out both series and not add them: 6 / 7

2.2.1	60 ; 78	✓✓ answers (2)
2.2.2	8 18 30 44 10 12 14 2 2 $2a = 2$ $a = 1$ $T_n = n^2 + bn + c$ $8 = 1 + b + c$ $7 = b + c$ …(i) $18 = 4 + 2b + c$ $14 = 2b + c$ …(ii) (ii) – (i): $14 = 2b + c$ $7 = b + c$ $\therefore 7 = b$ $c = 0$ $T_n = n^2 + 7n$ **OR**	✓ $a = 1$ ✓ substitution ✓ solving simultaneously ✓ $b = 7$ ✓ $c = 0$ ✓ general term (6)
	$T_1 = 8$ $T_2 - T_1 = 10$ $T_3 - T_2 = 12$ $T_n - T_{n-1} =$ nth term of sequence with $a = 8$ and $d = 2$ Add both sides $T_n = 8 + 10 + 12 + ... +$ to 25 terms $T_n = \frac{n}{2}[16 + 2(n-1)]$ $T_n = n(n+7)$ **OR**	✓ $T_1 = 8$ ✓ $T_2 - T_1 = 10$ ✓ $T_3 - T_2 = 12$ ✓ Add both sides ✓ sequence ✓ substitution (6)

T_0 T_1 T_2 T_4 T_5

0 8 18 30 44

8 10 12 14

2 2 2

$T_0 = 0$

$a(0)^2 + b(0) + c = 0$

$c = 0$

constant second difference = 2

$a = 1$

$T_1 = 1 + b = 8$

$b = 7$

$T_n = n^2 + 7n$

$T_n = n(n+7)$

✓ finding T_0
✓ $c = 0$
✓ second difference = 2
✓ $a = 1$
✓ substitution
✓ $b = 7$
(6)

OR

$$T_n = \frac{n-1}{2}\left[2(\textit{first first difference}) + (n-2)(\textit{second difference})\right] + T_1$$

$$T_n = \frac{n-1}{2}[2(10) + (n-2)(2)] + 8$$

$$T_n = 10(n-1) + (n-2)(n-1) + 8$$

$$T_n = 10n - 10 + n^2 - 3n + 2 + 8$$

$$T_n = n^2 + 7n$$

✓ formula
✓✓ substitution
✓✓ simplification
✓ answer
(6)

OR

$$T_n = (n-1)T_2 - (n-2)T_1 + 2nd\ difference\frac{(n-1)(n-2)}{2}$$

$$T_n = (n-1)(18) - (n-2)(8) + 2\frac{(n-1)(n-2)}{2}$$

$$T_n = 18n - 18 - 8n + 16 + n^2 - 3n + 2$$

$$T_n = n^2 + 7n$$

✓✓ formula
✓✓ substitution
✓ simplification
✓ answer
(6)

OR

	$T_n = \dfrac{(n-2)(n-3)T_1 - 2(n-1)(n-3)T_2 + (n-2)(n-1)T_3}{2}$ $T_n = \dfrac{(n^2-5n+6)(8) - 2(n^2-4n+3)(18) + (n^2-3n+2)(30)}{2}$ $T_n = 4n^2 - 20n + 24 - 18n^2 + 72n - 54 + 15n^2 - 45n + 30$ $T_n = n^2 + 7n$ **OR** $T_1 = 8 = 1.8$ $T_2 = 18 = 2.9$ $T_3 = 30 = 3.10$ $T_4 = 44 = 4.11$ $T_n = n^2 + 7n$	✓ formula ✓✓ substitution ✓✓ simplification ✓ answer (6) ✓✓✓✓✓ observation ✓ answer (6) Note: By trial and error: 6 / 6 Answer only: 6 / 6
2.2.3	$n(n+7) = 330$ $n^2 + 7n - 330 = 0$ $(n+22)(n-15) = 0$ $n = -22$ or $n = 15$ $n = 15$ $\therefore 15^{th}$ term is 330. Note: 3 / 4 if did not reject $n = -22$ Answer only: 4 / 4 By trial and error and then write $n = 15$: 4 / 4 1 / 4 if just equate T_n that they found If linear T_n and valid answer : 2 / 4	✓ substitution ✓ standard form ✓ factorisation ✓ answer (4) **[21]**

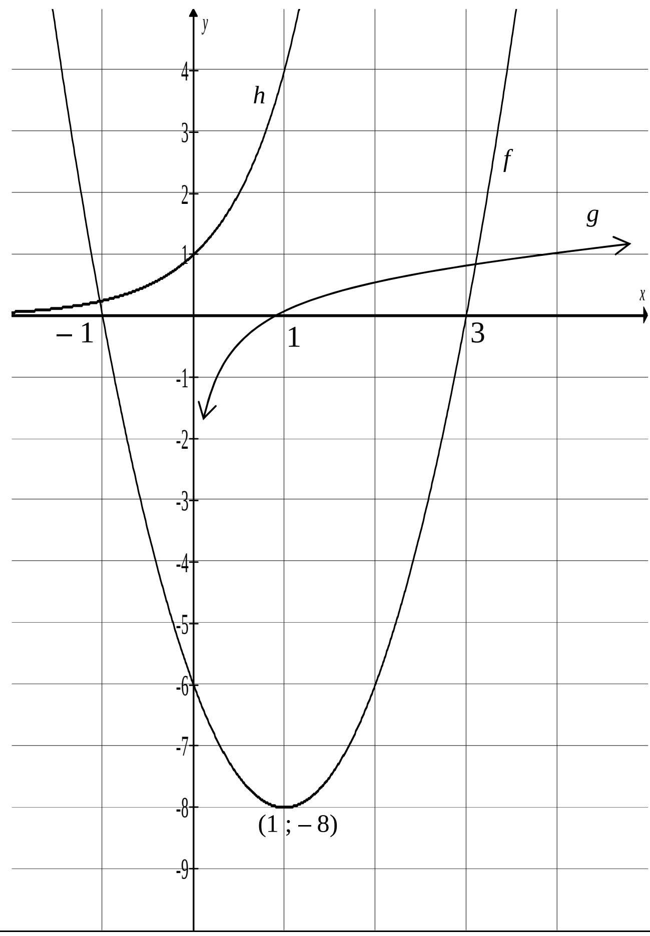
QUESTION 3

3.1	$T_n = (8x^2)\left(\frac{x}{2}\right)^{n-1}$ **OR** $T_n = 8\left(\frac{1}{2}\right)^{n-1}.x^{n+1}$ **OR** $T_n = 16x\left(\frac{x}{2}\right)^{n}$ **OR** $T_n = 2^{4-n}x^{n+1}$	✓ answer (1)
3.2	$ratio = \frac{x}{2}$ $-1 < \frac{x}{2} < 1$ $-2 < x < 2$	✓ ratio ✓ inequality ✓ answer (3)
3.3	$S_\infty = \frac{a}{1-r}$ $S_\infty = \frac{8x^2}{1-\frac{x}{2}}$ $S_\infty = \frac{8\left(\frac{3}{2}\right)^2}{1-\frac{1}{2}\left(\frac{3}{2}\right)}$ $S_\infty = 72$ **OR** $18+\frac{27}{2}+\frac{81}{8}+\dots$ $S_\infty = \frac{18}{1-\frac{3}{4}}$ $S_\infty = \frac{18}{\frac{1}{4}}$ $S_\infty = 72$	✓ substitution into formula for S_∞ ✓ substitution of $x=\frac{3}{2}$ ✓ answer (3) ✓ series ✓ substitution ✓ answer (3) Formula Incorrect: 0 / 3 **[7]**

QUESTION 4

4.1	$p = 4$ $q = 2$ $3 = \frac{a}{5-4} + 2$ $1 = \frac{a}{1}$ $a = 1$	✓ answer *p* ✓ answer *q* ✓ substitution of (5; 3) ✓ answer (4) Answer for *p* 1 mark Answer for *q* 1 mark Answer for *a* 2 marks
4.2	$y = -x + c$ substitute (4 ; 2) $2 = -4 + c$ $c = 6$ **OR** Translation of the line $y = -x$ 2 units up and 4 units right $y = -(x-4) + 2$ $y = -x + 6$	✓ correct point (4 ; 2) ✓ substitution ✓ answer (3) ✓ substitution of $x - 4$ ✓ adding 2 ✓ answer (3) Substitution of T(3 ; 5): 0 / 3 Answer only: 3 / 3 **[7]**

QUESTION 5

5.1 & 5.2	 	EXPONENTIAL ✓ shape (must be increasing above *x*-axis) ✓ *y*-int PARABOLA ✓ shape ✓✓ turning point ✓ *y*-intercept ✓✓ *x*-intercepts (8) INVERSE/LOG ✓ *x*-int ✓ shape (must be increasing on the right of the *y*-axis) (2) Note: If *x*-intercepts not shown but correct on graph 2/2 for *x*-intercepts.
	Calculation of *x*-intercepts of parabola $0 = 2(x-1)^2 - 8$ $8 = 2(x-1)^2$ $4 = (x-1)^2$ $2 = x-1 \quad or \quad -2 = x-1$ $x = 3 \quad or \quad x = -1$ OR $0 = 2(x-1)^2 - 8$ $0 = 2(x^2 - 2x + 1) - 8$ $0 = 2x^2 - 4x - 6$ $0 = x^2 - 2x - 3$ $0 = (x-3)(x+1)$ $x = 3 \quad or \quad x = -1$	
5.3	$y = 2(x+1)^2 - 8$ **OR** $y = 2x^2 + 4x - 6$	✓ -8 ✓ $+1$ (2) ✓ -6 ✓ $+4$ (2)

5.4	$h\left(x+\frac{1}{2}\right)=4^{x+\frac{1}{2}}$ $=4^x.4^{\frac{1}{2}}$ $=2\left(4^x\right)$ $=2h(x)$	✓ substitution ✓ $4^x.4^{\frac{1}{2}}$ ✓ $2\left(4^x\right)$ (3)
	OR	
	$h\left(x+\frac{1}{2}\right)=4^{x+\frac{1}{2}}$ $=(2^2)^{x+\frac{1}{2}}$ $=2^{2x+1}$ $=2^{2x}.2$ $=2.\left(4^x\right)$ $=2h(x)$	✓ substitution ✓ $(2^2)^{x+\frac{1}{2}}$ ✓ $2\left(4^x\right)$ (3) Note: If numerical examples are used : 1 / 3 **[15]**

QUESTION 6

6.1	$x = -45°$ $x = 135°$	✓ answer ✓ answer (2) Note: If correct numbers but not writing as an equation 1 / 2 If units left out: 2 / 2
6.2	$h(x) = \tan(45° - x)$ $h(x) = -\tan(x - 45°) = -f(x)$ *h* is the reflection of *f* about the *x*-axis **OR** *h* is the reflection of *f* about the line *y* = 0	✓✓ reflection about *x*-axis (2) ✓✓ reflection about *y* = 0 (2) Note: If calculation only: 1 /2 If answer is: Reflection only: 0 / 2 If do calculation and say reflection: 1 / 2 Only $h(x) = \tan(45° - x)$ $h(x) = -\tan(x - 45°) = -f(x)$ 1 / 2
6.3	$y = 3\sin 2x$	✓ 3 ✓ 2*x* (2) **[6]**

QUESTION 7

Penalise ONCE in question 7 for early rounding off.

7.1	$A = P(1+i)^n$ $23000 = 1570(1.12)^n$ $(1.12)^n = 14,64968153..$ $n\log(1,12) = \log 14,64968153..$ $n = 23,69$ years (23,68701...) or n = 24 years or n = 23 years 8 months or n = 23,7 years Note: Accept 24 years : 4 / 4 Incorrect Formula: 0/4 **OR** $A = P(1+i)^n$ $23000 = 1570(1+\frac{12}{100})^n$ $(1.12)^n = 14,64968153..$ $n\log(1,12) = \log 14,64968153..$ $n = 23,69$ years (23,68701...) or n = 24 years or n = 23 years 8 months or n = 23,7 years	✓ formula ✓ substitution ✓ apply log function ✓answer (4) ✓ formula ✓ substitution of $\frac{12}{100}$ ✓ apply log function ✓answer (4)
7.2.1	$A = P(1+i)^n$ $= 800000(1.08)^5$ $= R1175462,46$ $\therefore R1175462,46 - R200\ 000$ $= R975462,46$ Some calculators give R 975 462,50	✓ substitution ✓ R 1 175 462,46 ✓ R 975 462,46 (3) Incorrect Formula: 0/3
7.2.2	$F = \frac{x[(1+i)^n - 1]}{i}$ $975462,46 = x\frac{[1,01]^{60} - 1}{0,01}$ $\frac{975462,46 \times 0.01}{[1,01]^{60} - 1} = x$ $x = R\,11944,00$	✓ F = R975462,46 or answer in 7.2.1 ✓ n = 60 ✓ i = 1,01 ✓ formula ✓ simplification ✓ answer (6)

	OR $975462,46 = x\dfrac{[1,01]^{60}-1}{0,01}$ $975462,46 = 81,66966986x$ $x = R\,11944,00$	✓ F = R975462,46 ✓ n = 60 ✓ i = 1,01 ✓ formula ✓ simplification ✓ answer (6) Note: Continued Accuracy applies.

7.2.3	$Service = [5000(1,01)^{48} + 5000(1,01)^{36} + 5000(1,01)^{24} + 5000(1,01)^{12} + 5000]$ $= 32197,77$ $975462,46 = x\dfrac{[1,01]^{60}-1}{0,01} - Service$ $975462,46 = 81,66966986x - 32197,77$ $x = R\,12338,24$	✓✓ 32 197,77 ✓ setting up of correct equation ✓ answer (4)
	OR $Service = \dfrac{5000[1,01^{60}-1]}{1,01^{12}-1}$ $= 32197,77$ $975462,46 = x\dfrac{[1,01]^{60}-1}{0,01} - Service$ $975462,46 = 81,66966986x - 32197,77$ $x = R\,12338,24$	✓✓ 32 197,77 ✓ setting up of correct equation ✓ answer (4)
	OR Present Value payment of R 5000 $= 5000\{(1,01)^{-12} + (1,01)^{-24} + (1,01)^{-36} + (1,01)^{-48} + (1,01)^{-60}\}$ $= 5000(1,01)^{-12}\left\{\dfrac{1-(1,01)^{-60}}{1-(1,01)^{-12}}\right\}$ = R 17 723,25 Present Value of the sinking fund $= 975462,46(1,01)^{-60}$ = R 536 942,94 Total Value of sinking fund = R 17 723,25 + R 536 942,94 = R 554 666,19 $\therefore\ 554666,19 = x\left\{\dfrac{1-(1,01)^{-60}}{0,01}\right\}$ x = R 12 338,24 **OR**	✓ 17723,25 ✓ 554666,19 ✓ setting up of correct equation ✓ answer (4)

	$(1+i_{eff}) = (1+0{,}01)^{12}$ $i_{eff} = 0{,}12682503......$ $P(1+i)^n$ $= 5000\dfrac{(1{,}12682503)^5 - 1}{0{,}12682503}$ $= 32197{,}77$ $975462{,}46 = x\dfrac{[1{,}01]^{60} - 1}{0{,}01} - 32197{,}77$ $975462{,}46 = 81{,}66966986x - 32197{,}77$ $x = R\,12338{,}24$	✓ substitution into formula ✓ 32 197,77 ✓ setting up of correct equation ✓ answer R 12 338,24 (4)
	OR	
	$5000 = \dfrac{x[(1{,}01)^{12} - 1)}{0{,}01}$ $x = \dfrac{5000 \times 0{,}01}{1{,}01^{12} - 1}$ $x = 394{,}24$ So monthly deposit must be increased by R 394,24 New monthly deposit = R 11 944 + R 394,24 = R 12 338,24	✓ substitution into formula ✓ 394,24 ✓ setting up of correct equation ✓ answer R 12 338,24 (4) **[17]**

QUESTION 8

8.1	$f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\frac{-3(x+h)^2-(-3x^2)}{h}$ $=\lim_{h\to 0}\frac{-3x^2-6xh-3h^2+3x^2}{h}$ $=\lim_{h\to 0}\frac{-6xh-3h^2}{h}$ $=\lim_{h\to 0}\frac{h(-6x-3h)}{h}$ $=\lim_{h\to 0}(-6x-3h)$ $=-6x$	✓✓ definition $\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ ✓ $-3(x+h)^2$ ✓substitution of $-3x^2$ ✓correct answer (5) Note: Penalty 1 for incorrect notation If a candidate has used the rules only: 0/5
8.2	$y=\frac{\sqrt{x}}{2}-\frac{1}{6x^3}$ $y=\frac{1}{2}.x^{\frac{1}{2}}-\frac{1}{6}.x^{-3}$ $\frac{dy}{dx}=\frac{1}{4}x^{-\frac{1}{2}}+\frac{3}{6}x^{-4}$ $\frac{dy}{dx}=\frac{1}{4}x^{-\frac{1}{2}}+\frac{1}{2}x^{-4}$ $\frac{dy}{dx}=\frac{1}{4\sqrt{x}}+\frac{1}{2x^4}$ Note: If removed coefficients, or moved the numbers from the denominator to the numerator: **Continued accuracy applies for each correct derivative** **Max 2/3** If leave out $\frac{dy}{dx}$ penalise 1 mark.	✓ Simplification ✓ $\frac{1}{4}x^{-\frac{1}{2}}$ ✓ $\frac{1}{2}x^{-4}$ or $\frac{3}{6}x^{-4}$ (3) **[8]**

QUESTION 9

9.1	$-(2x-5)(x+2)=0$ $x=\frac{5}{2} or -2$ AB = 4,5 units **OR** $-(2x-5)(x+2)=0$ $x=\frac{5}{2} or -2$ AB = $\sqrt{(2,5-(-2)^2+(0-0)^2}$ AB = 4,5 units	✓ $x=\frac{5}{2}; x=-2$ ✓ answer (2) ✓ $x=\frac{5}{2}; x=-2$ ✓ answer (2)
9.2	$g'(x)=0$ $-6x^2-6x+12=0$ $x^2+x-2=0$ $(x+2)(x-1)=0$ $x = -2$ or $x = 1$ at T: $x = 1$	✓ $g'(x)=0$ ✓ $g'(x)=-6x^2-6x+12$ ✓ factorisation ✓ answer (4)
9.3	$g'(x)=-6x^2-6x+12$ $g'(-3)=-6(-3)^2-6(-3)+12$ $g'(-3)=-54+18+12$ $g'(-3)=-24$ $y=ax+q$ $11=-24(-3)+q$ $q=-61$ $y=-24x-61$ **OR** $g'(x)=-6x^2-6x+12$ $g'(-3)=-6(-3)^2-6(-3)+12$ $g'(-3)=-54+18+12$ $g'(-3)=-24$ $y-11=-24(x+3)$ $y-11=-24x-72$ $y=-24x-61$	✓ $g'(-3)$ ✓ – 24 ✓ method of setting up straight line equation ✓ substitution of point (– 3 ; 11) ✓ answer in equation form (5) ✓ $g'(-3)$ ✓ – 24 ✓ formula ✓ substitution of point (– 3 ; 11) ✓ answer in equation form (5)

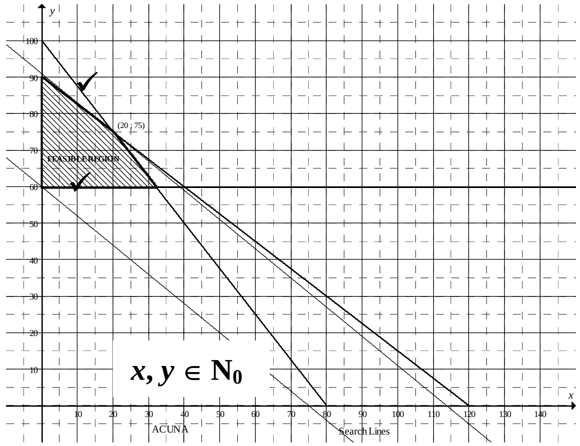
9.4	y-coordinate of T is $g(1) = -2(1)^3 - 3(1)^2 + 12(1) + 20$ $= 27$ T(1 ; 27) $\therefore 0 < k < 27$ **OR** $-2x^3 - 3x^2 + 12x + 20 = k$ $-2x^3 - 3x^2 + 12x + 20 - k = 0$ $-7 < 20 - k < 20$ $-27 < -k < 0$ $0 < k < 27$	✓ y-coordinate of T (27) ✓✓ answer (3) ✓ $-7 < 20 - k < 20$ ✓✓ answer (3) Answer Only: 3/3 $0 \le k \le 27$: 2 / 3 $k > 0$: 1 / 3 $k < 27$: 1 / 3
9.5	$g'(x) = -6x^2 - 6x + 12$ $g''(x) = -12x - 6$ $12x + 6 = 0$ $x = -\frac{1}{2}$ $g''(x) < 0$ $g''(x) > 0$ $x = -\frac{1}{2}$ $g''(x)$ changes sign at $x = -\frac{1}{2}$ $\therefore$ point of inflection at $x = -\frac{1}{2}$ **OR** Turning points A(-2;0); T(1;27) Now x co-ordinate of point of inflection is $x = -\frac{-2+1}{2} = -\frac{1}{2}$	✓ – $12x$ ✓ – 6 ✓ = 0 ✓ $x = -\frac{1}{2}$ (4) ✓✓ points ✓✓ $x = -\frac{1}{2}$ (4) **[18]**

QUESTION 10

10.1	$V = \pi r^2 h$ $200 = \pi r^2 h$ $h = \dfrac{200}{\pi r^2}$	✓ formula ✓ substitution (2)
10.2	Surface Area $= 2\pi rh + \pi r^2$ $S(r) = \pi r^2 + \dfrac{200}{\pi r^2}.2\pi r$ $S(r) = \pi r^2 + \dfrac{400}{r}$	✓ formula ✓ substitution (2)
10.3	$S(r) = \pi r^2 + 400r^{-1}$ $\dfrac{dS}{dr} = 2\pi r - 400r^{-2}$ At minimum : $\dfrac{dS}{dr} = 0$ $2\pi r - \dfrac{400}{r^2} = 0$ $\pi r^3 - 200 = 0$ $r^3 = \dfrac{200}{\pi}$ $r = 3{,}99$ cm	✓ exponents correct ✓ $\dfrac{dS}{dr} = 2\pi r - 400r^{-2}$ ✓ $\dfrac{dS}{dr} = 0$ ✓ $r^3 = \dfrac{200}{\pi}$ ✓ $r = 3{,}99$ or $r = \sqrt[3]{\dfrac{200}{\pi}}$ (5) Note: If did not put = 0, penalise 1 mark If notation is $\dfrac{dy}{dx}$, ignore notation. **[9]**

QUESTION 11

11.1	$10x + 8y \leq 800$ $3x + 4y \leq 360$ $y \geq 60$ $x, y \in N_0$	✓ answer ✓ answer ✓ answer (3)
11.2 & 11.3	See attached graph … (5) See attached graph … (1)	11.2 ✓✓ $y = -\frac{3}{4}x + 90$ ✓✓ $y = -\frac{5}{4}x + 100$ ✓ $y = 60$ (5) 11.3 ✓ feasible region (1) Note: If shading only, and did not state feasible region 1/1
11.4	P = 200*x* + 250*y*	✓ answer (1)
11.5	$250y = -200x + P$ $y = -\frac{4}{5}x + \frac{P}{250}$ Maximum at (20 ; 75)	✓ gradient ✓ search line ✓ answer (3) Note: Read correctly from the candidate's graph for the point for maximum profit. If used vertices method: 1/3 for accurate answer.
11.6	$m = -\frac{3}{4}$ Since the gradient of the new profit function is equal to the gradient of the constraint $3x + 4y \leq 360$, there are points other than (20 ; 75) that give an optimal solution.	✓ $m = -\frac{3}{4}$ ✓✓ more points in optimal solution (more than one solution) (3) Note: If just answer Yes 0 / 3 If just answer No 0 / 3 **[16]**



✓

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