SA-STUDENT

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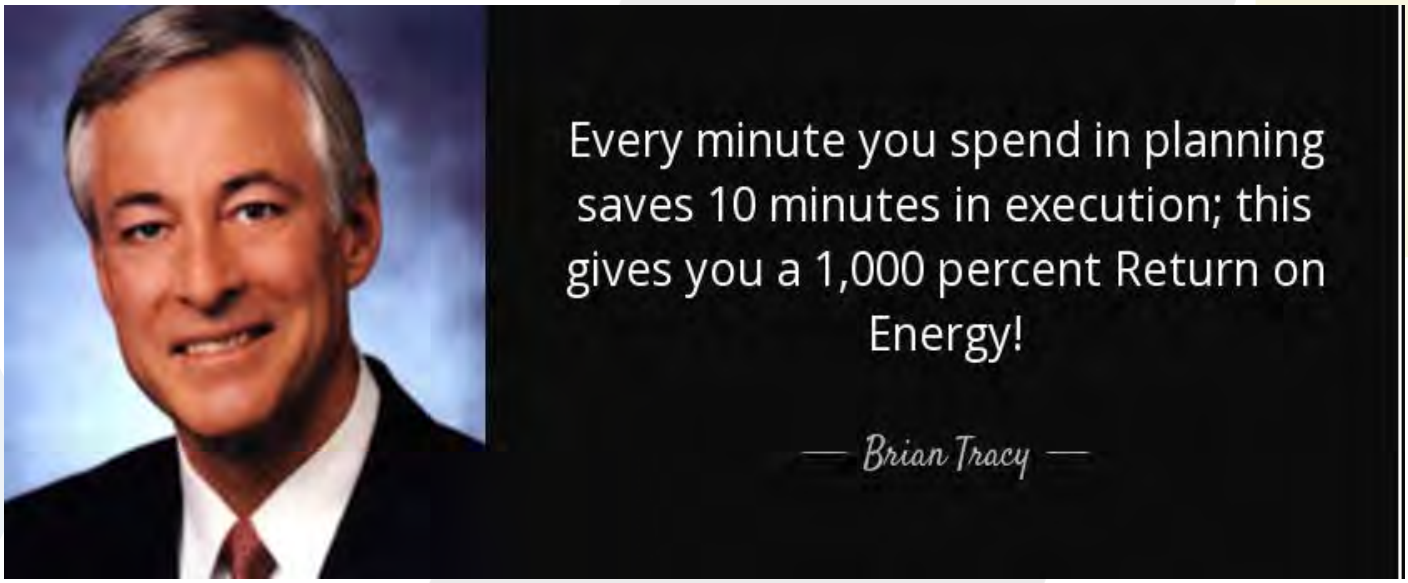
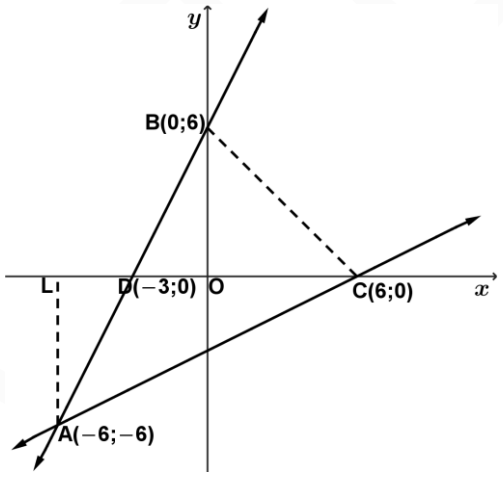


QUESTION 5/*VRAAG* 5

5.1	T.P$(-3;4)$	✓-3 ✓ 4 (2)
5.2	$y \le 4$ or $y \in (-\infty;4]$	✓answer (1)
5.3	$f(x) = g(x)$ $-(x+3)^2 + 4 = x + 5$ $-x^2 - 6x - 9 + 4 = x + 5$ $-x^2 - 7x - 10 = 0$ $x^2 + 7x + 10 = 0$ $(x+5)(x+2) = 0$ $x = -5$ or $x = -2$	✓ equating ✓ $-x^2 - 6x - 9$ ✓ standard form ✓ factors (4)
5.4	The graph must shift more than 2 and less than 5 units to the right $\therefore -5 < c < -2$	✓✓answer (2)
5.5	$D(x) = f(x) - g(x) = -x^2 - 7x - 10$ Max: $-2x - 7 = 0$ **OR/OF** $x = \frac{-(-7)}{2(-1)}$ $x = -\frac{7}{2}$ $D\left(-\frac{7}{2}\right) = -\left(-\frac{7}{2}\right)^2 - 7\left(-\frac{7}{2}\right) - 10 = 2{,}25$ $\therefore k = 2{,}25$ $\therefore h(x) = x + 7{,}25$	✓distance ✓ $-2x - 7 = 0$ ✓ $x = -\frac{7}{2}$ ✓ $k = 2{,}25$ ✓ $h(x) = x + 7{,}25$ (5)
		[14]

QUESTION 5/*VRAAG* 5

5.1	$g(x) = 2x + 6$ $y = 6$	✓ $y = 6$ (1)
5.2	$y = 2x + 6$ $x = 2y + 6$ $y = \frac{1}{2}x - 3$ Answer only: Full marks	✓ swop x and y ✓ equation (2)
5.3	$\frac{1}{2}x - 3 = 2x + 6$ $x - 6 = 4x + 12$ $3x = -18$ $x = -6$ $A(-6;-6)$ **OR/*OF*** $2x + 6 = x$ $x = -6$ $y = -6$	✓equating ✓$x = -6$ ✓ $y = -6$ (3) **OR/*OF*** ✓equating ✓$x = -6$ ✓$y = -6$ (3)
5.4	$AB = \sqrt{(6)^2 + (12)^2}$ $= \sqrt{180} = 6\sqrt{5} = 13{,}42$	✓substitution ✓answer (2)
		

5.5	$BC = \sqrt{6^2 + 6^2} = \sqrt{72} = 6\sqrt{2}$ $AB = AC = \sqrt{180}$ symmetry of g and g^{-1} $\perp h = (\sqrt{180})^2 - \left(\frac{\sqrt{72}}{2}\right)^2$ $= \sqrt{162} = 9\sqrt{2}$ area of $\Delta ABC = \frac{1}{2} BC \times h$ $= \frac{1}{2} \times \sqrt{72} \times \sqrt{162} = 54 \text{ units}^2$ **OR/*OF*** $\tan B\hat{D}C = 2$ $\therefore B\hat{D}C = 63{,}43°$ $\tan D\hat{C}A = \frac{1}{2}$ $\therefore D\hat{C}A = 26{,}57°$ $\therefore D\hat{A}C = 36{,}86°$ (ext angle triangle) Area of $\Delta ABC = \frac{1}{2}\left(\sqrt{180}\right)\left(\sqrt{180}\right)\sin 36{,}86°$ $= 53{,}99 \text{ units}^2$ **OR/OF** Area of ΔABC = Area of ΔBDC + Area of ΔADC $= \frac{1}{2} DC.BO + \frac{1}{2} DC.height$ $= \frac{1}{2}(9)(6) + \frac{1}{2}(9)(6)$ $= 54 \text{ units}^2$	✓ BC ✓ AB = AC /midpoint $(3 ; 3)$ ✓ $\perp h$ (A) ✓ substitution ✓ answer (A) (5) **OR/*OF*** ✓ $B\hat{D}C = 63{,}43°$ ✓ $D\hat{A}C = 36{,}86°$ ✓ AC = $\sqrt{180}$ ✓ substitution into the correct formula ✓ answer (A) (5) **OR/OF** ✓ Areas ($\Delta BDC + \Delta ADC$) ✓ $\frac{1}{2} DC.BO$ ✓ $\frac{1}{2} DC.height$ ✓ substitution ✓ answer (A) (5)
		[13]

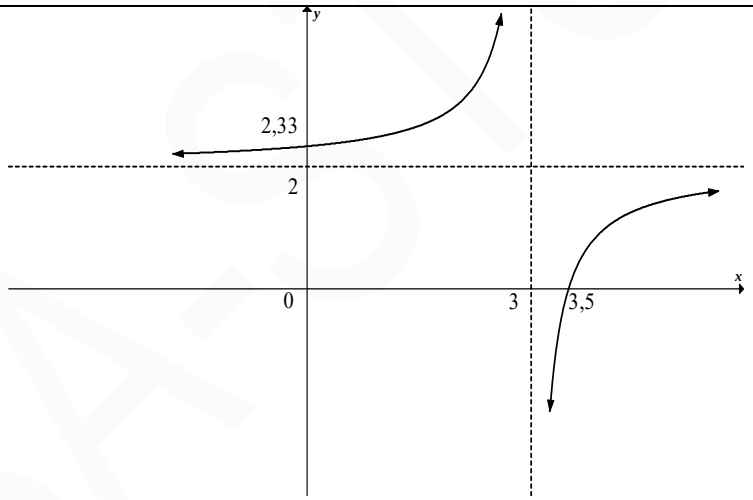
QUESTION 5

5.1	$g(x)=\frac{a}{x+2}+q$ Subs (1 ; 0): $0=\frac{a}{1+2}+q$ $0=a+3q$ Subs $\left(0\ ;-\frac{1}{2}\right)$ $-\frac{1}{2}=\frac{a}{0+2}+q$ $-1=a+2q$ Solving simultaneously: $q=1$ $a=-3$ $\therefore g(x)=\frac{-3}{x+2}+1$	✓ $g(x)=\frac{a}{x+2}+q$ ✓ $0=a+3q$ ✓ $-1=a+2q$ ✓ solving simultaneously ✓ $q=1$ ✓ $a=-3$ (6)
5.2	$y \in \text{R};\ y \neq 1$ **OR/*OF*** $(-\infty\,;1)$ or $(1\,;\infty)$ **OR/*OF*** $y<1$ or $y>1$	✓ answer (1)
5.3	$y-1=1(x+2)$ **OR/*OF*** $1=1(-2)+c$ $y=x+3$ $c=3$ $y=x+3$ ANSWER ONLY: FULL MARKS	✓ $m=1$ ✓ subs point (– 2 ; 1) ✓ answer (3)
5.4	K$'$ (–3 ; 4)	✓ x-value ✓ y-value (2)
		[12]

QUESTION 6

6.1	$f(x) = -x^2 - 6x + 7$ $f'(x) = -2x - 6$ $-2x - 6 = 0$ **OR/*OF*** $x = -\frac{(-6)}{2(-1)}$ $x = -3$ E(–3 ; 16) ANSWER ONLY: FULL MARKS	✓ method ✓ *x*-value ✓ *y*-value (3)
6.2	$k = f(-5)$ $k = -(-5)^2 - 6(-5) + 7$ $\therefore k = 12$	✓ answer (A) (1)
6.3	C(0 ; 7) D(–5 ; 12) $m_{CD} = \frac{12 - 7}{-5 - 0}$ $m_{CD} = -1$ Equation of CD: $y = -x + 7$	✓ coordinates of C ✓ substitution ✓ *m* ✓ answer (4)
6.4	$-2x - 6 = -1$ $-2x = 5$ $x = -\frac{5}{2}$ $y = f\left(\frac{-5}{2}\right) = -\left(\frac{-5}{2}\right)^2 - 6\left(\frac{-5}{2}\right) + 7 = \frac{63}{4} = 15,75$ $\therefore \text{P}\left(-\frac{5}{2}; \frac{63}{4}\right)$	✓ $f'(x) = -2x - 6$ ✓ equating to -1 ✓ *x*-value ✓ *y*-value (A) (4)
6.5	Point by symmetry: (–1 ; 12) $-5 < x < -1$ **OR/*OF*** $-x^2 - 6x + 7 > 12$ $-x^2 - 6x - 5 > 0$ $x^2 + 6x + 5 < 0$ $(x + 1)(x + 5) < 0$ $-5 < x < -1$ ANSWER ONLY: FULL MARKS	✓ –1 ✓ answer (2) ✓ –1 ✓ answer (2)
		[14]

QUESTION/VRAAG 5

5.1	$x = 3$ $y = 2$	✓ $x = 3$ ✓ $y = 2$ (2)
5.2	$x \in R,\ x \neq 3$ **OR/*OF*** $x \in (-\infty\ ;3) \cup (3\ ;\infty)$ **OR/OF** $x < 3$ or $x > 3$	✓answer (1) **OR/OF** ✓answer (1) **OR/OF** ✓answer (1)
5.3	$0 = \frac{-1}{x-3} + 2$ $-2x + 6 = -1$ $x = \frac{7}{2}$ *x*-int: $\left(\frac{7}{2}\ ;\ 0\right)$	✓ $y = 0$ ✓ answer (2)
5.4	*y*-int: $\left(0\ ;\ \frac{7}{3}\right)$	✓ $x = 0$ ✓ $\frac{7}{3}$ (2)
5.5		✓ asymptotes ✓ intercepts with the axes ✓ shape (3)
		[10]

QUESTION/VRAAG 6

6.1	$f(x)=\log_4 x$ $2=\log_4 k$ $4^2=k$ $\therefore k=16$	✓ substitution of $(k\ ;\ 2)$ ✓ answer (2)
6.2	$-1=\log_4 x \quad \therefore\ x=\frac{1}{4}$ $\frac{1}{4}\le x\le 16$ or/of $x\in\left[\frac{1}{4}\ ;\ 16\right]$	✓ $x=\frac{1}{4}$ ✓ answer (2)
6.3	$f(x)=\log_4 x$ $y=\log_4 x$ $x=\log_4 y$ $y=4^x$	✓swopping x and y ✓answer (2)
6.4	$x<0$ **OR/*OF*** $x\in(-\infty\ ;\ 0)$	✓✓answer (2) **OR/*OF*** ✓✓answer (2)
		[8]

QUESTION 7

7.1	B(–4 ; 0) D(6 ; 0)	✓ B(–4 ; 0) ✓ D(6 ; 0) (2)
7.2	$f(x)=x^2-2x-24$ $x_{tp}=\frac{-b}{2a}$ **OR/*OF*** $2x-2=0$ **OR/OF** $x=\frac{-4+6}{2}$ $x=\frac{-(-2)}{2(1)}$ $\therefore\ x_{tp}=1$ $y_{tp}=f(1)$ $=1^2-2(1)-24$ $=-25$ C(1 ; –25)	✓ $x_{tp}=1$ ✓ $y_{tp}=-25$ (2)
7.3	$y\geq -25$ **OR/*OF*** $y\in[-25\ ;\ \infty)$	✓ answer (1) **OR/OF** ✓ answer (1)
7.4.1	$m_{AE}=\tan 14,04°=0,25=\frac{1}{4}$	✓ answer (1)
7.4.2	$m_{\text{tang}}=-4$ $f'(x)=2x-2$ $2x-2=-4$ $x_T=-1$ $y_T=-21$	✓ $m_{\text{tang}}=-4$ ✓ $f'(x)=2x-2$ ✓ equating ✓ $x_T=-1$ ✓ $y_T=-21$ (5)
7.5	$m_{line}=\frac{1}{4}$ $y+9=\frac{1}{4}(x+3)$ **OR/OF** $-9=\frac{1}{4}(-3)+c$ $y+9=\frac{1}{4}x+\frac{3}{4}$ $c=-\frac{33}{4}=-8,25$ $y=\frac{1}{4}x-\frac{33}{4}$ **OR/OF** $y=0,25x-8,25$ $x^2-2x-24=\frac{1}{4}x-\frac{33}{4}$ $4x^2-8x-96=x-33$ $4x^2-9x-63=0$ $(4x-21)(x+3)=0$ $\therefore x=\frac{21}{4}=5,25$ or $x\neq -3$	✓ $m_{line}=\frac{1}{4}$ ✓ substitution *m* and K(– 3 ; – 9) ✓ $y=\frac{1}{4}x-\frac{33}{4}$ ✓ equating ✓ standard form ✓ answer with selection (6)
		[17]

QUESTION/*VRAAG* 5

5.1	$-2x^2+4x+16=0$ $x^2-2x-8=0$ $(x-4)(x+2)=0$ $x=4$ or $x=-2$ $\therefore$ A$(-2;0)$ and B$(4;0)$	✓ factors ✓ $x=-2$ ✓ $x=4$ (3)
5.2	$f(x)=-2x^2+4x+16$ $-\frac{b}{2a}=-\frac{-4}{-2(2)}=1$ $f(1)=-2(1)^2+4(1)+16=18$ $\therefore$ C$(1;18)$ **OR/OF** $f(x)=-2x^2+4x+16$ $f'(x)=-4x+4$ $-4x+4=0$ $x=1$ $f(1)=-2(1)^2+4(1)+16=18$ $\therefore$ C$(1;18)$	✓ 1 ✓ 18 (2) **OR/OF** ✓ 1 ✓ 18 (2)
5.3	$y\leq 18$ **OR/OF** $y\in(-\infty;18]$	✓ $y\leq 18$ (1) **OR/OF** ✓ $y\in(-\infty;18]$ (1)
5.4	TP (1 ; 18) for f TP (2 ; 15) for h $\therefore p=-1 \quad q=-3$	✓ TP for h at (2 ; 15) ✓ $p=-1$ ✓ $q=-3$ (3)
5.5	$y=2x+4$ $x=2y+4$ $\therefore y=\frac{1}{2}x-2$	✓swop x and y ✓ $y=\frac{1}{2}x-2$ (2)
5.6	$g(x)=0$ or $g^{-1}(x)=0$ $x=4$ or $x=-2$ (product 0 at x-intercepts)	✓ $x=4$ ✓ $x=-2$ (2)

5.7	$-2x^2+4x+16+k=2x+4$ $-2x^2+2x+12+k=0$ $b^2-4ac<0$ $(2)^2-4(-2)(12+k)<0$ $4+8(12+k)<0$ $100+8k<0$ $k<-12{,}5$ **OR/OF** $g'(x)=2$ $f'(x)=-4x+4=2$ $x=\frac{1}{2}$ $f\left(\frac{1}{2}\right)=17{,}5$ $g\left(\frac{1}{2}\right)=5$ $\therefore k<-12{,}5$	✓equating ✓ standard form ✓ $b^2-4ac<0$ ✓ substitution ✓ answer (5) **OR/OF** ✓ $g'(x)=2$ ✓ $f'(x)=-4x+4$ ✓ $f\left(\frac{1}{2}\right)=17{,}5$ ✓ $g\left(\frac{1}{2}\right)=5$ ✓ answer (5)
		[18]

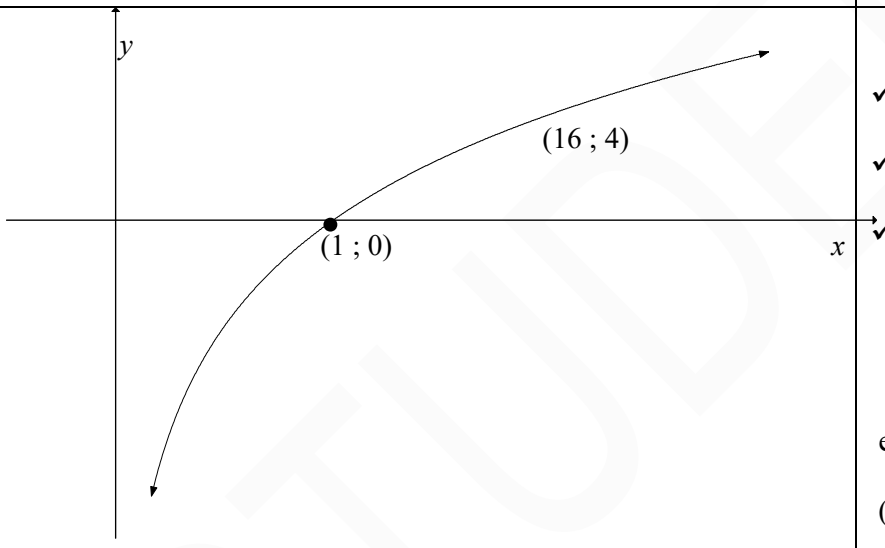
QUESTION/*VRAAG* 6

6.1.1	$y=3^x$ $x=3^y$ $y=\log_3 x$	✓ swop x and y ✓ equation (2)
6.1.2	$h(x)=3^{x-4}+2$ Transformation: 4 units left, 2 units down $P'(2;9)$	✓ $x=2$ (A) ✓ $y=9$ (A) (2)
6.2	$f(x)=2^{x+p}+q$ $q=-16$ $16=2^{p+3}-16$ $2^{p+3}=32$ $2^{p+3}=2^5$ $\therefore p+3=5$ $p=2$	✓ $q=-16$ ✓ substitute (3 ; 16) ✓ $2^{p+3}=2^5$ or $p+3=\log_2 32$ ✓ $p=2$ (4)
		[8]

QUESTION/*VRAAG* 5

5.1	A(0 ; 1)	✓ answer (1)
5.2	$9 = 3^{-x}$ $3^2 = 3^{-x}$ $x = -2$ B(–2 ; 9)	✓ equating ✓ $3^2 = 3^{-x}$ ✓ $x = -2$ (3)
5.3	$x \in (0;\infty)$ or $x > 0$	✓✓answer (2)
5.4	$h(x) = 27.3^{-x}$ $h(x) = 3^{-(x-3)}$ *f* shifted 3 units to the right	✓ $h(x) = 3^{-(x-3)}$ ✓3 units ✓ right (3)
5.5	$\frac{27}{3^x} < 1$ $\quad 3^{-x+3} < 1$ $3^x > 27$ **or** $3^{-x+3} < 3^0$ $3^x > 3^3$ $\quad -x+3 < 0$ $x > 3$ $\quad x > 3$ **OR** The graph shifts 3 units to the right Thus the *y*-intercept shift 3 units to the right (3 ; 1) $\therefore x > 3$	✓ $3^x > 27$ **or** $3^{-x+3} < 3^0$ ✓ $3^x > 3^3$ **or** $-x+3 < 0$ ✓ $x > 3$ (3) **OR** ✓ translation ✓ *y*-intercept ✓answer (3)
		[12]

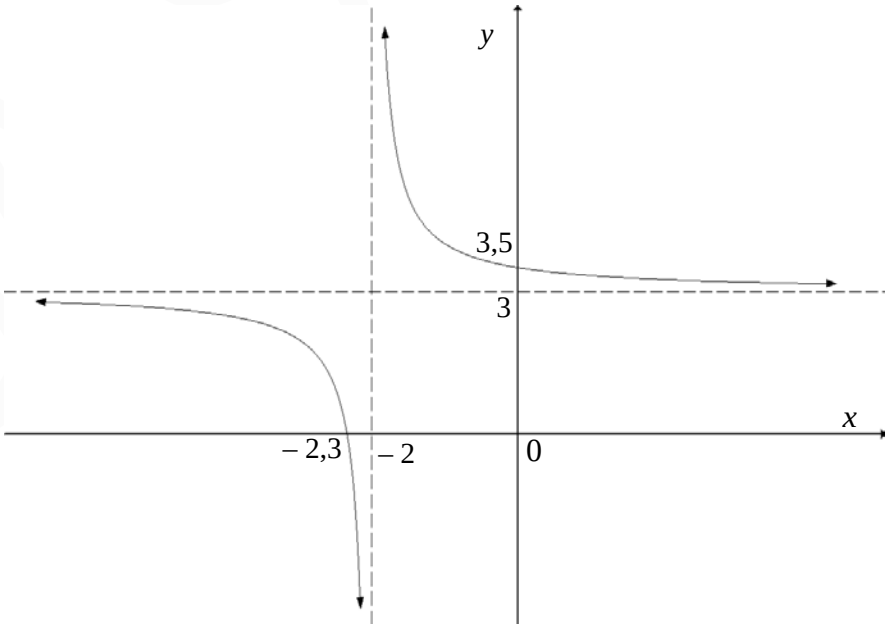
QUESTION/*VRAAG* 5

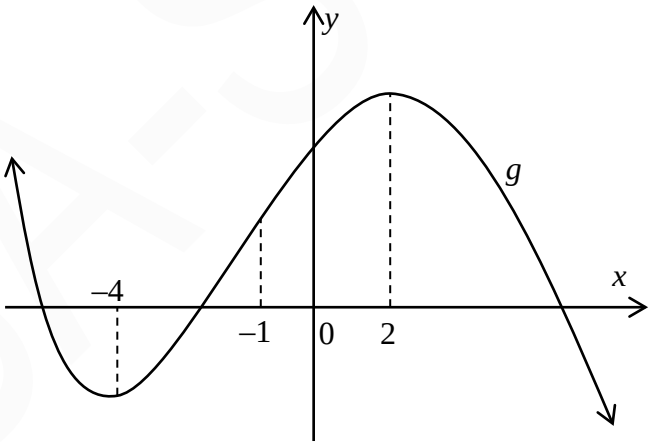
5.1	$f(x)=k^x$ $16=k^4$ $k=2$	✓substitution (4 ; 16) ✓answer (2)
5.2	$f:\quad y=2^x$ $f^{-1}:\quad x=2^y$ $y=\log_2 x$	✓ $x=2^y$ ✓ $y=\log_2 x$ (2)
5.3		✓asymptote ✓shape ✓✓for any two valid points eg.(16 ; 4) or (2 ; 1) or (4 ; 2) or (1 ; 0) (4)
5.4.1	$x\in(1\,;\infty)$ or $x>1$	✓1 ✓ answer (2)
5.4.2	$0<x\leq\frac{1}{2}$ or $x\in\left(0;\frac{1}{2}\right]$	✓$\frac{1}{2}$ ✓ answer (2)

5.5	$2^x - 2^{-x} = \frac{15}{4}$	✓ $2^x - 2^{-x} = \frac{15}{4}$
	$2^x - \frac{1}{2^x} = \frac{15}{4}$	
	$2^{2x} - 1 = \frac{15}{4} \times 2^x$	
	$4.2^{2x} - 4 = 15 \times 2^x$	
	$4.2^{2x} - 15.2^x - 4 = 0$	✓standard form
	$(4.2^x + 1)(2^x - 4) = 0$	
	$4.2^x + 1 = 0$ or $2^x - 4 = 0$	✓factors
	$2^x = \frac{-1}{4}$ or $2^x = 2^2$	
	N/A $x = 2$	✓answer (4)
	OR/OF	**OR/OF**
	$2^x - 2^{-x} = \frac{15}{4}$	✓ $2^x - 2^{-x} = \frac{15}{4}$
	$2^x - \frac{1}{2^x} = \frac{15}{4}$	
	Let $k = 2^x$	
	$k^2 - 1 = \frac{15}{4} \times k$	
	$4.k^2 - 4 = 15 \times k$	
	$4.k^2 - 15.k - 4 = 0$	✓standard form
	$(4.k + 1)(k - 4) = 0$	✓factors
	$k = \frac{-1}{4}$ or $k = 4$	
	$2^x = \frac{-1}{4}$ or $2^x = 2^2$	
	N/A $x = 2$	✓answer (4)
		[16]

4.4.1	$y = -\log_2 x$ $2 = -\log_2 a$ $a = 2^{-2} = \frac{1}{4}$ or $a = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$	✓ correct subst into correct formula (a ; 2) ✓answer (2)
4.4.2	$M'\left(2;\frac{1}{4}\right)$ or $M'(2;a)$	✓ answer (1)
4.5	$M''\left(-1;\frac{9}{4}\right)$	✓ -1 ✓✓ $\frac{9}{4}$ (3)
		[11]

QUESTION/*VRAAG* 5

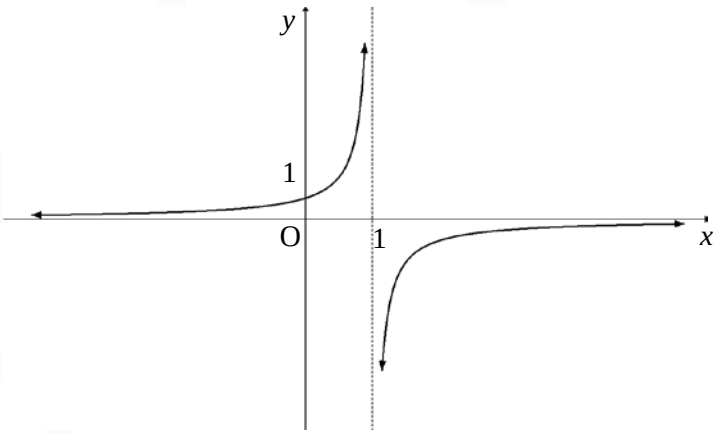
5.1.1	$x = -2$ $y = 3$	✓ answer ✓ answer (2)
5.1.2	$\left(0\,;\frac{7}{2}\right)$	✓ answer (1)
5.1.3	$\frac{1}{x+2} + 3 = 0$ $1 + 3(x+2) = 0$ $3x = -7$ $x = -\frac{7}{3}$ x-intercept $\left(-\frac{7}{3}\,;0\right)$	✓ $y = 0$ ✓ answer (2)
5.1.4		✓asymptotes at $y = 3$ and $x = -2$ ✓intercepts at $y = 3{,}5$ and $x = -2{,}3$ ✓shape (reasonable representation in correct quadrants) (3)

5.2.1	$-2x+4=0$ $2x=4$ $x=2$ $\therefore$ S(2 ; 0)	✓ $y=0$ ✓ $x=2$ (2)
5.2.2	Equation of k: $y=a(x+1)^2+18$ $0=a(2+1)^2+18$ or $0=a(-4+1)^2+18$ $9a=-18$ $a=-2$ $y=-2(x+1)^2+18$	✓ $y=a(x+1)^2+18$ ✓ substitute (2 ; 0) or (– 4 ; 0) ✓ a (3)
5.2.3	$-2x^2-4x+16=-2x+4$ $-2x^2-2x+12=0$ $x^2+x-6=0$ $(x+3)(x-2)=0$ $x=-3$ or $x=2$ $y=-2(-3)+4=10$ T(–3 ; 10)	✓ equating ✓ standard form ✓ factors ✓ choosing $x=-3$ ✓ answer (5)
5.2.4	$x<-3$ or $x>2$ **OR/*OF*** $(-\infty\ ;-3)\cup(2\ ;\infty)$	✓✓ answer (2) **OR/*OF*** ✓✓ answer (2)
5.2.5(a)	$x<-1$ **OR/*OF*** $(-\infty\ ;-1)$	✓✓ answer (2) **OR/*OF*** ✓✓ answer (2)
5.2.5(b)		✓ shape of cubic with local min tp moving to local max tp ✓ turning points at $x=2$ and $x=-4$ ✓ point of inflection at $x=-1$ (3) **[25]**

QUESTION/*VRAAG* 4

4.1	Yes For every x-value there is only one corresponding y value **OR/OF** One to one mapping (vertical line test)	✓answer ✓reason (2)
4.2	R(–12 ; –6)	✓answer (1)
4.3	$f(x) = ax^2$ substitute $(-6;-12)$ $-12 = a(-6)^2$ $a = \frac{-1}{3}$	✓substitution ✓answer (2)
4.4	$f: y = -\left(\frac{1}{3}\right)x^2$ $f^{-1}: x = -\left(\frac{1}{3}\right)y^2$ $y^2 = -3x$ $y = \pm\sqrt{-3x}$ Only $y = -\sqrt{-3x}$ and $x \le 0$	✓swapping x and y ✓ $y^2 = -3x$ ✓ $y = -\sqrt{-3x}$ (3)
		[8]

QUESTION/*VRAAG* 5

5.1	Domain: $x \in R$; $x \ne 1$ **OR/OF** $x \in (-\infty;1) \cup (1;\infty)$	✓answer (1)
5.2	$x = 1$ $y = 0$	✓$x = 1$ ✓$y = 0$ (2)
5.3		✓ y intercept ✓vertical asymptote ✓shape (3)
5.4	$x \ge 0$; $x \ne 1$ **OR/OF** $0 \le x < 1$ or $x > 1$ **OR/OF** $x \in [0;1) \cup (1;\infty)$	✓$x \ge 0$ ✓$x \ne 1$ (2) **OR/OF** ✓ $0 \le x < 1$ ✓ $x > 1$
		[8]

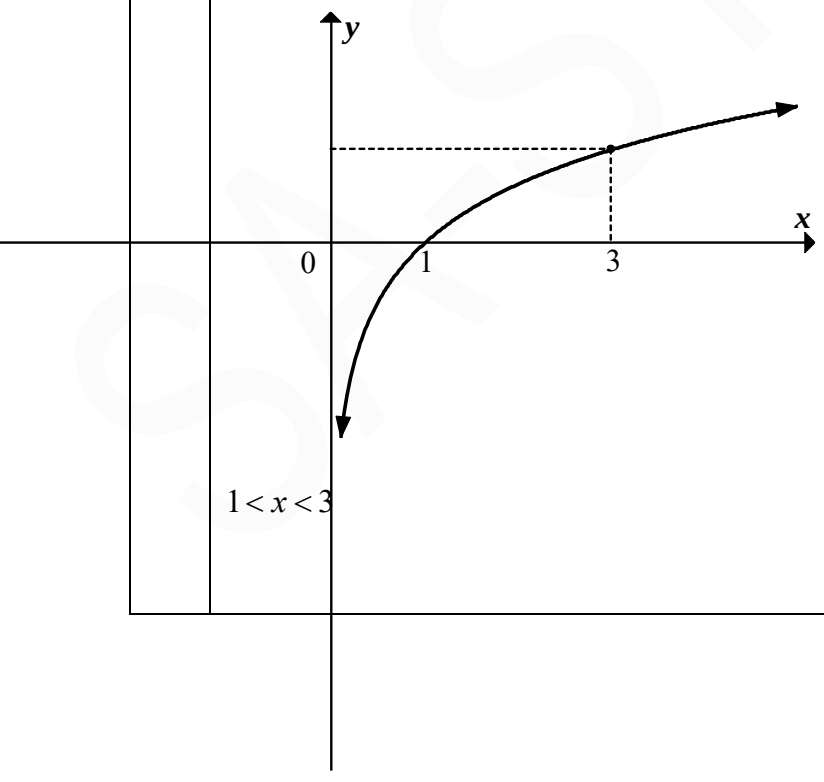
QUESTION/*VRAAG* 6

6.1	$y = mx + c$ $m = \frac{5-1}{4-0}$ $m = 1$ $c = 1$ $g(x) = x + 1$ **OR/OF** $y = mx + c$ $5 = m(4) + 1$ $m = 1$ $g(x) = x + 1$	✓substitution into gradient formula ✓y-intercept (0 ; 1) (2) **OR/OF** ✓substitute (4 ; 5) ✓$c = 1$ (2)
6.2	$x^2 - 2x - 3 = 0$ $(x+1)(x-3) = 0$ $x = -1$ or $x = 3$ A(–1 ; 0) B(3 ; 0)	✓$y = 0$ ✓factors ✓x-values (3)
6.3	$x = \frac{-1+3}{2}$ or $x = \frac{-b}{2a} = \frac{-(-2)}{2(1)}$ or $f'(x) = 2x - 2 = 0$ $x = 1$ $f(x) = x^2 - 2x - 3$ $y = (1)^2 - 2(1) - 3$ or $y = (x^2 - 2x + (-1)^2) - 3 - 1$ $y = -4$ $= (x-1)^2 - 4$ $y \geq -4$ or $[-4; \infty)$	✓x -value ✓ substitution/ completing the square ✓ answer (3)
6.4.1	**MN:** $y = (x^2 - 2x - 3) - (x + 1)$ $= x^2 - 3x - 4$ $6 = x^2 - 3x - 4$ $0 = x^2 - 3x - 10$ $0 = (x-5)(x+2)$ $x = 5$ or $x = -2$ OT = 2 or OT = 5 NA	✓ $x^2 - 3x - 4$ ✓substituting $y = 6$ ✓values of x ✓ OT = 2 (4)
6.4.2	$y = x + 1$ substitute $x = -2$ $= (-2) + 1$ $= -1$ N(–2 ; –1)	✓substituting $x = -2$ ✓answer (2)

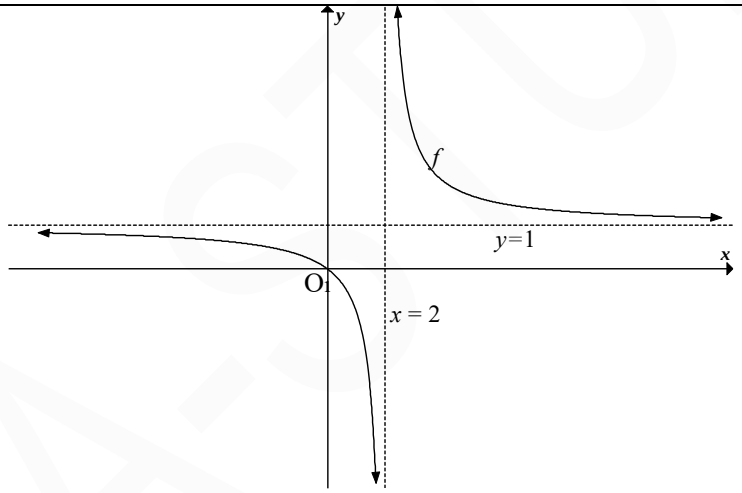
6.5	$f'(x) = 2x - 2$ $2x - 2 = 1$ $x = \frac{3}{2}$ $f\left(\frac{3}{2}\right) = \frac{-15}{4}$ $y + \frac{15}{4} = 1\left(x - \frac{3}{2}\right)$ or $-\frac{15}{4} = \frac{1}{2} + c$ $y = x - \frac{21}{4}$ **OR/OF** $x^2 - 2x - 3 = x + p$ $x^2 - 2x - 3 - x - p = 0$ This equation will have equal roots, therefore: $b^2 - 4ac = 0$ $(-3)^2 - 4(1)(-3 - p) = 0$ $9 + 12 + 4p = 0$ $p = \frac{-21}{4}$ $y = x - \frac{21}{4}$	✓ $f'(x) = 2x - 2$ ✓ $2x - 2 = 1$ ✓ $x = \frac{3}{2}$ ✓ $f\left(\frac{3}{2}\right) = \frac{-15}{4}$ ✓answer (5) **OR/OF** ✓equating ✓equal roots ✓ substitution ✓simplification ✓answer (5)
6.6	$k < \frac{-21}{4}$	✓answer (1)
		[20]

	g^{-1} is the straight line through (0 ; 4) and (7 ; 0) $y = mx + 4$ $0 = 7m + 4$ $y = -\frac{4}{7}x + 4$	✓ straight line through (0 ; 4) and (7 ; 0) ✓ substitution ✓ $y = -\frac{4}{7}x + 4$ (3)
4.6	$x \cdot f(x) \leq 0$ $\therefore x \leq 0$ or $1 \leq x \leq 7$	✓✓ $x \leq 0$ ✓✓ $1 \leq x \leq 7$ (4) **[18]**

QUESTION/*VRAAG* 5

5.1	$a^0 = 1$ T(0 ; 1)	✓ $x = 0$ ✓ $y = 1$ (2)
5.2	$g(x) = a^x$ $9 = a^2$ $a = 3$ $a > 0$	✓ substitution ✓ $a = 3$ (2)
5.3	$y = \left(\frac{1}{3}\right)^x$ or $y = 3^{-x}$	✓✓ $y = \left(\frac{1}{3}\right)^x$ (2)
5.4	$3^0 < 3^{\log_3 x} < 3^1$ $1 < x < 3$ **OR**  $1 < x < 3$	✓ $1 < x$ ✓ $x < 3$ (2) ✓ $1 < x$ ✓ $x < 3$ (2) **[8]**

QUESTION/*VRAAG* 6

6.1	$q=1$	✓ $q=1$ (1)
6.2	Subs $(0;0)$ $0=\frac{a}{0+p}+1$ $\frac{a}{p}=-1$ $a=-p$ Subs P: $\sqrt{2}+1=\frac{a}{\sqrt{2}+2+p}+1$ $\sqrt{2}=\frac{a}{\sqrt{2}+2+p}$ $2+2\sqrt{2}+\sqrt{2}p=a$ $2+2\sqrt{2}=a-p\sqrt{2}=a+a\sqrt{2}$ $2\left(1+\sqrt{2}\right)=a\left(1+\sqrt{2}\right)$ $a=2$; $p=-2$ NOTE: Answer only 2 / 5	✓ $0=\frac{a}{0+p}+1$ ✓ $a=-p$ ✓ substitution ✓ $a=2$ ✓ $p=-2$ (5)
6.3		✓$y=1$ ✓$x=2$ ✓shape ✓(0 ; 0) (4) **[10]**

QUESTION/*VRAAG* 5

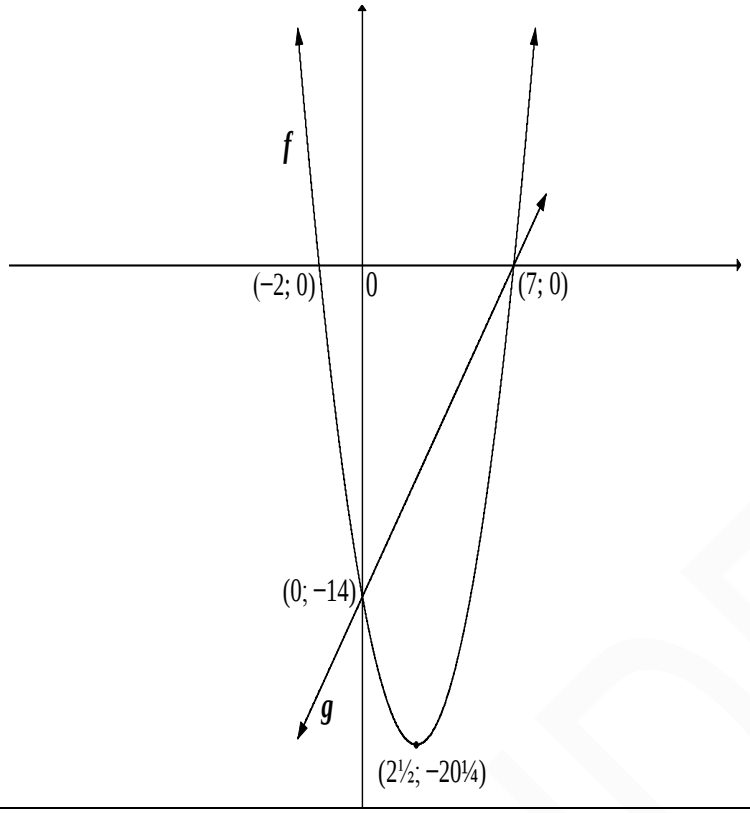
5.1	$x \in R;\ x \neq -1$	✓ $x \in R$ ✓ $x \neq -1$ (2)
5.2	x-intercept of f: $0 = \frac{2}{x+1} + 4$ $\frac{2}{x+1} = -4$ $2 = -4x - 4$ $4x = -6$ $x = -\frac{3}{2}$	✓ equating to 0 ✓ answer (2)
5.3	$y = \frac{2}{x+1} + 4$ $\frac{14}{3} = \frac{2}{k+1} + 4$ $\frac{2}{k+1} = \frac{14}{3} - 4$ $\frac{2}{k+1} = \frac{2}{3}$ $2k + 2 = 6$ $k + 1 = 3$ $k = 2$	✓ substitution ✓simplification ✓ answer (3)
5.4	$C(2;4)$	✓ 2 ✓ 4 (2)
5.5	$y = a(x+p)^2 + q$ $= a(x-2)^2 + 4$ Substitute (0 ; 0): $0 = a(0-2)^2 + 4$ $0 = 4a + 4$ $a = -1$ $y = -(x-2)^2 + 4$	✓ $a(x-2)^2 + 4$ ✓ Substitute (0 ; 0) ✓ $a = -1$ (3)
5.6	$x \leq -\frac{3}{2}$ or $-1 < x < 0$ or $x > 4$	✓ $x \leq -\frac{3}{2}$ ✓✓ $-1 < x < 0$ ✓ $x > 4$ (4)

5.7	$\frac{2}{x}-5$: f shifted 1 unit to the right and 9 units down. f *is* 1 *eenheid na regs en* 9 *eenhede afgeskuif.* $-(x-3)^2-5$: g shifted 1 unit to the right and 9 units down. g *is* 1 *eenheid na regs en* 9 *eenhede afgeskuif.* Therefore the shift of both graphs took place relative to each other/*Dus het die skuif van die grafieke relatief tot mekaar plaasgevind.* They only intersect in the third quadrant. *Hulle sny mekaar slegs in die derde kwadrant.* Therefore there is only one point of intersection. *Daar is dus slegs een snypunt.*	✓ both shifted 1 unit to the right ✓ both shifted 9 units down ✓ relative shift ✓ one real root (4) **[20]**

QUESTION/*VRAAG* 5

5.1	$y \in R\,;\, y \neq -1$ **OR/*OF*** $y < -1$ or $y > -1$ **OR/*OF*** $y \in (-\infty\,;-1)$ or $y \in (-1;\infty)$ **OR/*OF*** $R - \{-1\}$	✓✓ answer (2)
5.2	$\text{D}(2\,;-1)$ $g(x) = \frac{2}{x-2} - 1$	✓ $\text{D}(2\,;-1)$ ✓ $\frac{2}{x-2} - 1$ (2)
5.3	$f(x) = \log_3 x.$ $\log_3 t = 1$ **OR/*OF*** $g(x) = \frac{2}{x-2} - 1$ $t = 3$ $1 = \frac{2}{t-2} - 1$ $2 = \frac{2}{t-2}$ $2t - 4 = 2$ $t = 3$	✓correct substitution of A ✓✓ $t = 3$ (3)
5.4	$x = \log_3 y$ $y = 3^x$	✓interchange x and y ✓ $y = 3^x$ (2)
5.5	$3^x < 3^1$ $x < 1$ **OR/*OF*** $3^x < 3^1$ $x \in (-\infty\,;1)$	✓$3^x < 3^1$ ✓$x < 1$ (2) ✓$3^x < 3^1$ ✓$x \in (-\infty\,;1)$ (2)
5.6	Equation of the axis of symmetry: $y = -x + 1$ x-intercept of the axis of symmetry is at $x = 1$ f has an x-intercept at B(1 ; 0) which is the same as the x-intercept of the axis of symmetry Point of intersection: B $(1\,;0)$ **OR/*OF*** Since BE = ED = 1 and D lies on the axis of symmetry and the gradient of the axis of symmetry is –1, B will also lie on the axis of symmetry. But B also lies on f. Therefore B(1 ; 0) is the point of intersection between f and the axis of symmetry with a negative gradient./ *Omdat* BE = ED = 1 *en* D *op die simmetrie-as lê en die simmetrie-as se gradiënt* –1 *is, sal* B *ook op die simmetrie-as lê. Maar* B *lê ook op f. Dus is* B(1 ; 0) *die snypunt van f en die simmetrie-as met negatiewe gradiënt.*	✓✓ equation of axis of symmetry ✓B or $(1\,;0)$ **OR/*OF*** ✓✓ BE = ED = 1 ✓ B or $(1\,;0)$ (3) **[14]**

QUESTION/*VRAAG* 5

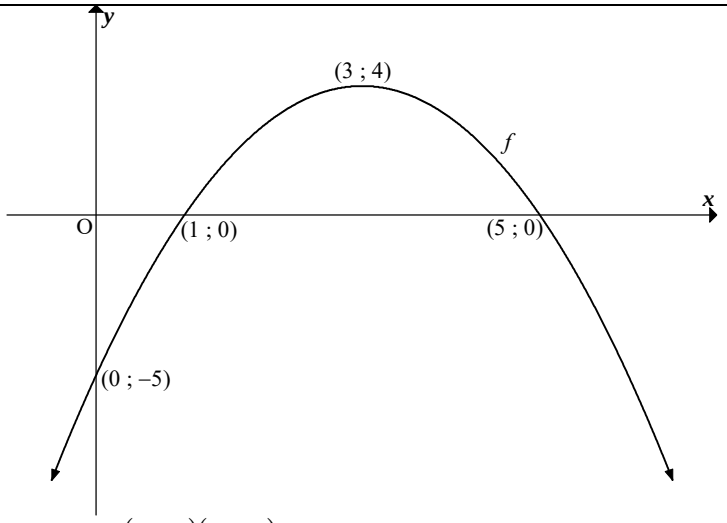
5.1		*f*: ✓ *x*-intercepts ✓*y*-intercept ✓ shape ✓TP *g*: ✓ *x*-intercept and *y*-intercept ✓ shape (6)
5.2	$y = -20\frac{1}{4}$	✓✓ $y = -20\frac{1}{4}$ / $-\frac{81}{4}$ (2)
5.3	$-20\frac{1}{4} < k < -14$	✓ $-20\frac{1}{4} < k$ ✓ $k < -14$ (2)
5.4	Reflecting in the *x*-axis: $y = -2x + 14$ Shifting 7 units to the left: $y = -2(x + 7) + 14$ $= -2x - 14 + 14$ $= -2x$	✓ $y = -2x + 14$ ✓ $y = -2x$ (2) **[12]**

QUESTION/*VRAAG* 6

6.1	$f: y = b^x$ $f^{-1}: x = b^y$ $y = \log_b x$	✓ interchange x and y ✓ answer (2)
6.2	$y = x$	✓ answer (1)
6.3	P(0; 1)	✓ answer (1)
6.4	T(1; 0) $y = mx + c$ $y = -x + 1$	✓ coordinates of T ✓ $y = -x + 1$ (2)
6.5	At point R, PT and OR intersect: $-x + 1 = x$ $2x = 1$ $x = \frac{1}{2}$ $y = \frac{1}{2}$ Substitute $\left(\frac{1}{2}; \frac{1}{2}\right)$ into the equation of f: $y = b^x$ $\frac{1}{2} = b^{\frac{1}{2}}$ $b = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$ **OR/*OF*** At point R, PT and OR intersect: $-x + 1 = x$ $2x = 1$ $x = \frac{1}{2}$ $y = \frac{1}{2}$ Substitute $\left(\frac{1}{2}; \frac{1}{2}\right)$ into the equation of g: $y = \log_b x$ $\frac{1}{2} = \log_b\left(\frac{1}{2}\right)$ $b^{\frac{1}{2}} = \frac{1}{2}$ $b = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$	✓ $-x + 1 = x$ ✓ $x = \frac{1}{2}$ ✓ $y = \frac{1}{2}$ ✓ substitution ✓ $b = \frac{1}{4}$ (5) ✓ $-x + 1 = x$ ✓ $x = \frac{1}{2}$ ✓ $y = \frac{1}{2}$ ✓ substitution ✓ $b = \frac{1}{4}$ (5) **[11]**

QUESTION 5

5.1.1	C(0 ; –3)	✓ C(0 ; –3) (1)
5.1.2	$f(x)=x^2-2x-3$ $(x-3)(x+1)=0$ $x=-1$ or $x=3$ AB = 3 – (–1) AB = 4 units	✓ factors ✓ x-value ✓ other x-value ✓ answer (4)
5.1.3	$x=\frac{2}{2(1)}$ or $2x-2=0$ or $x=\frac{-1+3}{2}$ $=1$ $y=(1)^2-2(1)-3$ $=-4$ $D(1;-4)$	✓ $x=1$ ✓ y value (2)
5.1.4	C(0 ; –3) D(1 ; – 4) Average gradient / *Gemiddelde gradiënt* $=\frac{-4+3}{1-0}$ or $\frac{-3+4}{0-1}$ $=-1$	✓ $\frac{-4+3}{1-0}$ or $\frac{-3+4}{0-1}$ ✓ – 1 (2)
5.1.5	OC = OB = 3 $O\hat{C}B=45°$ isosceles right angled triangle / *Gelykbenige reghoekige driehoek* **OR / OF** $\tan\beta=m_g$ $\tan\beta=1$ $\beta=45°$ $O\hat{B}C=45°$ $O\hat{C}B=45°$	✓equal lengths ✓ 45° (2) ✓ $\tan\beta=1$ ✓ 45° (2)
5.1.6	$-4<k<-3$ **OR** (–4 ; –3)	✓–4 ✓ –3 ✓ notation (3)
5.1.7	$f'(x)\,.\,f''(x)>0$ $(2x-2).2>0$ $2x-2>0$ $x>1$	✓ $2x-2$ ✓ 2 ✓ $x>1$ (3)

5.2	 $f(x) = a(x-1)(x-5)$ $4 = a(3-1)(3-5)$ $4 = -4a$ $a = -1$ $f(x) = -x^2 + 6x - 5$	TP ✓ $x = 3$ ✓ $y = 4$ ✓ x – intercepts ✓ y-intercept ✓ shape (5)
		[22]

QUESTION/*VRAAG* 6

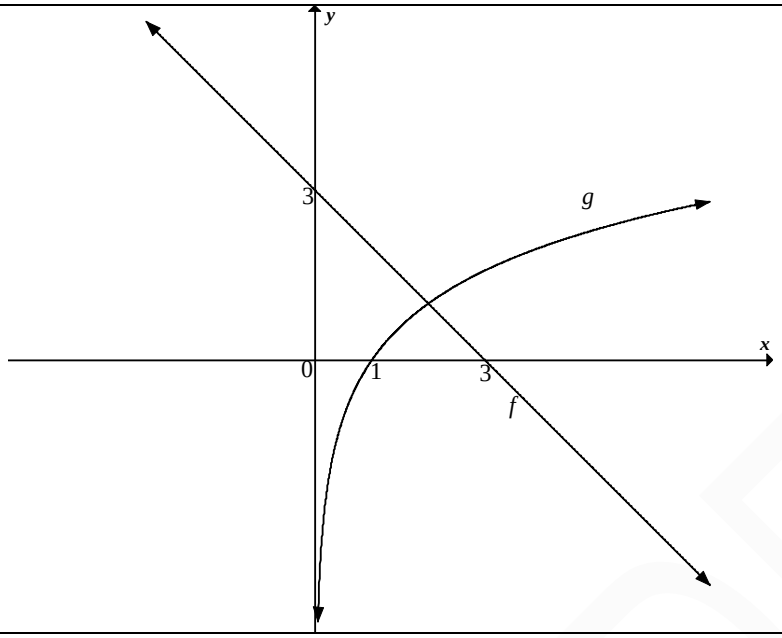
6.1.1	$A = 150\,000(1-0,2)^2$ $= R96\,000$	✓ $n = 2$ ✓ 150 000 in correct formula ✓ 96 000 (3)
6.1.2	$150\,000(1-0,2)^n = 49\,152$ $(0,8)^n = \frac{1024}{3125}$ $n\log(0,8) = \log\frac{1024}{3125}$ $n = 5$ The machine will need to be replaced at the beginning of 2020 / *Masjien moet aan die begin van 2020 vervang word* **OR / OF** $150\,000(1-0,2)^n = 49\,152$ $(0,8)^n = \frac{1024}{3125}$ $n = \log_{0,8}\frac{1024}{3125}$ $n = 5$ The machine will need to be replaced at the beginning of 2020 / *Masjien moet aan die begin van 2020 vervang word*	✓ $150\,000(1-0,2)^n = 49\,152$ ✓ $n\log(0,8) = \log\frac{1024}{3125}$ ✓ $n = 5$ ✓ 2020 (4) ✓ $150\,000(1-0,2)^n = 49\,152$ ✓ $n = \log_{0,8}\frac{1024}{3125}$ ✓ $n = 5$ ✓ 2020 (4)

QUESTION/*VRAAG* 5

5.1	$f(x) = -x^2 + 4x - 3$ $f'(x) = 0$ or $x = -\frac{4}{2(-1)}$ $-2x + 4 = 0$ $x = 2$ $x = 2$ $y = -(2)^2 + 4(2) - 3$ $= 1$ $B(2\ ;\ 1)$ **OR/OF** $-x^2 + 4x - 3 = 0$ $x^2 - 4x + 3 = 0$ $(x-3)(x-1) = 0$ $x = 3$ or $x = 1$ $x = \frac{3+1}{2}$ $x = 2$ $y = -(2)^2 + 4(2) - 3$ $= 1$ B(2 ; 1)	✓ $-2x + 4 = 0$ or $x = -\frac{4}{2(-1)}$ ✓ $y = -(2)^2 + 4(2) - 3$ (2) ✓ $x = \frac{3+1}{2}$ ✓ $y = -(2)^2 + 4(2) - 3$ (2)
5.2	Range/*Waardeversameling* : $y \leq 1$ **OR/OF** Range/*Waardeversameling* : $y \in (-\infty\ ;\ 1]$	✓ $y \leq 1$ (1) ✓ $(-\infty\ ;\ 1]$ (1)
5.3	$x \leq -1$ or $x > 2$ **OR/OF** $(-\infty\ ;\ -1] \cup (2\ ;\ \infty)$	✓ critical values ✓ $x \leq -1$ or $x > 2$ (2) ✓ critical values ✓ $x \leq -1$ or $x > 2$ (2)
5.4	$(x - p)(y + t) = 3$ Vertical asymptote of h(*x*) /*vertikale asimptoot* at $x = 2$ Translation 4 units to the left / *Translasie 4 eenhede links* $x = 2 - 4 = -2$ is the equation of the vertical asymptote of h($x + 4$) $x = 2 - 4 = -2$ *is die vergelyking van die vertikale asimptoot* **OR/OF**	✓ $x = -2$ (1)

	OR/OF $h(x)=\frac{3}{x-2+4}+1$ $=\frac{3}{x+2}+1$ $x=-2$ is the equation of the vertical asymptote / *is die vergelyking van die vertikale asimptoot*	✓ $x=-2$ (1)
5.5	$(x-p)(y+t)=3$ $(y+t)=\frac{3}{(x-p)}$ $y=\frac{3}{x-p}-t$ $\text{B}(2;1)$ Point of intersection of the asymptotes *Snypunt van die asimptote* $p=2$ $-t=1$ $t=-1$	✓ $\frac{3}{x-p}$ ✓ $-t$ ✓ $p=2$ ✓ $t=-1$ (4)
5.6	*x*-intercepts of f / *x-afsnitte van f*: $x^2-4x+3=0$ $(x-3)(x-1)=0$ $x=1$ or $x=3$ $g'(x)<0$ for $x\in R;\ x\neq 2$ Hence $f(x)<0$ $x\leq 1$ or $x\geq 3$ **OR/OF** $(-\infty;1]\cup[3;\infty)$	✓ both critical values ✓ $x\leq 1$ ✓ or ✓ $x\geq 3$ (4) **[14]**

QUESTION/*VRAAG* 6

6.1		*g*: ✓shape: increasing curve ✓(1 ; 0): only on log graph *f*: ✓(3 ; 0) ✓(0 ; 3) (4)
6.2	$y = \log_2 x$ $g^{-1}: \ x = \log_2 y$ $y = 2^x$	✓ interchange x and y ✓ $y = 2^x$ (2)
6.3	$\log_2(3-x) = x$ $2^x = 3 - x$ $2^x = -x + 3$ Reflect the graph of g about the line $y = x$ to obtain g^{-1} and determine the point of intersection of f and g^{-1}./ *Reflekteer die grafiek van g om die lyn* $y = x$ *en bepaal die snypunt van* f and g^{-1}	✓✓ $2^x = -x + 3$ ✓ point of intersection of f and g^{-1} (3)
6.4	$x = 1$	✓ answer (1) **[10]**

4.6	g: $y = 2x + 6$ g^{-1}: $x = 2y + 6$ $2y = x - 6$ $y = \frac{x-6}{2}$ or $y = \frac{x}{2} - 3$	✓ $x = 2y + 6$ ✓ $y = \frac{x-6}{2}$ or $y = \frac{x}{2} - 3$ (2)
4.7	$g(x) \geq g^{-1}(x)$ $2x + 6 \geq \frac{x-6}{2}$ $4x + 12 \geq x - 6$ $3x \geq -18$ $x \geq -6$	✓ $2x + 6 \geq \frac{x-6}{2}$ ✓ $4x + 12 \geq x - 6$ ✓ $x \geq -6$ (3) **[21]**

QUESTION/*VRAAG 5*

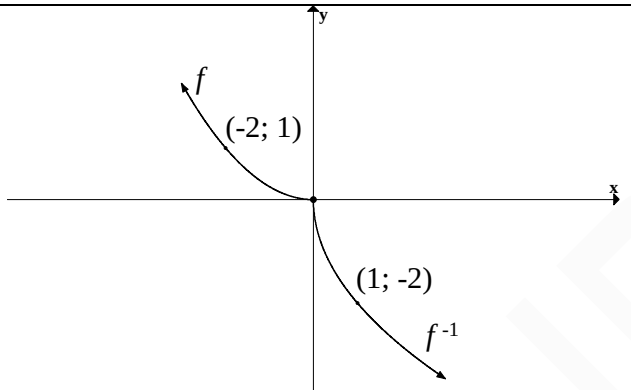
5.1	$r = 2$	✓$r = 2$ (1)
5.2	$g(x) = 2^x + 2$ $g(0) = 2^0 + 2 = 3$ B(0 ; 3) $3 = \frac{3}{0-p} + 2$ $p = -3$	✓ $g(0) = 2^0 + 2$ ✓ $y = 3$ ✓substitute B(0 ; 3) and $q = 2$ ✓ $p = -3$ (4)
5.3	at A: $x = -3$ $y = 2^{-3} + 2 = 2\frac{1}{8}$ $A\left(-3 ; 2\frac{1}{8}\right)$ or $A\left(-3 ; \frac{17}{8}\right)$ or $A(-3 ; 2{,}125)$	✓ at A : $x = -3$ (p-value) ✓ substitute $x = -3$ into exponential eqution ✓ y-value (3)
5.4	$-3 < x \leq 0$ **OR/ OF** $(-3 ; 0]$	✓ $-3 < x$ ✓ $x \leq 0$ (2)
5.5	$f(x) = \frac{3}{x+3} + 2$ $f(x-2) = \frac{3}{x-2+3} + 2$ $h(x) = \frac{3}{x+1} + 2$	✓substitution of $x - 2$ ✓ $h(x) = \frac{3}{x+1} + 2$ (2) **[12]**

QUESTION/*VRAAG* 5

5.1	$y = a(x+p)^2 + q$ Turning point $(1;-8)$: $y = a(x-1)^2 - 8$ Substitute $(0;-4)$: $-4 = a(0-1)^2 - 8$ $-4 = a - 8$ $a = 4 \quad p = -1 \quad q = -8$ $y = 4(x-1)^2 - 8$	✓ $y = a(x-1)^2 - 8$ ✓ substitute $(0;-4)$ ✓ $a = 4$ ✓ p and q values (4)
5.2	Asymptote is $y = -2 \quad \Rightarrow \quad d = -2$ Substitute $(1;-8)$: $-8 = \frac{k}{1+r} - 2$ $k = -6(1+r)$ $k = -6 - 6r$ ……line 1 Substitute $(0;-4)$: $-4 = \frac{k}{r} - 2$ $\frac{k}{r} = -2$ $k = -2r$ ……line 2 Equating lines 1 and 2: $-6 - 6r = -2r$ $-4r = 6$ $r = -\frac{3}{2}$ Substituting into line 2 or line 1: $k = (-2)\left(-\frac{3}{2}\right) = 3$ $\quad$ $k = -6 - 6\left(-\frac{3}{2}\right) = 3$	✓ $d = -2$ ✓ $k = -6 - 6r$ ✓ $k = -2r$ ✓ $-6 - 6r = -2r$ ✓ value of r ✓ value of k (6)
5.3	$g(x) \geq f(x)$ $\therefore 0 \leq x \leq 1$	✓ $0 \leq x$ ✓ $x \leq 1$ (2)
5.4	The line $y = k$ must pass through f twice on the positive side of the x-axis./*Die lyn $y = k$ moet twee keer deur f aan die positiewe kant van die x-as sny.* $-8 < k < -4$	✓ $-8 < k$ ✓ $k < -4$ (2)

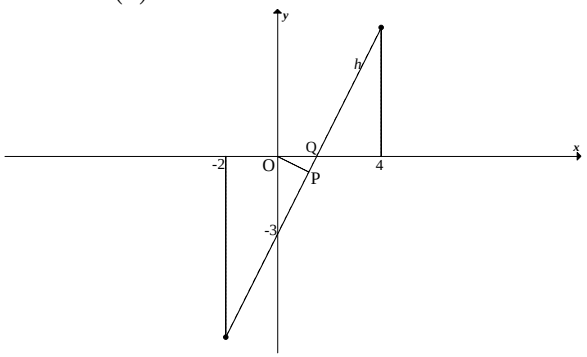
5.5	$y=-x+c$ Substitute the intersection point of the asymptotes, i.e. $\left(\frac{3}{2};-2\right)$: *Vervang die snypunt van die asimptote, m.a.w.* $\left(\frac{3}{2};-2\right)$: $-2=-\frac{3}{2}+c$ $c=-\frac{1}{2}$ $y=-x-\frac{1}{2}$ **OR/*OF*** $y=-x$ is translated $\frac{3}{2}$ units right and 2 units down/ $y=-x$ *transleer* $\frac{3}{2}$ *eenhede na regs en 2 eenhede na onder* $\Rightarrow$ $y=-\left(x-\frac{3}{2}\right)-2$ $y=-x-\frac{1}{2}$	✓ $y=-x+c$ ✓ $-2=-\frac{3}{2}+c$ ✓answer (3) ✓ $y=-x$ ✓ $y=-\left(x-\frac{3}{2}\right)-2$ ✓answer (3)
5.6	By symmetry, $Q=\left(\frac{3}{2}+8-2;-2+\frac{3}{2}-1\right)$ $=\left(\frac{15}{2};-\frac{3}{2}\right)$	✓ $x=\frac{15}{2}$ ✓ $y=-\frac{3}{2}$ (2) **[19]**

QUESTION/*VRAAG* 6

6.1	$f: \quad y=\frac{1}{4}x^2$ $f^{-1}: \quad x=\frac{1}{4}y^2$ $y^2=4x$ $y=\pm\sqrt{4x}$ $f^{-1}(x)=-\sqrt{4x}$ **OR**/OF $f^{-1}(x)=-2\sqrt{x}$	✓interchanging x and y ✓ $y^2=4x$ ✓answer (3)
6.2		✓both graphs pass through (0 ; 0) ✓shape for both ✓one additional point on both graphs (3)
6.3	Yes. No value of x in the domain of f^{-1} maps onto more than one y-value. *Ja. Geen waarde van x in die definisieversameling van f^{-1} assosieer met meer as een y-waarde nie.* **OR/*OF*** Yes. One to one function./*Ja. Een-tot-een-funksie.* **OR/*OF*** Yes. Vertical line test holds./*Ja. Die vertikale lyntoets werk.*	✓yes ✓reason (2) ✓yes ✓reason (2) ✓yes ✓reason (2) **[8]**

QUESTION/*VRAAG* 5

Given $h(x) = 2x - 3$ for $-2 \le x \le 4$.



5.1

For x-intercepts, $y = 0$

$2x - 3 = 0$

$x = 1{,}5$

$Q(1{,}5\,;\,0)$

✓ $x = 1{,}5$
✓ $y = 0$
(2)

5.2

h:

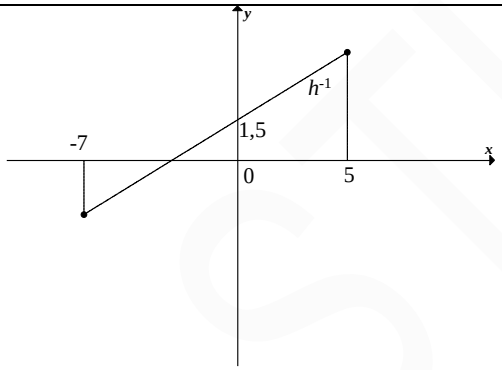
$x = -2$: $y = 2(-2) - 3 = -7$

$x = 4$: $y = 2(4) - 3 = 5$

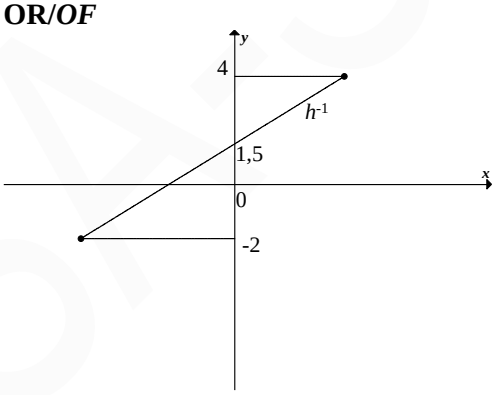
Domain of h^{-1}: $-7 \le x \le 5$ **OR/*OF*** $[-7;\,5]$

✓ $h(-2) = -7$
✓ $h(4) = 5$
✓ $-7 \le x \le 5$
(3)

5.3



OR/*OF*



✓ y-intercept on a straight line
✓ line segment
✓ accurate endpoints (x or y or both)
(3)

5.4	$h(x)=2x-3$ For the inverse of *h*, $x=2y-3$ $y=\frac{x+3}{2}$ $h^{-1}(x)=\frac{x+3}{2}$ $h(x)=h^{-1}(x)$ $2x-3=\frac{x+3}{2}$ $4x-6=x+3$ $x=3$ **OR/*OF*** $h(x)=2x-3$ *h* and h^{-1} intersect when $y=x$ $h(x)=x$ $2x-3=x$ $x=3$ **OR/*OF*** $h(x)=2x-3$ For the inverse of *h*, $x=2y-3$ $y=\frac{x+3}{2}$ $h^{-1}(x)=x$ $\frac{x+3}{2}=x$ $x+3=2x$ $x=3$	✓ $y=\frac{x+3}{2}$ ✓ $2x-3=\frac{x+3}{2}$ ✓ $x=3$ (3) ✓ $h(x)=x$ ✓ $2x-3=x$ ✓ $x=3$ (3) ✓ $y=\frac{x+3}{2}$ ✓ $\frac{x+3}{2}=x$ ✓ $x=3$ (3)

5.5

$OP^2 = (x-0)^2 + (y-0)^2$ ✓ $OP^2 = x^2 + y^2$

$= x^2 + (2x-3)^2$ ✓substitute $y = 2x-3$

$= x^2 + 4x^2 - 12x + 9$

$= 5x^2 - 12x + 9$ ✓ $5x^2 - 12x + 9$

For OP to be at its minimum, OP^2 has to be a minimum

Vir OP om minimum te wees, moet OP^2 'n minimum wees

$\frac{d(OP^2)}{dx} = 0$ **OR** / *OF* $x = -\frac{b}{2a}$

$10x - 12 = 0$ $= -\frac{-12}{2(5)}$

$\therefore x = \frac{6}{5}$ ✓*x*-value

Minimum length of OP $= \sqrt{5\left(\frac{6}{5}\right)^2 - 12\left(\frac{6}{5}\right) + 9} = \sqrt{\frac{9}{5}}$ or $\frac{3}{\sqrt{5}}$ or 1,34 units ✓answer (5)

OR/*OF*

For minimum distance OP ⊥ the line

$m_h = 2$ (given)

$m_{OP} = \frac{-1}{2}$

$\therefore$ OP has equation $y = \frac{-1}{2}x$

$\frac{-1}{2}x = 2x - 3$

$-x = 4x - 6$

$5x = 6$ ✓ $m_{OP} = \frac{-1}{2}$

$x_P = 1,2$

$y_P = -\frac{1}{2}(1,2) = -0,6$ ✓equation of OP

$OP = \sqrt{(1,2-0)^2 + (-0,6-0)^2}$ ✓ $\frac{-1}{2}x = 2x - 3$

$= 1,34$ or $\sqrt{1,8}$ units

✓*x*-value

✓answer (5)

OR/*OF*

For minimum distance OP ⊥ the line

$O(0;0)\quad P(x;\ 2x-3)\quad Q\left(\frac{3}{2};0\right)$

✓ $OP^2 = x^2 + y^2$

✓ substitute $y = 2x - 3$

$$OP^2 + PQ^2 = OQ^2 \quad \text{(pythag)}$$

$$(x-0)^2 + (2x-3-0)^2 + \left(x-\frac{3}{2}\right)^2 + (2x-3-0)^2 = \left(\frac{3}{2}\right)^2$$

✓ $10x^2 - 27x + 18$

$$x^2 + 4x^2 - 12x + 9 + x^2 - 3x + \frac{9}{4} + 4x^2 - 12x + 9 = \frac{9}{4}$$

$$10x^2 - 27x + 18 = 0$$

$$(5x-6)(2x-3) = 0$$

✓ x-value

$$x = \frac{6}{5} \text{ or } \frac{3}{2}$$

Hence, $x = \frac{6}{5}$ at P

$$OP^2 = x^2 + (2x-3)^2$$

$$= \left(\frac{6}{5}\right)^2 + \left(2\left(\frac{6}{5}\right)-3\right)^2$$

✓ answer (5)

$$= \frac{36}{25} + \frac{9}{25}$$

$$= \frac{9}{5}$$

$$OP = 1{,}34$$

OR/*OF*

For minimum distance OP ⊥ the line

✓ $\tan\hat{Q} = 2$

✓ $\hat{Q} = 63{,}43^\circ$

✓ $\sin 63{,}43^\circ$

✓ $\frac{OP}{1{,}5}$

✓ answer (5)

$$\tan\hat{Q} = 2$$

$$\hat{Q} = 63{,}43^\circ$$

$$\sin 63{,}43^\circ = \frac{OP}{1{,}5}$$

$$OP = 1{,}34$$

OR/*OF*

$$OP = \sqrt{(x-0)^2 + (y-0)^2}$$
$$= \sqrt{(x-0)^2 + (2x-3-0)^2}$$
$$= \sqrt{x^2 + 4x^2 - 12x + 9}$$
$$= \sqrt{5x^2 - 12x + 9}$$

✓ $OP = \sqrt{(x-0)^2 + (y-0)^2}$

✓substitute $y = 2x - 3$

✓ $5x^2 - 12x + 9$

By using the chain rule (which is not in the CAPS):

$$\frac{dOP}{dx} = \frac{1}{2}\left(5x^2 - 12x + 9\right)^{\frac{-1}{2}} \cdot (10x - 12)$$
$$0 = \frac{1}{2}\left(5x^2 - 12x + 9\right)^{\frac{-1}{2}} \cdot (10x - 12)$$
$$0 = \frac{1}{2}(10x - 12)$$
$$0 = 5x - 6$$
$$x = \frac{6}{5}$$

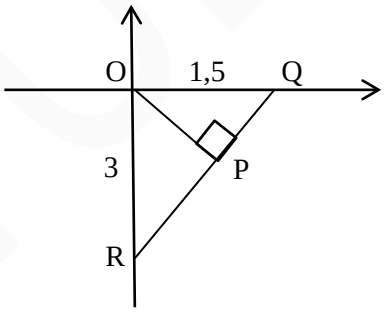
✓*x*-value

$$OP = \sqrt{5\left(\frac{5}{6}\right)^2 - 12\left(\frac{6}{5}\right) + 9}$$
$$= 1{,}34$$

✓answer (5)

OR/*OF*

For minimum distance OP ⊥ the line
Let the *y*-intercept be R
OR = 3 units



OQ = $\frac{3}{2}$ units

RQ = $\frac{3}{2}\sqrt{5}$ (Pythagoras)

✓ RQ = $\frac{3}{2}\sqrt{5}$

Area OQR = $\frac{1}{2} \times$ base $\times \perp$height

$$\frac{1}{2}.OR.OQ = \frac{1}{2}.\left(\frac{3}{2}\sqrt{5}\right).OP$$

✓ $\frac{1}{2}.\left(\frac{3}{2}\sqrt{5}\right).OP$

✓ $\frac{1}{2}.3.\left(\frac{3}{2}\right)$

$$\frac{1}{2}.3.\left(\frac{3}{2}\right) = \frac{1}{2}.\left(\frac{3}{2}\sqrt{5}\right).OP$$

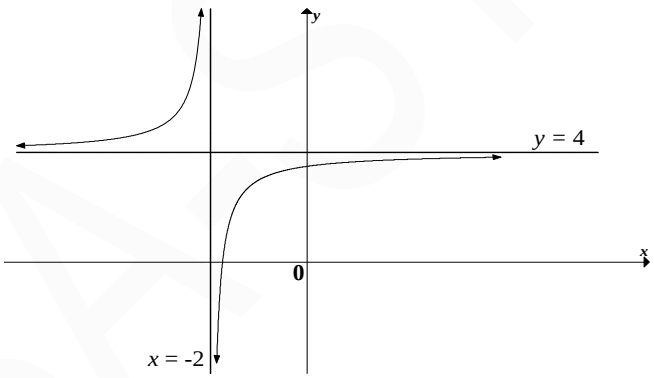
✓ equating

$$OP = \frac{3}{\sqrt{5}} = 1{,}34$$

✓ answer (5)

5.6.1	$f'(x) = 2x - 3$ Turning point at $x = \frac{3}{2}$ $f''(x) = 2 > 0$ or $f''\left(\frac{3}{2}\right) > 0$ f has a local minimum at $x = \frac{3}{2}$ *f het 'n lokale minimum by* $x = \frac{3}{2}$ **OR/*OF*** $h(x) = f'(x) < 0$ for $x \in (-2\ ;\ 1{,}5) \Rightarrow f$ is decreasing on the left of Q / *f is dalend links van Q.* $h(x) = f'(x) > 0$ for $x \in (1{,}5\ ;\ 4) \Rightarrow f$ is increasing on the right of Q / *f is stygend regs van Q.* $\therefore f(x)$ has a local minimum when $x = \frac{3}{2}$ / *$\therefore f(x)$ het 'n lokael minimum by* $x = \frac{3}{2}$ **OR/*OF*** $f(x) = x^2 - 3x + c$ f has a minimum value since $a > 0$ *f het 'n minimum waarde omdat $a > 0$*	✓ Turning point at $x = \frac{3}{2}$ ✓ $f''(x) = 2 > 0$ (2) ✓decreasing left of Q ✓increasing right of Q (2) ✓ $f(x) = x^2 - 3x + c$ ✓ explanation (2)
5.6.2	$m = f'(4) = h(4) = 5$	✓answer (1) **[19]**

QUESTION/*VRAAG* 6

6.1.1	$T(0;18)$	✓ (0;18) (1)
6.1.2	$-2x^2+18=0$ $(x-3)(x+3)=0$ Q(3; 0) **OR/*OF*** $-2x^2+18=0$ $x^2=9$ Q(3; 0)	✓y= 0 ✓factors ✓x = 3 (3) ✓ y= 0 ✓ $x^2=9$ ✓ x = 3 (3)
6.1.3	x-coordinate of S is 4,5/*x-koördinaat van S is 4,5* By symmetry about the line x = 4,5/*Deur simmetrie om die lyn x = 4,5:* R = (4,5 + 4,5–3 ; 0) = (6 ; 0)	✓ x = 6 ✓ y = 0 (2)
6.1.4	For all $x \in \mathbf{R}$ **OR/*OF*** $(-\infty;\infty)$	✓✓answer (2)
6.2	If C$(x;y)$is the centre of the hyperbola/*As* $C(x;y)$*die middelpunt is van die hiperbool* $y = x+6$ and $x=-2$ $\therefore y=-2+6=4$  	✓✓ asymptote $y=4$ ✓asymptote $x=-2$ ✓shape (increasing hyperbolic function) (4) **[12]**

QUESTION/*VRAAG* 5

5.1	$9 = a^2$ $a = 3$ **OR/*OF*** $f^{-1}(x) = \log_a x$ $2 = \log_a 9$ $a^2 = 9 = 3^2$ $\therefore a = 3$	✓ $9 = a^2$ ✓ $a = 3$ (2) ✓ $9 = a^2$ ✓ $a = 3$ (2)
5.2	$g(x) = 3^{-x}$ **OR/*OF*** $g(x) = \left(\frac{1}{3}\right)^x$	✓ answer/*antwoord* (1) ✓ answer/*antwoord* (1)
5.3	$x \geq 9$ **OR/*OF*** $f^{-1}(x) = \log_3 x$ $\log_3 x = 2$ $x = 3^2 = 9$ $\therefore x \geq 9$ **OR/*OF*** $\log_3 x \geq 2$ $x \geq 3^2$ $\therefore x \geq 9$	✓✓ answer/*antwoord* (2) ✓✓ answer/*antwoord* (2) ✓✓ answer/*antwoord* (2)
5.4	Yes/*Ja*. For every *y*-value there is only one *x* such that/*Vir elke y-waarde is daar slegs een x sodanig dat* $y = f(x)$. **OR/*OF*** Yes/*Ja*. f is a one-to-one relation/*is 'n een-tot-een-relasie*.	✓ Yes/*Ja* ✓ Reason/*Rede* (2) ✓ Yes/*Ja* ✓ Reason/*Rede* (2) **[7]**

QUESTION/*VRAAG* 6

6.1	$-3 \le x \le 2$	✓ critical values/ *kritiese waardes* ✓ notation/*notasie* (2)
6.2	$f: \quad y = a(x - x_1)(x - x_2)$ $y = a(x+3)(x-2)$ $-8 = a(1+3)(1-2)$ $-8 = -4a$ $2 = a$ $y = 2(x+3)(x-2)$ $y = 2x^2 + 2x - 12$ $b = 2$ and/*en* $c = -12$	✓ $y = a(x+3)(x-2)$ ✓ substitute/*vervang* $(1\ ;-8)$ ✓ $a = 2$ ✓ $b = 2$ and/*en* ✓ $c = -12$ (5)
	OR/*OF*	
	$y = a\left(x + \frac{1}{2}\right)^2 + q$ $0 = a\left(2 + \frac{1}{2}\right)^2 + q \quad \rightarrow \quad 0 = \frac{25}{4}a + q \quad ....(1)$ $-8 = a\left(1 + \frac{1}{2}\right)^2 + q \quad \rightarrow \quad -8 = \frac{9}{4}a + q \quad .....(2)$ $(1) - (2): 8 = 4a$ $a = 2$ $q = 0 - \frac{25}{4}(2) = -\frac{25}{2} = -12{,}5$	✓ equation/*vergelyking* 1 ✓ equation/*vergelyking* 2 ✓ $a = 2$
	$y = 2\left(x + \frac{1}{2}\right)^2 - 12\frac{1}{2}$ $y = 2\left(x^2 + x + \frac{1}{4}\right) - 12\frac{1}{2}$ $y = 2x^2 + 2x + \frac{1}{2} - 12\frac{1}{2}$ $y = 2x^2 + 2x - 12$ $\therefore b = 2$ and $c = -12$	✓ substitution/*substitusie* ✓ $b = 2$ and/*en* ✓ $c = -12$ (5)
	OR/*OF*	

	$f'(x) = 2ax + b$ $f'\left(-\frac{1}{2}\right) = 2a\left(-\frac{1}{2}\right) + b = 0$ $\therefore a = b$ $(-3;0): 9a - 3b + c = 0$ $\therefore 6a + c = 0 \ldots\ldots\ldots\ldots (1)$ $(1;-8): a + b + c = -8$ $\therefore 2a + c = -8 \ldots\ldots\ldots\ldots (2)$ $(1) - (2): \quad 4a = 8$ $\therefore a = 2$ $\Rightarrow b = 2$ $\therefore c = -12$	✓equation/*vergelyking* 1 ✓equation/*vergelyking* 2 ✓$a = 2$ ✓ $b = 2$ ✓$c = -12$ (5)
6.3	$x = -\frac{b}{2a}$ $x = -\frac{2}{2(2)} = -\frac{1}{2}$ $y = \frac{1}{2} - 1 - 12$ $y = -12\frac{1}{2}$ $\text{TP}\left(-\frac{1}{2}\ ;\ -12\frac{1}{2}\right)$ **OR/*OF***	✓ $x = -\frac{1}{2}$ ✓substitution/*substitusie* ✓y-value/*waarde* (3)

	$y = 2[x^2 + x - 6]$ $y = 2\left[x^2 + x + \left(\frac{1}{2}.1\right)^2 - 6 - \left(\frac{1}{2}.1\right)^2\right]$ $= 2\left[\left(x + \frac{1}{2}\right)^2 - 6{,}25\right]$ $= 2\left(x + \frac{1}{2}\right)^2 - 12{,}5$ $\text{TP}\left(-\frac{1}{2}; -12{,}5\right)$	✓ method/*metode* ✓*x*-value/*waarde* ✓*y*-value/*waarde* (3)
	OR/*OF* $x = \frac{-3+2}{2} = -\frac{1}{2}$ $y = 2\left(-\frac{1}{2}\right) + 2\left(-\frac{1}{2}\right) - 12$ $y = -12\frac{1}{2}$ $\text{TP}\left(-\frac{1}{2}; -12{,}5\right)$	✓ method/*metode* ✓*x*-value/*waarde* ✓*y*-value/*waarde* (3)
	OR/*OF* $f(x) = y = 2x^2 + 2x - 12$ $f'(x) = 4x + 2$ $4x + 2 = 0$ $4x = -2$ $x = -\frac{1}{2}$ $\therefore y = 2\left(-\frac{1}{2}\right)^2 + 2\left(-\frac{1}{2}\right) - 12 = -\frac{25}{2}$ $\text{TP}\left(-\frac{1}{2}; -\frac{25}{2}\right)$	✓ method/*metode* ✓*x*-value/*waarde* ✓*y*-value/*waarde* (3)
6.4	$x = \frac{13}{2}$	✓✓ answer/i (2)
6.5	$f'(x) = 4x + 2$ $m = f'(1) = 4(1) + 2$ $m = 6$	✓ $y' = 4x + 2$ ✓ subst. $x = 1$ ✓ answer/*antwoord* (3) **[15]**

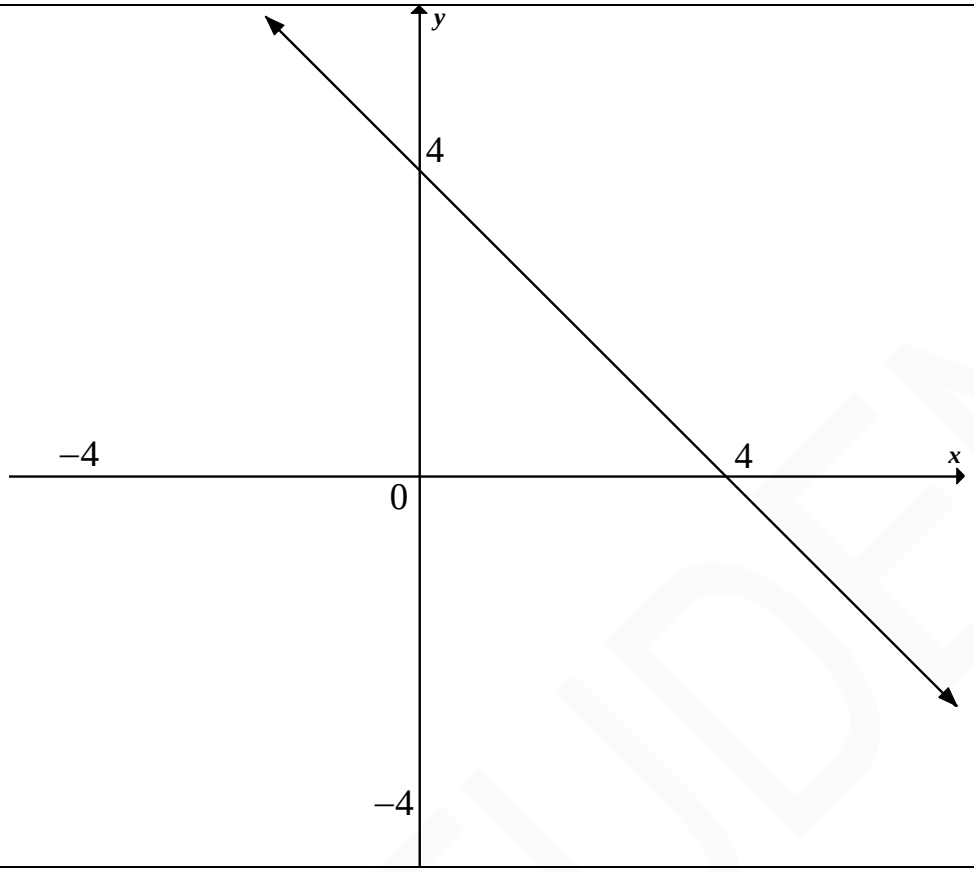
QUESTION 5

5.1	$y = \log_a x$ $-1 = \log_a \frac{1}{3}$ $a^{-1} = \frac{1}{3}$ $a = \left(\frac{1}{3}\right)^{-1}$ $\therefore a = 3$	✓subt. $\left(\frac{1}{3};-1\right)$ ✓ $a^{-1} = \frac{1}{3}$ or $a = \left(\frac{1}{3}\right)^{-1}$ (2)
5.2	$h: \quad x = \log_3 y$ $\therefore \quad y = 3^x$	✓swop x and y/*ruil x en y* ✓ answer/*antwoord* (2)
5.3	$g(x) = -\log_3 x$ **OR/*OF*** $g(x) = \log_3 \frac{1}{x}$ **OR/*OF*** $g(x) = \log_{\frac{1}{3}} x$ **OR/OF** $x = 3^{-y}$ **OR/OF** $x = \left(\frac{1}{3}\right)^{y}$	✓answer/*antwoord* (1) ✓answer/*antwoord* (1) ✓answer/*antwoord* (1) ✓answer/*antwoord* (1) ✓answer/*antwoord* (1)
5.4	$x > 0$ **OR/*OF*** $(0;\infty)$	✓ answer/*antwoord* (1) ✓ answer/*antwoord* (1)
5.5	$\log_3 x = -3$ $x = 3^{-3}$ $x = \frac{1}{27}$ $x \geq \frac{1}{27}$	✓ exponential form/ *eksponensiële vorm* ✓simplification/vereenvoudiging ✓answer/*antwoord* (3) **[9]**

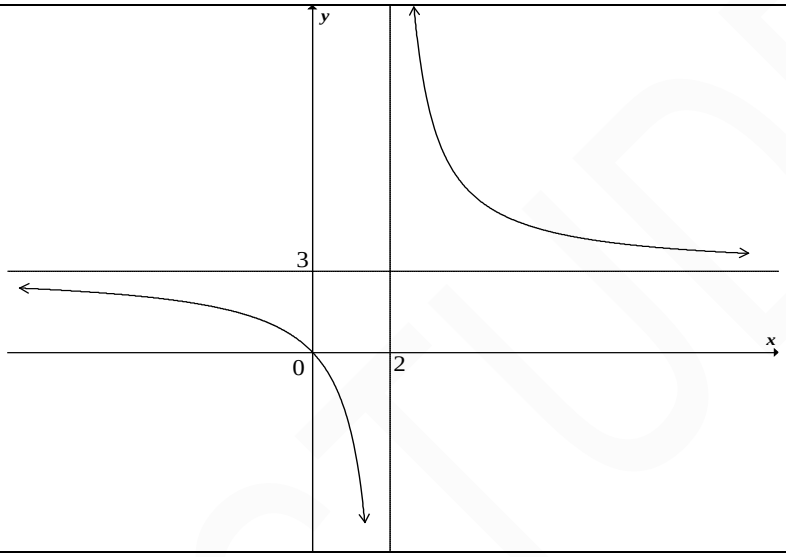
QUESTION/*VRAAG* 6

6.1	$4x^2 - 6 = 0$ $x^2 = \frac{3}{2}$ $x = 1{,}22$ (x - coordinate of S is positive)	✓$y = 0$ ✓1,22 (2)
6.2	$(0\ ;-6)$	✓ 0 ✓– 6 (2)
6.3.1	$QT = f(x) - g(x)$ $= 2\sqrt{x} - (4x^2 - 6)$ or $= 2\sqrt{x} - 4x^2 + 6$	✓✓ correct formula/ *korrekte formule* ✓substitution/*substitusie* (3)
6.3.2	$\text{QT} = 2x^{\frac{1}{2}} - 4x^2 + 6$ $\text{Deravitive of QT} = x^{\frac{-1}{2}} - 8x = 0$ $\frac{1}{\sqrt{x}} = 8x$ $x^{\frac{3}{2}} = \frac{1}{8}$ or $\frac{1}{x} = 64x^2$ $x = \left(\frac{1}{8}\right)^{\frac{2}{3}}$ $x = \left(\frac{1}{2}\right)^2$ or $x^3 = \frac{1}{64}$ $x = \frac{1}{4} = 0{,}25$ $\text{Max/}Maks\ \text{QT} = 2\left(\frac{1}{4}\right)^{\frac{1}{2}} - 4\left(\frac{1}{4}\right)^2 + 6$ $= 6\frac{3}{4} = 6{,}75 \text{units/}eenhede$	✓derivative/*afgeleide* ✓derivative equal to 0/ *afgeleide gelyk aan 0* ✓ $x^{\frac{3}{2}} = \frac{1}{8}$ ✓*x*-value/*x-waarde* ✓ substitution/*substitusie* ✓answer/*antwoord* (6) **[13]**

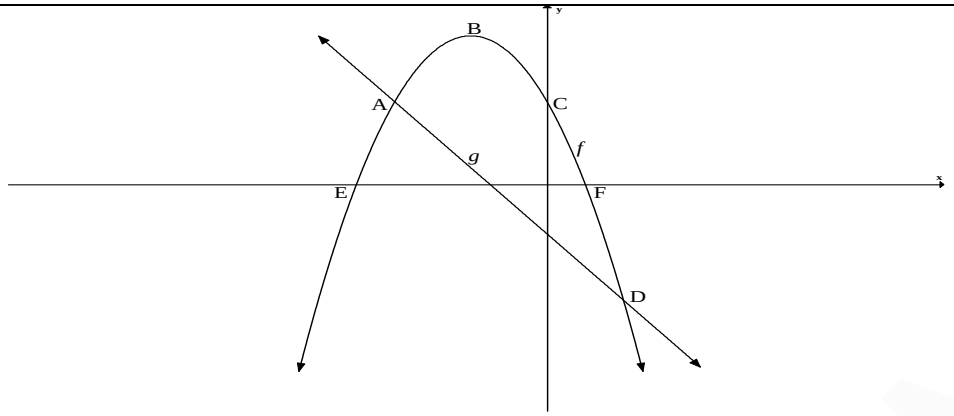
QUESTION/*VRAAG* 5

5.1		✓ *x*-intercept of straight line ✓ *y*-intercept of straight line ✓✓ circle (4)
5.2	Points of intersection are (0 ; 4) and (4 ; 0)	✓ (0 ; 4) ✓ (4 ; 0) (2) **[6]**

QUESTION/*VRAAG* 6

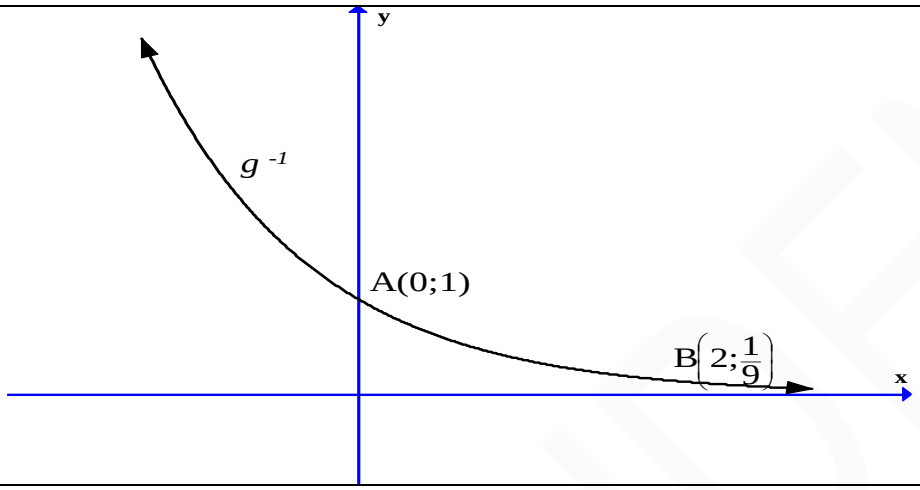
6.1	$x = 2$ $y = 3$	✓ $x = 2$ ✓ $y = 3$ (2)
6.2	**R** ; $x \neq 2$ **OR** $(-\infty ; 2) \cup (2 ; \infty)$ **OR** **R** $-\{2\}$	✓ answer (1)
6.3		✓ shape ✓ intercept at origin ✓✓asymptotes (4)
6.4	$y = x + 3$ and $y = -x + 1$ $x + 3 = -x + 1$ $2x = -2$ $x = -1$ $y = -1 + 3$ $= 2$ Point of intersection of asymptotes: $(-1 ; 2)$ *Die snypunt van die asimptote:* The transformation is a translation 3 units left and 1 unit down *Die transformasie is 'n translasie van 3 eenhede na links en 1 eenheid na onder* **OR** The transformation is $(x ; y) \rightarrow (x - 3 ; y - 1)$	✓ $x + 3 = -x + 1$ ✓$x = -1$ ✓ $y = 2$ ✓ transformation (4) **[11]**

QUESTION/*VRAAG* 7

7.1	 C(0 ; 5)	✓ C(0 ; 5) (1)
7.2	$x = \frac{-4+0}{2}$ $= -2$	✓ $\frac{-4+0}{2}$ (1)
7.3	$p = -2$ $y = a(x+2)^2 + q$ $5 = a(0+2)^2 + q$ $\quad 0 = a(1+2)^2 + q$ $5 = 4a + q$ $\quad 0 = 9a + q$ $5a = -5$ $a = -1$ $q = 9$ $f(x) = -(x+2)^2 + 9$ **OR** $p = -2$ $f(x) = a(x-1)(x+5)$ $5 = a(-1)(5)$ $a = -1$ $q = f(-2)$ $= -1(-3)(3)$ $= 9$	✓ $p = -2$ ✓ $5 = 4a + q$ ✓ $0 = 9a + q$ ✓ simultaneous equation ✓ $a = -1$ ✓ $q = 9$ (6) ✓ $p = -2$ ✓ $f(x) = a(x-1)(x+5)$ ✓substitution ✓ $a = -1$ ✓ substitution ✓ $q = 9$ (6)
7.4	$-x^2 - 4x + 5 = -2x - 3$ $x^2 + 2x - 8 = 0$ $(x+4)(x-2) = 0$ $x = -4$ or $x = 2$ $\therefore$ x – coordinate of D is 2	✓ equating ✓standard form ✓ factors ✓ 2 (4)

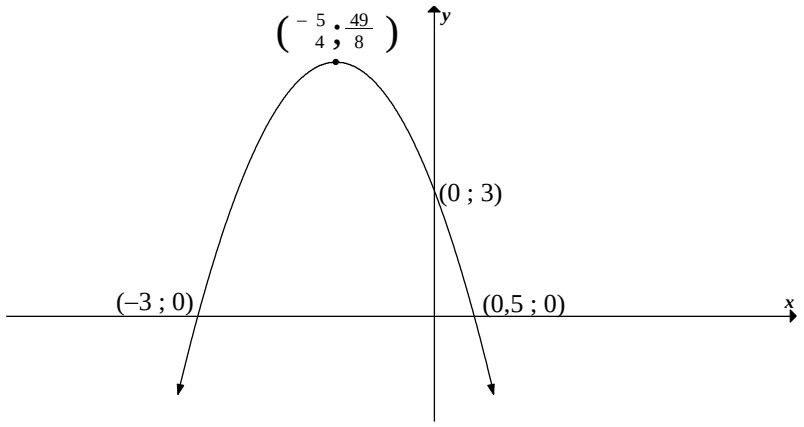
7.5	(–2 ; –9)	✓2 ✓ – 9 (2) **[14]**

QUESTION/*VRAAG* 8

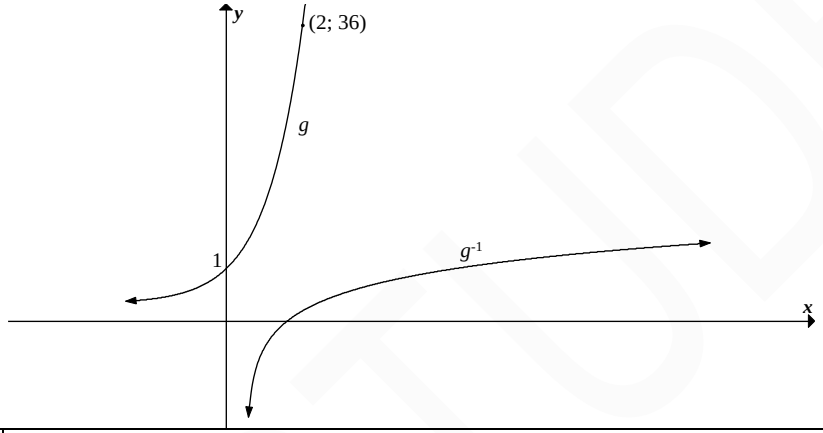
8.1	A(1; 0)	✓ answer (1)
8.2		✓shape ✓ A(0 ; 1) ✓ $B\left(2;\frac{1}{9}\right)$ (3)
8.3	**R**	✓ answer (1) **[5]**

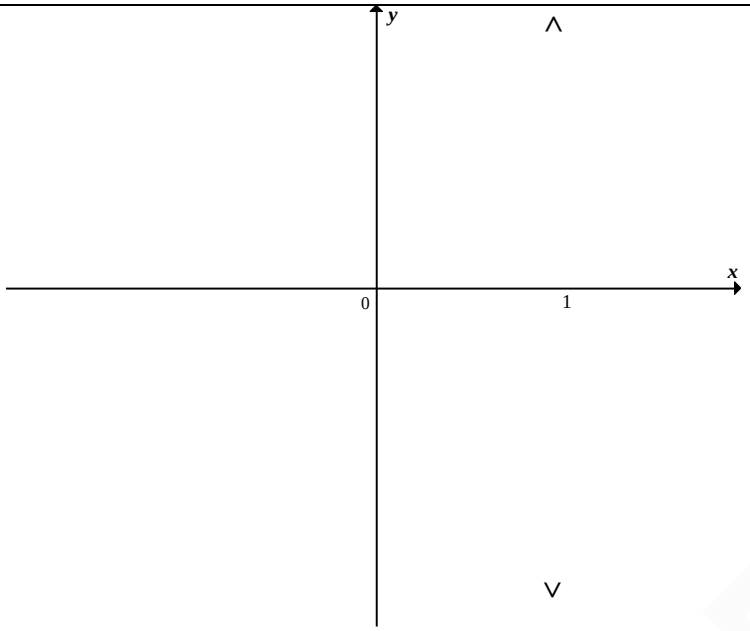
QUESTION/*VRAAG* 9

9.1	$1+i_{eff}=\left(1+\frac{i_{nom}}{m}\right)^{m}$ $1+i_{eff}=\left(1+\frac{0,07}{12}\right)^{12}$ $i_{eff}=0,07229008$ $i_{eff}=7,23\%$	✓ substitution into correct formula ✓ $\frac{0,07}{12}$ ✓ answer (3)

4.4		✓shape ✓intercepts with the axes ✓ turning point (3) **[10]**

QUESTION/*VRAAG* 5

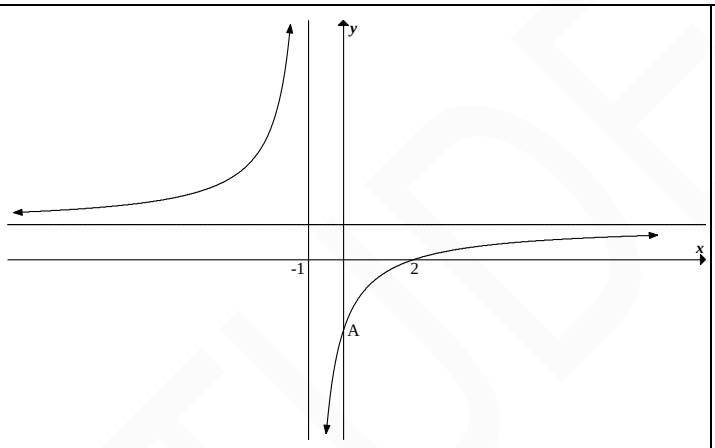
Given: $g(x)=k^x$ and $y=g^{-1}(x)$ 		
5.1.1	$k^2=36$ $k=6$	✓$k^2=36$ ✓answer (2)
5.1.2	g: $y=6^x$ g^{-1}: $x=6^y$ $y=\log_6 x$ or $y=\frac{\log x}{\log 6}$ **NOTE:** Answer only : 2/2 marks	✓$x=6^y$ ✓$y=\log_6 x$ or $y=\frac{\log x}{\log 6}$ (2)
5.1.3	$0<x\leq 1$ **OR** $(0;1]$	✓ $0<x$ ✓$x\leq 1$ (2)
5.1.4	$x>3$ **OR** $(3;\infty)$	✓ answer (1)

5.2.1		✓ vertical line ✓ vertical line has *x*-intercept (1 ; 0) (2) **NOTE:** Any other graph cutting at (1 ; 0): 0 / 2 marks
5.2.2	**NOTE:** If $x = 1$ is not drawn in 5.2.1: 0/2 marks No, the inverse of f is not a function because the vertical line test fails in the graph of $x = 1$. *Nee, die inverse van f is nie 'n funksie nie omdat die vertikalelyn-toets vir die grafiek $x = 1$ faal.* **OR** No, the inverse of f is not a function because the horizontal line test fails in the graph of $y = 1$. *Nee, die inverse van f is nie 'n funksie nie omdat die horisontalelyn-toets vir die grafiek $y = 1$ faal.* **OR** Since f as defined is a many-to-one function it does not have an inverse function. *f is gedefinieerd as 'n meer-tot-een-funksie en het dus nie 'n inverse funksie nie.* **OR** The inverse of f is a one-to-many relation. *Die inverse funksie van f is 'n een-tot-meer relasie.* **OR**	✓ not a function ✓ valid reason (2) ✓ not a function ✓ valid reason (2) ✓ not a function ✓ valid reason (2) ✓ not a function ✓ explanation (2)

	No, the inverse of f is not a function because there are some input (x) values (for example, $x = 0$) which have more than one output (y) value. *Nee, die inverse van f is nie 'n funksie nie omdat van die x-waardes (bv. $x = 0$) meer as een y-waarde het.* **OR** No, for one x-value there are more than one y-values. *Nee, vir 'n x-waarde is daar meer as een y-waarde.*	✓ not a function ✓ valid reason (2) ✓ not a function ✓ valid reason (2) **[11]**

QUESTION/*VRAAG* 6

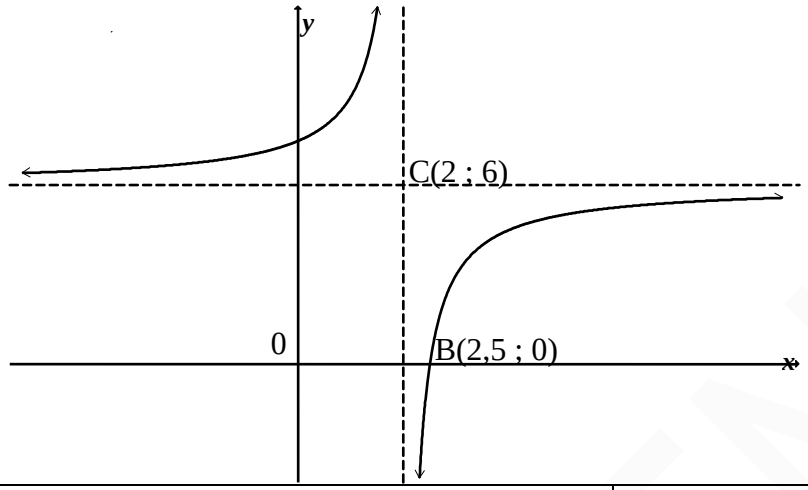
Given: $f(x)=\dfrac{x-d}{x-p}$



6.1.1	$0=\dfrac{2-d}{2-p}$ $d = 2$ $-1-p=0$ $p = -1$ **NOTE:** If candidate leaves answer as $f(x)=\dfrac{x-2}{x+1}$: 2/2 marks	✓ d value ✓ p value (2)
6.1.2	$y=\dfrac{x-2}{x+1}$ $=\dfrac{(x+1)-3}{x+1}$ $=\dfrac{x+1}{x+1}-\dfrac{3}{x+1}$ $=\dfrac{-3}{x+1}+1$ **OR** $\dfrac{-3}{x+1}+1$ $=\dfrac{-3+x+1}{x+1}$ $=\dfrac{x-2}{x+1}$ **NOTE:** • If the candidate starts with $y=\dfrac{a}{x+1}+1$ and substitutes (2 ; 0) and proves $a = -3$: 0/2 marks • If the candidate starts with $y=\dfrac{-3}{x+1}+1$ and calculates (2 ; 0) as x-intercept: 0/2 marks	✓ $\dfrac{x-2}{x+1}=\dfrac{x+1-3}{x+1}$ ✓ $\dfrac{x+1}{x+1}-\dfrac{3}{x+1}$ (2)

	OR $x+1\overline{)x-2}$ $\quad 1$ $\underline{-x-1}$ -3 Remainder = -3 $\therefore x-2=1(x+1)-3$ $\frac{x-2}{x+1}=1-\frac{3}{x+1}$ $f(x)=\frac{-3}{x+1}+1$	✓ $\frac{-3+x+1}{x+1}$ ✓ simplification (2) ✓ long division ✓ remainder = –3 (2)
6.1.3	P(– 1 ; 1)	✓*x*-coordinate ✓*y*-coordinate (2)
6.1.4	$(-2\,;4)$	✓*x*-coordinate ✓*y*-coordinate (2)
6.2	$q=1$ Substitute $A(0;-2)$ into $g(x)=p\cdot 2^x+1$: $-2=p(2)^0+1$ $p=-3$ Hence $g(x)=-3.2^x+1$ **NOTE:** Answer only: 3/3 marks	✓ q = 1 ✓ substitute A(0; –2) ✓ $p=-3$ (3) **[11]**

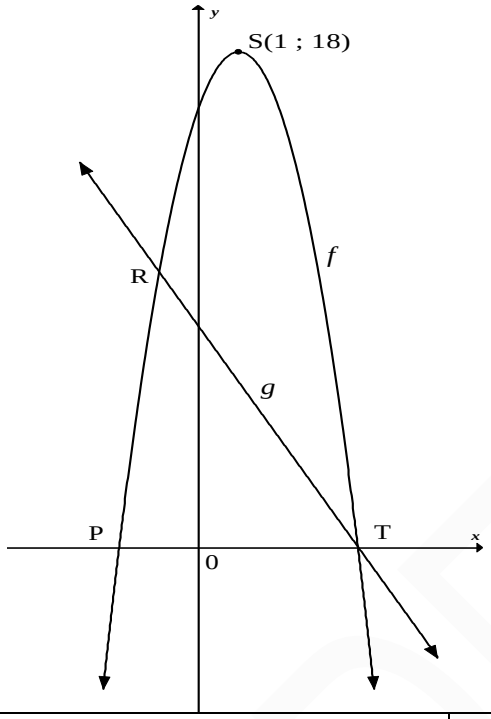
QUESTION 5



5.1	$g(x)=\frac{a}{x-2}+6$ $0=\frac{a}{2,5-2}+6$ $0=2a+6$ $a=-3$ $g(x)=\frac{-3}{x-2}+6$	✓ $p=2$ ✓ $q=6$ ✓ substitute B(2,5 ; 0) ✓ $a=-3$ (4)
5.2	$x_f=2-\frac{1}{2}$ $x_f=\frac{3}{2}$ $y_f=6+6$ $y_f=12$ $\text{F}\left(\frac{3}{2};12\right)$	✓x-coordinate ✓y-coordinate (2) **[6]**

QUESTION 6

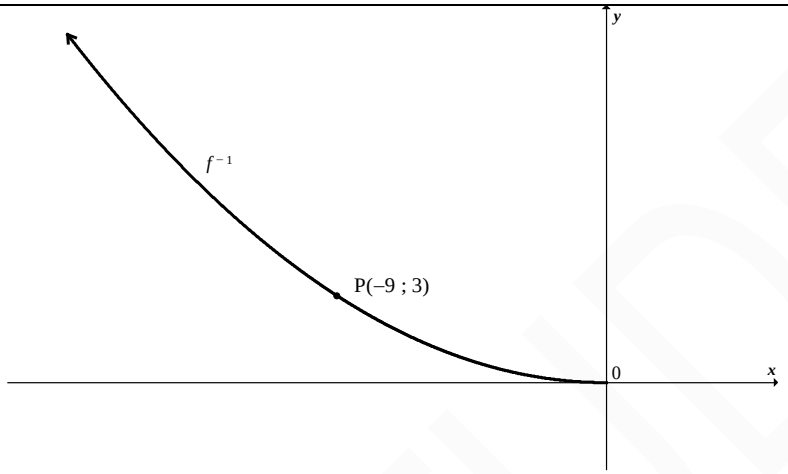
$f(x) = ax^2 + bx + c$
$g(x) = -2x + 8$



6.1	$0 = -2x + 8$ $2x = 8$ $x = 4$ T (4 ; 0)	✓ $y = 0$ ✓ $x = 4$ (2)
6.2	By symmetry, P(– 2 ; 0) $f(x) = a(x+2)(x-4)$ $18 = a(1+2)(1-4)$ $a = -2$ $f(x) = -2(x+2)(x-4)$ $= -2(x^2 - 2x - 8)$ $= -2x^2 + 4x + 16$ **OR** $f(x) = a(x-1)^2 + 18$ $0 = a(4-1)^2 + 18$ $a = -2$ $f(x) = -2(x-1)^2 + 18$ $= -2(x^2 - 2x + 1) + 18$ $= -2x^2 + 4x + 16$	✓ $f(x) = a(x+2)(x-4)$ ✓ substitutes S(1 ; 18) ✓ $a = -2$ ✓ multiplies out correctly to get $-2x^2 + 4x + 16$ (4) ✓ $f(x) = a(x-1)^2 + 18$ ✓ substitutes T(4 ; 0) ✓ $a = -2$ ✓ multiplies out correctly to get $-2x^2 + 4x + 16$ (4)

6.3	$-2x+8=-2x^2+4x+16$ $2x^2-6x-8=0$ $x^2-3x-4=0$ $(x-4)(x+1)=0$ $x=4$ or $x=-1$ at R, $y=-2(-1)+8=10$ i.e. R(– 1; 10)	✓ $-2x+8=-2x^2+4x+16$ ✓ $2x^2-6x-8=0$ ✓ $x=-1$ ✓ $y=10$ (4)
6.4.1	$-1\le x\le 4$	✓ $-1\le x$ ✓ $x\le 4$ (2)
6.4.2	$-2x^2+4x-2<0$ $-2x^2+4x-2+18<18$ $-2x^2+4x+16<18$ $f(x)<18$ $(-\infty;1)\cup(1;\infty)$ **OR** $-2x^2+4x-2<0$ $-2x^2+4x-2+18<18$ $-2x^2+4x+16<18$ $f(x)<18$ $x\in\mathbf{R}$; $x\neq 1$	✓ $-2x^2+4x-2+18<18$ ✓ $-2x^2+4x+16<18$ ✓ $f(x)<18$ ✓ $(-\infty;1)\cup(1;\infty)$ (4) ✓ $-2x^2+4x-2+18<18$ ✓ $-2x^2+4x+16<18$ ✓ $f(x)<18$ ✓ $x\in\mathbf{R}$; $x\neq 1$ (4) **[16]**

QUESTION 5

5.1	$0 \le x \le 3$ **OR** $[0;3]$ **Note:** if the candidate gives $0 < x < 3$, award 1/2 marks	✓ $0 \le x$ ✓ $x \le 3$ (2)
5.2	f^{-1}: $x = -\sqrt{27y}$ $x^2 = 27y$ $y = \frac{x^2}{27}$ $\quad x \le 0$ OR $(-\infty;0]$	✓ interchange x- and y- values ✓ $y = \frac{x^2}{27}$ ✓ $x \le 0$ or $(-\infty;0)$ (3)
5.3		✓ shape ✓ end at origin ✓ any other point on the graph (3)
5.4	Reflection about the x-axis **OR** $(x\,;y) \to (x\,;-y)$; $x \ge 0$	✓ answer (1) ✓ answer (1) **[9]**

QUESTION 6

$$f(x)=\frac{a}{x-5}+1$$

$$0=\frac{a}{(2)-5}+1$$

$$-1=\frac{a}{-3}$$

$$a=3$$

$$f(x)=\frac{3}{x-5}+1$$

✓ $x-5$
✓ $+1$
✓ substitution of $(2\ ;\ 0)$
✓ $a=3$

(4)

OR

$$(x-5)(y-1)=k$$

$$(2-5)(0-1)=k$$

$$k=3$$

$$(x-5)(y-1)=3$$

$$y=\frac{3}{x-5}+1$$

NOTE:
$f(x)=\frac{x-2}{x-5}$ as an alternative simplified form.

✓ $(x-5)$
✓ $(y-1)$
✓ substitution of $(2\ ;\ 0)$
✓ $k=3$

(4)

[4]

QUESTION 7

7.1.1

$$A = P(1-i)^n$$
$$= 120\,000(1-0,09)^5$$
$$= R74\,883,86$$

✓ i, n and P identified
✓ subs into correct formula
✓ answer

(3)

7.1.2

$$A = P(1+i)^n$$
$$= 120\,000(1+0,07)^5$$
$$= R168\,306,21$$

NOTE:
Incorrect formula (in 7.1.1 or 7.1.2) award max 1/3 marks

✓ i, n and P identified
✓ subs into correct formula
✓ answer

(3)

7.1.3

Sinking fund needed: $F_v = R\ 90\ 000$

$$F_v=\frac{x[(1+i)^n-1]}{i}$$

$$90\ 000=\frac{x\left[\left(1+\frac{0,085}{12}\right)^{61}-1\right]}{\frac{0,085}{12}}$$

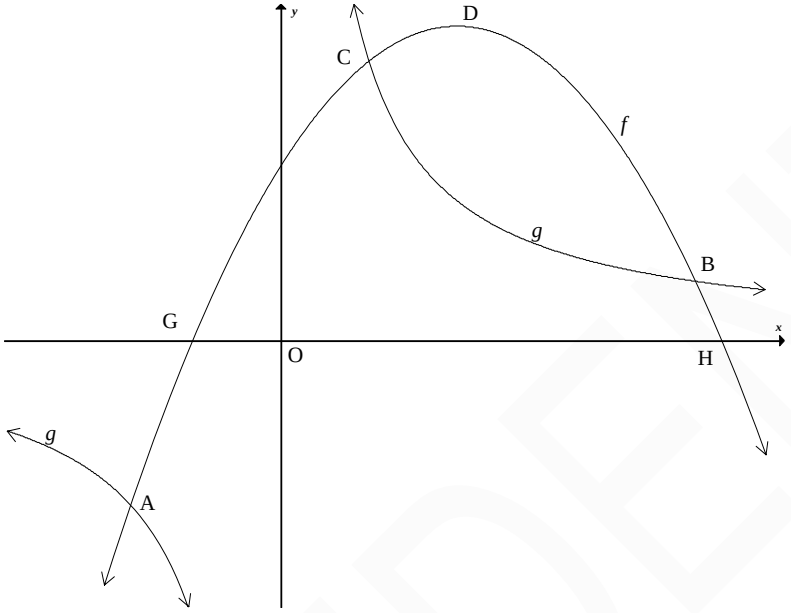
$$x = R\ 1\ 184,68$$

NOTE: Incorrect formula award max 2/5 marks

✓ $F_v = R\ 90\ 000$
✓ $i=\frac{0,085}{12}=\frac{17}{2400}$ in annuity formula
✓ $n = 61$
✓ subs into correct formula
✓ answer

(5)

QUESTION 5



5.1	$x = 0$ $y = 0$	✓ answer ✓ answer (2)
5.2	$f(x) = -2x^2 + 8x + 10$ $x^2 - 4x - 5 = 0$ $(x-5)(x+1) = 0$ $x = 5$ or $x = -1$ H(5 ; 0)	✓ equate to 0 ✓ factors ✓ x-values ✓ answer (4)
5.3	$f(x) = -2x^2 + 8x + 10$ $f(x) = -2(x-2)^2 + 18$ Range of f is $y \leq 18$ **OR** $y \in (-\infty ; 18]$ **OR** $f(x) = -2x^2 + 8x + 10$ $x = -\frac{8}{2(-2)}$ $x = 2$ $y = -2(2)^2 + 8(2) + 10$ $y = 18$ Range of f is $y \leq 18$ **OR** $y \in (-\infty ; 18]$ **OR**	✓ method ✓ $(x-2)^2$ ✓ 18 ✓ answer (4) ✓ method ✓ $x = 2$ ✓ $y = 18$ ✓ answer (4) ✓ method

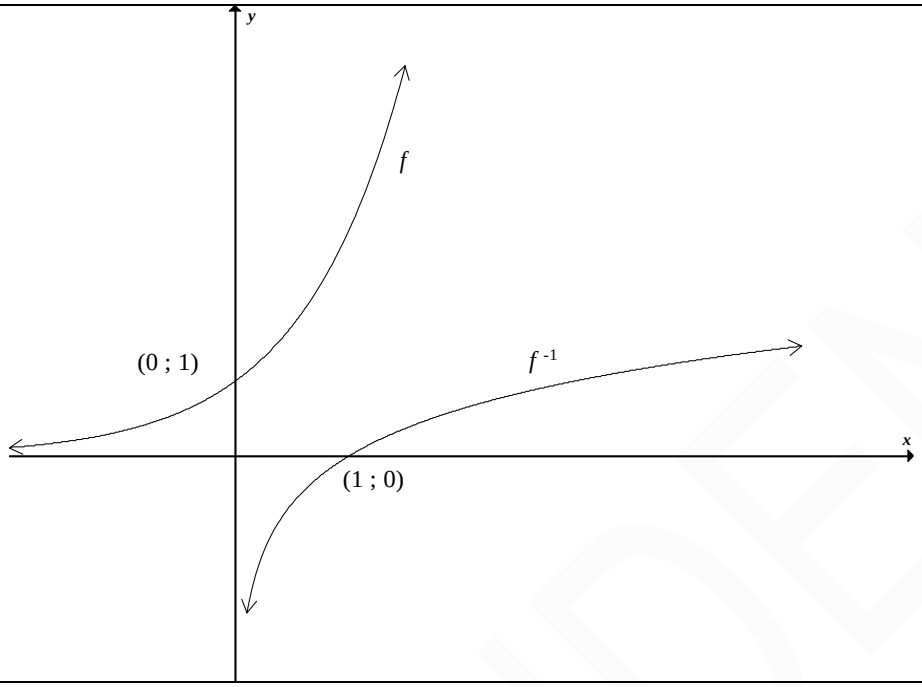
	$x = \frac{5-1}{2}$ $x = 2$ $y = -2(2)^2 + 8(2) + 10$ $y = 18$ Range of f is $y \leq 18$ **OR** $y \in (-\infty ; 18]$	✓ $x = 2$ ✓ $y = 18$ ✓ answer (4)

	OR $f(x) = -2x^2 + 8x + 10$ $f'(x) = -4x + 8$ $0 = -4x + 8$ $x = 2$ $y = -2(2)^2 + 8(2) + 10$ $y = 18$ Range of f is $y \leq 18$ **OR** $y \in (-\infty ; 18]$	✓ method ✓ $x = 2$ ✓ $y = 18$ ✓ answer (4)
5.4	$f(1) = -2(1)^2 + 8(1) + 10$ $f(1) = 16$ $g(1) = \frac{16}{1}$ $g(1) = 16$ C(1 ; 16) lies on both the graphs of f and g **OR** $-2x^2 + 8x + 10 = \frac{16}{x}$ $-2x^3 + 8x^2 + 10x - 16 = 0$ $x^3 - 4x^2 - 5x + 8 = 0$ $(x-1)(x^2 - 3x - 8) = 0$ $x = 1$ *or* $x^2 - 3x - 8 = 0$ C(1 ; 16)	✓ substitution $f(1)$ ✓ substitution $g(1)$ (2) ✓ equating ✓ answer (2)
5.5	$p(x) = f(3x)$ $3x = 2$ $x = \frac{2}{3}$ TP $(\frac{2}{3} ; 18)$ **OR** $p(x) = -2(3x)^2 + 8(3x) + 10$ $= -18x^2 + 24x + 10$ **NOTE:** Answer Only: Full Marks	✓ $3x = 2$ ✓ $x = \frac{2}{3}$ ✓ $y = 18$ (3) ✓ $x = -\frac{24}{2(-18)}$ ✓ $x = \frac{2}{3}$

	$x = -\frac{24}{2(-18)}$ $x = \frac{2}{3}$ TP $(\frac{2}{3}\ ; 18)$ **OR**	✓ $y = 18$ (3)

	$p(x) = -2(3x)^2 + 8(3x) + 10$ $= -18x^2 + 24x + 10$ $p'(x) = -36x + 24$ $0 = -36x + 24$ $x = \frac{2}{3}$ TP $(\frac{2}{3}\ ; 18)$ **OR** $p(x) = -2(3x)^2 + 8(3x) + 10$ $= -18x^2 + 24x + 10$ $= -18\left(x - \frac{2}{3}\right)^2 + 18$ TP $(\frac{2}{3}\ ; 18)$	✓ $0 = -36x + 24$ ✓ $x = \frac{2}{3}$ ✓ $y = 18$ (3) ✓ $p(x) = -18\left(x - \frac{2}{3}\right)^2 + 18$ ✓ $x = \frac{2}{3}$ ✓ $y = 18$ (3) **[15]**

QUESTION 6

6.1	$f(x) = 3^x$ $f^{-1}(x) = \log_3 x$	✓ answer (1)
6.2		$f^{-1}(x) = \log_3 x$ (Log Graph) ✓shape ✓x-intercept $f(x) = 3^x$ (Exponential Graph) ✓shape ✓y-intercept (4)
6.3	$x > 0$ **OR** $x \in (0 ; \infty)$	✓✓ answer (2)
6.4	$0 < x \leq 1$	✓ critical values ✓ notation (2)
6.5	$y > -4$ **OR** $y \in (-4 ; \infty)$	✓✓ answer (2)
6.6	$g(x) = -3^{x-2}$ **OR** $g(x) = -f(x-2)$ **OR** $g(x) = -\frac{1}{9}\left(3^x\right)$ **OR** $g(x) = -\frac{1}{9}f(x)$	✓ – (sign) ✓ $x - 2$ (2) ✓ – (sign) ✓ $\frac{1}{9}$ (2) **[13]**

QUESTION 5

5.1.1

$y = f(0)$

$= \frac{-6}{0-3} - 1$

$= 1$

$(0\ ;\ 1)$ **OR** $x = 0$ and $y = 1$

Note:
Mark 5.1.1 and 5.1.2 as a single question.
If the intercepts are interchanged:
max 3/5 marks

✓ $y = 1$
✓ $x = 0$
(2)

5.1.2

$0 = \frac{-6}{x-3} - 1$

$1 = \frac{-6}{x-3}$

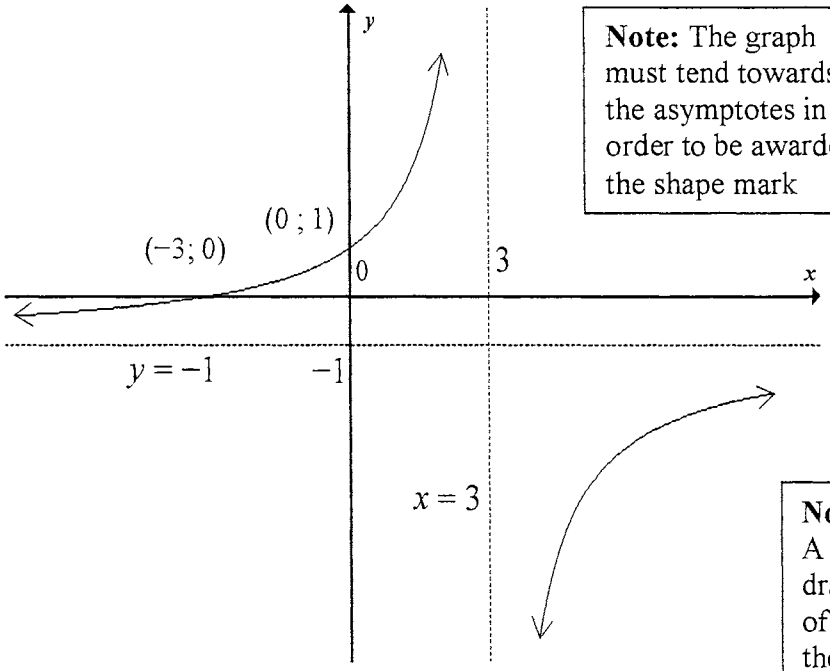
$x - 3 = -6$

$x = -3$

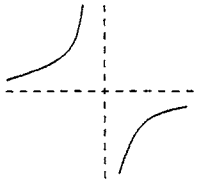
$(-3\ ;\ 0)$

✓ $y = 0$
✓ $x - 3 = -6$
✓ answer
(3)

5.1.3



Note: The graph must tend towards the asymptotes in order to be awarded the shape mark



✓ shape
✓ both intercepts correct
✓ horizontal asymptote
✓ vertical asymptote
(4)

Note:
A candidate who draws only one 'arm' of the hyperbola loses the 'shape' mark i.e. max 3/4 marks

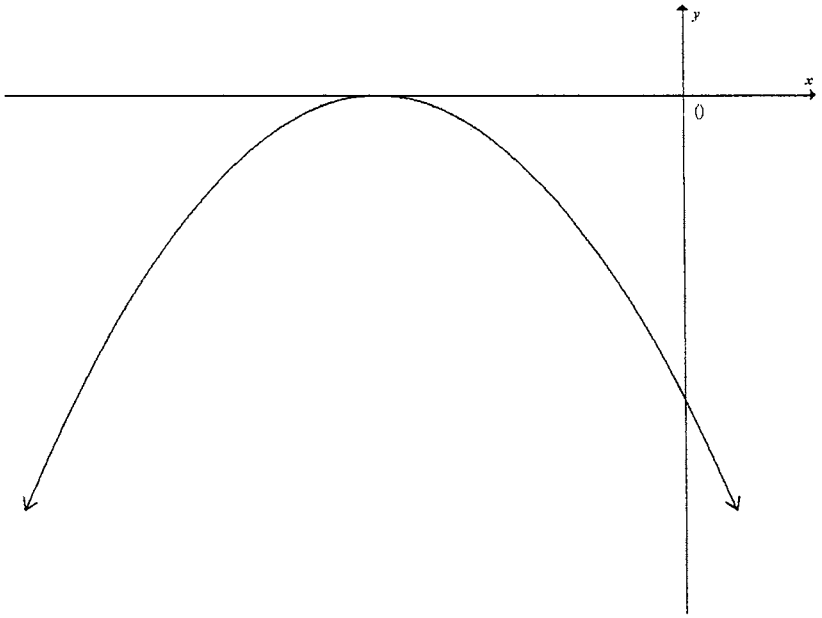
5.1.4

$-3 < x < 3$ **OR** $(-3; 3)$ **OR** $-3 < x$ and $x < 3$

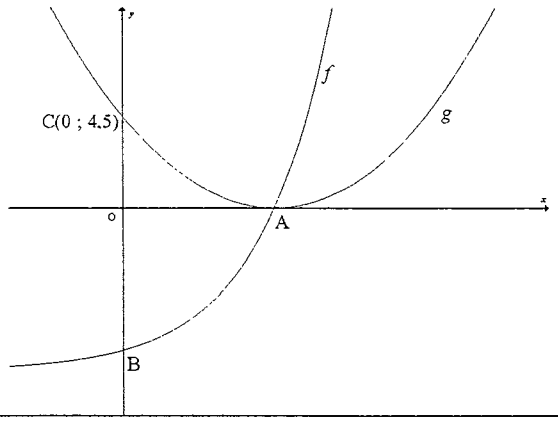
Note: if candidate writes $-3 < x$ only: 1/2 marks

Note: if candidate writes $x < 3$ only: 1/2 marks

✓ −3 and 3
✓ inequality OR interval notation
(2)

5.1.5	$y = \frac{-6}{-2-3} - 1$ $= \frac{1}{5}$ $m = \frac{1-\frac{1}{5}}{0-(-2)}$ $= \frac{2}{5}$ **OR** $m = \frac{f(0)-f(-2)}{0-(-2)}$ $= \frac{1-\frac{1}{5}}{0+2}$ $= \frac{2}{5}$	✓ $\frac{1}{5}$ ✓ formula ✓ substitution ✓ answer (4) ✓ formula ✓ $f(-2) = \frac{1}{5}$ ✓ substitution ✓ answer (4)
5.2	$x = -\frac{b}{2a} < 0$ since $b < 0$ and $a < 0$  	✓y-intercept negative ✓ turning point on the x axis ✓ turning point on the left of the y axis ✓ **maximum** TP and quadratic shape (4) **[19]**

QUESTION 6



6.1	$0 = 2^x - 8$ $8 = 2^x$ $2^3 = 2^x$ $x = 3$ A(3 ; 0)	$f(0) = 2^0 - 8$ $= 1 - 8$ $= -7$ B(0 ; –7)	✓ $y = 0$ ✓ answer for A ✓ $x = 0$ ✓ answer for B (4)
6.2	$y = -8$ **OR** $y + 8 = 0$	**Note**: no CA marks	✓ answer (1)
6.3	$h(x) = f(2x) + 8$ $= \left(2^{2x} - 8\right) + 8$ $= 4^x$ or 2^{2x}	**Note**: answer only: award 2/2 marks	✓ $\left(2^{2x} - 8\right)$ ✓ answer of $h(x) = 4^x$ or 2^{2x} (2)
6.4	$x = 4^y$ **OR** $y = \log_4 x$ **OR** $y = \dfrac{\log x}{\log 4}$	$x = 2^{2y}$ $2y = \log_2 x$ $y = \frac{1}{2}\log_2 x$ **OR** $y = \log_2 \sqrt{x}$	**Note**: answer only award 2/2 marks **Note**: candidate works out f^{-1} and gets $y = \log_2(x + 8)$ award 1/2 marks ✓ switch x and y ✓ answer in the form $y = ...$ (2)
6.5	$p(x) = -\log_4 x$ **OR** $p(x) = \log_{\frac{1}{4}} x$ **OR** $p(x) = \log_4 \frac{1}{x}$ **OR** $p(x) = -\frac{1}{2}\log_2 x$ **OR** $y = -\log_2 \sqrt{x}$		✓answer (1)

6.6

$\sum_{k=0}^{3} g(k) - \sum_{k=4}^{5} g(k)$

$= g(0) + g(1) + g(2) + g(3) - g(4) - g(5)$ ✓ $= g(0) + g(1) + g(2) + g(3) - g(4) - g(5)$

$x = 3$ is the axis of symmetry of g

$\therefore$ by symmetry

$g(2) = g(4)$ and $g(1) = g(5)$ ✓ $g(2) = g(4)$ and $g(1) = g(5)$

Answer = $g(0) + g(3)$ ✓ $g(0) + g(3)$

$= 4,5 + 0$

$= 4,5$ ✓ answer (4)

OR

$\sum_{k=0}^{3} g(k) - \sum_{k=4}^{5} g(k)$ ✓ expansion

$\sum_{k=0}^{3} g(k) = g(0) + g(1) + g(2) + g(3)$

$\sum_{k=4}^{5} g(k) = g(4) + g(5)$

$x = 3$ is the axis of symmetry of g

$\therefore$ by symmetry

$g(4) = g(2)$ ✓ $g(2) = g(4)$ and $g(1) = g(5)$

$g(5) = g(1)$

$\sum_{k=0}^{3} g(k) - \sum_{k=4}^{5} g(k)$ ✓ $g(0) + g(3)$

$= g(0) + g(3)$

$= 4,5 + 0$ ✓ answer

$= 4,5$ (4)

OR

$g(x) = a(x-3)^2 + 0$

$4,5 = a(0-3)^2 + 0$

$4,5 = 9a$

$a = \frac{1}{2}$

$g(x) = \frac{1}{2}(x-3)^2$ ✓ $g(x) = \frac{1}{2}(x-3)^2$

$\sum_{k=0}^{3} g(k) - \sum_{k=4}^{5} g(k)$

$\sum_{k=0}^{3} g(k) = g(0) + g(1) + g(2) + g(3)$

$= 4,5 + 2 + 0,5 + 0$ ✓ expansion

$= 7$

$\sum_{k=4}^{5} g(k) = g(4) + g(5)$

$= 0,5 + 2$

$= 2,5$

$\sum_{k=0}^{3} g(k) - \sum_{k=4}^{5} g(k)$

$= 7 - 2,5$

$= 4,5$

✓ $7 - 2,5$
✓ answer

(4)

OR

$g(x) = ax^2 + bx + c$

$g(k) = ak^2 + bk + c$

$g(0) = c$

$g(1) = a + b + c$

$g(2) = 4a + 2b + c$

$g(3) = 9a + 3b + c$

$\sum_{k=0}^{3} g(k) = 14a + 6b + 4c$

$g(4) = 16a + 4b + c$

$g(5) = 25a + 9b + c$

$\sum_{k=4}^{5} g(k) = 41a + 9b + 2c$

$\sum_{k=0}^{3} g(k) - \sum_{k=4}^{5} g(k) = -27a - 3b + 2c$

✓✓ $-27a - 3b + 2c$

$g(x) = a(x-3)^2 + 0$

$4,5 = a(0-3)^2 + 0$

$4,5 = 9a$

$a = \frac{1}{2}$

$g(x) = \frac{1}{2}(x-3)^2$

$= \frac{1}{2}x^2 - 3x + \frac{9}{2}$

✓ $g(x) = \frac{1}{2}(x-3)^2$

$\sum_{k=0}^{3} g(k) - \sum_{k=4}^{5} g(k) = -27a - 3b + 2c$

$= -27\left(\frac{1}{2}\right) - 3(-3) + 2\left(\frac{9}{2}\right)$

$= 4,5$

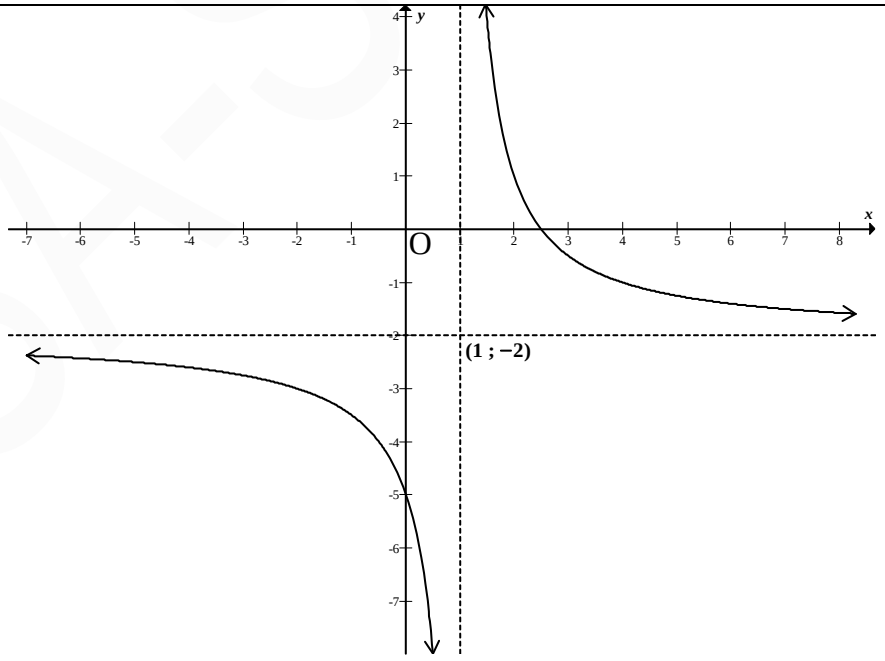
✓ answer

(4)

[14]

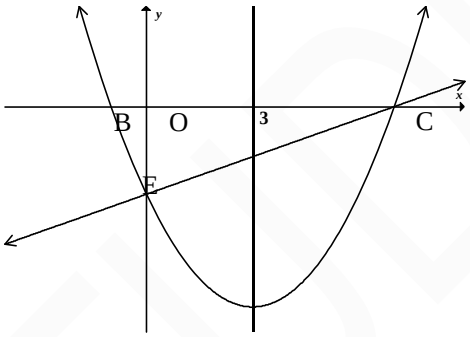
	OR The 3^{rd} term of GP = 3 + 3^{rd} term of AP $12r^2 = 3 + 12 + 2d$ $12r^2 = 15 + 24r - 24$ $12r^2 - 24r + 9 = 0$ $4r^2 - 8r + 3 = 0$ $(2r - 3)(2r - 1) = 0$ $r = \frac{3}{2}$ *or* $r = \frac{1}{2}$	✓ equation ✓ equation ✓ standard form ✓ factors ✓ answers **[11]**

QUESTION 5

5.1	$x = 1$ $y = -2$	✓✓ answers (2)
5.2	y-intercept: $y = \frac{3}{0-1} - 2 = -5$ x-intercept: $\left(\frac{5}{2}; 0\right)$ $0 = \frac{3}{x-1} - 2$ $2 = \frac{3}{x-1}$ $2x - 2 = 3$ $2x = 5$ $x = \frac{5}{2}$	✓ y = -5 ✓ substitute $y = 0$ ✓ answer (3)
5.3		✓ asymptotes ✓ y–intercept ✓ shape (3)

5.4	$-f(x)=\frac{-3}{x-1}+2$ $y \in R-\{2\}$ OR $y \in (-\infty\,;2)\cup(2\,;\infty)$ OR $y \in R; y \neq 2$	✓ answer (1)
5.5	$g(x)=\frac{-3}{x+1}-2$ $=\frac{3}{-x-1}-2$ Reflection of f about the y-axis. OR (i) horizontal shift 2 units to the left followed by (ii) reflection in x-axis, followed by (iii) vertical downward shift of 4 units	✓ manipulation ✓ answer (2) **[11]**

QUESTION 6



6.1	$\frac{x}{2}-\frac{7}{2}=0$ $x=7$ C(7 ; 0) OR $y=\frac{7}{2}-\frac{7}{2}$ $y=0$ C(7 ; 0)	$\frac{x}{2}-\frac{7}{2}=0$ (1) ✓ substitution ✓ answer (2)
6.2	x- coordinate of B is $3-4=-1$	✓ answer (1)

- Consistent Accuracy will apply as a general rule.
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- If a candidate does a question, crosses it out and does not re-do it, mark the deleted attempt.

QUESTION 6

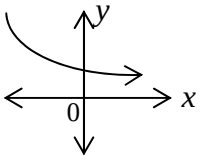
6.1	$\frac{1}{2}x^2 = -\frac{1}{x+1}+1$ $x^2(x+1) = -2+2(x+1)$ $x^3+x^2 = -2+2x+2$ $x^3+x^2-2x = 0$ $x(x^2+x-2) = 0$ $x(x+2)(x-1) = 0$ $x = 0 \quad or \quad x = -2 \quad or \quad x = 1$ $y = 0$ or $y = \frac{1}{2}(-2)^2$ or $y = \frac{1}{2}(1)^2$ $y = 2$ or $y = \frac{1}{2}$ P(– 2 ; 2) $Q\left(1;\frac{1}{2}\right)$ **OR** $\frac{1}{2}(-2)^2 = 2$ ∴ (– 2 ; 2) lies on $f(x) = \frac{1}{2}x^2$ $-\frac{1}{(-2)+1}+1 = 2$ ∴ (– 2 ; 2) lies on $g(x) = -\frac{1}{x+1}+1$ ∴ (– 2 ; 2) is one of the points P, O or Q. From the graph it is P $\frac{1}{2}(1)^2 = \frac{1}{2}$ ∴ (– 2 ; 2) lies on $f(x) = \frac{1}{2}x^2$ ∴ $\left(1;\frac{1}{2}\right)$ is one of the points P, O or Q. From the graph it is Q $-\frac{1}{(1)+1}+1 = \frac{1}{2}$ ∴ Q lies on $g(x) = -\frac{1}{x+1}+1$ ∴ $\left(1;\frac{1}{2}\right)$ is one of the points P, O or Q. From the graph it is Q	✓ equating ✓ multiplication by LCD ✓ standard form ✓ common factor ✓ factorisation of quadratic ✓ *y*-answer answer P(– 2 ; 2) answer $Q\left(1;\frac{1}{2}\right)$ (6) ✓ substitution ✓ substitution ✓ P lies on *f* and *g* ✓ substitution ✓ substitution ✓ Q lies on *f* and *g* (6)
6.2	For $m > 0$, $m = 1$ the equation of the axis of symmetry is $y = x + c$. $1 = (-1) + c$ $c = 2$ Therefore the equation is $y = h(x) = x + 2$.	✓ gradient $m = 1$ ✓ $c = 2$ (2)

6.3	OPTION 1 $f(x) = a(x-3)^2 + q$ At B and C: $0 = 16a + q$ At E: $-\frac{7}{2} = 9a + q$ Solving simultaneously gives $a = \frac{1}{2}$ and $q = -8$	✓ substitution ✓ substitution ✓ substitution ✓✓ $a = \frac{1}{2}$ ✓ $q = -8$ (6)
	OPTION 2 $f(x) = a(x+1)(x-7)$ $y = a(x+1)(x-7)$ $-3{,}5 = a(0+1)(0-7)$ $-3{,}5 = -7a$ $a = \frac{1}{2}$ $f(x) = \frac{1}{2}(x+1)(x-7)$ $= \frac{1}{2}(x^2 - 6x - 7)$ $= \frac{1}{2}\left[(x-3)^2 - 16\right]$ $= \frac{1}{2}(x-3)^2 - 8$	✓ substitution ✓ substitution ✓ $a = \frac{1}{2}$ ✓ substitution ✓ simplification ✓ answer (6)
	OPTION 3 $a = \frac{1}{2}$ Axis of symmetry: $x = 3$ or $x = \frac{-1+7}{2} = 3$ $f(x) = \frac{1}{2}(x-3)^2 + q$ $0 = \frac{1}{2}(7-3)^2 + q$ $q = -8$ $y = \frac{1}{2}(x-3)^2 - 8$	✓✓✓ $a = \frac{1}{2}$ ✓ substitution ✓ substitution ✓ answer (6)

	OPTION 4 $a = \frac{1}{2}$ Axis of symmetry: $x = 3$ $f(x) = \frac{1}{2}(x-3)^2 + q$ $q = f(3)$ $q = \frac{1}{2}(3+1)(3-7)$ $q = -8$ $y = \frac{1}{2}(x-3)^2 - 8$	✓✓✓ $a = \frac{1}{2}$ ✓ substitution ✓ substitution ✓ answer (6)
6.4	$h(x) = -f(x) = \frac{-1}{2}(x-3)^2 + 8$	✓ answer (1)
6.5	$1 - f(x) = -\frac{1}{2}(x-3)^2 + 9$ $\therefore$ Maximum value is 9. **OR** Maximum value = 1 – (– 8) = 9 OR $t(x) = -\frac{1}{2}x^2 + 3x + \frac{9}{2}$ $t'(x) = -x + 3 = 0$ Max V $_{at\ x=3}$ = $-\frac{1}{2}(3)^2 + 3(3) + \frac{9}{2} = 9$	✓ method ✓ answer (2)
6.6	$f(x^2 - 2) = 0$ $f(x) = 0$ *if* $x = -1$ or $x = 7$ $\therefore f(x^2 - 2) = 0$ if $x^2 - 2 = -1$ or $x^2 - 2 = 7$ $\therefore x^2 = 1$ or $x^2 = 9$ $\therefore x = 1$ or $x = -1$ or $x = 3$ or $x = -3$	✓ substitution ✓ simplification ✓ answer ✓ answer (4)

	$\frac{1}{2}\left(x^2-2-3\right)^2-8=0$ $\frac{1}{2}\left(x^2-5\right)^2=8$ $\left(x^2-5\right)^2=16$ $x^2-5=4$ or $x^2-5=-4$ $x^2=9$ or $x^2=1$ $x=3$ or $x=-3$ or $x=1$ or $x=-1$ **OR** $f(x^2-2)=0$ $\frac{1}{2}\left(x^2-2-3\right)^2-8=0$ $\frac{1}{2}\left(x^2-5\right)^2=8$ $\left(x^2-5\right)^2-16=0$ $\left(x^2-5-4\right)\left(x^2-5+4\right)=0$ $\left(x^2-9\right)\left(x^2-1\right)=0$ $(x-3)(x+3)(x-1)(x+1)=0$ $x=3$ or $x=-3$ or $x=1$ or $x=-1$	✓ substitution ✓ simplification ✓ factors ✓ answer (4) ✓ substitution ✓ simplification ✓ factors ✓ answer (4) **[15]**

QUESTION 7

7.1	Decreasing function Since $0 < a < 1$ OR As x increases, $f(x)$ decreases	✓ decreasing ✓ $a < 1$ (2)
7.2	$f^{-1}: \quad x=\left(\frac{1}{3}\right)^y$ OR  $y=\log_{\frac{1}{3}} x$ OR $f^{-1}: \quad x=\left(\frac{1}{3}\right)^y$ $y=-\log_3 x$	✓ $x=\left(\frac{1}{3}\right)^y$ ✓ $y=\log_{\frac{1}{3}} x$ or $y=-\log_3 x$ (2)
7.3	$y=-5$	✓ answer (1)

7.4	Reflection about $y = x$. Reflection about the x-axis. **OR** Reflection about the y-axis. Then reflection about the line $y = x$. **OR** Reflection about the line $y = -x$ followed by reflection about the y-axis. **OR** Rotation through $90°$ in a clockwise direction. **OR** Rotation through $90°$ in an anti-clockwise direction. Reflection through the origin.	✓ reflection about $y = x$ ✓ reflection about y-axis (2) ✓ reflection about y-axis ✓ reflection about $y = x$ (2) ✓ rotation through $90°$ ✓ clockwise direction (2) ✓ answer ✓ answer (2) **[7]**

QUESTION 8

8.1	$A = P(1+i)^n$ $1711{,}41 = 1430{,}77\left(1+\frac{i}{12}\right)^{18}$ $\left(1+\frac{i}{12}\right)^{18} = 1{,}196146131...$ **OR** $\left[\frac{1711{,}41}{1430{,}77}\right]^{\frac{1}{18}} = 1{,}00999...$ $1+\frac{i}{12} = 1{,}009999937...$ $\therefore i = 12(1{,}01-1)$ $i = 0{,}1199992431...$ $= 0{,}12$ $= 12\%$ Rate = 12, 00% p.a. compounded monthly.	✓ substitution ✓ $\left(1+\frac{i}{12}\right)^{18} = 1{,}196146131...$ ✓ $1+\frac{i}{12} = 1{,}009999937...$ ✓ answer (4)

- Consistent Accuracy will apply as a general rule.
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- If a candidate does a question, crosses it out and does not re-do it, mark the deleted attempt.

8.4.2 contd	**OR** Sketch the graph of the inverse of *f*. Shift the graph of the inverse of *f* down by 5 units. **OR** Shift the graph 5 units LEFT. Reflect the graph over the line $y = x$.	
8.5	$\log_2 x < 3$ $-\log_2 x > -3$ For $-\log_2 x = -3$ $2^3 = x$ $x = 8$ $f(x) > -3$ $0 < x < 8$ or $x \in (0\,;8)$ **NOTE:** Notation incorrect: Answer $x < 8$: 2 / 3 Answer only correct: 3 / 3	✓ multiplication by – 1 ✓ Notation ✓ critical values (3) **[10]**

QUESTION 9

Penalise ONCE in question 9 for early rounding off.

9.1	$A = P(1-i)^n$ $15000 = 24000(1-0{,}18)^n$ $0{,}625 = (0{,}82)^n$ $n = \dfrac{\log 0{,}625}{\log 0{,}82}$ $= 2{,}37$ years **NOTE:** If subs A and P incorrectly: Answer would be $n = -2{,}37$ years $\therefore n = 2{,}37$ years: 2 / 4 If subs A and P incorrectly: Answer would be $n = -2{,}37$ years : 1 / 4 Answer $n = 2{,}4$ years 4 / 4 Answer rounded to 3 years and all calculations shown and $n = 2{,}37$ shown: 4/4 Answer rounded to 3 years and $n = 2{,}37$ not shown: 3 / 4	✓ substitution ✓ simplification ✓application of logs ✓ answer (4) Incorrect formula: 0/4
9.2.1	$130\,000\left(1+\dfrac{0{,}18}{12}\right)^2$ $= 130000\,(1{,}015)^2$ = R 133 929,25 **NOTE:** – 1 per error for incorrect substitution to a max of 2 marks	✓✓ substitution ✓ answer (3) Incorrect formula: 0/3

- Consistent Accuracy will apply as a general rule.
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- If a candidate does a question, crosses it out and does not re-do it, mark the deleted attempt.

6.3	The equation of the inverse of h is $x = y + 2$ $\therefore y = x - 2$ Answer only: Full marks	✓interchange x and y ✓ answer (2)
6.4	$g(x) = -\frac{1}{x+1} + 1 = \frac{-1+x+1}{x+1} = \frac{x}{x+1}$ $LHS = \frac{x}{x+1} + \frac{\frac{1}{x}}{\frac{1}{x}+1}$ $= \frac{x}{x+1} + \frac{1}{x+1}$ $= \frac{x+1}{x+1}$ $= 1$ LHS = RHS $RHS = \left(\frac{-x}{1-x}\right)\left(\frac{x-1}{(x-1)+1}\right)$ $= \frac{(1-x)x}{(1-x)x}$ $= 1$ **NOTE**: If substitute a value of x and prove it, then 0 / 3 **OR** $\text{LHS} = g(x) + g\left(\frac{1}{x}\right)$ $= -\frac{1}{x+1} + 1 - \frac{1}{\frac{1}{x}+1} + 1$ $= -\frac{1}{x+1} + 2 - \frac{x}{1+x}$ $= -\frac{1+x}{1+x} + 2$ $= -1 + 2$ $= 1$ LHS = RHS $\text{RHS} = g(-x).g(x-1)$ $= \left(-\frac{1}{-x+1} + 1\right)\left(-\frac{1}{x-1+1} + 1\right)$ $= \left(\frac{-1+1-x}{1-x}\right)\left(\frac{-1+x}{x}\right)$ $= \left(\frac{-x}{1-x}\right)\left(\frac{x-1}{x}\right)$ $= \left(\frac{x}{x-1}\right)\left(\frac{x-1}{x}\right)$ $= 1$	✓ simplification of $g(x)$ ✓simplification of LHS ✓simplification of RHS (3) ✓ 2 substitutions correct. **NOTE**: not just rewriting $g(x)$ again ✓ simplification of LHS ✓simplification of RHS (3) **[13]**

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QUESTION 5

5.1

First year: 150

Second year: 150 + 18 = 168

Third year: $168 + \frac{8}{9}(18) = 184$

Growth = $18\left(\frac{8}{9}\right)^{n-2}$ after *n* years

17^{th} year growth is $18\left(\frac{8}{9}\right)^{17-2}$ = 3,08 cm

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9
Ht	150	168	184	198,2	210,84	222,07	232,06	240,94	248,83
Inc		18	16	14,2	12,64	11,23	9,99	8,88	7,89
	Yr 10	**Yr 11**	**Yr 12**	**Yr 13**	**Yr 14**	**Yr 15**	**Yr 16**	**Yr 17**	
Ht	255,84	262,08	267,62	272,55	276,93	280,82	284,28	287,36	
Inc	7,01	6,24	5,54	4,93	4,38	3,89	3,46	3,08	

✓ general terms

✓ answer (2)

5.2

Height after 10 years

$$= 150 + \frac{18\left(1-\left(\frac{8}{9}\right)^{9}\right)}{1-\frac{8}{9}}$$

= 150 + 105,8768146 …

= 255,88 cm

OR

$$= 150 + \frac{18\left(\left(\frac{8}{9}\right)^{9}-1\right)}{\frac{8}{9}-1}$$

= 150 + 105,8768146 ...

= 255,88 cm

NOTE:
By writing out 9 terms and adding to 150 and answer correct, full marks

Answer only: 2 / 3

✓ $n = 9$
✓ substitution into sum formula
✓ answer (3)

5.3

Max height = 150 + sum to infinity

$$= 150 + \frac{18}{1-\frac{8}{9}}$$

= 150 cm + 162 cm

= 312 cm

The tree will never reach a height of more than 312 cm.

✓ statement
✓ substitution into the sum to infinity formula
✓ max height (3) **[8]**

NOTE:

If a candidate answers in 5.1 that the growth is $18\left(\frac{8}{9}\right)^{n-1} = 18\left(\frac{8}{9}\right)^{16}$ = 2,73 cm then 1 / 2

The answer for 5.2 as continued accuracy uses *n* = 10,

Height after 10 years

$$= 150 + \frac{18\left(1-\left(\frac{8}{9}\right)^{10}\right)}{1-\frac{8}{9}}$$ = 150 + 112,11 … = 262,11 cm

This is awarded 3/3 as consistent accuracy

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QUESTION 7

7.1	$y \in [-3\,;3]$ **OR** $-3 \le y \le 3$ **OR** y can be any value from – 3 to 3 **NOTE**: Notation incorrect : 0 / 1	✓ answer (1)
7.2	x–value is 7,37° to the left of 90° B(82,63° ; 0,38) **NOTE**: Answer only : 3 / 3 x-value correct and y-value incorrect : 2 / 3 x-value incorrect and y-value correct : 1 / 3 If decimal part incorrect of x and y-value correct: 2 / 3	✓ method ✓ x-value ✓ y-value (3)
7.3	Period $= \frac{360°}{3}$ $= 120°$ **NOTE**: Answer only : 2 / 2	✓ $\frac{360°}{3}$ ✓ answer (2)
7.4	$x = -180°$	✓ ✓answer (2) **[8]**

QUESTION 8

8.1	$x > 0$ **OR** $x \in (0;\infty)$	✓ answer (1)
8.2	$y = 2^{-x}$ **OR** $y = \left(\frac{1}{2}\right)^x$	✓ answer (1)
8.3	$y = 0$	✓ answer (1)
8.4.1	Reflect the graph of f over the x-axis OR For each point the y-coordinate changes sign. **NOTE**: Reflect only : 0 / 1	✓ answer (1)
8.4.2	Reflect the graph of f over the line $y = x$. Then shift the graph down 5 units	✓✓ answer ✓ answer (3)

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8.4.2 contd	**OR** Sketch the graph of the inverse of *f*. Shift the graph of the inverse of *f* down by 5 units. **OR** Shift the graph 5 units LEFT. Reflect the graph over the line $y = x$.	
8.5	$\log_2 x < 3$ $-\log_2 x > -3$ For $-\log_2 x = -3$ $2^3 = x$ $x = 8$ $f(x) > -3$ $0 < x < 8$ or $x \in (0\,;8)$ **NOTE:** Notation incorrect: Answer $x < 8$: 2 / 3 Answer only correct: 3 / 3	✓ multiplication by – 1 ✓ Notation ✓ critical values (3) **[10]**

QUESTION 9

Penalise ONCE in question 9 for early rounding off.

9.1	$A = P(1-i)^n$ $15000 = 24000(1-0{,}18)^n$ $0{,}625 = (0{,}82)^n$ $n = \dfrac{\log 0{,}625}{\log 0{,}82}$ $= 2{,}37$ years **NOTE:** If subs A and P incorrectly: Answer would be $n = -2{,}37$ years $\therefore n = 2{,}37$ years: 2 / 4 If subs A and P incorrectly: Answer would be $n = -2{,}37$ years : 1 / 4 Answer $n = 2{,}4$ years 4 / 4 Answer rounded to 3 years and all calculations shown and $n = 2{,}37$ shown: 4/4 Answer rounded to 3 years and $n = 2{,}37$ not shown: 3 / 4	✓ substitution ✓ simplification ✓application of logs ✓ answer (4) Incorrect formula: 0/4
9.2.1	$130\,000\left(1+\dfrac{0{,}18}{12}\right)^2$ $= 130000\,(1{,}015)^2$ = R 133 929,25 **NOTE:** – 1 per error for incorrect substitution to a max of 2 marks	✓✓ substitution ✓ answer (3) Incorrect formula: 0/3