MATHEMATICS

MATERIAL FOR GRADE 12

ALGEBRA

M E M O R A N D A

QUESTION 1

1.1.1	$x^2 = 4 \quad x = 2$✓ $x = \pm\sqrt{4}$✓ $= \pm 2$✓	✓Equating to 0 ✓ $x = 2$ ✓$= \pm 2$✓ (3)
1.1.2	$x = \frac{-(-1)\pm\sqrt{(-1)^2-4(-1)(1)}}{2(-1)}$ ✓ $= \frac{1 \pm \sqrt{5}}{-2}$ $= -1{,}62$✓ or $0{,}62$✓	✓Substitution into correct formula ✓✓Answers (3)
1.1.3	$2^{x+2} + 2^{x-2} + 2^x = 42$ $2^2 2^x + \frac{2^x}{2^2} + 2^x = 42$ $2^x\left(2^2 + \frac{1}{2^2} + 1\right) = 42$ $2^x = \frac{42.4}{21}$ $2^x = 2^3$ $x = 3$	✓Common factor ✓Simplification ✓same base ✓Answers (4)
1.2.1	No Solution ✓**(**Square root non-negative)	✓Answer (1)
1.2.2	$\sqrt{4x-11} = 2 - x$ $4x - 11 = 4 - 4x + x^2$✓ $x^2 - 8x + 15 = 0$ $(x-5)(x-3) =$✓ $x = 5$ or $x = 3$✓ Checking shows No Solution✓	✓Squaring ✓Standard form ✓factors ✓No solution (4)
1.3	$-x^2 + 5x \leq 4$ $x^2 - 5x + 4 \geq 0$✓ $0 \leq (x-4)(x-1)$✓ $cv: 1\ ;\ 4$ $x \leq 1$✓or✓ $x \geq 4$✓	✓Standard form ✓factors ✓or ✓✓Answers (5)

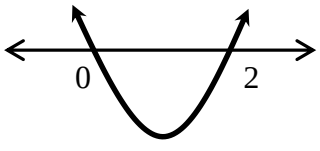
1.4	$(2q+x)^2 = 4q^2 + 12q + y$ $4q^2 + 4qx + x^2$✓ $= 4q^2 + 12q + y$ $4qx + x^2 = 12q + y$✓ $4qx + x^2 = 3.4q + y$✓ For these sides to be equal, we must have $4qx = 12q$ and $y = x^2$ $x = 3$ ✓; $y = x^2 = 9$✓ $(3; 9)$	✓Expansion ✓Simplification. ✓$4qx = 3.4q$ ✓$x = 3,\ y = x^2$ ✓$(3; 9)$ (5)
		[25]

QUESTION 2

2.1	2.1.1	$4x^2 = 25$ $x^2 = \frac{25}{4}$ $x = \pm\sqrt{\frac{25}{4}}$ $= = \pm\ \frac{5}{2}$ OR $4x^2 - 25 = 0$ $(2x-5)(2x+5) = 0$ $x = \frac{5}{2}\ or\ x = -\frac{5}{2}$	✓ ✓	square root both sides answer OR/OF factors both answer	(2)
	2.1.2	$x^2 - 5x = 2$ $x^2 - 5x - 2 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \frac{-(-5)\pm\sqrt{(-5)^2-4(1)(-2)}}{2(1)}$ $= \frac{5 \pm \sqrt{33}}{2}$ $= 5{,}37$ or $-0{,}37$	✓ ✓ ✓✓	standard form substitution answer NB: penalise one mark for wrong rounding	(4)
	2.1.2 (b)	$(x-2)^2 - 5(x-2) - 2 = 0$ $(x-2)^2 - 5(x-2) - 2 = 0$ $x - 2 = 5{,}37\ or\ x - 2 = -0{,}37$ $x = 7{,}37\ or\ 1{,}63$	✓ ✓ ✓	standard form $x - 2 = 5{,}37\ or\ x - 2 = -0{,}37$	(3)

				$x = 7{,}37$ or $x = 1{,}63$	
	2.1.3	$(2-x)(x+4) \geq 0$ critical values are at $x = 2\ or\ x = -4$ solution $-4 \leq x \leq 2$ or $x \in [-4;2]$	 ✓ ✓✓	 critical values correct solution.	 (3)
	2.1.4	$3^{x+1} - 4 + \frac{1}{3^x} = 0$ $3.3^x - 4 + \frac{1}{3^x} = 0$ $3.3^{2x} - 4.3^x + 1 = 0$ $(3.3^x - 1)(3^x - 1) = 0$ $3^x = \frac{1}{3} = 3^{-1}$ or $3^x = 1 = 3^0$ $x = -1$ or $x = 0$	✓ ✓ ✓ ✓ ✓	multiplying by 3^x throughout $3^{x+1} = 3.3^x$ or $3^{2x+1} = 3.3^{2x}$ factorization $3^x = \frac{1}{3} = 3^{-1}$ or $3^x = 1 = 3^0$ $x = -1$ or $x = 0$	 (5)
2.2		$y = 2x + 1$ ……(1) $x^2 - 3x - 4 - y = y^2$…….(2) subst. $x^2 - 3x - 4 - (2x+1) = (2x+1)^2$ $x^2 - 3x - 4 - 2x - 1 = 4x^2 + 4x + 1$ $3x^2 + 9x + 6 = 0$ OR $x^2 + 3x + 2 = 0$ $(x+2)(x+1) = 0$ $x = -2\ or\ x = -1$ $y = 2(-2) + 1\ or\ 2(-1) + 1$ $y = -3$ or -1	✓ ✓ ✓ ✓ ✓ ✓	y subject of formula substitution standard form factors values of x values of y	 (6)
	2.3	$x = \frac{\pm\sqrt{b^2-9}}{-2}$ $b^2 - 9 \geq 0$ $(b-3)(b+3) \geq 0$ $b \leq -3\ OR\ b \geq 3$	✓ ✓ ✓	$b^2 - 9 \geq 0$ factors $b \leq -3\ or\ b \geq 3$	 (3)
					[26]

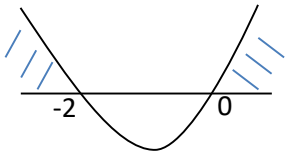
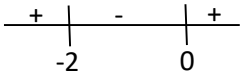
QUESTION 3

$(x-1)(x+8)=10$ $x^2+8x-x-8-10=0$ $x^2+7x-18=0$ $(x+9)(x-2)=0$ $x+9=0$ or $x-2=0$ $x=-9 \qquad x=2$	✓ simplification ✓ standard form ✓ factors ✓ both answers (4)
OR $(x-1)(x+8)=10$ $x^2+8x-x-8-10=0$ $x^2+7x-18=0$ $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ $x=\frac{-7\pm\sqrt{7^2-4(1)(-18)}}{2(1)}$ $x=\frac{-7\pm\sqrt{121}}{2}$ $x=-9 \quad$ or $\quad x=2$	✓ simplification ✓ standard form ✓ substitution into the correct formula ✓ both answers (4)
$4x+\frac{4}{x}+11=0$ $4x^2+4+11x=0$ $4x^2+11x+4=0$ $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ $=\frac{-11\pm\sqrt{11^2-4(4)(4)}}{2(4)}$ $=\frac{-11\pm\sqrt{57}}{8}$ $x=-0,43$ or $x=-2,32$	✓ standard form ✓ substitution into the correct formula ✓ $x=-0,43$ ✓ $x=-2,32$ (4)
$6x<3x^2$ $0<3x^2-6x$ $0<x^2-2x$ $0<x(x-2)$ $x<0$ or $x>2; \quad x\in\mathbb{R}$ 	✓ standard form ✓ factors ✓ method ✓ both x-values ✓ notation

	(5)
OR	
$6x < 3x^2$	
$0 < 3x^2 - 6x$	✓ standard form
$0 < x^2 - 2x$	✓ factors
$0 < x(x - 2)$	✓ method
$x \in (-\infty; 0)$ or $x \in (2; \infty)$	✓ both x-values ✓ notation
	(5)
OR	
$6x < 3x^2$	
$0 < 3x^2 - 6x$	✓ standard form
$0 < x^2 - 2x$	✓ factors
$0 < x(x - 2)$	✓ method
$x \in (-\infty; 0) \cup (2; \infty)$	✓ both x-values ✓ notation
	(5)
$3 + x = 2y$ and $x^2 + 4y^2 = 2xy + 7$	
$x = 2y - 3$	✓ x subject
$(2y - 3)^2 + 4y^2 = 2(2y - 3)y + 7$	✓ substitution
$4y^2 - 12y + 9 + 4y^2 = 4y^2 - 6y + 7$	
$4y^2 - 6y + 2 = 0$	
$2y^2 - 3y + 1 = 0$	✓ standard form
$(2y - 1)(y - 1) = 0$	✓ factors
$2y = 1$ or $y = 1$	
$y = \frac{1}{2}$	✓ y-values
$x = 2\left(\frac{1}{2}\right) - 3$ or $x = 2(1) - 3$	
$= -2$ $\quad\quad$ $= -1$	✓✓ x-values
	(7)
OR	
	✓ y subject
	✓ substitution

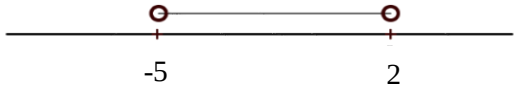
$3 + x = 2y$ and $x^2 + 4y^2 = 2xy + 7$ $y = \frac{3 + x}{2}$ $x^2 + 4\left(\frac{3 + x}{2}\right)^2 = 2x\left(\frac{3 + x}{2}\right) + 7$ $x^2 + 9 + 6x + x^2 = 3x + x^2 + 7$ $x^2 + 3x + 2 = 0$ $(x + 2)(x + 1) = 0$ $x = -2$ or $x = -1$ $y = \frac{3 - 2}{2}$ or $y = \frac{3 - 1}{2}$ $= \frac{1}{2}$ $= 1$	✓ standard form ✓ factors ✓ x-values ✓✓ y-values (7)
$x = -y$ $f(x) = x^m + y^m$ $f(-y) = (-y)^m + y^m = 0$ $\therefore$ only if m is an odd number	✓ substitution ✓ answer (2) **[22]**

QUESTION 4

Q#	SUGGESTED ANSWER(S)	DESCRIPTOR(S)	
4.1.1	$x(x+2)=0$ $x=0$ OR $x=-2$	✓$x=0$ ✓ $x=-2$	(2)
4.1.2	$x^2+2x\geq 0$ $x(x+2)\geq 0$  OR/OF  $\therefore x>0$	✓$x^2+2x\geq 0$ ✓graph critical pts ✓ $x>0$ If $x\geq 0$ only 1 mark	(3)
4.2	$x=\frac{-(-3)\pm\sqrt{(-3)^2-4(2)(-7)}}{2(2)}$ $=\frac{3\pm\sqrt{65}}{4}$ $x=2{,}77 \quad OR/OF \quad x=-1{,}27$ If left in surd form only 2 marks.	✓ substitution into correct formula ✓ simplify ✓2,77 ✓ -1,27	(4)
4.3.1	$k^2+5k-14=0$ $(k-2)(k+7)=0$ $k=2$ or $k=-7$	✓ multiplying ✓ factorising ✓ both solutions	(3)
4.3.2	$\sqrt{x+5}=2$ or $\sqrt{x+5}=-7$ $x+5=4$ or invalid/ no solution $x=-1$	✓ substitution ✓ identifying invalid ✓ value of x	(3)

4.4	$\frac{1}{x}+\frac{1}{y}=3$ …… (1) $x-y=\frac{1}{2}$ …… (2) From (2): $x=y+\frac{1}{2}$ ..…… (3) Substituting (3) in (1) yields: $\frac{1}{y+\frac{1}{2}}+\frac{1}{y}=3$ $y+y+\frac{1}{2}=3y\left(y+\frac{1}{2}\right)$ $4y+1=3y(2y+1)=6y^2+3y$ $6y^2-y-1=0$ $(2y-1)(3y+1)=0$ $y=\frac{1}{2}$ or $y=-\frac{1}{3}$ $x=\frac{1}{2}+\frac{1}{2}$ or $x=-\frac{1}{3}+\frac{1}{2}$ $=1$ or $=\frac{1}{6}$ i.e. $\left(\frac{1}{2};1\right)$ or $\left(-\frac{1}{3};\frac{1}{6}\right)$	✓ equation (3) ✓ substitution ✓ simplification ✓ standard form ✓ factors ✓ both *y* values ✓ both *x*-values	(7)
4.5	For real roots : $4-20k\geq 0$ $\therefore -20k\geq -4$ $\therefore k\leq\frac{1}{5}$	✓ $4-20k\geq 0$ ✓ Answer	(2)
			[24]

QUESTION 5

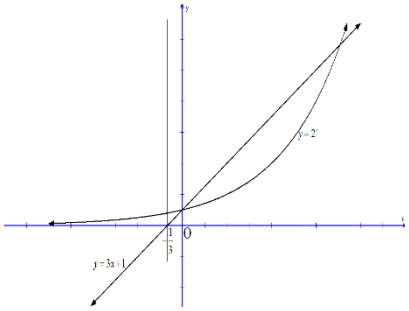
5.1.1	$x^2 + x = 0$ $x(x+1) = 0$ $x = 0$ or $x = -1$	✓ factors ✓ $x = 0$ ✓ $x = -1$ (3)
5.1.2	$\sqrt{x+2} = x$ $x + 2 = x^2$ $x^2 - x - 2 = 0$ $(x-2)(x+1) = 0$ $x = -1$ or $x = 2$ NA	✓ $x + 2 = x^2$ ✓ factors ✓ answers ✓ correct selection of $x = 2$ (4)
5.1.3	$x^2 + 3x - 10 < 0$ $(x-2)(x+5) < 0$ $cv: -5; 2$  $-5 < x < 2$	✓factors ✓critical values in context of inequality ✓notation (3)
5.1.4	$x^{-1} - x^{-\frac{1}{2}} - 20 = 0$ Let $x^{-\frac{1}{2}} = k$ $k^2 - k - 20 = 0$ $(k-5)(k+4) = 0$ $k = 5$ or $k = -4$ $x^{-\frac{1}{2}} = 5$ or $x^{-\frac{1}{2}} = -4$ $x = \frac{1}{25}$ no real solution **OR**	✓standard form ✓factors ✓ $x^{-\frac{1}{2}} = 5$ and $x^{-\frac{1}{2}} = -4$ ✓ $x = \frac{1}{25}$ as only solution (4)

	$x^{-1} - x^{-\frac{1}{2}} - 20 = 0$ $\left(x^{-\frac{1}{2}} - 5\right)\left(x^{-\frac{1}{2}} + 4\right) = 0$ $x^{-\frac{1}{2}} = 5$ or $x^{-\frac{1}{2}} = -4$ $x = \frac{1}{25}$ no real solution	✓standard form ✓factors ✓ $x^{-\frac{1}{2}} = 5$ and $x^{-\frac{1}{2}} = -4$ ✓ $x = \frac{1}{25}$ as only solution (4)
5.2	$y = x + 2$ $x^2 + (x+2)^2 = 20$ $x^2 + x^2 + 4x + 4 = 20$ $2x^2 + 4x - 16 = 0$ $x^2 + 2x - 8 = 0$ $(x-2)(x+4) = 0$ $x = 2$ or $x = -4$ $y = 4$ or $y = -2$	✓substitution of y ✓simplification ✓standard form ✓factors ✓both x-values ✓both y-values (6)
5.2.1	$2x^2 - 7xy + 4y^2 = 0$ $2\frac{x^2}{y^2} - 7\frac{x}{y} + 4 = 0$ $\frac{x}{y} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \frac{7 \pm \sqrt{49 - 4 \times 2 \times 4}}{2 \times 2}$ $= \frac{7 \pm \sqrt{17}}{4}$ $= 0{,}72$ or $2{,}78$ **OR** $2x^2 - 7xy + 4y^2 = 0$ $2\frac{x^2}{y^2} - 7\frac{x}{y} + 4 = 0$ Let $t = \frac{x}{y}$ $\therefore 2t^2 - 7t + 4 = 0$	✓dividing by y^2 ✓ correct subst. into correct formula ✓ 0,72 ✓ 2,78 (4) ✓dividing by y^2

	$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \frac{7 \pm \sqrt{49 - 4 \times 2 \times 4}}{2 \times 2}$ $= \frac{7 \pm \sqrt{17}}{4}$ $= 0{,}72 \text{ or } 2{,}78$	✓ correct subst. into correct formula ✓ 0,72 ✓ 2,78 (4)
		[24]

QUESTION 6

6.1.1	$2x(3x-5)=0$ $x=0 \quad \text{or} \quad x=\frac{5}{3}$	AA✓✓ Answers	(2)
6.1.2	$x^2-3x=7$ $x^2-3x-7=0$ $x=\frac{-(-3)\pm\sqrt{(-3)^2-4(1)(-7)}}{2(1)}$ $x=4{,}54 \quad or \quad x=-1{,}54$	A✓ equation in std. form CA✓ substitution Penalise rounding off CACA✓✓ answers	(4)
6.1.3	$2x-5\sqrt{x}=3$ $2x-3=5\sqrt{x}$ $4x^2-12x+9=25x$ $4x^2-37x+9=0$ $(4x-1)(x-9)=0$ $x=\frac{1}{4} \quad \text{or} \quad x=9$ n/a **OR** $2x-5x^{\frac{1}{2}}-3=0$ $\left(2x^{\frac{1}{2}}+1\right)\left(x^{\frac{1}{2}}-3\right)=0$ $x^{\frac{1}{2}}=\frac{-1}{2} \quad \text{or} \quad x^{\frac{1}{2}}=3$ No solution $\quad x=9$	A✓ isolating $5\sqrt{x}$ M✓ squaring both sides CA✓ standard form CA✓ factors CA✓ both answers CA✓ rejecting	(6)

		A✓ standard form CA✓factors CA✓ $x^{\frac{1}{2}} = \frac{-1}{2}$ CA✓ $x^{\frac{1}{2}} = 3$ CA✓answer CA✓rejecting	(6)
6.1.4	$2^x(3x+1) < 0$ $2^x > 0$ for all $x \in R$ $\therefore 3x+1 < 0$ $x < -\frac{1}{3}$ **OR [Graphically]**  $x < -\frac{1}{3}$	A✓ $2^x > 0$ for all $x \in R$ A✓ $3x+1<0$ A✓ $x < -\frac{1}{3}$ A✓ sketch of $y = 2^x$ A✓ sketch of $y = 3x+1$ A✓ $x < -\frac{1}{3}$	(3) (3)

6.2	$2^{99} \cdot 2^{1} - 2^{99}$ $2^{99}(2-1)$ $= 2^{99}$	M✓ for taking 2^{99} as a common factor A✓ $(2-1)$ A✓ answer	(3)
6.3	$2x - y = 3 \quad \rightarrow (1)$ $x^2 + 5xy + y^2 = 15 \rightarrow (2)$ From (1) : $y = 2x - 3$ Subst. (1) into (2) $x^2 + 5x(2x-3) + (2x-3)^2 = 15$ $x^2 + 10x^2 - 15x + 4x^2 - 12x + 9 - 15 = 0$ $15x^2 - 27x - 6 = 0$ $(5x+1)(3x-6) = 0$ $x = \frac{-1}{5}$ or $x = 2$ $y = \frac{-17}{5}$ or $y = 1$ **OR** $2x - y = 3 \quad \rightarrow (1)$ $x^2 + 5xy + y^2 = 15 \rightarrow (2)$	A✓ y as subject CA✓ substitution $y = 2x - 3$ CA✓ std. form CA✓factors CA✓x values CA✓y values	(6)

	From(1) : $x = \frac{y+3}{2}$ *Subst.* (1) *into(2)* $\left(\frac{y+3}{2}\right)^2 + 5y\left(\frac{y+3}{2}\right) + y^2 = 15$ $\left(\frac{y^2+6y+9}{4}\right) + \frac{5y^2+15y}{2} + y^2 = 15$ $y^2 + 6y + 9 + 10y^2 + 30y + 4y^2 = 60$ $15y^2 + 36y - 51 = 0$ $5y^2 + 12y - 17 = 0$ $(5y+17)(y-1) = 0$ $y = \frac{-17}{5}$ *or* $y = 1$ $x = \frac{-1}{5}$ *or* $x = 2$	A✓ x as subject CA✓ substitution $x = \frac{y+3}{2}$ CA✓ std. form CA✓factors CA✓y values CA✓x values	(6)
			[24]

QUESTION 7

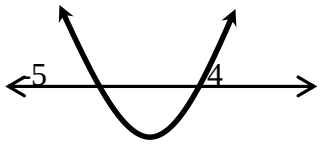
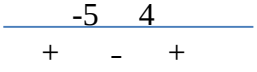
7.1	7.1.1	$x(x-1)+2(x-1)=0$ $(x-1)(x+2)=0$ $x=1\ or\ x=-2$	✓ ✓	Factors Answers	(2)
	7.1.2	$1+3x^2-5x=0$ $3x^2-5x+1=0$ $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ $=\frac{-(-5)\pm\sqrt{(-5)^2-4(3)(1)}}{2(3)}$ $=\frac{5\pm\sqrt{13}}{2(3)}$ = 1,43 or 0,23	✓ ✓ ✓	standard form substitution answers (all correct with correct rounding)	(3)
	7.1.3	$\sqrt{2x-1}=2x-3$ $2x-1=(2x-3)^2$ $2x-1=4x^2-12x+9$ $4x^2-14x+10=0$ $(4x-10)(x-1)=0$ $x=\frac{5}{2}$ or $x=1(not\ a\ solution)$ solution: $x=\frac{5}{2}$	✓ ✓ ✓ ✓	Squaring standard form factors solution: $x=\frac{5}{2}$	(4)
	7.1.4	$(2x)^{-\frac{3}{2}}=64$ $2x=64^{\frac{2}{3}}$ $x=\frac{64^{-\frac{2}{3}}}{2}$ $=8$ OR $(2x)^{\frac{3}{2}}=64$ $2^{\frac{3}{2}}.x^{\frac{3}{2}}=64$ $x^{\frac{3}{2}}=\frac{64}{2^{\frac{3}{2}}}$	✓ ✓ ✓ OR ✓ ✓ ✓	$2x=64^{\frac{2}{3}}$ $x=\frac{64^{\frac{2}{3}}}{2}$ 8 OR $2^{\frac{3}{2}}.x^{\frac{3}{2}}$ $(\frac{64}{2^{-\frac{3}{2}}})^{-\frac{2}{3}}$	(3)

		$x = \ (\frac{64}{2^{\frac{3}{2}}})^{\frac{2}{3}}$ $= 8$ OR $(2x)^{\frac{3}{2}} = 2^6$ $2x = (2^6)^{\frac{2}{3}}$ $= 2^4$ $x = 2^3 = 8$	OR ✓ ✓ ✓	8 OR $64 = 2^6$ $(2^6)^{\frac{2}{3}}$ 8	
	7.1.5	$(1-x)^2(2-x) \leq 0$ $(1-x)^2 > 0$ for all values of $x \neq 1$ and $(1-x)^2 = 0$ for $x = 1$ so $(2-x) \leq 0$ $x \geq 2$ Solution $x = 1$ or $x \geq 2$	✓ ✓✓ ✓	critical values i.e. $x = 1$ or $x = 2$ $x = 1$ $x \geq 2$	(4)

7.2		$y + 3 = 2x$; and $x^2 - xy + 2y^2 = 4$ $y = 2x - 3$ $x^2 - x(2x-3) + 2(2x-3)^2 - 4 = 0$ $x^2 - 2x^2 + 3x + 2(4x^2 - 12x + 9) - 4 = 0$ $x^2 - 2x^2 + 3x + 8x^2 - 24x + 18 - 4 = 0$ $7x^2 - 21x + 14 = 0$ $x^2 - 3x + 2 = 0$ $(x-2)(x-1) = 0$ $x = 2$ or $x = 1$ $y = 2(2) - 3$ or $y = 2(1) - 3$ $y = 1$ or $y = -1$ OR $x = \frac{y+3}{2}$	✓ ✓ ✓ ✓ ✓ OR ✓ ✓	Substitution standard form factors values of x values of y OR	(5)

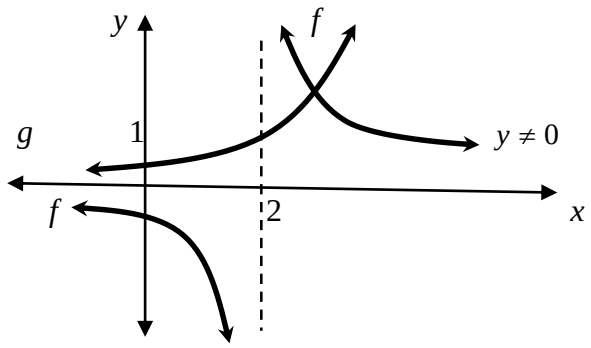
		$\left(\frac{y+3}{2}\right)^2$ or $-\frac{y+3}{2}.y+2y^2=4$ $\frac{y^2+6y+9}{4}-\frac{y^2+3y}{2}+2y^2-4=0$ $y^2+6y+9-2y^2-6y+8y^2-16=0$ $7y^2-7=0$ $(y-1)(y+1)=0$ $y=1$ or $y=-1$ $x=2$ *or* $x=1$	✓ ✓ ✓	Substitution standard form factors/ values of y values of x	
7.3		$bx^2+3x+4=-x-1$ $bx^2+3x+4+x+1=0$ $bx^2+4x+5=0$ $\Delta \geq 0$ $16-4(b)5 \geq 0$ $20b \leq 16$ $b \leq \frac{16}{20}$ $b \leq \frac{4}{5}$	✓ ✓ ✓ ✓	equating f and g standard form subst. $in\ \Delta$ formula answer	(4)
					[25]

QUESTION 8

$7x(2x-1)=0$ $7x=0 \quad \text{or} \quad 2x-1=0$ $x=0 \qquad 2x=1$ $x=\frac{1}{2}$	✓ $x=0$ ✓ $x=\frac{1}{2}$ (2)
$2x^2+x=4$ $2x^2+x-4=0$ $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ $=\frac{-1\pm\sqrt{1^2-4(2)(-4)}}{2(2)}$ $=\frac{-1\pm\sqrt{33}}{4}$ $x=1{,}19 \quad \text{or} \quad x=-1{,}69$	✓ standard form ✓ substitution into the correct formula ✓ $x=1{,}19$ ✓ $x=-1{,}69$ (4)
$(x-4)(x+5)\geq 0$ $\therefore x\leq -5 \quad \text{or} \quad x\geq 4$  **OR**  $(-\infty;-5]\cup[4;\infty)$	✓ $x\leq -5$ ✓ $x\geq 4$ ✓ or (3) ✓ $x\in(-\infty;-5]$ ✓ $x\in[4;\infty)$ ✓ or (3)

$3x^{\frac{2}{5}} - 5x^{\frac{1}{5}} - 2 = 0$ Let $x^{\frac{1}{5}} = k$ $\therefore 3k^2 - 5k - 2 = 0$ $(3k + 1)(k - 2) = 0$ $3k = -1 \quad \text{or} \quad k = 2$ $k = -\frac{1}{3}$ $x^{\frac{1}{5}} = -\frac{1}{3} \quad \text{or} \quad x^{\frac{1}{5}} = 2$ $x = \left(-\frac{1}{3}\right)^5 \qquad x = 2^5$ $x = -\frac{1}{243} \qquad x = 32$ **OR** $3x^{\frac{2}{5}} - 5x^{\frac{1}{5}} - 2 = 0$ $(3x^{\frac{1}{5}} + 1)(x^{\frac{1}{5}} - 2) = 0$ $3x^{\frac{1}{5}} = -1 \quad \text{or} \quad x^{\frac{1}{5}} = 2$ $x^{\frac{1}{5}} = -\frac{1}{3} \qquad x = 2^5$ $x = \left(-\frac{1}{3}\right)^5 \qquad x = 32$ $x = -\frac{1}{243}$	✓ factors ✓ $x^{\frac{1}{5}} = -\frac{1}{3}$ of $x^{\frac{1}{5}} = 2$ ✓ $x = -\frac{1}{243}$ ✓ $x = 32$ (4) ✓ factors ✓ $x^{\frac{1}{5}} = -\frac{1}{3}$ or $x^{\frac{1}{5}} = 2$ ✓ $x = 32$ ✓ $x = -\frac{1}{243}$ (4)
$\frac{2x}{1+y} = 1;\ y \neq -1$ and $(3x - y)(x + y) = 0$ $2x = 1 + y$ $2x - 1 = y$ $(3x - y) = 0 \quad \text{or} \quad x + y = 0$ $3x - (2x - 1) = 0 \quad \text{or} \quad x + (2x - 1) = 0$ $x = -1 \quad \text{or} \quad 3x = 1$ $x = \frac{1}{3}$ $y = 2(-1) - 1 \quad \text{or} \quad y = 2\left(\frac{1}{3}\right) - 1$ $= -3 \qquad = -\frac{1}{3}$	✓ $2x - 1 = y$ ✓ two factors = 0 ✓ substitution ✓ both x-values ✓✓ y-values (6)

OR $\frac{2x}{1+y} = 1;\ y \neq -1$ and $(3x - y)(x + y) = 0$ $2x = 1 + y$ $2x - 1 = y$ $(3x - (2x - 1))(x + (2x - 1)) = 0$ $(x + 1)(3x - 1) = 0$ $x = -1$ or $3x = 1$ $x = \frac{1}{3}$ $y = 2(-1) - 1$ or $y = 2\left(\frac{1}{3}\right) - 1$ $= -3$ $= -\frac{1}{3}$	✓ $2x - 1 = y$ ✓ substitution ✓ factors = 0 ✓ both x-values ✓✓ y-values (6)
OR $\frac{2x}{1+y} = 1;\ y \neq -1$ and $(3x - y)(x + y) = 0$ $2x = 1 + y$ $x = \frac{1+y}{2}$ $(3x - y) = 0$ or $(x + y) = 0$ $3\left(\frac{1+y}{2}\right) - y = 0$ $\frac{1+y}{2} + y = 0$ $3(1 + y) = 2y$ $1 + y = -2y$ $3 + 3y = 2y$ $3y = -1$ $y = -3$ $y = -\frac{1}{3}$ $x = \frac{1-3}{2}$ or $x = \frac{1-\frac{1}{3}}{2}$ $x = -1$ $x = \frac{1}{3}$	✓ $x = \frac{1+y}{2}$ ✓ two factors = 0 ✓ substitution ✓ both y-values ✓✓ x-values (6)
$f(x)$ a hyperbola with asymptotes $y = 0$ and $x = 2$. Range of f: $y > 0$ ór $y < 0$. $g(x)$ is an increasing exponential function translated 2 units right, thus $y > 0$ for all $x \in$ R. Therefore, f and g intersect only once.	✓ *f is* hyperbola; $y > 0$ ór $y < 0$ ✓ g: range of g: $y > 0$ (increasing exponential) ✓ explanation (3)

OR  	✓ *f:* hyperbola sketch; ✓ *g*: sketch of *g* ✓ *g*: explanation: If $x < 2$: $g(x) > 0$, $f(x) < 0$ thus no root. If $x > 2$: $g(x) > 0$, $f(x) > 0$ thus one root only (3) **[22]**

QUESTION 9

#	SUGGESTED ANSWER	DESCRIPTORS	Mark/
9.1.1	$x(5x+2)=0$ $x=0$ or $x=-\frac{2}{5}$	✓✓Each root	(2)
9.1.2	$2x^2-3x-4=0$ $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ $x=\frac{-(-3)\pm\sqrt{(-3)^2-4(2)(-4)}}{2(2)}$ $=\frac{3\pm\sqrt{41}}{4}$ $x=-0{,}85$ or $x=2{,}35$	✓ Std form ✓Substitution ✓✓Each root $x=-0{,}85$ or/ *of* $x=2{,}35$ **(-1, if incorrect rounding)**	(4)
9.1.3	$x^2-x-6\geq 6$ $x^2-x-12\geq 0$ $(x+3)(x-4)\geq 0$ 0 0 + −3 − 4 + $x<-3$ or/ *of* $x>4$	✓std form ✓factors ✓ both critical values ✓notation	(4)
9.2	$x=y+3$ ……(1) Subst (1) into (2): $x^2+xy-2y^2=0$ ……(2) $\therefore (y+3)^2+y(y+3)-2y^2=0$ $\therefore y^2+6y+9+y(y+3)-2y^2=0$ $\therefore y^2+6y+9+y^2+3y-2y^2=0$ $\therefore 9y+9=0$ $\therefore y=-1$ $\therefore x=2$ OR $y=x-3$ ……(1)	✓x subject ✓subst in (2) ✓simplify ✓value of y ✓value of x ✓**y** subject	(5)

	Subst (1) into (2): $x^2 + xy - 2y^2 = 0$ ……(2) $\therefore x^2 + x(x-3) - 2(x-3)^2 = 0$ $\therefore x^2 + x^2 - 3x - 2x^2 + 12x - 18 = 0$ $\therefore 9x - 18 = 0$ $\therefore \quad x = 2$ $\therefore \quad y = -1$	✓subst in (2) ✓simplify ✓value of x ✓value of y	(5)
9.3	$x = \frac{-2 \pm \sqrt{13-2k}}{3}$ $\therefore \Delta = 13 - 2k \geq 0$ $\therefore 2k \leq 13$ $\therefore k \leq \frac{13}{2}$ ∴If $k = 6$, Δ is a perfect square and roots rational	✓$\Delta \geq 0$ ✓value $k \leq \frac{13}{2}$ ✓ deriving k = 6 **Answer only = FULL MARKS**	(3)
9.4	If graphs intersect: $f(x) = g(x)$ $\therefore x^2 - 2x - 3 = 2x + a$ $\therefore x^2 - 4x - 3 - a = 0$ If graphs do not intersect: $\Delta < 0$ $(-4)^2 - 4(1)(-3-a) < 0$ $\therefore 16 + 12 + 4a < 0$ $\therefore 4a < -28$ $\therefore a < -7$	✓ equating f and g ✓ $\Delta < 0$ ✓ Subst. ✓ Simplify ✓ answer	(5)
			[23