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MATHEMATICS

MATERIAL FOR GRADE 12

ALGEBRA

MEMORANDA

QUESTION 1

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

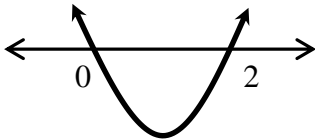
1.4	$(2q + x)^2 = 4q^2 + 12q + y$ $4q^2 + 4qx + x^2 \checkmark = 4q^2 + 12q + y$ $4qx + x^2 = 12q + y \checkmark$ $4qx + x^2 = 3.4q + y \checkmark$ For these sides to be equal, we must have $4qx = 12q$ and $y = x^2$ $x = 3 \checkmark$; $y = x^2 = 9 \checkmark$ $(3; 9)$	$\checkmark$ Expansion $\checkmark$ Simplification. $\checkmark 4qx = 3.4q$ $\checkmark x = 3, y = x^2$ $\checkmark (3; 9)$ (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 $x = -\frac{5}{2}$	$\checkmark$ $\checkmark$	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 $-0,37$	$\checkmark$ $\checkmark$ $\checkmark \checkmark$	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 $1,63$	$\checkmark$ $\checkmark$ $\checkmark$	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	$3^{x+1} - 4 + \frac{1}{3^x} = 0$ $3 \cdot 3^x - 4 + \frac{1}{3^x} = 0$ $3 \cdot 3^{2x} - 4 \cdot 3^x + 1 = 0$ $(3 \cdot 3^x - 1)(3^x - 1) = 0$ $3^x = \frac{1}{3} = 3^{-1}$ or $3^x = 1 = 3^0$ $x = -1$ or $x = 0$	✓ ✓ ✓ ✓ ✓	multiplying by 3^x throughout $3^{x+1} = 3 \cdot 3^x$ or $3^{2x+1} = 3 \cdot 3^{2x}$ 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]

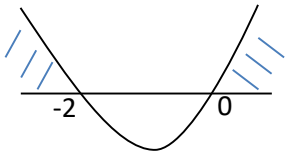
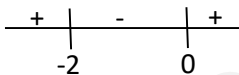
QUESTION 3

$(x - 1)(x + 8) = 10$ $x^2 + 8x - x - 8 - 10 = 0$ $x^2 + 7x - 18 = 0$ $(x + 9)(x - 2) = 0$ $x + 9 = 0$ or $x - 2 = 0$ $x = -9$ or $x = 2$ OR $(x - 1)(x + 8) = 10$ $x^2 + 8x - x - 8 - 10 = 0$ $x^2 + 7x - 18 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $x = \frac{-7 \pm \sqrt{7^2 - 4(1)(-18)}}{2(1)}$ $x = \frac{-7 \pm \sqrt{121}}{2}$ $x = -9$ or $x = 2$	✓ simplification ✓ standard form ✓ factors ✓ 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 $x > 2$; $x \in \mathbb{R}$	 ✓ standard form ✓ factors ✓ method ✓ both x-values ✓ notation

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

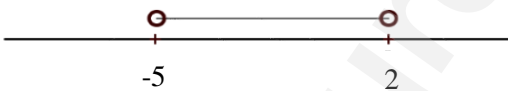
$3 + x = 2y$ and $x^2 + 4y^2 = 2xy + 7$ $y = \frac{3+x}{2}$ $x^2 + 4\left(\frac{3+x}{2}\right)^2 = 2x\left(\frac{3+x}{2}\right) + 7$ $x^2 + 9 + 6x + x^2 = 3x + x^2 + 7$ $x^2 + 3x + 2 = 0$ $(x+2)(x+1) = 0$ $x = -2$ or $x = -1$ $y = \frac{3-2}{2}$ or $y = \frac{3-1}{2}$ $= \frac{1}{2}$ $= 1$	✓ standard 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 $x = -2$	$\checkmark x = 0$ $\checkmark x = -2$	(2)
4.1.2	$x^2 + 2x \geq 0$ $x(x+2) \geq 0$  OR/OR  $\therefore x > 0$	$\checkmark x^2 + 2x \geq 0$ $\checkmark$ graph critical pts $\checkmark x > 0$ If $x \geq 0$ only 1 mark	(3)
4.2	$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(2)(-7)}}{2(2)}$ $= \frac{3 \pm \sqrt{65}}{4}$ $x = 2,77$ OR/OR $x = -1,27$ If left in surd form only 2 marks.	$\checkmark$ substitution into correct formula $\checkmark$ simplify $\checkmark 2,77$ $\checkmark -1,27$	(4)
4.3.1	$k^2 + 5k - 14 = 0$ $(k-2)(k+7) = 0$ $k = 2$ or $k = -7$	$\checkmark$ multiplying $\checkmark$ factorising $\checkmark$ both solutions	(3)
4.3.2	$\sqrt{x+5} = 2$ or $\sqrt{x+5} = -7$ $x+5 = 4$ or invalid/ no solution $x = -1$	$\checkmark$ substitution $\checkmark$ identifying invalid $\checkmark$ value of x	(3)

4.4	$\frac{1}{x} + \frac{1}{y} = 3 \quad \dots\dots\dots (1)$ $x - y = \frac{1}{2} \quad \dots\dots\dots (2)$ From (2): $x = y + \frac{1}{2} \quad \dots\dots\dots (3)$ Substituting (3) in (1) yields: $\frac{1}{y + \frac{1}{2}} + \frac{1}{y} = 3$ $y + y + \frac{1}{2} = 3y \left(y + \frac{1}{2} \right)$ $4y + 1 = 3y(2y + 1) = 6y^2 + 3y$ $6y^2 - y - 1 = 0$ $(2y - 1)(3y + 1) = 0$ $y = \frac{1}{2} \quad \text{or} \quad y = -\frac{1}{3}$ $x = \frac{1}{2} + \frac{1}{2} \quad \text{or} \quad x = -\frac{1}{3} + \frac{1}{2}$ $= 1 \quad \text{or} \quad = \frac{1}{6}$ 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

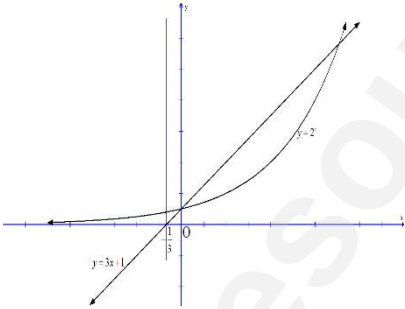
5.1.1	$x^2 + x = 0$ $x(x+1) = 0$ $x = 0$ or $x = -1$	✓ factors ✓ $x = 0$ ✓ $x = -1$ (3)
5.1.2	$\sqrt{x+2} = x$ $x+2 = x^2$ $x^2 - x - 2 = 0$ $(x-2)(x+1) = 0$ $x = -1$ or $x = 2$ NA	✓ $x+2 = x^2$ ✓ factors ✓ answers ✓ correct selection of $x = 2$ (4)
5.1.3	$x^2 + 3x - 10 < 0$ $(x-2)(x+5) < 0$ $cv: -5; 2$  $-5 < x < 2$	✓ 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)

	$x^{-1} - x^{-\frac{1}{2}} - 20 = 0$ $\left(x^{\frac{1}{2}} - 5\right)\left(x^{\frac{1}{2}} + 4\right) = 0$ $x^{\frac{1}{2}} = 5 \text{ or } x^{\frac{1}{2}} = -4$ $x = \frac{1}{25} \quad \text{no real solution}$	✓ standard form ✓ factors ✓ $x^{\frac{1}{2}} = 5$ and $x^{\frac{1}{2}} = -4$ ✓ $x = \frac{1}{25}$ as only solution (4)
5.2	$y = x + 2$ $x^2 + (x + 2)^2 = 20$ $x^2 + x^2 + 4x + 4 = 20$ $2x^2 + 4x - 16 = 0$ $x^2 + 2x - 8 = 0$ $(x - 2)(x + 4) = 0$ $x = 2 \text{ or } x = -4$ $y = 4 \text{ or } y = -2$	✓ substitution of y ✓ simplification ✓ standard form ✓ factors ✓ both x-values ✓ both y-values (6)
5.2.1	$2x^2 - 7xy + 4y^2 = 0$ $2\frac{x^2}{y^2} - 7\frac{x}{y} + 4 = 0$ $\frac{x}{y} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \frac{7 \pm \sqrt{49 - 4 \times 2 \times 4}}{2 \times 2}$ $= \frac{7 \pm \sqrt{17}}{4}$ $= 0,72 \text{ or } 2,78$ 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	$2x(3x-5)=0$ $x=0$ or $x=\frac{5}{3}$	AA✓✓ Answers	(2)
6.1.2	$x^2-3x=7$ $x^2-3x-7=0$ $x=\frac{-(-3)\pm\sqrt{(-3)^2-4(1)(-7)}}{2(1)}$ $x=4,54$ or $x=-1,54$	A✓ equation in std. form CA✓ substitution Penalise rounding off CACA✓✓ answers	(4)
6.1.3	$2x-5\sqrt{x}=3$ $2x-3=5\sqrt{x}$ $4x^2-12x+9=25x$ $4x^2-37x+9=0$ $(4x-1)(x-9)=0$ $x=\frac{1}{4}$ or $x=9$ n/a OR $2x-5x^{\frac{1}{2}}-3=0$ $\left(2x^{\frac{1}{2}}+1\right)\left(x^{\frac{1}{2}}-3\right)=0$ $x^{\frac{1}{2}}=\frac{-1}{2}$ or $x^{\frac{1}{2}}=3$ No solution $x=9$	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	$2x - y = 3 \rightarrow (1)$ $x^2 + 5xy + y^2 = 15 \rightarrow (2)$ From (1): $y = 2x - 3$ Subst. (1) into (2) $x^2 + 5x(2x - 3) + (2x - 3)^2 = 15$ $x^2 + 10x^2 - 15x + 4x^2 - 12x + 9 - 15 = 0$ $15x^2 - 27x - 6 = 0$ $(5x + 1)(3x - 6) = 0$ $x = \frac{-1}{5} \quad \text{or} \quad x = 2$ $y = \frac{-17}{5} \quad \text{or} \quad y = 1$ OR $2x - y = 3 \rightarrow (1)$ $x^2 + 5xy + y^2 = 15 \rightarrow (2)$	A✓ y as subject CA✓ substitution $y = 2x - 3$ CA✓ std. form CA✓ factors CA✓ x values CA✓ y values	(6)

$\left(\frac{-4}{2}\right) + \frac{15}{2} + y = 15$ $y^2 + 6y + 9 + 10y^2 + 30y + 4y^2 = 60$ $15y^2 + 36y - 51 = 0$ $5y^2 + 12y - 17 = 0$ $(5y + 17)(y - 1) = 0$ $y = \frac{-17}{5} \quad \text{or} \quad y = 1$ $x = \frac{-1}{5} \quad \text{or} \quad x = 2$	CA✓ std. form CA✓ factors CA✓ y values CA✓ x values

QUESTION 7

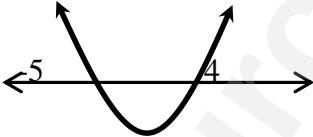
7.1	7.1.1	$x(x-1) + 2(x-1) = 0$ $(x-1)(x+2) = 0$ $x = 1 \text{ or } x = -2$	✓ ✓	Factors Answers	(2)
	7.1.2	$1 + 3x^2 - 5x = 0$ $3x^2 - 5x + 1 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \frac{-(-5) \pm \sqrt{(-5)^2 - 4(3)(1)}}{2(3)}$ $= \frac{5 \pm \sqrt{13}}{2(3)}$ $= 1,43 \text{ or } 0,23$	✓ ✓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

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

7.2		$y + 3 = 2x; \text{ and } x^2 - xy + 2y^2 = 4$ $y = 2x - 3$ $x^2 - x(2x - 3) + 2(2x - 3)^2 - 4 = 0$ $x^2 - 2x^2 + 3x + 2(4x^2 - 12x + 9) - 4 = 0$ $x^2 - 2x^2 + 3x + 8x^2 - 24x + 18 - 4 = 0$ $7x^2 - 21x + 14 = 0$ $x^2 - 3x + 2 = 0$ $(x - 2)(x - 1) = 0$ $x = 2 \text{ or } x = 1$ $y = 2(2) - 3 \text{ or } y = 2(1) - 3$ $y = 1 \text{ or } y = -1$ OR $x = \frac{y + 3}{2}$	✓ ✓ ✓ ✓ ✓ OR ✓ ✓	Substitution standard form factors values of x values of y OR	(5)
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		$\left(\frac{y+3}{2}\right)^2$ or $-\frac{y+3}{2} \cdot y + 2y^2 = 4$ $\frac{y^2 + 6y + 9}{4} - \frac{y^2 + 3y}{2} + 2y^2 - 4 = 0$ $y^2 + 6y + 9 - 2y^2 - 6y + 8y^2 - 16 = 0$ $7y^2 - 7 = 0$ $(y - 1)(y + 1) = 0$ $y = 1$ 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 Δ formula answer	(4)
					[25]

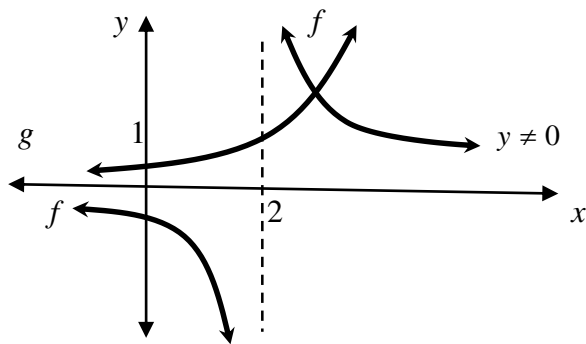
QUESTION 8

$7x(2x - 1) = 0$ $7x = 0 \quad \text{or} \quad 2x - 1 = 0$ $x = 0 \qquad 2x = 1$ $\qquad \qquad x = \frac{1}{2}$	$\checkmark x = 0$ $\checkmark x = \frac{1}{2}$ (2)						
$2x^2 + x = 4$ $2x^2 + x - 4 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \frac{-1 \pm \sqrt{1^2 - 4(2)(-4)}}{2(2)}$ $= \frac{-1 \pm \sqrt{33}}{4}$ $x = 1,19 \quad \text{or} \quad x = -1,69$	$\checkmark \text{ standard form}$ $\checkmark \text{ substitution into the correct formula}$ $\checkmark x = 1,19$ $\checkmark x = -1,69$ (4)						
$(x - 4)(x + 5) \geq 0$ $\therefore x \leq -5 \quad \text{or} \quad x \geq 4$  OR <table border="0" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">-5</td> <td style="text-align: center;">4</td> </tr> <tr> <td style="text-align: center;">+</td> <td style="text-align: center;">-</td> </tr> <tr> <td style="text-align: center;">+</td> <td style="text-align: center;">+</td> </tr> </table> $(-\infty; -5] \cup [4; \infty)$	-5	4	+	-	+	+	$\checkmark x \leq -5$ $\checkmark x \geq 4$ $\checkmark \text{ or}$ (3) $\checkmark x \in (-\infty; -5]$ $\checkmark x \in [4; \infty)$ $\checkmark \text{ or}$ (3)
-5	4						
+	-						
+	+						

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

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

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QUESTION 9

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

	Subst (1) into (2): $x^2 + xy - 2y^2 = 0 \dots\dots\dots(2)$ $\therefore x^2 + x(x - 3) - 2(x - 3)^2 = 0$ $\therefore x^2 + x^2 - 3x - 2x^2 + 12x - 18 = 0$ $\therefore 9x - 18 = 0$ $\therefore x = 2$ $\therefore y = -1$	✓ 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]