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# MATHEMATICS

## MATERIAL FOR GRADE 12

## ALGEBRA

MEMORANDA

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**QUESTION 1**

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

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

**QUESTION 2**

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

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

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**QUESTION 3**

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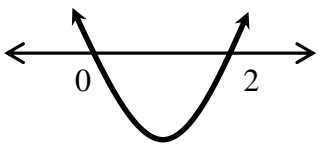
|---|---|
| $(x-1)(x+8)=10$<br>$x^2+8x-x-8-10=0$<br>$x^2+7x-18=0$<br>$(x+9)(x-2)=0$<br>$x+9=0$ or $x-2=0$<br>$x=-9$ $\quad$ $x=2$ | ✓ simplification<br>✓ standard form<br>✓ factors<br>✓ both answers<br>(4) |
| **OR**<br>$(x-1)(x+8)=10$<br>$x^2+8x-x-8-10=0$<br>$x^2+7x-18=0$<br>$x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$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

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

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

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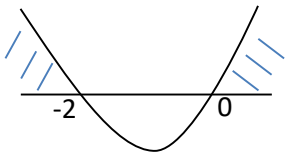
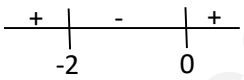
**QUESTION 4**

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

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

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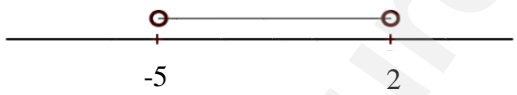
| 5.1.1 | $x^2+x=0$<br>$x(x+1)=0$<br>$x=0$ or $x=-1$ | ✓ factors<br>✓ $x=0$<br>✓ $x=-1$<br>(3) |
| 5.1.2 | $\sqrt{x+2}=x$<br>$x+2=x^2$<br>$x^2-x-2=0$<br>$(x-2)(x+1)=0$<br>$x=-1$ or $x=2$<br>NA | ✓ $x+2=x^2$<br>✓ factors<br>✓ answers<br>✓ correct selection of $x=2$<br>(4) |
| 5.1.3 | $x^2+3x-10<0$<br>$(x-2)(x+5)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

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

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| | $t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$<br>$= \frac{7 \pm \sqrt{49 - 4 \times 2 \times 4}}{2 \times 2}$<br>$= \frac{7 \pm \sqrt{17}}{4}$<br>$= 0{,}72$ or $2{,}78$ | ✓ correct subst. into correct formula<br>✓ 0,72<br>✓ 2,78 (4) |
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**QUESTION 6**

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

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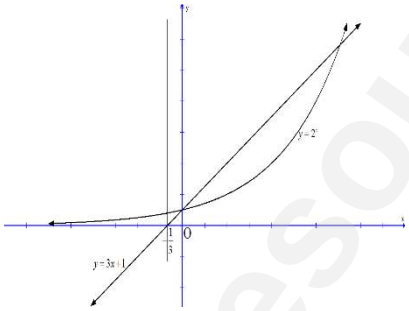
| | | A✓ standard form<br><br>CA✓factors<br><br>CA✓ $x^{\frac{1}{2}} = \frac{-1}{2}$ CA✓<br>$x^{\frac{1}{2}} = 3$<br>CA✓answer CA✓rejecting | (6) |
| 6.1.4 | $2^x(3x+1) < 0$<br>$2^x > 0$ for all $x \in R$<br>$\therefore 3x+1 < 0$<br>$x < -\frac{1}{3}$<br><br>**OR [Graphically]**<br>  <br><br>$x < -\frac{1}{3}$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

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

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

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**QUESTION 7**

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

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

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

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

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**QUESTION 8**

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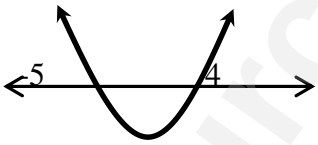
|---|---|
| $7x(2x-1)=0$<br>$7x=0$ or $2x-1=0$<br>$x=0$ $\quad 2x=1$<br>$x=\frac{1}{2}$ | ✓ $x=0$<br>✓ $x=\frac{1}{2}$<br>(2) |
| $2x^2+x=4$<br>$2x^2+x-4=0$<br>$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$<br>$=\frac{-1\pm\sqrt{1^2-4(2)(-4)}}{2(2)}$<br>$=\frac{-1\pm\sqrt{33}}{4}$<br>$x=1{,}19$ or $x=-1{,}69$ |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

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

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| **OR**<br>$\frac{2x}{1+y} = 1;\ y \neq -1$ and $(3x - y)(x + y) = 0$<br>$2x = 1 + y$<br>$2x - 1 = y$<br>$(3x - (2x - 1))(x + (2x - 1)) = 0$<br>$(x + 1)(3x - 1) = 0$<br>$x = -1$ or $3x = 1$<br>$x = \frac{1}{3}$<br>$y = 2(-1) - 1$ or $y = 2\left(\frac{1}{3}\right) - 1$<br>$= -3$ $\quad = -\frac{1}{3}$ | ✓ $2x - 1 = y$<br>✓ substitution<br>✓ factors = 0<br>✓ both $x$-values<br>✓✓ $y$-values<br>(6) |
| **OR**<br>$\frac{2x}{1+y} = 1;\ y \neq -1$ and $(3x - y)(x + y) = 0$<br>$2x = 1 + y$<br>$x = \frac{1+y}{2}$<br>$(3x - y) = 0$ or $(x + y) = 0$<br>$3\left(\frac{1+y}{2}\right) - y = 0$ $\quad \frac{1+y}{2} + y = 0$<br>$3(1 + y) = 2y$ $\quad 1 + y = -2y$<br>$3 + 3y = 2y$ $\quad 3y = -1$<br>$y = -3$ $\quad y = -\frac{1}{3}$<br>$x = \frac{1-3}{2}$ or $x = \frac{1 - \frac{1}{3}}{2}$<br>$x = -1$ $\quad x = \frac{1}{3}$ | ✓ $x = \frac{1+y}{2}$<br>✓ two factors = 0<br>✓ substitution<br>✓ both $y$-values<br>✓✓ $x$-values<br>(6) |
| $f(x)$ a hyperbola with asymptotes $y = 0$ and $x = 2$. Range of f: $y > 0$ ór $y < 0$.<br>$g(x)$ 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 $y < 0$<br>✓ g: range of g: $y > 0$ (increasing exponential)<br>✓ explanation<br>(3) |

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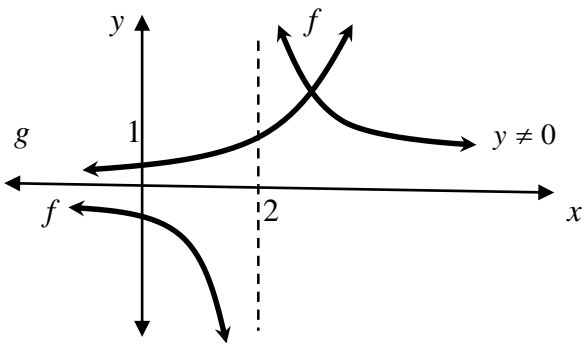
| **OR**   | ✓ *f:* hyperbola sketch;<br><br>✓ *g*: sketch of *g*<br><br>✓ *g*: explanation:<br>If $x < 2$: $g(x) > 0$,<br>$f(x) < 0$ thus no root.<br>If $x > 2$: $g(x) > 0$,<br>$f(x) > 0$ thus one root only<br><br>(3)<br>**[22]** |

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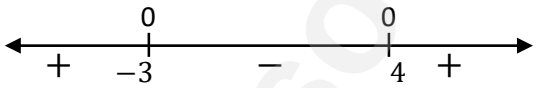
**QUESTION 9**

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

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

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