

Question		Answer	Marks	AO	Guidance	
4	(a)	$(f^{-1}(x) =) 2x + k$	B1	2.1	For $2x + k$	
		$(f^{-1}g(x) =) 2(x^2 + kx + 5) + k$	M1	1.1	Correct order of operations for the composite function $f^{-1}g$	
		Alternative for first two marks in part (a)				
		$(g(x) =) f(4 - 2kx)$	B1		soi	
		$x^2 + kx + 5 = \frac{4 - 2kx - k}{2}$	M1		Condone sign errors only	
		$2(x^2 + kx + 5) + k = 4 - 2kx$ $\Rightarrow 2x^2 + 4kx + (6 + k) (= 0)$ $(4k)^2 - 4(2)(6 + k) (> 0)$ $16k^2 - 8k - 48 > 0$ $\Rightarrow 2k^2 - k - 6 > 0$	M1* M1dep* A1	2.1 3.1a 2.1	Expanding and simplifying to obtain a three-term quadratic expression in x (allow sign errors only in the simplification and collection of terms) – all terms must be on the same side and the constant term must be a two-term linear expression in k Calculating correct discriminant for their 3TQ – allow $4k^2$ recovered to $16k^2$ for M1 only – do not award this mark if only embedded in quadratic formula AG www – sufficient working must be seen. Discriminant must have been set > 0 before dividing by 8	Must come from considering $a(x^2 + kx + 5) + bk = 4 - 2kx$ where $a, b \neq 0$ Condone $2x^2 + 4kx + (6 + k) > 0$ for M1 but cannot score the final A1 mark (as www) Condone $= 0, < 0$ etc. for this M1 mark A0 for setting discriminant $= 0$ or < 0 (oe wrong inequality) and later replacing with the correct inequality
			[5]			

Question			Answer	Marks	AO	Guidance	
4	(b)		DR				
			$(2k + 3)(k - 2) \ (> 0)$	M1	1.1	Correct method for solving their 3 term quadratic which would lead to the critical values of k	See appendix for solving 3TQ
			$k < -\frac{3}{2}, k > 2$	B1	1.1	Correct set of values for k so must be strict inequalities – allow in terms of x and/or k . Ignore any working seen	Condone poor set notation if intention is clear
			$\left\{k : k < -\frac{3}{2}\right\} \cup \{k : k > 2\}$	B1FT	2.5	Correct union set notation for their values of k so must be in terms of k (and not x). Must be of the form $\{k : k < k_1\} \cup \{k : k > k_2\}$ where $k_1 < k_2$ B0 for interval notation Note that for full marks to be awarded no incorrect working seen	Note that, for example, $\left\{k < -\frac{3}{2}\right\} \cup \{k > 2\}$ and $\left\{k : k < -\frac{3}{2} \cup k : k > 2\right\}$ etc. are B0 Ignore inclusion of $\in \mathbb{R}$ inside the $\{ \}$ brackets
				[3]			

Rules for solving quadratics in question 4(b) ONLY

In question **4(b)** candidates are required to solve a 3 term quadratic (3TQ) using **DR** – therefore we must see a correct, complete method for solving this quadratic – the correct answers do not imply the corresponding M mark, for example $2x^2 - x - 6 = 0 \Rightarrow x = 2$ or $x = -\frac{3}{2}$ is **M0**

Rules for factorising:

$at^2 + bt + c \Rightarrow (mt + n)(pt + q)$ where $a = mp$ **and** one of $mq + np = b$ **or** $c = nq$ (so when expanding their factorised expression it must give the correct quadratic term and one other term correct of the preceding 3TQ expression/equation)

e.g. in question **4b**:

$2x^2 - x - 6 = (x + \frac{3}{2})(x - 2)$ is **M0** (but the following **B1** for the correct $x < -\frac{3}{2}$ and $x > 2$ can still be awarded)

$2x^2 - x - 6 = (2x - 3)(x + 2)$ is **M1** (when expanded the x^2 and constant terms are correct)

Allow correct part factorisation for their 3TQ expression e.g. $2x(x - 2) + 3(x - 2)$ scores **M1**

Rules for the formula:

Must apply the correct formula for their three-term quadratic (no errors even if correct formula is stated) – note that stating the formula (in terms of a , b and c) followed immediately by the corresponding roots is **M0** – we **must** see the formula being applied e.g. $2x^2 - x - 6 = 0 \Rightarrow x = \frac{1 \pm \sqrt{1^2 - 4(2)(-6)}}{2(2)}$. Minimal

acceptable working would be $x = \frac{1 \pm \sqrt{49}}{4}$ (so must explicitly see the value of the discriminant) for **M1**

Rules for completing the square

The **M1** is not awarded until correctly getting to the stage of $x - \frac{1}{4} = \pm \sqrt{\frac{49}{16}}$ (must include $\pm$ so implying two roots) with no errors (so consistent with applying the formula correctly)