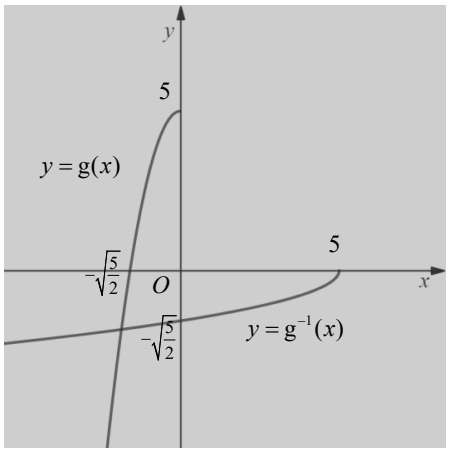
Question Number	Scheme		Marks
4(a)	$\text{fg}(x) = \dfrac{4\left(5-2x^2\right)+6}{5-2x^2-5}$		M1
	$\text{fg}(x) = 3 \Rightarrow \dfrac{26-8x^2}{-2x^2} = 3 \Rightarrow x = -\sqrt{13}$		**d**M1 A1 A1
			(4)
(b)	$y = \dfrac{4x+6}{x-5} \Rightarrow yx-5y = 4x+6 \Rightarrow yx-4x = 5y+6$		M1
	$\Rightarrow x = \dfrac{5y+6}{y-4}$		A1
	$\Rightarrow \text{f}^{-1}(x) = \dfrac{5x+6}{x-4} \qquad x \in \mathbb{R},\ x \neq 4$		A1
			(3)
(c)		Shape and position for $y = \text{g}(x)$. A parabola starting on the y-axis that extends down in quadrant 2 to at least the x-axis. Condone slips of the pen e.g. if the curve heads back towards the y-axis in quadrant 3 slightly.	B1
		Shape and position for $y = \text{g}(x)$ as above that crosses the x-axis **and** $y = \text{g}^{-1}(x)$ a parabola starting on the x-axis with graphs crossing as shown in quadrant 3. Condone slips of the pen e.g. if $\text{g}^{-1}(x)$ heads back towards the x-axis in quadrant 3 slightly.	B1
		Correct intercepts. This mark is for the 4 correct intercepts as shown. Allow as values or coordinates and allow coordinates the wrong way round (e.g. (0, 5) for (5, 0)) as long as they are in the correct places. The negative intercepts must be exact as shown or equivalent. The graphs must cross the axes at these points and you can ignore any other intercepts.	B1
	Note that labels for g(x) and $\text{g}^{-1}(x)$ are not required		
			(3)
			(10 marks)

(a)

M1: For attempting $\text{fg}(x)$ in the correct order.

dM1: For proceeding to $x^2 = \ldots$ **Depends on the first mark**.

A1: For $x^2 = 13$ which may be implied by $x = \sqrt{13}$

A1: For $x = -\sqrt{13}$ only

Note that in (a) some candidates may take an alternative approach for the first mark:

$$\mathrm{fg}(x) = 3 \Rightarrow \mathrm{g}(x) = \mathrm{f}^{-1}(3) = -21 \Rightarrow 5 - 2x^2 = -21$$

Score M1 for finding $\mathrm{f}^{-1}(3)$ and setting $\mathrm{g}(x) = \mathrm{f}^{-1}(3)$ then as main scheme

or

$$\mathrm{fg}(x) = 3 \Rightarrow \mathrm{g}(x) = \mathrm{f}^{-1}(3) = -21 \Rightarrow x = \mathrm{g}^{-1}(-21)$$

Score M1 for finding $\mathrm{f}^{-1}(3)$ and setting $\mathrm{g}^{-1}\mathrm{f}^{-1}(3) = x$ then as main scheme

(b)

M1: For attempting to change the subject. In the attempt shown in the mark scheme score when both terms in x have been isolated and set on one side of the equation

A1: For $x = \dfrac{5y+6}{y-4}$ or equivalent such as $x = 5 + \dfrac{26}{y-4}$

If the x and y have been swapped award for $y = \dfrac{5x+6}{x-4}$ or equivalent.

A1: Requires both the expression in x **and** the domain.

$\mathrm{f}^{-1}(x) = \dfrac{5x+6}{x-4} \quad x \neq 4$ or $\mathrm{f}^{-1}(x) = \dfrac{5x+6}{x-4} \quad x \in \mathbb{R}, x \neq 4$ (Condone $\mathrm{f}^{-1} = \ldots$)

Do **not** allow $y = \ldots$

(c) See scheme

Question Number	Scheme	Marks
5(a)	States or implies that $\log_{10} p = 0.32$ **or** $\log_{10} q = \frac{0.56-0.32}{8}$	M1
	p = awrt 2.089 **or** q = awrt 1.072	A1
	States or implies that $\log_{10} p = 0.32$ **and** $\log_{10} q = \frac{0.56-0.32}{8}$	M1
	p = awrt 2.089 **and** q = awrt 1.072	A1
		(4)
(b)	States or implies that $\frac{\mathrm{d}A}{\mathrm{d}t} = p \ln q \times q^t$ with their values for p and q	M1 A1
	Rate of increase in pond weed after 6 days is 0.22 (m^2/day)	A1
		(3)
		(7 marks)

(a)

M1: States or implies that $\log_{10} p = 0.32$ **or** $\log_{10} q = \frac{0.56-0.32}{8}$ or equivalent equations

A1: p = awrt 2.089 **or** q = awrt 1.072

M1: States or implies that $\log_{10} p = 0.32$ **and** $\log_{10} q = \frac{0.56-0.32}{8}$ or equivalent equations

A1: p = awrt 2.089 **and** q = awrt 1.072

(b)

M1: Uses $\frac{\mathrm{d}}{\mathrm{d}t} q^t \to kq^t \quad k \neq 1$

A1: States or implies that $\frac{\mathrm{d}A}{\mathrm{d}t} = p \ln q \times q^t$ with their values for p and q

A1: awrt 0.22 Units are not required

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Alt (b) using $\log_{10} A = 0.03t + 0.32$ as a starting point

M1: Attempts to differentiate and reaches $\frac{1}{A}\frac{\mathrm{d}A}{\mathrm{d}t} = k$ or equivalent

A1: $\frac{1}{A \ln 10}\frac{\mathrm{d}A}{\mathrm{d}t} = 0.03$

A1: awrt 0.22 Units are not required