Question	Scheme	Marks	AOs
8(a)	$\mathrm{fg}(2)=4-3\left(\dfrac{5}{2(2)-9}\right)^2=\ldots$	M1	1.1b
	$\mathrm{fg}(2)=1$	A1	1.1b
		(2)	
(b)	$y=\dfrac{5}{2x-9}\Rightarrow 2xy-9y=5\Rightarrow 2xy=5+9y$	M1	1.1b
	$2xy=5+9y\Rightarrow x=\dfrac{5+9y}{2y}$	A1	2.1
	$g^{-1}(x)=\dfrac{5+9x}{2x} x\neq 0\{x\in\mathbb{R}\}$	A1	2.5
		(3)	
(c)(i)	$\{\mathrm{gf}(x)=\}\ \dfrac{5}{2(4-3x^2)-9}$	M1	1.1b
	$=\dfrac{5}{-1-6x^2}$ or $\dfrac{-5}{1+6x^2}$	A1	1.1b
(ii)	$-5\leqslant \mathrm{gf}(x)<0$	B1	2.2a
		(3)	
(d)	$\mathrm{f}(x)=\mathrm{h}(x)\Rightarrow 4-3x^2=2x^2-6x+k$ $\Rightarrow 5x^2-6x+k-4=0$	M1	1.1b
	$b^2-4ac<0\Rightarrow 36-4(5)(k-4)<0\Rightarrow k>\ldots$	dM1	3.1a
	$k>5.8$ o.e.	A1	2.2a
		(3)	
			(11 marks)

Notes

(a)

M1: Correct method, e.g. attempts to find g(2) $\left(=\dfrac{5}{4-9}\right)$ and substitutes its value into f to achieve a value.

Alternatively, attempts $\mathrm{fg}(x)=4-3\left(\dfrac{5}{2x-9}\right)^2$, condoning slips, and substitutes $x=2$ to achieve a value.

A1: Correct answer only. If gf(2) is also attempted, then mark the final attempt which is the most complete.

(b)

M1: Eliminates the fraction and puts the *xy* term (or *x* term) onto one side of the equation. Alternatively swaps *x*'s and *y*' s, eliminates the fraction and puts the *xy* term (or *y* term) onto one side of the equation. Condone minor slips in rearranging e.g. $-9y$ instead of $+9y$

A1: Correct expression for the inverse, *x* in terms of *y* or *y* in terms of *x*. Need not be simplified.

Note that $y=\dfrac{5}{2x-9}\Rightarrow 2x-9=\dfrac{5}{y}\Rightarrow 2x=\dfrac{5}{y}+9$ is M1 and $\Rightarrow x=\dfrac{\frac{5}{y}+9}{2}$ is A1

A1: Fully correct notation for the inverse including its domain and including the e.g. $g^{-1} =$. Condone $x \neq 0$ without $x \in \mathbb{R}$ Need not be simplified.
Do not be too worried about g^{-1} looking a bit like y^{-1} due to poor handwriting but if it is clearly y^{-1} then withhold this mark.

Accept e.g. $g^{-1}(x) = \frac{5+9x}{2x} x \in \mathbb{R}, x \neq 0$ **or** $g^{-1}(x) = \frac{5}{2x} + \frac{9}{2} \quad x \neq 0$ **or** $g^{-1} = \frac{\frac{5}{x}+9}{2} \quad x \neq 0$

Ignore any reference to the range of g.

(c)(i)

M1: Correct method. Attempts to substitute f into g, condoning slips, e.g. missing the 3.

A1: Correct simplified fraction. Ignore any reference to domains. Do not isw.
There is no need to include the gf(x) =
If fg(x) is also attempted, then mark the final attempt which is the most complete.

(ii)

B1: Deduces the correct range. May be scored even if gf(x) is incorrect (but not a follow through).
Allow e.g. $-5 \leqslant y < 0$, $y \in [-5, 0)$, $[-5, 0)$
Do not allow e.g. $-5 \leqslant x < 0$, $y \in (-5, 0)$, $-5 \leqslant f(x) < 0$, $-5 \leqslant g(x) < 0$

(d)

M1: Sets f(x) = h(x) and attempts to collect terms to obtain a 3TQ = 0
The = 0 may be implied by use of the discriminant. Condone copying slips in f(x) and h(x).

dM1: Recognises the need to use "$b^2 - 4ac \ldots 0$" on their 3TQ and uses this to establish a value or range of values for k. Allow for an attempt to solve $b^2 - 4ac \ldots 0$ or $b^2 \ldots 4ac$, which must be in terms of k only, where ... is an equality or any inequality.

(Alt 1) Attempts to complete the square for their 3TQ (usual rules) and uses its minimum value set … 0 to establish a value or range of values for k. Their expression for the minimum value must be in terms of k only. Condone any equality or inequality when comparing their minimum value to 0.

e.g. $5x^2 - 6x + k - 4 \rightarrow 5\left(x - \frac{3}{5}\right)^2 - \frac{29}{5} + k \rightarrow "-\frac{29}{5} + k" > 0 \Rightarrow k > \ldots$ scores dM1

(Alt 2) Differentiates their 3TQ with respect to x to achieve a linear expression, sets = 0 (which may be implied), solves for x and substitutes x back into their 3TQ set … 0 to establish a value or range of values for k. Here … can be any equality or inequality.
e.g. $5x^2 - 6x + k - 4 \rightarrow 10x - 6 \rightarrow x = 0.6 \Rightarrow 5(0.6)^2 - 6(0.6) + k - 4 > 0 \Rightarrow k > \ldots$ scores dM1

A1: Deduces the correct range for k, e.g. $k > \frac{29}{5}$ o.e. Must be in terms of k and not e.g. x

Accept e.g. $k \in (5.8, \infty)$ or just $\left(\frac{29}{5}, \infty\right)$ but **not** e.g. $k \ldots \frac{29}{5}$ or $x > \frac{29}{5}$ or $[5.8, \infty)$