Question 3 **(25 marks)**

(a) $f(x) = 6x - 5$ and $g(x) = \frac{x+5}{6}$. Investigate if $f\big(g(x)\big) = g\big(f(x)\big)$.

(b) The real variables y and x are related by $y = 5x^2$.

(i) The equation $y = 5x^2$ can be rewritten in the form $\log_5 y = a + b\log_5 x$. Find the value of a and the value of b.

(ii) Hence, or otherwise, find the real values of $\boldsymbol{y}$ for which

$$\log_5 y = 2 + \log_5\left(\frac{126}{25}x - 1\right).$$

Q3	Model Solution – 25 Marks	Marking Notes
(a)	$fg(x) = f\left(\frac{x+5}{6}\right)$ $fg(x) = 6\left(\frac{x+5}{6}\right) - 5 = x$ $gf(x) = g(6x-5)$ $gf(x) = \frac{(6x-5)+5}{6} = \frac{6x}{x} = x$	**Scale 10C (0, 4, 8, 10)** *Low Partial Credit:* $f\left(\frac{x+5}{6}\right)$ $g(6x-5)$ Particular case verification *High Partial Credit:* One correct composition simplified to x
(b) (i)	$\log_5 y = \log_5 5x^2$ $\log_5 y = \log_5 5 + \log_5 x^2$ $\log_5 y = 1 + 2\log_5 x$ $a = 1$ and $b = 2$	**Scale 5C (0, 3, 4, 5)** *Low Partial Credit:* $\log_5 5x^2 = \log_5 y$ $\log_5 y = \log_5 5x^2$ *High Partial Credit:* $\log_5 y = \log_5 5 + \log_5 x^2$
(b) (ii)	$\log_5 y = \log_5 5x^2 = 2 + \log_5\left(\frac{126x}{25} - 1\right)$ $\log_5 5x^2 = \log_5\left(\frac{126x}{25} - 1\right) \times 25$ $5x^2 = 126x - 25$ $5x^2 - 126x + 25 = 0$ $(5x-1)(x-25) = 0$ $x = \frac{1}{5}$ **or** $x = 25$ $y = 5x^2 = 5\left(\frac{1}{5}\right)^2 2 = \frac{1}{5}$ **or** $y = 5(25)^2 = 3125$	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* Some relevant use of laws of logs *Mid Partial Credit:* Quadratic equation *High Partial Credit:* x values found **Note**: If 2 is incorrectly (non log) dealt with then award MPC at most **Note**: If incorrect work leads to a non-quadratic equation then award MPC at most