1		7, −1	P1	for strategy to use g(3) = 20, e.g. $3a + b = 20$	
			P1	for g(1) = $a + b$	
			P1	for a process to find inverse of f. e.g. $f^{-1}(x) = \frac{x-3}{5}$ or $f^{-1}(33) = 6$	
			P1	for using $f^{-1}(33)$ = g(1) to find an equation e.g. $\frac{33-3}{5} = a + b$	
			A1	for $a = 7$, $b = -1$	

2	(a)	$\frac{2}{25}$	B1	accept 0.08	
	(b)	$\frac{1}{8}$	M1	$fg(x) = \frac{2}{(4x^3)^2}$ oe **or** g(1) = 4 **or** $\frac{2}{(4\times1^3)^2}$ oe	
			A1	oe	All powers and products must be evaluated

3	(a)	shown	C1	for first step, eg $2((x + 1)^2 - 1)$ or $2(x^2 + 2x + 1 - 1)$ oe	
			C1	for fully correct chain of reasoning	It is insufficient to state $gf(x) = 2x(x + 2)$ without showing the first step, and the following sequence of algebraic steps leading to it.
	(b)	4.5	M1	process to find inverse of g, eg $g^{-1}(x) = \frac{1}{2}x + 1$ **or** for $2(x - 1) = 7$	Could be shown in the form of a flowchart, which must show inverse operations.
			A1	for 4.5 oe	

4	(a)	$\frac{x+1}{3}$	M1	first step to change the subject of $y = 3x - 1$ **or** $x = 3y - 1$, eg $y + 1 = 3x$	
			A1	oe	
	(b)	Shown	M1	for method to find fg(x), eg $fg(x) = 3(x^2 + 4) - 1$	
			M1	for method to find gf(x), eg $gf(x) = (3x - 1)^2 + 4$	
			M1	(dep on previous two M marks) for setting up equation, eg $3(x^2 + 4) - 1 = 2[(3x - 1)^2 + 4]$	
			M1	(dep 2nd M1) for correct expansion of $(3x - 1)^2$ eg $9x^2 - 3x - 3x + 1$	
			C1	for $15x^2 - 12x - 1 = 0$ from correct working	

5	(a)	Shown	C1	for $f^{-1}(x) = \sqrt[3]{\frac{x+4}{2}}$ OR for $2x^3 - 4 = 50$ OR for substituting $x = 3$ to find f(3)	
			C1	for substituting $x = 50$ to show the result giving $f^{-1}(50) = 3$ OR solving for x to give $x = 3$ OR for showing that f(3) = 50	
	(b)	$x = -1$ and $x = 2.5$	P1	for $hg(x) = (x + 2)^2$	
			P1	(dep) for start to a process to derive a quadratic equation eg. $x^2 + 4x + 4 = 3x^2 + x - 1$	$(x + 2)^2$ must be correctly expanded
			P1	for a process to solve the quadratic equation $2x^2 - 3x - 5 = 0$ eg $(2x - 5)(x + 1)$ (= 0) or $\frac{--3\pm\sqrt{(-3)^2-4\times2\times-5}}{2\times2}$ or $2\left[(x - \frac{3}{4})^2 - \frac{9}{16} - \frac{5}{2}\right]$ (= 0)	
			A1	for $x = -1$ and $x = 2.5$	2.5 or $2\frac{1}{2}$ or $\frac{5}{2}$ acceptable

6	(a)	33	B1	cao	
	(b)	27	M1	for f(9) = 12 ÷ √9 (=4) **and** a clear intention to find g("4") **or** for $3\times(2\times\frac{12}{\sqrt{9}}+1)$ **or** for stating gf eg $3(2\times\frac{12}{\sqrt{x}}+1)$ oe	
			A1	cao	
	(c)	$\frac{1}{2}$	M1	for g^{-1} as $\frac{x-3}{6}$ oe **or** for starting to solve $3(2x + 1) = 6$	Accept $\frac{y-3}{6}$
			A1	for $\frac{1}{2}$ oe	

7	(a)	$\frac{1}{4}$	M1	for f(1) = $3 \times 1^2 + 1$ (= 4) **and** a clear intention to find g("4") **or** for $\frac{4}{\left(3\times1^2+1\right)^2}$ **or** for stating gf(x), eg $\frac{4}{\left(3x^2+1\right)^2}$ oe	
			A1	oe	
	(b)	$\sqrt[4]{\frac{48}{x-1}}$	M1	for finding fg(x), eg $3\times\left(\frac{4}{x^2}\right)^2+1$ **or** $\frac{48}{x^4}+1$	
			M1	for start of method to find the inverse of fg(x), eg $y-1=3\times\left(\frac{4}{x^2}\right)^2$ **or** $y-1=\frac{48}{x^4}$ **or** $x-1=\frac{48}{y^4}$ **or** $x-1=3\times\left(\frac{4}{y^2}\right)^2$	
			M1	for $y^4=\frac{48}{x-1}$ **or** $x^4=\frac{48}{y-1}$ **or** for a final answer of $\sqrt[4]{\frac{48}{y-1}}$	
			A1	oe	