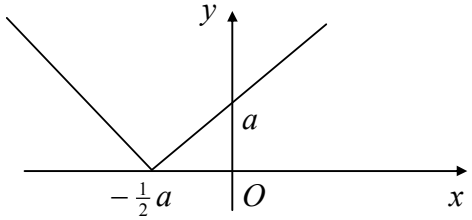
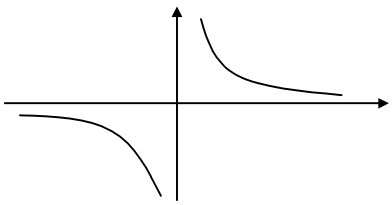
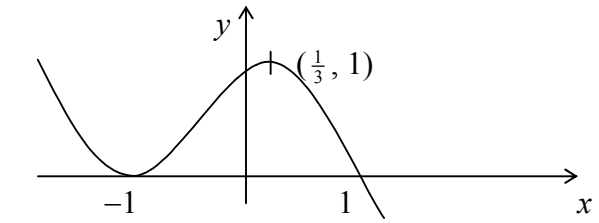
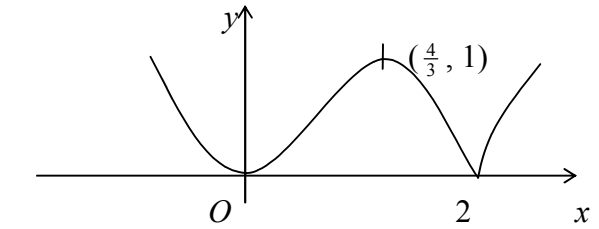
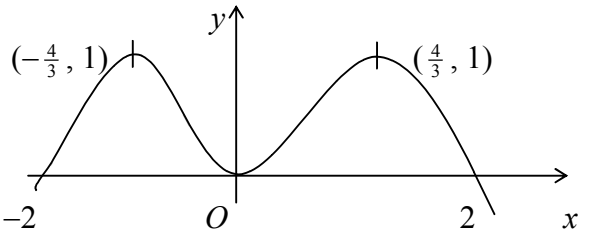
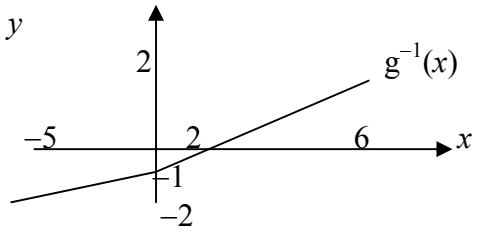
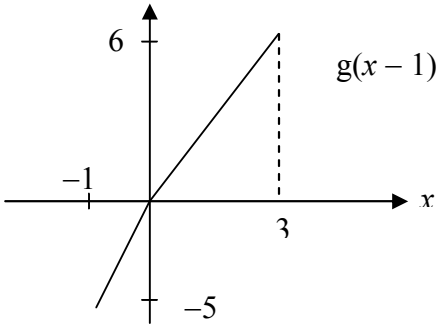
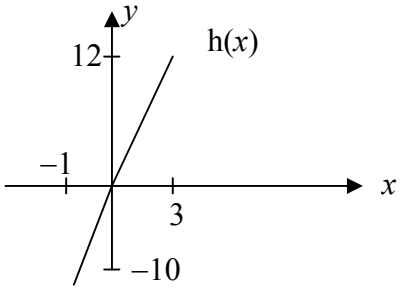
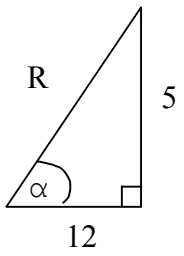
Question Number		Scheme	Marks
1.	(*a*)	$4^x = \left(2^x\right)^2 = u^2$ or $2^{(x+1)} = 2.2^x = 2u$, $\rightarrow u^2 - 2u - 15 (= 0)$	M1, A1 c.s.o (2)
	(*b*)	$u^2 - 2u - 15, = (u-5)(u+3)$	M1, A1
		$u = 5 \Rightarrow 2^x = 5 \Rightarrow x = \dfrac{\log 5}{\log 2}, = 2.32$	M1, A1 (4)
		[Ignore any other solution]	**(6 marks)**
2.	(*a*)	f`(*x*) = $0.5e^x - 2x$	M1
		f`(0) = 0.5	A1 c.s.o
		Equation of tangent at *A* is: *y* = f`(0)*x* + f(0), i.e *y* = 0.5*x* + 0.5	M1, A1 (4)
	(*b*)	f`(*x*) = 0 $\Rightarrow$ $2x = \frac{1}{2}e^x$	M1
		i.e $4x = e^x$	M1
		$\Rightarrow$ $x = \ln(4x)$ *	A1 c.s.o (3)
	(*c*)	x_1 = ln 8.6 = 2.1517622	M1
		x_2 = 2.1525814	
		x_3 = 2.152962… = 2.1530 (4dp) only	A1 c.a.o (2)
			(9 marks)
3.	(*a*)	 V graph with 'vertex' on *x*-axis $\{-\frac{1}{2}a, (0)\}$ and $\{(0), a\}$ seen	M1 A1 (2)
	(*b*)	 Correct graph (could be separate)	B1 (1)
	(*c*)	Meet where $\dfrac{1}{x} = \lvert 2x + a \rvert \Rightarrow x\lvert 2x + a \rvert - 1 = 0$; only one meet	B1 (1)
	(*d*)	$2x^2 + x - 1$	B1
		Attempt to solve; $x = \frac{1}{2}$ (no other value)	M1; A1 (3)
			(7 marks)

Question Number	Scheme	Marks
4. (*a*)	 Translation in ← or → Points correct	B1 B2, 1, 0 (–1eeoo) (3)
(*b*)	 $x < 2$ including points $x > 2$ correct reflection cusp at (2, 0) (not ∪)	B1 B1 B1 (3)
(*c*)	 correct shape $x \geq 0$ symmetry in y-axis correct maxima correct x intercepts	B1 B1 B1 B1 (4) **(10 marks)**
5. (i)	A correct form of $\cos 2x$ used $1-2\left(\frac{3}{5}\right)^2$ or $\left(\frac{4}{5}\right)^2-\left(\frac{3}{5}\right)^2$ or $2\left(\frac{4}{5}\right)^2-1$ $\left\{\frac{7}{25}\right\}$ $\sec 2x = \frac{1}{\cos 2x}$; $= \frac{25}{7}$ or $3\frac{4}{7}$	M1 A1 M1A1 (4)
(ii)	(*a*) $\frac{\cos 2x}{\sin 2x}+\frac{1}{\sin 2x}$ or (*b*) $\frac{1}{\tan 2x}+\frac{1}{\sin 2x}$ Forming single fraction (or multiplying both sides by sin2x) Use of correct trig. formulae throughout and producing expression in terms of sin x and cos x Completion (cso) e.g. $\frac{2\cos^2 x}{2\sin x\cos x} = \frac{\cos x}{\sin x} = \cot x$ **(*)**	M1 M1 M1 A1 (4) **(8 marks)**

Question Number	Scheme	Marks
6. (*a*)	$y = \dfrac{3x-1}{x-3} \Rightarrow y(x-3) = 3x-1$	M1
	$yx - 3x = 3y - 1$	
	$x(y-3) = 3y-1$	M1
	$x = \dfrac{3y-1}{y-3}$ $\therefore$ $f^{-1}(x) = \dfrac{3x-1}{x-3} = f(x)$	A1 cso (3)
(*b*)	$ff(k) = f^{-1}f(k), = k$	M1 A1 (2)
(*c*)	$g(-2) = -5$	B1
	$f(-5) = \dfrac{-15-1}{-8}, = \dfrac{-16}{-8} = 2$	M1, A1 (3)
(*d*)	shape	B1
	 (0, −1) and (2, 0)	B1
	Domain: $-5 \le x \le 6$	B1 (3)
(*e*)	 Translation +1 →	
	(lines join at (0,0))	B1
	 Stretch ×2↕	B1
	Range: $-10 \le h(x) \le 12$	B1 (3)
		(14 marks)

Question Number	Scheme	Marks
7. (*a*)	$12\cos\theta - 5\sin\theta = R\cos\theta\cos\sigma - R\sin\theta\sin\sigma$	
	 $R^2 = 5^2 + 12^2, \Rightarrow R = 13$	M1 A1
	$\tan\sigma = \frac{5}{12}, \Rightarrow \sigma = 22.6°$ (awrt 22.6)	M1, A1 (4)
	(AWRT or 0.39^c (AWRT 0.39^c)	
(*b*)	$\cos(\theta + 22.6) = \frac{4}{13}$	M1
	$\theta + 22.6 = 72.1,$	M1
	$\theta = 49.5$ (only)	A1 (3)
(ii)	$\frac{8}{\tan\theta} - 3\tan\theta = 2$	M1
	i.e. $0 = 3\tan^2\theta + 2\tan\theta - 8$	M1
	$0 = (3\tan\theta - 4)(\tan\theta + 2)$	M1
	$\tan\theta = \frac{4}{3}$ *or* -2	
	$\tan\theta = \frac{4}{3} \Rightarrow \theta = 53.1$	A1
	[*ignore* θ *not in range e.g.* $\theta = 116.6$]	A1 (5)
		(12 marks)

Question Number	Scheme	Marks
8. (*a*)	$f'(x) = \frac{3}{x} - \frac{1}{x^2}$	M1 A1
	$\frac{3}{x} - \frac{1}{x^2} = 0 \Rightarrow 3x^2 - x = 0 \Rightarrow x = \frac{1}{3}$	M1 A1 (4)
(*b*)	$y = 3\ln\left(\frac{1}{3}\right) + \frac{1}{\left(\frac{1}{3}\right)} = 3 - 3\ln 3 \quad (k = 3)$	M1 A1 (2)
(*c*)	$x = 1 \quad \Rightarrow \quad y = 1$	B1
	$f(1) = 2 \Rightarrow m = -\frac{1}{2}$	M1
	$y - 1 = -\frac{1}{2}(x - 1) \quad \left(y = -\frac{x}{2} + \frac{3}{2}\right)$	M1 A1 (4)
(*d*) (i)	$-\frac{x}{2} + \frac{3}{2} = 3\ln x + \frac{1}{x}$	M1
	leading to $6\ln x + x + \frac{2}{x} - 3 = 0$ *	A1 c.s.o
(ii)	g(0.13) = 0.273…	
	g(0.14) = -0.370… both, except 1 d.p	M1
	Sign change (and continuity) $\Rightarrow$ root $\in (0.13, 0.14)$	A1 (4)
		(14 marks)