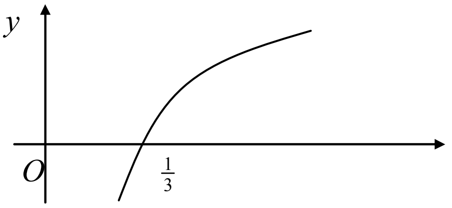
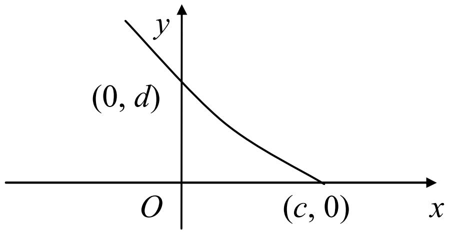
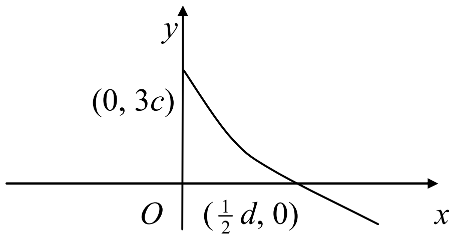
Question Number	Scheme	Marks
1.	$y = \tan x = \dfrac{\sin x}{\cos x}$	M1
	$\dfrac{dy}{dx} = \dfrac{\cos x \cos x - \sin x(-\sin x)}{\cos^2 x}$ (use of quotient rule)	M1 A1
	$= \dfrac{1}{\cos^2 x} = \sec^2 x$ *	A1
		(4 marks)
2. (*a*)	$2 + \dfrac{3}{x+2}$ $\left(= \dfrac{2(x+2)+3}{x+2}\right)$ $= \dfrac{2x+7}{x+2}$ or $\dfrac{2(x+2)+3}{x+2}$	B1 (1)
(*b*)	$y = 2 + \dfrac{3}{x+2}$ or $y = \dfrac{2x+7}{x+2}$	
	$y - 2 = \dfrac{3}{x+2}$ $y(x+2) = 2x + 7$ = $yx - 2x = 7 - 2y$	M1
	$x + 2 = \dfrac{3}{y-2}$ $x(y-2) = 7 - 2y$	M1
	$x = \dfrac{3}{y-2} - 2$ $x = \dfrac{7-2y}{y-2}$	
	$\therefore$ $f^{-1}(x) = \dfrac{3}{x-2} - 2$ $f^{-1}(x) = \dfrac{7-2x}{x-2}$ o.e	A1 (3)
(*c*)	Domain of $f^{-1}(x)$ is $x \in \mathbb{R}, x \neq 2$ [NB $x \neq +2$]	B1 (1)
		(5 marks)
3. (*a*)	$\dfrac{2}{x-3} + \dfrac{13}{(x-3)(x+7)}$	M1
	$= \dfrac{2(x+7)+13}{(x-3)(x+7)} = \dfrac{2x+27}{(x-3)(x+7)}$	M1 A1 (3)
(*b*)	$2x + 27 = x^2 + 4x - 21$	M1
	$x^2 + 2x - 48 = (x+8)(x-6) = 0$	
	$x = -8, 6$	M1 A1 (3)
		(6 marks)

Question Number	Scheme	Marks
4. (*a*)	$\dfrac{x^2+4x+3}{x^2+x} = \dfrac{(x+3)(x+1)}{x(x+1)}$ Attempt to factorise numerator or denominator	M1
	$= \dfrac{x+3}{x}$ or $1 + \dfrac{3}{x}$	A1 (2)
(*b*)	LHS = $\log_2\left(\dfrac{x^2+4x+3}{x^2+x}\right)$ Use of log *a* – log *b*	M1
	RHS = 2^4 or 16	B1
	$x + 3 = 16x$ Linear or quadratic equation in *x*	M1
	$x = \frac{3}{15}$ or $\frac{1}{5}$ or 0.2	A1 (4)
		(6 marks)
5. (i)	Choosing values of *A* and *B* and attempting to evaluate LHS and RHS of statement	M1
	Showing that LHS ≠ RHS + conclusion	A1 (2)
(ii)	Using $\tan\theta \equiv \dfrac{\sin\theta}{\cos\theta}$	M1
	to obtain $\dfrac{\sin^2\theta+\cos^2\theta}{\sin\theta\cos\theta}$	A1
	Using $\cos^2\theta + \sin^2\theta \equiv 1$	M1
	Using $2\sin\theta\cos\theta \equiv \sin 2\theta$	M1
	Leading without any error or fudge to 2 cosec 2θ	A1 cso (5)
		(7 marks)

Question Number	Scheme	Marks
6. (*a*)	LHS = $\dfrac{2\sin^2\theta}{2\sin\theta\cos\theta}$	M1 A1
	$= \dfrac{\sin\theta}{\cos\theta} = \tan\,\theta = \text{RHS}$	A1 c.s.o (3)
(*b*)	From (*a*) $\dfrac{1-\cos 2\theta}{\tan\theta} = \dfrac{1}{2}$	M1
	$\sin\,2\theta = \dfrac{1}{2}$	A1
	$2\theta = \dfrac{\pi}{6}, \dfrac{5\pi}{6}$	B1 M1
	$\theta = \dfrac{\pi}{12}, \dfrac{5\pi}{12}$	M1 A1 cao
		(6)
		(9 marks)
7. (*a*) (i)	$x = a^y$	B1 (1)
(ii)	In both sides of (i) i.e $\ln x = \ln a^y$ or $(y =)\ \log_a x = \dfrac{\ln x}{\ln a}$	
	$= y\ln a$ * $\Rightarrow y\ln a = \ln x$	B1 cso (1)
(*b*)	$y = \dfrac{1}{\ln a} \times \ln x \ ,\Rightarrow \ \dfrac{dy}{dx}, = \underline{\dfrac{1}{\ln a} \times \dfrac{1}{x}}$ *	M1, A1 cso
	$\left[\text{or} \ \dfrac{1}{x} = \dfrac{dy}{dx} \cdot \ln a \ ,\Rightarrow \ \underline{\dfrac{dy}{dx} = \dfrac{1}{x\ln a}} \ *\right]$	(2)
(*c*)	$\log_{10} 10 = 1 \quad \Rightarrow \quad$ A is $(10, \underline{1})$ $\qquad y_A = 1$	B1
	from(b) $\underline{m = \dfrac{1}{10\ln a} \ \text{or} \ \dfrac{1}{10\ln 10}}$ or 0.043 (or better)	B1
	equ of target $y - 1 = m(x - 10)$	M1
	i.e $\underline{y - 1 = \dfrac{1}{10\ln 10}(x - 10) \ \text{or} \ y = \dfrac{1}{10\ln 10}x + 1 - \dfrac{1}{\ln 10}}$ (o.e)	A1 (4)
(*d*)	$y = 0\ in(\text{c}) \Rightarrow 0 = \dfrac{x}{10\ \ln 10} + 1 - \dfrac{1}{\ln 10} \qquad \Rightarrow x, = 10\ln 10\left(\dfrac{1}{\ln 10} - 1\right)$	M1
	$x = 10 - 10\ \ln 10$ or $10\ (1 - \ln 10)$ or $\underline{\underline{10\ln 10(\dfrac{1}{\ln 10} - 1)}}$	A1 (2)
		(10 marks)

Question Number	Scheme	Marks
8. (*a*)	Shape	B1
	 $p = \frac{1}{3}$ or $\{\frac{1}{3}, 0\}$ seen	B1 (2)
(*b*)	Gradient of tangent at $Q = \dfrac{1}{q}$	B1
	Gradient of normal = $-q$	M1
	Attempt at equation of OQ [$y = -qx$] and substituting $x = q$, $y = \ln 3q$	
	or attempt at equation of tangent [$y - 3\ln q = -q(x - q)$] with $x = 0$, $y = 0$	
	or equating gradient of normal to $(\ln 3q)/q$	M1
	$q^2 + \ln 3q = 0$ (*)	A1 (4)
(*c*)	$\ln 3x = -x^2 \Rightarrow 3x = e^{-x^2}$; $\Rightarrow x = \frac{1}{3}e^{-x^2}$	M1; A1 (2)
(*d*)	$x_1 = 0.298280$; $x_2 = 0.304957$, $x_3 = 0.303731$, $x_4 = 0.303958$	M1; A1
	Root = 0.304 (3 decimal places)	A1 (3)
		(11 marks)

Question Number	Scheme	Marks
9. (*a*)	 shape	B1
	intersections with axes $(c, 0)$, $(0, d)$	B1 (2)
(*b*)	 shape	B1
	x intersection $(\frac{1}{2}d, 0)$	B1
	y intersection $(0, 3c)$	B1 (3)
(*c*)(i)	$c = 2$	B1
(ii)	$-1 < f(x) \leq$ (candidate's) c value	B1 B1 ft (3)
(*d*)	$3(2^{-x}) = 1 \Rightarrow 2^{-x} = \frac{1}{3}$ and take logs; $-x = \dfrac{\ln\frac{1}{3}}{\ln 2}$	M1; A1
	d (or x) = 1.585 (3 decimal places)	A1 (3)
(*e*)	$fg(x) = f[\log_2 x] = [3(2^{-\log_2 x}) - 1]$; $= [3(2^{\log_2 \frac{1}{x}}) - 1]$ or $\dfrac{3}{2^{\log_2 x}} - 1$	M1; A1
	$= \dfrac{3}{x} - 1$	A1 (3)
		(14 marks)