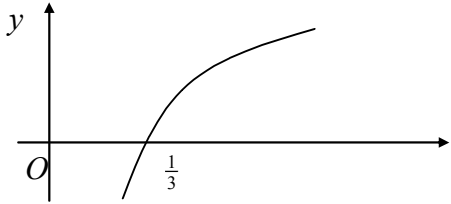
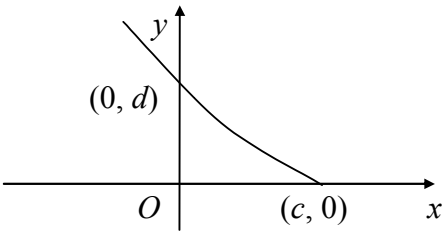
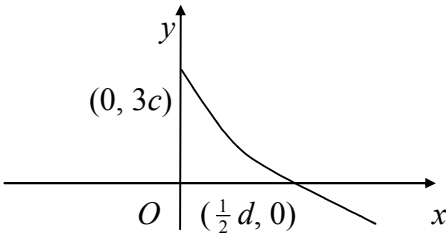


Question Number	Scheme	Marks
1.	$y = \tan x = \frac{\sin x}{\cos x}$ $\frac{dy}{dx} = \frac{\cos x \cos x - \sin x(-\sin x)}{\cos^2 x} \quad \text{(use of quotient rule)}$ $= \frac{1}{\cos^2 x} = \sec^2 x \quad *$	<p>M1</p> <p>M1 A1</p> <p>A1</p> <p>(4 marks)</p>
2.	<p>(a) $2 + \frac{3}{x+2} \left(=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

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

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

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 $Q = \frac{1}{q}$ Gradient of normal = $-q$ 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 $(\ln 3q)/q$ $q^2 + \ln 3q = 0$ (*)	B1 M1 M1 A1 (4)
(c)	$\ln 3x = -x^2 \Rightarrow 3x = e^{-x^2}; \Rightarrow x = \frac{1}{3}e^{-x^2}$	M1; A1 (2)
(d)	$x_1 = 0.298280; x_2 = 0.304957, x_3 = 0.303731, x_4 = 0.303958$ Root = 0.304 (3 decimal places)	M1; A1 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; $-x = \frac{\ln \frac{1}{3}}{\ln 2}$	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 $\frac{3}{2^{\log_2 x}} - 1$ $= \frac{3}{x} - 1$	M1; A1 A1 (3)
(14 marks)		