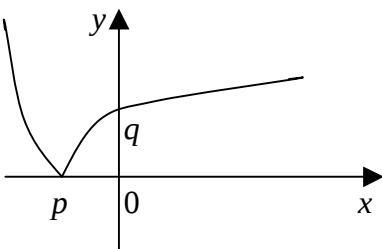
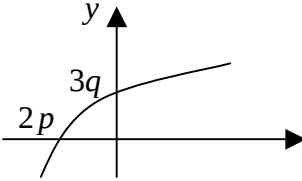
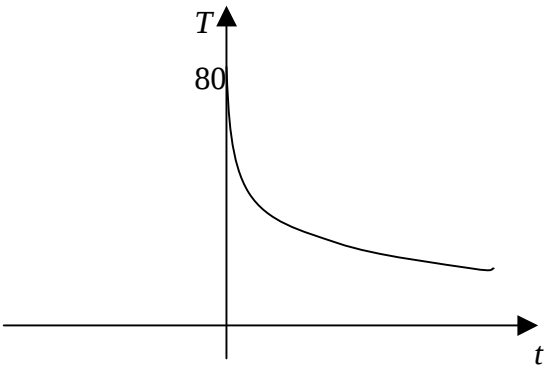


Question number	Scheme	Marks
1.	(a) $x - 2 - 3 = 1$ $x = 6$ $-(x - 2) - 3 = 1 \Rightarrow x = -2$ (b) $g(x) = x^2 - 4x + 11 = (x - 2)^2 + 7$ or $g'(x) = 2x - 4$ $g'(x) = 0 \Rightarrow x = 2$ Range: $g(x) \geq 7$. (c) $gf(-1) = g(0)$ correct order; $= 11$	B1 M1 A1 (3) M1 A1 A1 (3) M1 A1 (2) (8 marks)
2.	(a) $f(2) = 8 - 4 - 5 = -1$ method shows change of sign $f(3) = 27 - 6 - 5 = 16$ $\Rightarrow$ root with accuracy (b) $x_1 = 2.121, \quad x_2 = 2.087, \quad x_3 = 2.097, \quad x_4 = 2.094$ (c) Choosing suitable interval, e.g. [2.09455, 2.09465] $f(2.09455) = -0.00001\dots$ shows change of sign $f(2.09465) = +0.001(099\dots)$ accuracy and conclusion	M1 A1 (2) M1 A2 (1, 0) (3) M1 M1 A1 (3) (8 marks)
3.	(a) $\cos(A + B) = \cos A \cos B - \sin A \sin B$ (formula sheet) $\cos(\frac{1}{2}\theta + \frac{1}{2}\theta)$ $= \cos(\frac{1}{2}\theta) \cos(\frac{1}{2}\theta) - \sin(\frac{1}{2}\theta) \sin(\frac{1}{2}\theta) = \cos^2(\frac{1}{2}\theta) - \sin^2(\frac{1}{2}\theta)$ $= \{1 - \sin^2(\frac{1}{2}\theta)\} - \sin^2(\frac{1}{2}\theta) = 1 - 2\sin^2(\frac{1}{2}\theta)$ (b) $\sin\theta + 1 - \cos\theta = 2 \sin(\frac{1}{2}\theta) \cos(\frac{1}{2}\theta) + 2 \sin^2(\frac{1}{2}\theta)$ $= 2 \sin(\frac{1}{2}\theta) [\cos(\frac{1}{2}\theta) + \sin(\frac{1}{2}\theta)]$ [M1 use of $\sin 2A = 2 \sin A \cos A$; M1 use of (a)] (c) $2 \sin(\frac{1}{2}\theta) [\cos(\frac{1}{2}\theta) + \sin(\frac{1}{2}\theta)] = 0$ $\Rightarrow \sin(\frac{1}{2}\theta) = 0$ or $\cos(\frac{1}{2}\theta) + \sin(\frac{1}{2}\theta) = 0$ $\theta = 0$ $\tan \frac{1}{2}\theta = -1; \Rightarrow \theta = \frac{3}{2}\pi$	M1 M1 A1 (3) M1 M1 A1 (3) M1 B1 M1 A1 (4) (10 marks)

Question number	Scheme	Marks
4. (a)	$x^2 + 2x - 3 = (x + 3)(x - 1)$ $f(x) = \frac{x(x^2 + 2x - 3) + 3(x + 3) - 12}{(x + 3)(x - 1)} \quad [= \frac{x^3 + 2x^2 - 3}{(x + 3)(x - 1)}]$ $= \frac{(x - 1)(x^2 + 3x + 3)}{(x - 1)(x + 3)}$ $= \frac{(x^2 + 3x + 3)}{(x + 3)}$	B1 M1A1 M1 A1 (5)
(b)	$f'(x) = \frac{(x + 3)(2x + 3) - (x^2 + 3x + 3)}{(x + 3)^2} \quad [= \frac{x^2 + 6x + 6}{(x + 3)^2}]$ Setting $f'(x) = \frac{22}{25}$ and attempting to solve quadratic $x = 2$ (only this solution)	M1 A2, 1, 0 M1 A1 (5) (10 marks)
ALT (b)	ALT: $f(x) = x + \frac{3}{x + 3}, \quad f'(x) = 1 - \frac{3}{(x + 3)^2}$	

Question number	Scheme		Marks
5.	(a)	(i)	
			Shape correct: B1
		Intercepts	B1 (2)
		(ii)	
			Shape correct B1
		(2p, 0) on x B1	(0, 3q) on y B1 (3)
	(b)	$q = 3 \ln 3$	B1 (1)
	(c)	$\ln(2p + 3) = 0 \Rightarrow 2p + 3 = 1; \quad p = -1$	M1 A1 (2)
	(d)	$\frac{dy}{dx} = \frac{6}{2x+3}; \text{ evaluated at } x = p \quad (6)$	M1 A1
		Equation: $y = 6(x + 1)$ any form	M1 A1ft (4)
			(12 marks)

Question number	Scheme	Marks
6. (a)	$T = 80$	B1 (1)
(b)	$e^{-0.1t} \geq 0$ or equivalent	B1 (1)
(c)	Negative exponential shape $t \geq 0$, “80” clearly not $\rightarrow x$-axis 	M1 A1 (2)
(d)	$60 = 20 + 60 e^{-0.1t} \Rightarrow 60 e^{-0.1t} = 40$ $\Rightarrow -0.1 t = \ln \left(\frac{2}{3} \right)$ $t = 4.1$	M1 M1A1 A1 (4)
(e)	$\frac{dT}{dt} = -6 e^{-0.1t}$	M1A1 (2)
(f)	Using $\frac{dT}{dt} = -1.8$ Solving for t, or using value of $e^{-0.1t}$ (0.3) $T = 38$	B1 M1 A1 (3)
		(13 marks)

Question number	Scheme	Marks
7. (i)	$\frac{dy}{dx} = \sec^2 x - 2 \sin x$ When $x = \frac{1}{4}\pi$, $\frac{dy}{dx} = 2 - \sqrt{2}$	B1 B1 B1 (3)
(ii)	$\frac{dx}{dy} = \frac{1}{2} \sec^2 \frac{1}{2} y$ $\frac{dy}{dx} = \frac{2}{\sec^2\left(\frac{y}{2}\right)} = \frac{2}{1 + \tan^2\left(\frac{y}{2}\right)} = \frac{2}{1 + x^2}$	B1 M1 M1 A1 (4)
(iii)	$\frac{dy}{dx} = 2e^{-x} \cos 2x - e^{-x} \sin 2x = e^{-x} (2\cos 2x - \sin 2x)$ Method for R: $R = 2.24$ (allow $\sqrt{5}$) Method for α : $\alpha = 0.464$	M1 A1 A1 M1 A1 M1 A1 (7) (14 marks)