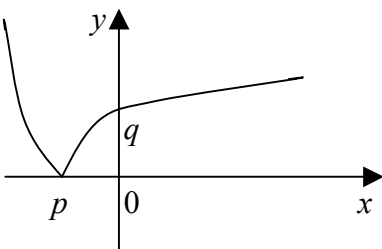
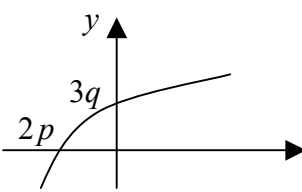
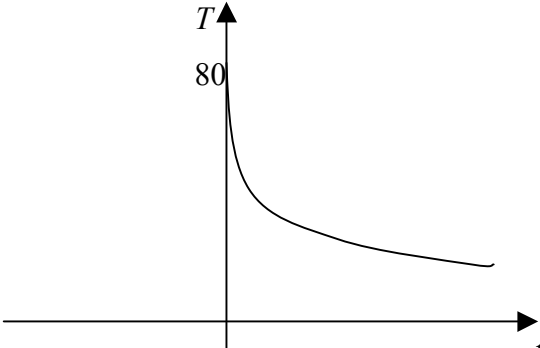


Question number	Scheme	Marks
<p>1. (a)</p> <p>(b)</p> <p>(c)</p>	$ x - 2 - 3 = 1$ $x = 6$ $-(x - 2) - 3 = 1 \Rightarrow x = -2$ $g(x) = x^2 - 4x + 11 = (x - 2)^2 + 7$ or $g'(x) = 2x - 4$ $g'(x) = 0 \Rightarrow x = 2$ Range: $g(x) \geq 7$. $gf(-1) = g(0)$ correct order; $= 11$	B1 M1 A1 (3) M1 A1 A1 (3)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

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

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

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

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