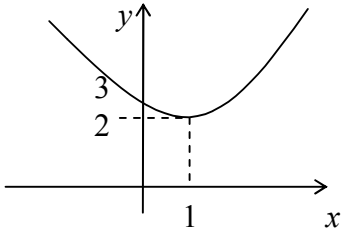
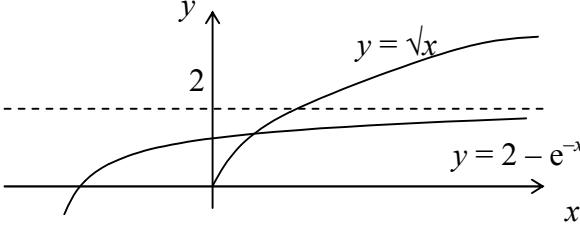

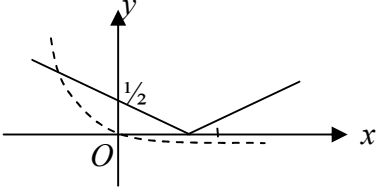



Question Number	Scheme	Marks
1.	$y = 2e^x + 3x^2 + 2 \qquad \frac{dy}{dx} = 2e^x + 6x$ <p>Evidence of differentiation M1 correct $\frac{dy}{dx}$ A1</p> <p>At (0, 4) $\frac{dy}{dx} = 2$</p> <p>Tangent at (0, 4) $y - 4 = 2x$</p>	<p>M1A1</p> <p>A1 ft</p> <p>M1 A1 cso</p> <p>(5 marks)</p>
2.	<p>$x^2 - 9 = (x - 3)(x + 3)$ seen</p> <p>Attempt at forming single fraction</p> $\frac{x(x - 3) + (x + 12)(x + 1)}{(x + 1)(x + 3)(x - 3)} = \frac{2x^2 + 10x + 12}{(x + 1)(x + 3)(x - 3)}$ <p>Factorising numerator = $\frac{2(x + 2)(x + 3)}{(x + 1)(x + 3)(x - 3)}$ or equivalent = $\frac{2(x + 2)}{(x + 1)(x - 3)}$</p>	<p>B1</p> <p>M1; A1</p> <p>M1 M1 A1</p> <p>(6 marks)</p>
3. (a)	 $x^2 - 2x + 3 = (x - 1)^2 + 2$ $f(4) = 3^2 + 2 = 11$	<p>M1</p> <p>$f \geq 2$ A1</p> <p>$f \leq 11$ B1 (3)</p>
(b)	<p>$f(2) = 3$; $\therefore 16 = gf(2) \Rightarrow 16 = 3\lambda + 1$ M for using their $f(2)$ for eqn</p> <p>$\therefore \lambda = 5$ ft their genuine $f(2)$</p>	<p>B1; M1</p> <p>A1 ft (3)</p> <p>(6 marks)</p>

Question Number	Scheme	Marks
<p>4</p>	<div style="display: flex; align-items: center;">  <div style="margin-left: 20px;"> <p>$y = \sqrt{x}$: starting (0,0)</p> <p>$y = 2 - e^{-x}$:</p> <p>shape & int. on + y-axis</p> <p>correct relative posns</p> </div> </div> <p>(b) Where curves meet is solution to $f(x) = 0$; only one intersection</p> <p>(c) $f(3) = -0.218\dots$ $f(4) = 0.018\dots$ change of sign \therefore root in interval</p> <p>(d) $x_0 = 4$ $x_1 = (2 - e^{-4})^2 = 3.92707\dots$ $x_2 = 3.92158\dots$ $x_3 = 3.92115\dots$ $x_4 = 3.92111(9)\dots$ Approx. solution = 3.921 (3 dp)</p>	<p>B1</p> <p>B1</p> <p>B1 (3)</p> <p>B1 (1)</p> <p>M1</p> <p>M1 (2)</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1 cao (4)</p> <p>(10 marks)</p>
<p>5. (a)</p>	<p>Shape  with vertex on +ve x-axis</p>  <p>(1, 0) and (0, 1/2)</p> <p>(b) $x = \alpha$ given by: $e^x - 1 = -\frac{1}{2}(x-1)$ Use of $-\frac{1}{2}(x-1)$</p> <p>$\Rightarrow 2e^x - 2 = -x + 1$, i.e. $x + 2e^x - 3 = 0$</p> <p>(c) $f(x) = x + 2e^x - 3$: $f(0) = 2 - 3 = -1$ 1 correct value to 1.s.f</p> <p>$f(-1) = -4 + 2e^1 = 1.43\dots$</p> <p>Change of sign \therefore root in $-1 < \alpha < 0$ Both correct and comment</p> <p>(d) $x_1 = -0.693(1\dots)$, $x_2 = -0.613(3\dots)$</p> <p>(e) $f(-0.575) = -0.0207\dots$ } Change of sign $f(-0.585) = 0.00498\dots$ } so root is -0.58 to 2dp.</p>	<p>B1</p> <p>B1 (2)</p> <p>M1 A1</p> <p>A1 cso (3)</p> <p>M1</p> <p>A1 (2)</p> <p>B1, B1 (2)</p> <p>M1 A1 (2)</p> <p>(11 marks)</p>

Question Number	Scheme	Marks
<p>6. (a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p>	<p>$f(x) \geq -4$</p> <p>Domain: $x \geq -4$, range: $f^{-1}(x) \geq 1$</p>  <p>Shape: Above x-axis, right way round:</p> <p>x-scale: -4</p> <p>y-intercept: 3</p> <p>$gf(x) = (x^2 - 2x - 3) - 4$</p> <p>$x^2 - 2x - 7 = 8: \quad x^2 - 2x - 15 = 0$ $(x - 5)(x + 3) = 0$ $x = 5, \quad x = -3$ (reject)</p> <p>$x^2 - 2x - 7 = -8: \quad x^2 - 2x + 1 = 0$ $x = 1$</p>	<p>B1 (1)</p> <p>B1, B1 (2)</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>B1 (4)</p> <p>M1 A1 (2)</p> <p>M1</p> <p>A1 A1ft</p> <p>M1</p> <p>A1 (5)</p> <p>(14 marks)</p>
<p>7. (a)</p> <p>(b)</p> <p>(c)</p>	<p>Differentiating; $f'(x) = 1 + \frac{e^x}{5}$</p> <p>$A: \left(0, \frac{1}{5}\right)$</p> <p>Attempt at $y - f(0) = f'(0)x;$</p> <p>$y - \frac{1}{5} = \frac{6}{5}x$ or equivalent “one line” 3 termed equation</p> <p>1.24, 1.55, 1.86</p>	<p>M1; A1 (2)</p> <p>B1</p> <p>M1</p> <p>A1 ft (3)</p> <p>B2(1,0) (2)</p> <p>(7 marks)</p>

Question Number	Scheme	Marks
8. (a)	$R = \sqrt{29} = 5.39$	B1
	$\tan \alpha = \frac{5}{2} \quad \alpha = 1.19, 0.379\pi, 68.2^\circ$	M1 A1 (3)
(b)	Max = $\sqrt{29}$ (or as in (a))	B1 ft
	at $\theta = 1.19$ (or as in (a) above)	B1 ft (2)
(c)	$T = 15 + \sqrt{29} \cos\left(\frac{\pi t}{12} - 1.19\right)$	
	Max. $T = 15 + \sqrt{29}$	M1
	20.4°C (accept 20° AWR T)	A1
	Occurs when $t = \frac{12 \times 1.19}{\pi}$	M1
	= 4.5 or 4.6 hours	A1 (4)
(d)	$12 = 15 + \sqrt{29} \cos\left(\frac{\pi t}{12} - 1.19\right)$	M1
	$\cos\left(\frac{\pi t}{12} - 1.19\right) = -\frac{3}{\sqrt{29}}$	A1 ft
	$\frac{\pi t}{12} - 1.19 = 2.16$ (2) or 4.12 (2)	M1 M1
	$t = 12.8$ (0) or 20.2 (9) (either)	A1
	i.e 0100 0r 0830 (both)	A1 (6)
		(15 marks)