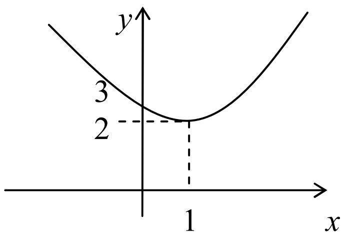
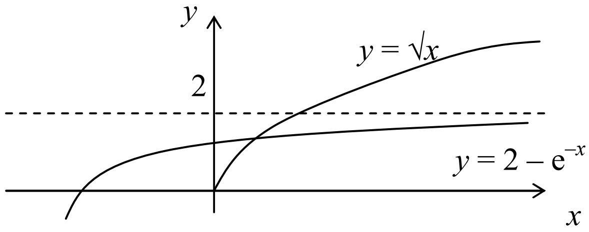
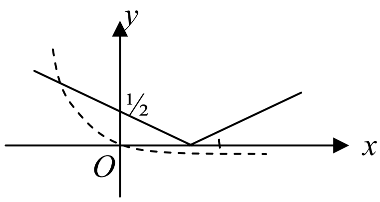
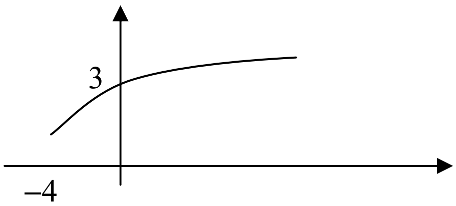
Question Number	Scheme	Marks
1.	$y = 2e^x + 3x^2 + 2$ $\qquad \frac{dy}{dx} = 2e^x + 6x$	M1A1
	Evidence of differentiation M1 $\qquad$ correct $\frac{dy}{dx}$ A1	
	At (0, 4) $\frac{dy}{dx} = 2$	A1 ft
	Tangent at (0, 4) $\qquad y - 4 = 2x$	M1 A1 cso
		(5 marks)
2.	$x^2 - 9 = (x-3)(x+3)$ seen	B1
	Attempt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

Question Number	Scheme	Marks
4		
	$y = \sqrt{x}$: starting (0,0)	B1
	$y = 2 - e^{-x}$: shape & int. on + y-axis	B1
	correct relative posns	B1 (3)
(*b*)	Where curves meet is solution to f(x) = 0; only one intersection	B1 (1)
(*c*)	f(3) = –0.218… f(4) = 0.018…	M1
	change of sign ∴ root in interval	M1 (2)
(*d*)	$x_0 = 4$ $x_1 = (2 - e^{-4})^2 = 3.92707\ldots$	M1
	$x_2 = 3.92158\ldots$	A1
	$x_3 = 3.92115\ldots$	
	$x_4 = 3.92111(9)\ldots$	M1
	Approx. solution = 3.921 (3 dp)	A1 cao (4)
		(10 marks)
5. (*a*)	 Shape ∨ with vertex on +ve x-axis	B1
	(1, 0) and (0, ½)	B1 (2)
(*b*)	$x = \alpha$ given by: $e^{-x} - 1 = -\frac{1}{2}(x-1)$ Use of $-\frac{1}{2}(x-1)$	M1 A1
	$\Rightarrow 2e^{-x} - 2 = -x + 1$, i.e. $x + 2e^{-x} - 3 = 0$	A1 cso (3)
(*c*)	$f(x) = x + 2e^{-x} - 3$: $f(0) = 2 - 3 = -1$ 1 correct value to 1.s.f	M1
	$f(-1) = -4 + 2e^{1} = 1.43\ldots$.	
	Change of sign ∴ root in $-1 < \alpha < 0$ Both correct and comment	A1 (2)
(*d*)	$x_1 = -0.693(1\ldots.)$, $x_2 = -0.613(3\ldots..)$	B1, B1 (2)
(*e*)	f(–0.575) = -0.0207… ; f(–0.585) = 0.00498… } Change of sign so root is –0.58 to 2dp.	M1 A1 (2)
		(11 marks)

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

Question Number	Scheme	Marks
8. (*a*)	$R = \sqrt{29} = 5.39$	B1
	$\tan \alpha = \frac{5}{2}$ $\alpha = 1.19, 0.379\pi, 68.2°$	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° AWRT)	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)