Question	Scheme	Marks	AOs
4	$\mathrm{f}(x) = x^3 - 6x^2 + 7x + 2, \quad x \in \mathbb{R}$		
(a)	$\mathrm{f}(x) = (x-2)(x^2 - 4x - 1)$	M1	2.2a
		A1	1.1b
		(2)	
(b) (i), (ii)	{Note: $(x-2) = 0 \Rightarrow x_Q = 2$ is known and at P, R, $(x^2 - 4x - 1) = 0$ }		
	$(x-2)^2 - 4 - 1 = 0$ **or** $x = \dfrac{4 \pm \sqrt{16 - 4(1)(-1)}}{2(1)}$	M1	1.1b
	$\Rightarrow x_P = 2 - \sqrt{5}$ and $x_R = 2 + \sqrt{5}$	A1	1.1b
		(2)	
(c)	$\sin^3\theta - 6\sin^2\theta + 7\sin\theta + 2 = 0, \quad -\pi \leqslant \theta \leqslant 12\pi,$		
	Deduces that there are 14 real solutions for $-\pi \leqslant \theta \leqslant 12\pi$	B1	2.2a
	Correct justification. E.g. Both • $\sin\theta = 2$ and $\sin\theta = 2 + \sqrt{5} = 4.236...$ have no real solutions and either • $\sin\theta = 2 - \sqrt{5} = -0.236...$ has 2 real solutions for each interval of 2π. So there are 12 real solutions in the interval $[0, 12\pi]$ and 2 real solutions in the interval $[-\pi, 0]$ • $\sin\theta = 2 - \sqrt{5} = -0.236...$ has 2 real solutions for each interval of 2π. So there are 12 real solutions in the interval $[-\pi, 11\pi]$ and 2 real solutions in the interval $[11\pi, 12\pi]$ • $\sin\theta = 2 - \sqrt{5} = -0.236...$ has 2 real solutions for each interval of 2π. So there are 14 real solutions in the interval $[-2\pi, 12\pi]$ and no real solutions in the interval $[-2\pi, -\pi]$ • $\sin\theta = 2 - \sqrt{5} = -0.236...$ has two real solutions in each of $[-\pi, 0], [\pi, 2\pi], [3\pi, 4\pi], [5\pi, 6\pi], [7\pi, 8\pi], [9\pi, 10\pi]$ and $[11\pi, 12\pi]$	B1ft	2.4
		(2)	
			(6 marks)

Question 4 Notes:	
(a)	
M1:	Deduces $(x-2)$ is a factor of $\mathrm{f}(x)$ and attempts to find a quadratic factor of $\mathrm{f}(x)$ by either equating coefficients or by algebraic long division
A1:	$(x-2)(x^2-4x-1)$
(b)	
(i), (ii)	
M1:	Correct method (i.e. completing the square or applying the quadratic formula) to solve a 3TQ. **Note:** M1 can be given here for at least one of either $2-\sqrt{5}$ or $2+\sqrt{5}$ written down in part (b).
A1:	Finds and identifies the correct exact *x* coordinate of *P* and the correct exact *x* coordinate of *R*
(c)	
B1:	Correct deduction of 14 (real solutions)
B1:	See scheme