1. Write your answer NEATLY in the space provided. [12 marks]

	QUESTION	ANSWER
(i)	Consider the one parameter family of curves $x^2 = ce^y$ where c is an arbitrary constant. The trajectory through the point $x = 0, y = 0$ which is orthogonal to the given family also passes through the point $x = 2$ and	$y = -1$
(ii)	Let $f : \mathbb{R}^2 \to \mathbb{R}$ be differentiable at $(0, 0)$. Further, for $u := (3/5, 4/5)$ and $v := (1/\sqrt{2}, 1/\sqrt{2})$, the directional derivatives are given by $D_u f(0, 0) = 12$ and $D_v f(0, 0) = -4\sqrt{2}$. Then	$f_x(0, 0) = -92$ $f_y(0, 0) = 84$
(iii)	Let $f : \mathbb{R}^3 \to \mathbb{R}$ be C^2 and $F : \mathbb{R}^3 \to \mathbb{R}^3$ be a C^2 vector field. Then	$\operatorname{curl}(\nabla f) = 0$ $\operatorname{div}(\operatorname{curl} F) = 0$
(iv)	If the equation $xy - z \log y + e^{xz} = 1$ can be solved locally as $y = f(x, z)$ around the point $(0, 1, 1)$ then $\nabla f(0, 1)$ equals	$(2, 0)$
(v)	Let Γ be the circle $x^2+y^2 = 9$ oriented positively. Then by Green's theorem $\oint_\Gamma \left((3y - e^{\sin x})dx + (7x + \sqrt{y^4 + 1})dy\right)$ equals	36π
(vi)	Let $D(r) := \{(x, y) \in \mathbb{R}^2 : x^2 + y^2 \leq r^2\}$. Then $\lim_{r\to\infty} \iint_{D(r)} e^{-(x^2+y^2)}dA$ equals	π