1. Let the curve $\alpha$ be the boundary of the region $D = \{(x,y) : 0 \leq x \leq \pi, |y| \leq \sin x\}$. Compute the integral
   \[ I = \int_{\alpha} x \, dy. \]

2. Let $D \subset \mathbb{R}^2$ be the interior of a simple closed curve $\alpha$, and let $\vec{n}$ be the outward unit normal on $\alpha$. If $\vec{f}(x,y) = \left( \frac{x + \sin x}{2y + y\cos x} \right)$ then show that there is an integer $k$ such that
   \[ \int_{\alpha} \vec{f} \cdot \vec{n} \, ds = k \cdot \text{area}(D), \]
   and find the value of $k$.

3. Let $T \subset \mathbb{R}^2$ be the plane triangle with corners $(0,0)$, $(1,1)$ and $(3,1)$. Compute
   \[ J = \iint_{T} (x^2 + y^2) \, dxdy. \]

4. Let $\beta$ be any curve in $\mathbb{R}^3$ connecting the origin to the point $(3,4,-1)$. Compute
   \[ \int_{\beta} x^2 \, dx + ydy - 2zdz. \]