1. Let $\mathbf{F}(x, y, z) = y^2 z^3 \mathbf{i} + 2xyz^3 \mathbf{j} + 3xy^2 z^2 \mathbf{k}$. If C is a line segment from $(0, 0, 0)$ to $(1, 1, 1)$, find $\int_C \mathbf{F} \cdot d\mathbf{r}$.

2. Let
$$\mathbf{F}(x, y) = (2xye^{x^2 y} + 1)\mathbf{i} + (x^2 e^{x^2 y} + 1)\mathbf{j}.$$

   (a) Is $\mathbf{F}$ conservative? If it is, find $f : \mathbb{R}^2 \to \mathbb{R}$ such that $\nabla f = \mathbf{F}$.

   (b) Let C be a curve parametrized by $\mathbf{r}(t) = (\cos t, \sin t)$ for $0 \le t \le \pi/2$. Find

   $$\int_C (2xye^{x^2 y} + 1 - y)dx + (x^2 e^{x^2 y} + 1 + x)dy.$$

   (Hint: express the vector field in the integral as $\mathbf{F} + \mathbf{G}$ for some vector field $\mathbf{G}$.)