

1. (7 points) Find the constants a and b that make \vec{F} a gradient field and then use the FTCLI to find $\int_C \vec{F} \cdot d\vec{s}$ if $\vec{F}(x, y) = \langle ax^2y + y^3 - 1, 2x^3 + bxy^2 + 2 \rangle$ and $C : \vec{r}(t) = \langle -1 + \cos(t), 3 \sin(0.5t) \rangle$ for $0 \leq t \leq \pi$.

2. (6 points) Sketch the region of integration for $I = \int_0^1 \int_{e^x}^e f(x, y) dy dx$ and then write I as an integral expression with the order of integration switched.

3. (6 points) Calculate $I = \int_0^3 \int_0^{\sqrt{9-x^2}} \int_0^{\sqrt{9-x^2-y^2}} xy \, dz \, dy \, dx$.

4. (6 points) Use a double integral to find the volume of the solid below the graph of $z = 12 - 6y$ and above the region in the xy -plane bounded by $y = x^2$ and $y = 2 - x^2$.