

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 $\vec{F}(x, y) = \langle y + \cos(\pi y), ax + bx \sin(\pi y) \rangle$ and $C : \vec{\alpha}(t) = \langle 2 \cos(t), 3 \sin(t) \rangle$ for $0 \leq t \leq \pi$.

2. (6 points) Evaluate $I = \int_0^1 \int_y^1 \cos\left(\frac{\pi x^2}{2}\right) dx dy$.

3. (6 points) Calculate $I = \int_0^1 \int_{-x}^x \int_0^{xy} 4z \, dz \, dy \, dx$.

4. (6 points) Use a double integral to find the volume of the solid below the graph of $z = 2y + x^2$ and above the region in the xy -plane bounded by $y = x^2$ and $y = x^3$.