Problem 1: Use a scalar line integral to find the length of the curve

$$\vec{r}(t) = \langle 20\sin(\frac{t}{4}), 20\cos(\frac{t}{4}), \frac{t}{2}\rangle, \text{ for } 0 \leq t \leq 2. \tag{1}$$

Problem 2: Find the work required to move an object along the line segment from $(1,1,1)$ to $(8,4,2)$ through the forcefield $\vec{F}$ given by

$$\vec{F} = \frac{\langle x, y, z\rangle}{x^2+y^2+z^2}. \tag{2}$$

Problem 3: Find the average value of

$$f(x, y) = \sqrt{4 + 9y^{2/3}} \tag{3}$$

on the curve $y = x^{3/2}$, for $0 \leq x \leq 5$.

Problem 4: Compute

$$\int_{\mathcal{C}} xe^{yz}ds, \tag{4}$$

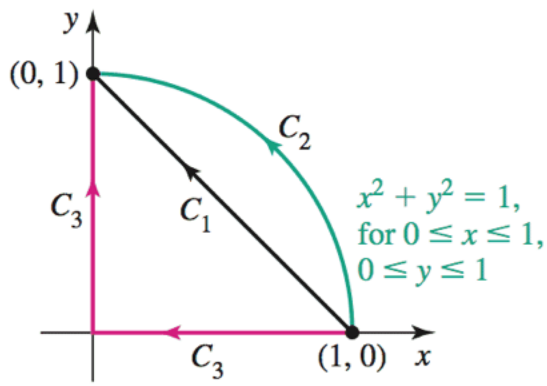
where $\mathcal{C}$ is $\vec{r}(t) = \langle t, 2t, -4t\rangle$ for $1 \leq t \leq 2$.

Problem 5: Compute

$$\int_{\mathcal{C}} \frac{xy}{z} ds, \tag{5}$$

where $\mathcal{C}$ is the line segment from $(1, 4, 1)$ to $(3, 6, 3)$.

Problem 6: Consider the rotation field $\vec{F} = \langle -y, x \rangle$, and the three paths shown in the figure.



1. Compute the work required in the presence of the force field $\vec{F}$ to move an object on the curve $\mathcal{C}_1$.
2. Compute the work required in the presence of the force field $\vec{F}$ to move an object on the curve $\mathcal{C}_2$.
3. Compute the work required in the presence of the force field $\vec{F}$ to move an object on the curve $\mathcal{C}_3$.
4. Does it appear that the line integral $\int_{\mathcal{C}} \vec{F} \cdot \vec{T} ds$ is independent of the path, where $\mathcal{C}$ is any path from $(1, 0)$ to $(0, 1)$?

Problem 7: Let $f(x, y) = x$ and consider the segment of the parabola $y = x^2$ joining $O(0, 0)$ and $P(1, 1)$.

1. Let $\mathcal{C}_1$ be the segment from O to P. Find a parameterization of $\mathcal{C}_1$, then evaluate $\int_{\mathcal{C}_1} f ds$.
2. Let $\mathcal{C}_2$ be the segment from P to O. Find a parameterization of $\mathcal{C}_2$, then evaluate $\int_{\mathcal{C}_2} f ds$.
3. Compare the results of (1) and (2).