1. \(10\) points) Evaluate the triple integral
\[
\int \int \int _{Q} yz \, dV,
\]
where \(Q\) is the cube given by \(2 \leq x \leq 6, \, 0 \leq y \leq 4, \, -1 \leq z \leq 1\).

2. \(15\) points) Consider the vector field
\[
\mathbf{F}(x, y) = (x^2 - y, y^2 + x).
\]
(a) Show that \(\mathbf{F}\) is not conservative.
(b) Use Green's Theorem to evaluate the line integral
\[
\int_{C} \mathbf{F} \cdot d\mathbf{r},
\]
where \(C\) is the circle with radius 2 and center at the origin.
3. (20 points) The region $R$ in the plane is bounded by $x = -1$, $x = 1$, $y = 1$, and $y = x^3$.

(a) Sketch $R$.
(b) Use a double integral to find the area of $R$.
(c) Compare the result to your sketch and comment.

4. (15 points) Consider the vector field $\mathbf{F}(x, y) = \langle 4y, 4x + e^y \rangle$

(a) Show that $\mathbf{F}$ is conservative and find a potential function.
(b) Calculate the work performed by $\mathbf{F}$ on a particle that moves from $(0, 0)$ to $(2, 1)$. 
5. (15 points) Let $C$ be the quarter of the ellipse

\[ \frac{x^2}{9} + y^2 = 1 \]

from $(3, 0)$ to $(0, 1)$.

(a) Sketch $C$ and find a parametrization.
(b) Calculate the line integral

\[ \int_C x + y \, ds \]
6a. (25 points) Find the volume of the solid bounded below by \( z = \sqrt{x^2 + y^2} \) and above by \( z = 2 \).

6b. (25 points) Find the volume of the solid bounded below by \( z = 1 \) and above by \( x^2 + y^2 + z^2 = 4 \).