1. (15%) Find the volume of the solid region R bounded by the surface $f(x, y) = e^{-x^2}$ and the planes $z = 0$, $y = 0$, $y = x$, and $x = 1$.

2. (15%) Find the volume of the solid region Q bounded below by the upper nappe of the cone $z^2 = x^2+y^2$ and above by the sphere $x^2 + y^2 + z^2 = 9$.

3. (15%) Let R be the region bounded by the lines $x - 2y = 0$, $x - 2y = -4$, $x + y = 4$, $x + y = 1$. Evaluate the double integral
$$\int_R\int 3xy dA.$$

4. (15%) Use Green's Theorem to evaluate the line integral
$$\int_C y^3 dx + (x^3 + 3xy^2)dy$$
where C is the path from $(0, 0)$ to $(1, 1)$ along the graph of $y = x^3$ and from $(1, 1)$ to $(0, 0)$ along the graph of $y = x$.

5. (10%) Let R be the annular region lying between the circles $x^2 + y^2 = 1$ and $x^2 + y^2 = 5$. Evaluate the integral $\int_R\int (x^2 + y)dA$.

6. (10%) Find the surface area of the portion of the plane $z = 2 - x - y$ that lies above the circle $x^2 + y^2 \leq 1$ in the first quadrant.

7. (10%) Evaluate $\int_C (x + 2)ds$, where C is the curve represented by $\mathbf{r}(t) = t\mathbf{i} + \frac{4}{3}t^{3/2}\mathbf{j} + \frac{1}{2}t^2\mathbf{k}$, $0 \leq t \leq 2$.

8. (10%) Evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$, where C is a piecewise smooth curve from $(1, 1, 0)$ to $(0, 2, 3)$ and
$$\mathbf{F}(x, y, z) = 2xy\mathbf{i} + (x^2 + z^2)\mathbf{j} + 2yz\mathbf{k}.$$