1. (5 points) Compute $\int_0^1 \int_{x^2}^1 x^2 y \, dy \, dx$.
   
   a. $\frac{1}{70}$
   
   b. $\frac{1}{35}$
   
   c. $\frac{2}{35}$
   
   d. $\frac{1}{14}$
   
   e. $\frac{1}{7}$

2. (5 points) Find the volume below the plane $z = 4x + 10y$ above the region between the parabola $y = x^2$ and the line $y = x$.
   
   a. 1
   
   b. 2
   
   c. 3
   
   d. 4
   
   e. 5

3. (5 points) Compute $\int_0^1 \int_0^{x^2} x \, dz \, dy \, dx$.
   
   a. $\frac{1}{8}$
   
   b. $\frac{1}{4}$
   
   c. $\frac{3}{8}$
   
   d. $\frac{1}{2}$
   
   e. $\frac{5}{8}$

4. (5 points) Compute $\int_0^{\pi} \int_y^{\pi} \sin(x^2) \, dx \, dy$.
   
   a. 1
   
   b. 2
   
   c. 3
   
   d. 4
   
   e. Cannot be computed.
5. (5 points) Reversing the order of integration gives \( \int_0^1 \int_0^1 f(x,y) \, dy \, dx = \)

a. \( \int_0^1 \int_0^1 f(x,y) \, dx \, dy \)
b. \( \int_0^1 \int_0^1 f(x,y) \, dx \, dy \)
c. \( \int_0^1 \int_0^1 f(x,y) \, dx \, dy \)
d. \( \int_0^1 \int_0^1 f(x,y) \, dx \, dy \)
e. \( \int_0^1 \int_0^1 f(x,y) \, dx \, dy \)

6. (5 points) Compute \( \iint_D e^{-x^2-y^2} \, dx \, dy \) over the disk \( D = \{(x,y) \mid x^2 + y^2 \leq 4\} \).

a. \( \frac{\pi}{2} (e^4 - 1) \)
b. \( \frac{\pi}{2} (1 - e^{-4}) \)
c. \( \pi (e^4 - 1) \)
d. \( \pi (1 - e^{-4}) \)
e. Cannot be computed.

7. (5 points) Find the area of one loop of the rose \( r = \sin(3\theta) \).

a. \( \frac{\pi}{12} + \frac{\sqrt{3}}{48} \)
b. \( \frac{\pi}{12} - \frac{\sqrt{3}}{48} \)
c. \( \frac{\pi}{12} + \frac{1}{24} \)
d. \( \frac{\pi}{12} - \frac{1}{24} \)
e. \( \frac{\pi}{12} \)

8. (5 points) Find the mass of the cylinder \( x^2 + y^2 \leq 4 \) for \( 0 \leq z \leq 3 \) if the density is \( \rho = x^2 + y^2 + z^2 \).

a. \( 24\pi \)
b. \( 30\pi \)
c. \( 36\pi \)
d. \( 52\pi \)
e. \( 60\pi \)
9. (20 points) Find the mass $M$ and center of mass $(\bar{x}, \bar{y})$ of the quarter of the circle $x^2 + y^2 \leq 4$ in the first quadrant if the density is $\rho = 3 + x^2 + y^2$.

HINT: By symmetry, $\bar{x} = \bar{y}$. So you only need to compute $\bar{x}$. 
10. (20 points) Compute $\iint_R x^2 y \, dx \, dy$ over the diamond shaped region $R$ bounded by

$$y = \frac{1}{x}, \quad y = \frac{2}{x}, \quad y = \frac{2}{x^2}, \quad y = \frac{4}{x^2}$$

FULL CREDIT for integrating in the curvilinear coordinates $u = xy$ and $v = x^2 y$. (Solve for $x$ and $y$.)

HALF CREDIT for integrating in rectangular coordinates.
11. (20 points) Find the volume $V$ and the $z$-component of the centroid $z$ of the hemisphere $0 \leq z \leq \sqrt{9 - x^2 - y^2}$. 