1. Evaluate the iterated integral $\int_0^9 \int_{\sqrt{y}}^3 \sin(\pi x^3) \, dx \, dy$.

2. Find the volume below the cone $z = r$ and above the unit disk centered at $r = 1, \theta = 0$.

3. Let $E$ be the spherical box defined by
   \[ E = \{(\rho, \theta, \phi) : 0 \leq \rho \leq 1, 0 \leq \theta \leq \pi/4, 0 \leq \phi \leq \pi/2\} \]
   Sketch $E$ carefully on axes labelled $x, y, z$. Then evaluate $\iiint_E \rho \sin \theta \, dV$.

4. Find the center of mass of the lamina that occupies the part of the unit disk $x^2 + y^2 \leq 1$ in the first quadrant, if the density at any point is proportional to its distance from the $x$-axis.

5. Find the surface area of that part of the paraboloid $z = 4 - x^2 - y^2$ that lies above the $x, y$-plane.

6. Let $f(x)$ and $g(y)$ be continuous functions which are odd and even respectively: that is, $f(-x) = -f(x)$ while $g(-y) = g(y)$. For each of the following integrals, say whether it is $\leq 0, \geq 0, = 0$, or impossible to tell. Give a very brief reason.
   \begin{enumerate}
   \item[(a)] $\int_0^1 \int_0^{x+1} \left( 2f(x)g(y) - f(x)^2 - g(y)^2 \right) \, dy \, dx$;
   \item[(b)] $\int_0^1 \int_{y-1}^{1-y} f(x)g(y) \, dx \, dy$;
   \item[(c)] $\int_0^1 \int_{-1}^1 f(x)g(y) \, dy \, dx$.
   \end{enumerate}

Some possibly useful integrals:
\[
\begin{align*}
\int \sin^2 u \, du &= \frac{1}{2} u - \frac{1}{4} \sin 2u + C \\
\int \cos^2 u \, du &= \frac{1}{2} u + \frac{1}{4} \sin 2u + C \\
\int \tan^2 u \, du &= \tan u - u + C \\
\int \sin^3 u \, du &= -\frac{1}{3} (2 + \sin^2 u) \cos u + C \\
\int \cos^3 u \, du &= \frac{1}{3} (2 + \cos^2 u) \sin u + C \\
\int \tan^3 u \, du &= \frac{1}{2} \tan^2 u + \ln |\cos u| + C
\end{align*}
\]