1. Set up but do not evaluate a triple integral to find the volume of the region bounded by \( x = 0 \), \( y = 0 \), \( z = 0 \), and \( 4x + 2y + 3z = 12 \).

\[
V = \int_0^3 \int_0^{2-2a} \int_0^\frac{6-3x-3y}{2} dz \, dy \, dx
\]

2. Evaluate \( \int_0^1 \int_0^{x^2} \sqrt{y} \, dy \, dx \).

\[
= \int_0^1 \left[ \frac{2}{3} y^{\frac{3}{2}} \right]_0^{x^2} \, dx
\]

\[
= \int_0^1 \frac{2}{3} x^3 \, dx
\]

\[
= \left[ \frac{1}{4} x^4 \right]_0^1
\]

\[
= \frac{1}{4}
\]
3. SET UP BUT DO NOT EVALUATE the integral(s) needed to find the surface area of \( z = 4 - x^2 - y^2 \) that lies above \( z = 3 \).

\[ S_B = \int_0^1 \int_{\sqrt{2z}}^{\sqrt{5 - 2z}} \sqrt{\left( -2z \right)^2 + (\sqrt{2z})^2} + 1 \, dx \, dz \]

4. Evaluate \( \int_R \int x \, dA \) where \( R \) is the region bounded by \( x = 0, y = x, x^2 + y^2 = 4, \) and \( x^2 + y^2 = 16. \)

\[
\begin{align*}
&= \int_0^\pi \int_0^{\sqrt{16 \cos^2 \theta}} r \cos \theta \, dr \, d\theta \\
&= \int_0^{\frac{\pi}{2}} \int_{\sqrt{r^2 / 2}}^{\sqrt{r^2 / 2} + 4} r^2 \cos \theta \, dr \, d\theta \\
&= \frac{5}{3} \left[ 1 - \frac{\sqrt{2}}{2} \right]
\end{align*}
\]
5. Evaluate \( \int_0^\pi \int_0^1 e^y \, dy \, dx \). 

\[
\int_0^\pi \int_0^1 e^y \, dy \, dx = \int_0^\pi \left[ e^y \right]_0^1 \, dx = \int_0^\pi (e - 1) \, dx = \pi (e - 1)
\]

6. SET UP BUT DO NOT EVALUATE integrals to find the y-coordinate of the center of mass of the solid bounded by \( x = 2 - x^2, y = 0, \) and \( z = 0 \).

\[
\text{Mass} = \int_0^1 \int_0^{\sqrt{2-x}} \int_0^{2-x} \, dz \, dy \, dx = \int_0^1 \int_0^{\sqrt{2-x}} (2-x) \, dy \, dx
\]

\[
\text{Moment} = \int_0^1 \int_0^{\sqrt{2-x}} \int_0^{2-x} y \, dz \, dy \, dx
\]

\[
\overline{y} = \frac{\text{Moment}}{\text{Mass}} = \frac{\int_0^1 \int_0^{\sqrt{2-x}} \int_0^{2-x} y \, dz \, dy \, dx}{\int_0^1 \int_0^{\sqrt{2-x}} (2-x) \, dy \, dx}
\]
1. A solid Q is bounded above by \( z = \sqrt{x^2 + y^2} \) and bounded below by \( z = \frac{1}{\sqrt{x^2 + y^2}} \). Consider the integral \( \iiint_E 1 \, dV \). SET UP BUT DO NOT EVALUATE.

Calculated expressions for this integral in cylindrical and spherical coordinates.

\[ x \to \rho \cos \phi, \quad y \to \rho \sin \phi, \quad z \to z. \]

2. Cylindrical

\[ x = \rho \cos \phi, \quad y = \rho \sin \phi, \quad z = z. \]

b) Spherical

\[ x = \rho \sin \phi \cos \theta, \quad y = \rho \sin \phi \sin \theta, \quad z = \rho \cos \phi. \]

4. SET UP BUT DO NOT EVALUATE the integral equivalent to \( \iint_R \sin \left( \frac{2 - x}{y} \right) \, dA \), where \( R \) is the region bounded by \( y = 0, \ y = 0, \ x + y = 1, \) and \( x + y = 2 \), by using the transformations \( u = x + y \) and \( v = x - y \).

\[ x = \frac{u + v}{2}, \quad y = \frac{u - v}{2}. \]

\[ J = \frac{1}{2} \begin{vmatrix} 1 & 1 \\ 1 & -1 \end{vmatrix} = -1. \]