1. SET UP BUT DO NOT EVALUATE the integral(s) needed to find the surface area of \( z = 4 + x^2 + y^2 \) that lies under \( z = 13 \).

2. Evaluate \( \int_{0}^{1} \int_{x^2}^{1} 4x \sin(y^2) \, dy \, dx \).
3. 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 \( x + y + z = 3. \)

4. Evaluate \( \iint_{R} 3y \, dA \) where \( R \) is the region in the first quadrant bounded by \( y = 0, \ y = x, \) \( x^2 + y^2 = 1, \) and \( x^2 + y^2 = 4. \)
5. SET UP BUT DO NOT EVALUATE integrals to find the \( y \)-coordinate of the center of mass of the solid bounded by \( z = 1 - y^2 \), \( x = 0 \), \( y = 0 \), \( z = 0 \), and \( x + z = 1 \), if the density is given by \( \rho = x \).

6. Evaluate \( \int_0^1 \int_0^{2x} \int_0^{x+y} 6xy \, dz \, dy \, dx \).

<table>
<thead>
<tr>
<th>12 Points</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>24 Points</th>
</tr>
</thead>
</table>
7. A solid $Q$ is bounded above by $x^2 + y^2 + z^2 = 4$ and bounded below by $z = \sqrt{x^2 + y^2}$.

Consider the integral $\iiint_Q e^{-(x^2 + y^2 + z^2)} \, dV$. SET UP BUT DO NOT EVALUATE equivalent expressions for this integral in cylindrical and spherical coordinates.

a) Cylindrical

b) Spherical

8. SET UP BUT DO NOT EVALUATE an integral equivalent to $\iint_R \cos \left( \frac{y-x}{y+x} \right) \, dA$,

where $R$ is the region bounded by $x = 1$, $y = 0$, $x - y = 2$, and $x - y = 3$, by using the transformation $u = x + y$, and $v = x - y$. 

12 Points

32 Points