All problems are worth 25 points. Choose one of problems 4 and 5.

1. Evaluate the double integral: 
\[ \int_0^2 \int_{2x}^4 e^{-(y/2)^2} \, dy \, dx = \int_0^2 \int_{2x}^4 \exp\left(-\frac{y^2}{4}\right) \, dy \, dx = \text{________________________} \]

2. Calculate the volume of the region of space which is the intersection of the interior of the sphere defined by \( \rho \leq a \) and the half space defined by \( z \geq -\frac{a}{2} \).
3. Evaluate the triple integral \( \iiint_S x^2 z \, dV \), where \( S \) is the intersection of the interior of a sphere of radius \( a \) centered at the origin and the half space \( z \geq 0 \).

Do one of the following two problems for 25 points. You must show the set-up of the problem to receive full credit. (10 points extra credit for both!) If both problems are done indicate which one is bonus!

4. Calculate the coordinates of the centroid of a uniform solid which is the intersection of the interior of a sphere of radius \( a \) centered at the origin and the half space \( x \leq 0 \).
5. Calculate the radius of gyration of a uniform solid hemisphere of radius $a$ about an axis perpendicular to its base and passing through the centroid of the hemisphere.