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(10) 1. Find the volume of the 3-dimensional region which is under the surface $z = 1 + xy$ and above the rectangle $0 \leq x \leq 2$, $0 \leq y \leq 3$ in the $xy$ plane.
2. Find the volume of the 3-dimensional region which is enclosed by the surfaces $y = x^2$, $y = 2x$, $z = y$ and $z = 6$.
(10) 3. Evaluate \( \int_0^2 \int_{x^2}^4 2x \cos(y^2) \, dy \, dx \) by \textbf{first reversing the order of integration}. 
(15) 4. A mass distribution occupies the region which is enclosed by the surfaces $z = 2 - x^2 - y^2$ and $z = x^2 + y^2$. The mass density function is \( \delta(x, y, z) = 2z \) units of mass/unit volume. Calculate the total mass.
5. A mass distribution occupies the region which is above the surface 
\[ z = \sqrt{x^2 + y^2} \] and under the plane \( z = 2 \). The mass density function 
is \( \delta(x, y, z) = z \sqrt{x^2 + y^2 + z^2} \) units of mass/unit volume. Use a triple 
integral in **spherical coordinate** to calculate the total mass.
6. Find the surface area of that part of the surface $z = y^2$ which is in the first octant and is above the region of the $xy$ plane bounded by the lines $y = x$, $y = 2$ and $x = 0$. 
(20) 7. The force field $\vec{F} = xy \vec{i} + x^2 \vec{j}$ acts on an object as it is moved in the plane. Find the work done by $\vec{F}$ as the object moves from (0,0) to (4,1) along the curve which is the parabola $y = x^2$ from (0,0) to (1,1) followed by the line segment from (1,1) to (4,1).