Each problem is worth 10 points. Show adequate justification for full credit. Please circle all answers and keep your work as legible as possible.

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

1. If the function \( h(x, y) = -2x + 3y + 2000 \) gives the density of field mice per square mile in Kansas (where Kansas is taken to be a rectangle with its lower left corner at the origin and other vertices at \((400,0), (400,200), \) and \((0,200))\), write an integral for the total number of field mice in Kansas.

2. Set up an iterated integral for the area of the region inside \( x^2 + y^2 = 9 \), outside \( x^2 + y^2 = 4 \), above \( y = 0 \), and below \( y = x \).
3. **Set up** iterated integrals for \( \bar{z} \), the \( z \) coordinate of the center of mass of the first-octant portion of a sphere with radius 3 and uniform density \( k \).

4. **Set up** an iterated integral for the volume of the tetrahedron with vertices \((0,0,0), (2,0,0), (0,3,0), \) and \((0,0,6)\).
5. **Set up** an iterated integral for the **surface area** of the portion of the paraboloid \( z = x^2 + y^2 \) below the plane \( z = 9 \).
6. Evaluate \( \int_0^2 \int_{\sqrt{3}}^2 \sqrt{4 + x^3} \, dx \, dy \) exactly.
7. Compute the Jacobian of the transformation \( x = \frac{1}{3}(u + v) \), \( y = \frac{1}{3}(v - 2u) \).
8. Biff is having some trouble with iterated integrals. Biff says “Man, we had this quiz and I know I did it wrong, ’cause I worked out this double integral and got zero. Volume can’t be zero, so I must have screwed up, but I went over it twenty times and I have no idea what was wrong. It wasn’t that complicated, either, the thing we integrated was just \( x \), so I don’t know how I messed up.”

Explain clearly to Biff whether zero is automatically a wrong answer for a double integral where the integrand is \( x \), and why.
9. Evaluate \( \int_{-3}^{3} \int_{0}^{\sqrt{9-x^2}} \int_{0}^{\sqrt{9-x^2-y^2}} 2dzdydx \) exactly.
10. **Set up** an iterated integral to find the volume of the solid in the first octant bounded by the elliptic cylinder \(y^2 + 4z^2 = 4\) and the plane \(y = x\).

Extra Credit (5 points possible):

Set up an iterated integral and use it to find the surface area of a sphere with radius \(R\).