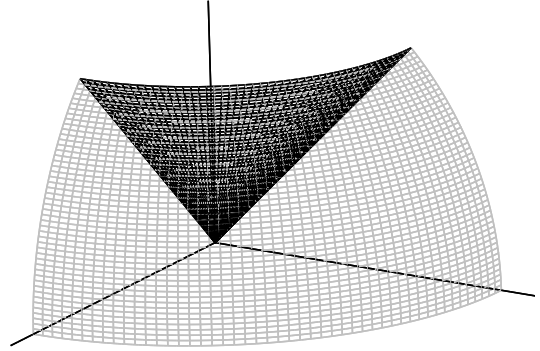


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3. (4 marks) Use Lagrange multipliers to find the minimum value of $f(x, y, z) = 4x^2 + y^2 + z^2$ subject to the constraint $2x - y + z = 4$. At what point(s) is the minimum attained?

4. (4 marks) Evaluate $\int_0^2 \int_{y^2}^4 4y \sin(x^2) dx dy$ by changing the order of integration.

5. (6 marks) Let Q be the solid region in the first octant that is inside the hemisphere $z = \sqrt{16 - x^2 - y^2}$ and below the cone $z = \sqrt{x^2 + y^2}$. If the solid has variable density $\omega(x, y, z) = k\sqrt{x^2 + y^2 + z^2}$, then find its mass m by setting up and evaluating a triple iterated integral in spherical coordinates.



6. (5 marks) Use a change of variables to find the volume of the solid region lying below the surface $z = f(x, y) = 6e^x$ and above the region R in the plane bounded by the graphs of $e^x - y = 1$, $e^x - y = 2$, $e^x + y = 1$ and $e^x + y = 2$.

