Instructions for written homework.

- You are encouraged to work with others on these problems. You are expected to write the solutions yourself.

- Your solutions should be legible and well organized. **Graders will deduct points for solutions that are difficult to read, or are disorganized.** For the benefit of the grader, please turn in solutions to problems in the assigned order, i.e. #1, then #2, then #3, etc.

- Staple your pages together. Do not turn in notebook paper with tattered edges. **Homework that is unstapled or is lacking a name will not be graded.**

Problem 1. What is the area of the region in the plane bounded by the curve given in polar coordinates by

\[ r = 4 + 2 \cos(2\theta). \]

**Problem 2 (Fall 2011).** Find the volume of the solid \( R \) bounded by the surface given in spherical coordinates by the equation

\[ \rho = (\sin \phi)^{1/3} \]

**Problem 3 (Spring 2011).** Find the volume of the solid bounded above by the paraboloid

\[ z = 5 - x^2 - y^2 \]

and below by the paraboloid

\[ z = 4x^2 + 4y^2. \]

**Problem 4 (Spring 2011).** Compute the volume of the solid bounded by the four surfaces \( x + z = 1, x + z = -1, z = 1 - y^2 \), and \( z = y^2 - 1 \).

**Problem 5 (Fall 2010).** Find the volume of the region \( R \) inside the sphere of radius 2 and above the cone

\[ \sqrt{3}z = \sqrt{x^2 + y^2}. \]

**Problem 6 (Spring 2013).** Compute the integral

\[
\int_0^1 \int_0^{2-2x} \frac{(2x - y)^2}{2x + y} dy \, dx
\]

Hint: A change of variable might help.
Problem 7 (Fall 2010). Find the volume inside the cylinder

\[ x^2 + y^2 = 1, \]

below the plane

\[ x + y + z = 2, \]

above the xy plane, and in the first octant.

Problem 8 (Fall 2010). Evaluate

\[ \iint_S (x + y)e^{x^2 - y^2} \, dA \]

where \( S \) is the rectangle with vertices \((1, 0), (0, 1), (-1/2, 1/2)\) and \((1/2, -1/2)\). Note that \( x^2 - y^2 = (x + y)(x - y) \).

Problem 9 (Fall 2011). Evaluate the integral

\[ \iint_R \cos \left( \frac{x - y}{x + y} \right) \, dA, \]

where \( R \) is the triangle in the xy-plane with vertices \((0, 0), (2, 2)\), and \((2 + \pi, 2 - \pi)\).