To prepare for the final exam, I assume that you are:

- caught-up on your reading; and
- have also studied the midterms carefully. The following may be helpful in preparing you for the remainder of the materials.

The final exam will look very much like a subset of the combined union of the following, and the three midterms.

1. What is the surface area of the surface described by $z = xy$ over the circle on the $xy$-plane which is centered at $(0,0)$ and has radius 4?

2. Find the volume of the solid that is inside the solids that are defined, in spherical coordinates, by $\rho = 2$ and $\rho = 2\sqrt{2}\cos \phi$.

3. Compute $\oint_C (xdx + ydy)$, where $C$ denotes the boundary of the triangle with vertices $(0,0), (0,1),$ and $(1,0)$.

4. Consider the surface $z = \cos(x) + \sin(y)$, where $x$ and $y$ range between 0 and $\pi/2$. Find the point at which the tangent plane is horizontal; i.e., parallel to the $xy$-plane.

5. Compute $\iiint_S (x^2 + y^2 + z^2)\,dV$ where $S$ is the region that is circumscribed by $\rho = 1$ (in spherical coordinates).

6. Consider the vector field $\mathbf{F}(x, y, z) = yi + xj + zk$. Is $\mathbf{F}$ conservative? If so, then find $f$ such that $\mathbf{F} = \nabla f$. If not, prove why it is not.

7. Given a function $\mathbf{F}(x, y, z)$ with continuous derivatives, compute $\text{div} (\text{curl} \mathbf{F})$. (The answer is a real number that you are being asked to find.)

8. Consider the solid three-dimensional sphere $G$ of radius $r$, centered at $(0,0,0)$. Use Stokes’ theorem to compute

$$\int\int_G (\text{curl} \, \mathbf{F}) \cdot \mathbf{n}\,dS,$$

where $\mathbf{F}(x, y, z) = M(x, y, z)i + N(x, y, z)j + P(x, y, z)k$.

9. What is the volume of the region, in the first octant, that is bounded by $x + y + z = 0$ and $x - y - z = 0$?