Math 13, Multivariable Calculus
Written Homework 5

1. (Ch 16.1, #26) Find the gradient vector field ∇f of $f(x, y) = \sqrt{x^2 + y^2}$ and sketch it.

2. (Ch 16.2, #16) Evaluate the line integral

$$\int_C (y + z)dx + (x + z)dy + (x + y)dz,$$

where C is the concatenation of the line segment from $(0, 0, 0)$ to $(1, 0, 1)$ with the line segment from $(1, 0, 1)$ to $(0, 1, 2)$.

3. (Ch 16.2, #32(a)) Find the work done by the force field $\mathbf{F}(x, y) = x^2\mathbf{i} + xy\mathbf{j}$ on a particle that moves once around the circle $x^2 + y^2 = 4$ oriented in the counterclockwise direction.

4. (Ch 16.2, #34) A thin wire has the shape of the first-quadrant part of the circle with center the origin and radius a. If the density function is $\rho(x, y) = kxy$, find the mass and center of mass of the wire.

5. (Ch 16.2, #42) The force exerted by a unit electric charge at the origin on a charged particle at a point (x, y, z) is $\mathbf{F}(\mathbf{r}) = \mathbf{r}/|\mathbf{r}|^3$, where $\mathbf{r} = \langle x, y, z\rangle$. Find the work done as the particle moves along a straight line from $(2, 0, 0)$ to $(2, 1, 5)$.

6. (Ch 16.3, #14) Find a potential function $f(x, y)$ for $\mathbf{F} = \langle(1 + xy)e^{xy}, x^2e^{xy}\rangle$, and evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$, where C is given by $\mathbf{r}(t) = \langle\cos t, 2\sin t\rangle$, $0 \le t \le \pi/2$.