Math 11, 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 16.3, #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 $\mathbf{r}(t) = \langle \cos t, 2\sin t \rangle$, $0 \le t \le \pi/2$.

6. (Ch 16.3, #36a) Suppose that $\mathbf{F}$ is an inverse square field; that is,

$$\mathbf{F}(\mathbf{r}) = \frac{c\mathbf{r}}{|\mathbf{r}|^3}$$

for some constant c, where $\mathbf{r} = \langle x, y, z \rangle$. Find the work done by $\mathbf{F}$ in moving an object from a point P_1 along a path to a point P_2 in terms of the distances d_1, d_2 from these points to the origin. Hint: Section 16.1 may be of help in finding a potential function.