

**Mathematics 266 – Spring 2000 — Section 201**

**First home work — due Friday, January 14**

**Exercise 1.** Find the gradients of (a)  $f(x, y) = 1/r$ ; (b)  $f(x, y, z) = 1/r$ ; (c)  $f(x, y) = 1/r^2$ . Sketch (a) and (c) on a graph, along with contour lines  $f = c$  with  $c = 1/2, 1, 3/2, 2, 5/2$ .

**Exercise 2.** Find the electric field generated by a charge distributed with density 1 along the  $z$ -axis.

**Exercise 3.** Find the electric potential for the same problem.

**Exercise 4.** Let  $V(x, y)$  be the 2D vector field  $(-y, x)$ . (a) Sketch this field. (b) Calculate the corresponding work integral along (a) the radial path from  $(0, 0)$  to  $(0, 1)$ ; (b) the path going from  $(0, 0)$  first radially to  $(1, 0)$ , then along an arc to  $(0, 1)$ .

**Exercise 5.** Same problem for  $V(x, y) = (x, y)$ .

Same problem for  $V(x, y) = (x, 2y)$ .

**Exercise 6.** You are traveling along the straight line in the direction  $[1, 1, 1]$  with speed 1, starting at  $(0, -3, 0)$ , through the electric field with  $PE = 1/r$ . (a) At what rate is the PE changing when you start? (b) When you are closest to the origin?