

1. (10 pts) A lamina occupies the region  $D = \{(x, y) : x^2 + y^2 \leq 25, x \leq y\}$  and has density  $\rho(x, y) = e^{-\sqrt{x^2+y^2}}$ . Find the mass of the lamina.
2. (10 pts) Find the volume of the solid  $E \subset \mathbb{R}^3$  that consists of all points satisfying the equations  $x^2 + y^2 + z^2 \leq 1$  and  $z \geq \sqrt{3}\sqrt{x^2 + y^2}$ . (You are given that  $\tan(\frac{\pi}{6}) = \frac{1}{\sqrt{3}}$ .)
3. (10 pts) Let  $f$  be an integrable function. Change the order of integration for the iterated integral  $\int_{-1}^1 \int_{y^2}^1 \int_0^{1-x} f(x, y, z) dz dx dy$  to be of the form  $\iiint f(x, y, z) dy dz dx$ .
4. (15 pts) Define the vector field  $\mathbf{F} = y\mathbf{i} - x\mathbf{j}$ .
  - (a) (5 pts) Draw what the vector field looks like in the square  $[0, 1] \times [0, 1]$ .  
[You must draw at least nine arrows.]
  - (b) (1 pt) On your vector field drawing in part (a), draw the curve  $C$  that starts at  $(0, 0)$  and ends at  $(1, 1)$  that follows the graph of  $y = \sqrt{x}$ .
  - (c) (4 pts) Using two to three sentences, **explain in words** whether you should expect the quantity  $\int_C \mathbf{F} \cdot d\mathbf{r}$  to be positive or negative.
  - (d) (5 pts) Compute  $\int_C \mathbf{F} \cdot d\mathbf{r}$ .