1) Electric charge is distributed over the disk $x^2 + y^2 \le 4$ so that the charge density at (x, y) is $\sigma = x + y + x^2 + y^2$ (measured in coulombs per square meter). Find the total charge on the disk.

8π Coulombs

2) Find the mass and center of mass of the lamina that occupies the region $D = \{(x, y) \mid 0 \le x \le a,\ 0 \le y \le b\}$ and has the density function $\rho(x, y) = cxy$.

$$m = \frac{1}{4}a^2b^2c,\ (\overline{x}, \overline{y}) = \left(\frac{2}{3}a, \frac{2}{3}b\right)$$

3) Find the moments of inertia I_x, I_y, I_o for the lamina bounded by the parabola $x = y^2$ and the line $y = x - 2$ and has the density function $\rho(x, y) = 3$.

$$I_x = \frac{189}{20},\ I_y = \frac{1269}{28},\ I_o = \frac{1917}{35}$$

4) The joint density function for a pair for random variables X and Y is:

$$f(x,y)=\begin{cases} Cx(1+y) & \text{if } 0\le x\le 1,\ 0\le y\le 2 \\ 0 & \text{otherwise} \end{cases}$$

a) Find the value of the constant C.

b) Find $P(X\le 1, Y\le 1)$.

c) Find $P(X+Y\le 1)$.

a) $\boxed{C=\frac{1}{2}}$

b) $\boxed{\frac{3}{8}}$

c) $\boxed{\frac{5}{48}}$

5) A lamp has two bulbs of a specific type with an average lifetime of 1000 hours. Assuming that we can model the probability of failure of these bulbs by an exponential density function with mean $\mu=1000$, find the probability that both of the lamp's bulbs fail within 1000 hours.

$$\boxed{P\left(X\le 1000,\ Y\le 1000\right)=\left(e^{-1}-1\right)^2}$$