Show all work!

1. Evaluate the integral of $f(x, y) = e^{-(x+y)}$ over the domain $\Omega = \{(x, y) : 0 \leq x, \ 0 \leq y, \ x + y \leq z\}$.

2. Reverse the order of integration and evaluate:

$$\int_0^{\sqrt{\pi/2}} \int_y^{\sqrt{\pi/2}} \sin\left(x^2\right) \ dx \ dy \tag{1}$$

3. Integrate $f(x, y) = e^{-\left(x^2 + y^2\right)}$ over the annular region $\ln(2) \leq x^2 + y^2 \leq \ln(5)$.