Answer the following questions:

Q1: (15 points)

a) For \( f(x) = \int_0^{x^2} \left( e^{-t^2} + 1 \right) dt \), compute \( F'(x) \).

b) Use the method of disks to find the volume of the solid resulting from revolving the region bounded by the curve \( y = \sqrt{x} \) on the interval \([1, 4]\) about the \( x \)-axis.

Q2: (15 points)

a) Find the area bounded by the graphs of \( y = 1 - x^2 \), \( y = x^2 - 1 \).

b) Evaluate the integral \( \int_{-2}^{-1} e^{\ln(x^2+1)} dx \).

Q3: (15 points)

a) Determine whether the improper integral \( \int_0^\infty x e^{-x} dx \) converges or diverges.

b) Evaluate \( \int \frac{x^2 - 1}{x^2 + 1} dx \).

Q4: (15 points)

a) Investigate the convergence or divergence of the series \( \sum_{k=0}^{\infty} 4 \left( \frac{1}{2} \right)^k \).

b) Find the sum of the series \( \sum_{k=1}^{\infty} \frac{1}{k(k+1)} \).