CS575 Basic Math Exercises

1. Logarithm:
   a. Find the values of the following:
      (1) \( \log_4 8 = \)  
      (2) \( \log_9 \sqrt{27} = \)
   b. Solve for the unknown:
      (1) \( \log_x 16 = \frac{4}{3} \)  
      (2) \( \ln x = -1 \)
   c. Simplify:
      (1) \( 2^{\log_2 3x} = \)  
      (2) \( \ln e^x = \)
   d. Write as a single logarithm:
      (1) \( \ln 3 + \ln 4 = \)  
      (2) \( \frac{1}{2} \log_5 49 - \frac{1}{3} \log_5 8 + 14 \log_5 1 = \)

2. Series:
   find the values of the following sequence.
   (1) 1, 3, 5, 7, ..., 99

   (2) \( 7, \frac{7}{3}, \frac{7}{9}, \frac{7}{27}, ..., \frac{7}{3^{10}} \) (assume \( 3^{10} = a \))

3. Derivative:
   (1) \( y = 4x^3 - 3x^2 + 2x + 1 \)  
   (2) \( y = x - \ln x + 1 \)

   (3) \( y = \frac{1+x}{1-x} \)  
   (4) \( y = 2^x x^2 \)
4. Using Mathematical induction to prove:

\[ 1^3 + 2^3 + 3^3 + \cdots + n^3 = (1 + 2 + 3 + \cdots + n)^2 \]

5. Please implement any one of those sorting algorithm [quick sorting, insert sorting, heap sorting, merge sorting]