Assignment One

Name	
Student number	

Direction:

Please answer all the questions below and hand in your answers before the due day. All work, must be handed in ON TIME.

Due Date:

April 7, 2022. Please hand it in by the class time.

Questions:

1. Please write the pseudocode of ***Quick Sort***.

2. Which of the following statements is/are valid? (more than one answer is possible)

A. Time Complexity of Quick Sort is $\Theta(n^2)$

B. Time Complexity of Quick Sort is $O(n^2)$

C. For any two functions $f(n)$ and g(n), we have $f(n) = \Theta(g(n))$ if and only if $f(n) = O(g(n))$ and $f(n) = \Omega(g(n))$.

D. Time complexity of all computer algorithms can be written as $\Omega(1)$

3.

(a) The 1-D Discrete Fourier Transform (**DFT**) of N samples of a signal $f(x)$ sampled at $x = 0,1,2 \ldots N-1$ is:

$$F(u) = \frac{1}{N}\sum_{x=0}^{N-1}(x)e^{\frac{-j2\pi ux}{N}}$$

for $u = 0, 1, \ldots, N-1$, and $j = \sqrt{-1}$. If $f(x)$ is generally complex, how many complex multiplications are needed to compute the Fourier Transform of the given sample?

(b) A significantly more efficient algorithm for computing the DFT is called the Fast Fourier Transform **(FFT)**. The FFT algorithm has the following recurrence relation:

$$T(n) = 2T\left(\frac{n}{2}\right) + n, \ for\ n > 1 \ with\ T(1) = 1, \ n\ is\ a\ power\ of\ 2$$

Find the complexity of the FFT.