1. Consider a sequence $[a_0, a_1, a_2, a_3]$. Let $[A_0, A_1, A_2, A_3]$ be the discrete fourier transform of this sequence. Select all the correct options below.

4 / 4 points

- [x] The 4th roots of unity are $\{1, j, -1, -j\}$.

Correct

Correct.

- [x] $A_0 = a_0 + a_1 + a_2 + a_3$.

Correct

Correct

- [x] The DFT can be viewed as evaluating the polynomial $a(x) = a_0 + a_1 x + a_2 x^2 + a_3 x^3$ for $x = 1, j, -1$ and $-j$ respectively.

Correct

Correct.

- [ ] $A_1 = a(j) = a_0 + a_1 j + a_2 - a_3 j$
- [x] $A_2 = a(-1) = a_0 - a_1 + a_2 - a_3$

Correct

Correct.

- [ ] $A_3 = a(-j) = a_0 - a_1 j + a_2 - a_3 j$
- [x] A_1 and A_3 must be complex conjugates of each other as long as the sequence a_0, a_1, a_2, a_3 consist of real numbers.

Correct

2. Let $a_0, \ldots, a_{511}$ be a sequence of real numbers obtained from sampling wind velocity with 8 samples per minute over 64 minutes (roughly 1 hour).

6 / 6 points

Suppose we compute the DFT and obtain the sequence $[A_0, \ldots, A_{n-1}]$ as the DFT coefficients.

- [x] $A_0 = \sum_{j=0}^{511} a_j$.

> **Correct**
> Correct.

- [x] $A_{256} = a_0 - a_1 + a_2 - a_3 + \cdots + a_{510} - a_{511}$.

> **Correct**
> Correct. Note that $\omega^{256} = -1$ where ω is the root $\exp \frac{2\pi j}{512}$. Thus plugging in $x = -1$ in the polynomial $a_0 + a_1 x + a_2 x^2 + \cdots + a_{511} x^{511}$.

- [ ] A_{12} and A_{499} are always complex conjugates for all real values $a_0, \ldots, a_{511}$.
- [x] A_{128} corresponds to the frequency: $8 \times \frac{128}{512} =$ per minute = 2/minute.

> **Correct**
> Correct.

- [ ] The highest frequency component is A_{511}.
- [x] The highest frequency component is A_{256} which corresponds to a frequency of 4/minute.

> **Correct**
> Correct: The frequency would be $8 \times 256/512$

- [ ] The component A_{511} is always the complex conjugate of A_1 and corresponds to a frequency of -8/minute
- [x] The reason we assign negative frequencies to components A_j for $j > \frac{n}{2}$ is because they correspond to