7.13. Determine the DFT of \( y = 32 \sin^5(2\pi ft) \) where \( f = 30 \) Hz. Use 512 points sampled over 1 second. From the imaginary part of the DFT estimate the coefficients \( a_0, a_1, a_2 \) in the relationship

\[
32 \sin^5(2\pi ft) = a_0 \sin[2\pi/ft] + a_1 \sin[2\pi(3/ft)] + a_2 \sin[2\pi(5/ft)]
\]

Repeat the process for \( y = 32 \sin^6(2\pi ft) \) where \( f = 30 \) Hz. Use 512 points sampled over 1 second. From the real part of the DFT estimate the coefficients \( b_0, b_1, b_2, b_3 \) in the relationship

\[
32 \sin^6(2\pi ft) = b_0 + b_1 \cos[2\pi(2/ft)] + b_2 \cos[2\pi(4/ft)] + b_3 \cos[2\pi(6/ft)]
\]

7.16. The following 32 data points are sampled over a period of 0.0625 second.

\[
y = [0 \ 0.9094 \ 0.4251 \ -0.6030 \ -0.6567 \ 0.2247 \ 0.6840 \ 0.1217 \\
-0.5462 \ -0.3626 \ 0.3120 \ 0.4655 \ -0.0575 \ -0.4373 \ -0.1537 \\
0.3137 \ 0.2822 \ -0.1446 \ -0.3164 \ -0.0204 \ 0.2694 \ 0.1439 \ -0.1702 \\
-0.2065 \ 0.0536 \ 0.2071 \ 0.0496 \ -0.1594 \ -0.1182 \ 0.0853 \\
0.1441 \ -0.0078]
\]

(a) Determine the DFT and estimate the frequency of the most significant component present in the data. What is the frequency increment in the DFT?

(b) To the end of the existing data, add an additional 480 zero values, thus increasing the number of data points to 512. This process is called “zero padding” and is used to improve the frequency resolution in the DFT. Determine the DFT of the new data set and estimate the frequency of the most significant component. What is the frequency increment in the DFT?