1. Draw the detailed flow diagram for a radix 4 FFT butterfly. Except for multiplies by 1, label all the branch multiply coefficients explicitly.

\[
W_{4}^{(3)(3)} = e^{-j\frac{2\pi}{4}} = e^{-j\frac{\pi}{2}} = -j
\]

2. Consider a signal \( x_c(t) \) which is sampled at 100 ksamp/sec to produce discrete-time sequence \( x[n] \). You wish to use an FFT to compute frequency values for successive \( N \)-sample-long windows of \( x[n] \). What should the value of \( N \) be so that each frequency bin output \( X[k] \) represents (spans) 100 Hz of the original \( x_c(t) \) signal? In other words, we want the separation between successive frequency bins \( X[k] \) and \( X[k+1] \) to correspond to frequency samples of \( X_c(j\Omega) \) which are separated by 100 Hz.

\[
N = \frac{10^5 \text{ Hz}}{100 \text{ Hz/bin}} = 1000 \text{ bins}
\]

3. Consider computing an \( N = 500 \) point FFT. Give the name of an efficient algorithm to use for this, the number of stages it will have, and the radix used in each stage.

Name: Cooley-Tukey Factored \( N \).

Number of stages: 5

Stage radii: (5) (5) (5) (2) (2) in any order.

you would use, how many stages it would have, and the radix used for each stage.