2. (10 marks) For the algorithm below, derive a worst-case time complexity function $T(n)$.

```plaintext
i = 1
sum = 57
finished = false
while ((i <= n) and (not finished))
    for j = 1 to i do
        if (COND(i))
            sum = sum + (i/j)
            for k = 1 to log(n) do
                sum = sum + k
        else
            sum = sum - (j/i)
            if COND(sum) then
                finished = true
                i = 57
            else
                i = i + 1
    sum = sum / i + 63
```

Note that method `COND()` runs in 4 timesteps.

3. (10 marks) For the algorithm below, derive an asymptotic worst-case, i.e., Big-Oh, complexity function $O(f(n))$. Briefly explain the reasoning behind your derivation.

```plaintext
sum = 42
for i = 1 to n * log(n) do
    j = 1
    finished = false
    for k = 1 to n do
        if COND(sum)
            sum = sum / (k * i) + j
        while ((j <= n) and (not finished)) do
            finished = true
```

Note that method `COND()` runs in $(n + 13)$ timesteps.
4. (10 marks) For the algorithm below, derive a parameterized asymptotic worst-case time complexity function.

\[
\begin{align*}
\text{sum} &= 0 \\
\text{tsum} &= -15 \\
\text{for } i = 1 \text{ to } n \text{ do} \\
& \quad \text{x} = P1(n) \\
& \quad \text{sum} = \text{sum} - x + 5 \\
& \quad \text{for } j = 1 \text{ to } n \times n \text{ do} \\
& \quad \quad \text{y} = x / (P2(n) + P1(n)) \\
& \quad \quad \text{if} \ (P3(n)) \\
& \quad \quad \quad \text{if} \ (P4(n)) \\
& \quad \quad \quad \quad \text{tsum} = \text{tsum} + \text{tsum} \\
& \quad \quad \quad \text{else} \\
& \quad \quad \quad \quad \text{for } j = 1 \text{ to } \log(n) \text{ do} \\
& \quad \quad \quad \quad \quad \text{if} \ (P4(n)) \\
& \quad \quad \quad \quad \quad \quad \text{y} = \text{y} \times i - j \\
& \quad \quad \quad \quad \quad \quad \text{tsum} = \text{tsum} / \text{y} \\
& \quad \quad \text{sum} = \text{sum} - \text{tsum} \times \text{tsum}
\end{align*}
\]

5. (12 marks) Prove or disprove the following:

a) (4 marks) \( f(n) = (n - 2)(n - 6) \) is not \( \Theta(n^2) \).

b) (4 marks) \( f(n) = n^d + 10n^2 \), where \( d \) is some integer constant greater than or equal to 2, is \( O(n^d) \).

c) (4 marks) \( f(n) = 10^{127}2^n \) is \( \Omega(3^n) \).

6. (8 marks) Determine the longest common subsequence (LCS) of the strings GAAGCCTA and TATCGA using the algorithm given on page 353 of the textbook. In the style of Figure 15.6, show the filled-in dynamic programming matrix, all matrix-cell backpointers, the backpointer path that gives an optimal LCS, and the LCS associated with that path.