Q1: \[
\begin{align*}
T_m &\leq T_{m/2} + 1 \\
T_m &\leq T_{m/2} + T_{m/2} + a-1 \\
T_m &\leq 7 T_{m/2} + a^2 \\
\end{align*}
\]

Q2: Compute \( [x_1, y_1; x_2, y_2] \) using Strassen's 7 multiplications. For the remaining two dot products, \( x_3 y_2 + y_3 x_2 \), \( x_4 y_3 + y_4 x_3 \), compute 4 products. The total is \( 7 + 4 = 11 \).

Q3: \[
\begin{align*}
(i) &\quad f_2 \cdot f_2 = 6 \\
(ii) &\quad f_2 \cdot f_3 = 10 \\
(iii) &\quad f_2 \cdot f_3 \cdot f_2 = 7 \\
(iv) &\quad f_2 \cdot f_3 \cdot f_2 \cdot f_3 = 3 \\
\end{align*}
\]

Q4: \[
N[i, j] = \sum_{k=0}^{\sigma(i/j)} N[i - k \cdot \frac{n}{\sigma(i/j)}, j - 1] 
\]

Q5: \[
\begin{align*}
(i) &\quad F \\
(ii) &\quad T \\
(iii) &\quad F
\end{align*}
\]

Q6: (i) By two horizontal cuts, split the points into three sets of size \( n \) each. Color these points white, black, and red. By the ham-sandwich theorem, we can balance each of these sets by one hyperplane cut, leaving six sets of size \( n \) in each.

(ii) 7

(iii) 45

(iv) 32

Q7: \[
T_m \leq T_{m/3} + T_{m/3} + Cm \quad \text{for some constant } C. \quad \text{The solution is} \\
T_m \leq O(m \log m) \quad \text{by observing that in a recursion tree, each} \\
\text{of the } \Theta(\log m) \text{ levels requires work proportional to } m. \quad \text{[One} \]
\text{could also use induction.]} \]

Q8. A B C D E F G H I J K