Problem 1  (16 points)

\[
\frac{\partial E}{\partial b_j} = -\sum_\ell \zeta_\ell \left( \frac{p b_j^{p-1} \delta_{j \ell} - p b_j^{p-1}}{\frac{1}{2} \sum_k (b_k^p)^2} \right) = -\sum_\ell \frac{p}{b_j} \zeta_\ell (\delta_{j \ell} - z_j) \\
= -\frac{p}{b_j} (\delta_{j e^*} - z_j) = -\frac{p}{b_j} (\zeta_j - z_j)
\]

Problem 2  (17 points)

\[
\frac{\partial E}{\partial w} = \sum_{k=1}^5 \epsilon[k] x[\arg\max_{2k-1 \leq n \leq 2k} a[n]]
\]

Problem 3  (16 points)

\[
u_0 = \frac{(e - 1)c - bf}{\lambda}, \quad v_0 = \frac{-df + (a - 1)f}{\lambda}
\]

Problem 4  (17 points)

\[
\nabla_w E = \frac{1}{n} \sum_{i=1}^n \left( (1 - \zeta_i) z_i - \zeta_i (1 - z_i) + w^T \bar{x}_i \right) \bar{x}_i^T
\]

Problem 5  (17 points)

Line segment connects \( \bar{x}_3 \), at (1, 2), to (1, 0), and passes through \( \bar{x}_0 \).

Problem 6  (17 points)

\[
y[n] = \sum_{m=1}^n \left( \frac{1}{2} \right)^{n-m+2} x[m]
\]