First, observe that market demand is:

$$p(Q) = a - b \sum_{i=1}^{i=N} q_i$$

where

$$Q = \sum_{i=1}^{i=N} q_i$$

Each firm i has therefore the following profit function:

$$\begin{aligned}
\Pi_i &= p(Q)q_i - c_i q_i \\
&= \left(a - b \sum_{i=1}^{i=N} q_i\right) q_i - c_i q_i \\
&= (a - c_i)\, q_i - b q_i \sum_{i=1}^{i=N} q_i \\
&= (a - c_i)\, q_i - b q_i \left(q_i + \sum_{j=1, j \neq i}^{j=N} q_j\right)
\end{aligned}$$

since

$$Q = \sum_{i=1}^{i=N} q_i = q_i + \sum_{j=1, j \neq i}^{j=N} q_j$$

For example, if $i = 1$ then

$$\sum_{i=1}^{i=N} q_i = q_1 + \sum_{j=2}^{j=N} q_j$$

Thus, finally, the profit of firm i is given by:

$$\Pi_i = (a - c_i)\, q_i - b q_i^2 - b q_i \sum_{j=1, j \neq i}^{j=N} q_j$$

As a result, each firm i solves the following program:

$$\max_{q_i} \left[\Pi_i = (a - c_i)\, q_i - b q_i^2 - b q_i \sum_{j=1, j \neq i}^{j=N} q_j\right]$$

The first-order condition for each firm is:

$$a - c_i - 2b q_i - b \sum_{j=1, j \neq i}^{j=N} q_j = 0$$

which is equivalent to:

$$a - c_i - bq_i - bq_i - b \sum_{j=1, j \neq i}^{j=N} q_j = 0$$

$$\Leftrightarrow a - c_i - bq_i - b \left(q_i + \sum_{j=1, j \neq i}^{j=N} q_j \right) = 0$$

$$\Leftrightarrow a - c_i - bq_i - bQ = 0$$

$$\Leftrightarrow q_i = \frac{a - c_i}{b} - Q$$