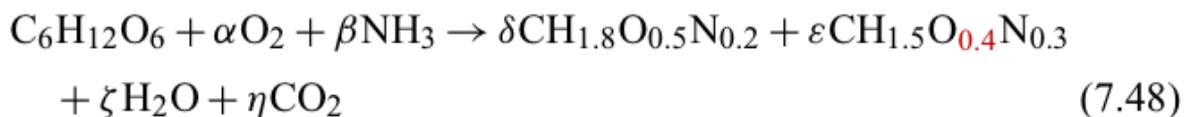


Example 7-2 Yeast is grown with glucose and ammonia to generate a recombinant protein ($\text{CH}_{1.5}\text{O}_{0.4}\text{N}_{0.3}$). The respiratory quotient is 0.2. Determine the reaction stoichiometry if the yield coefficient for biomass from glucose is 0.3 g/g.

Solution From equation 7.40, we have



We can then write the elemental balances:

$$\text{C} : 6 = \delta + \varepsilon + \eta \quad (7.49)$$

$$\text{H} : 12 + 3\beta = 1.8\delta + 1.5\varepsilon + 2\zeta \quad (7.50)$$

$$\text{O} : 6 + 2\alpha = 0.5\delta + 0.4\varepsilon + \zeta + 2\eta \quad (7.51)$$

$$\text{N} : \beta = 0.2\delta + 0.3\varepsilon \quad (7.52)$$

with additional constraints for the respiratory quotient

$$\frac{\eta}{\alpha} = 0.2 \quad (7.53)$$

and the yield coefficient

$$\frac{\delta(24.6 \text{ g/mol})}{1(180 \text{ g/mol})} = 0.3 \quad (7.54)$$

This series of equations can be written in matrix form:

$$\begin{bmatrix} 0 & 0 & 1 & 1 & 0 & 1 \\ 0 & -3 & 1.8 & 1.5 & 2 & 0 \\ -2 & 0 & 0.5 & 0.4 & 1 & 2 \\ 0 & -1 & 0.2 & 0.3 & 0 & 0 \\ 0.2 & 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 24.6 & 0 & 0 & 0 \end{bmatrix} \times \begin{bmatrix} \alpha \\ \beta \\ \delta \\ \varepsilon \\ \zeta \\ \eta \end{bmatrix} = \begin{bmatrix} 6 \\ 12 \\ 6 \\ 0 \\ 0 \\ 54 \end{bmatrix} \quad (7.55)$$

The solution to this system of equations reveals the following stoichiometry:

