Degree of freedom Analysis

Before you attempt any mass balance calculations make sure that you have enough information. The procedure to check that is called: degree of freedom analysis.

$$N_{df} = N_{unknown} - N_{independent\ equation}$$

$N_{df} = 0$ (The problem can be solved)

$N_{df} > 0$ there are more unknowns than the independent equations $\Longrightarrow$ N_{df} additional variables values must be specified.

$N_{df} < 0$ the problem may be overspecified with redundant and possibly inconsistant relation or the flowchart is incompletely labeled

Source of equations:

1) Material balance N_{ms} the number of molecular species in nonreactive system.

2) Energy balance $\xrightarrow{1\ equation}$ Provides a relation between inlet and outlet material flows and temperatures.

3) Process specification From the statment of the Problem

4) Physical Constraints i.e $\sum x_i = 1$

5) Stoichiometric relations.

$$CH_4 + 2H_2O \longrightarrow CO_2 + 3H_2$$

Provides relations between the amount of reactants consumed and the products generated