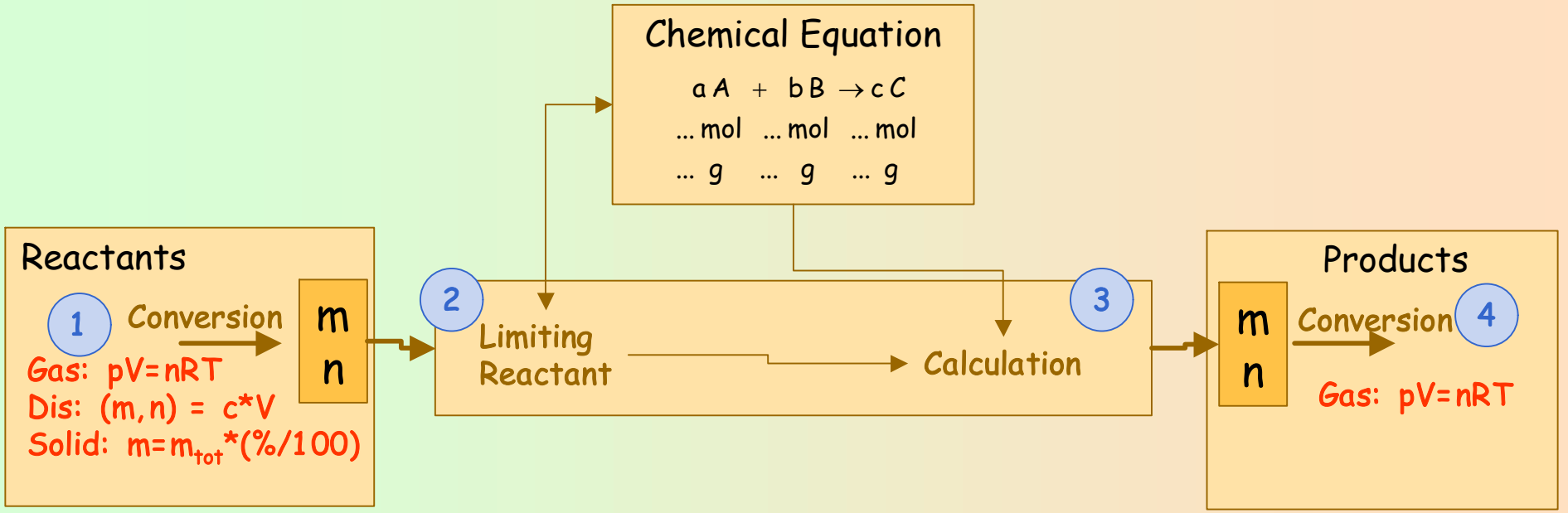
Rafa Muñoa
Lizardi Institutua
Zarautz

Chemical Calculus: Example

When hydrogen gas and nitrogen gas combine together, we get ammonia. In a container, we have 70 g of nitrogen and 80 L of hydrogen (at P=2 atm and T=17ºC)

a) **Write the balanced chemical equation**
b) **Determine the limiting reactant**
c) **Calculate the amount of ammonia in grams**
d) **Calculate the amount of the reactant in excess (in grams)**

Atomic weights: N=14; H=1; $R = 0.082 \frac{atm.L}{K.mol}$



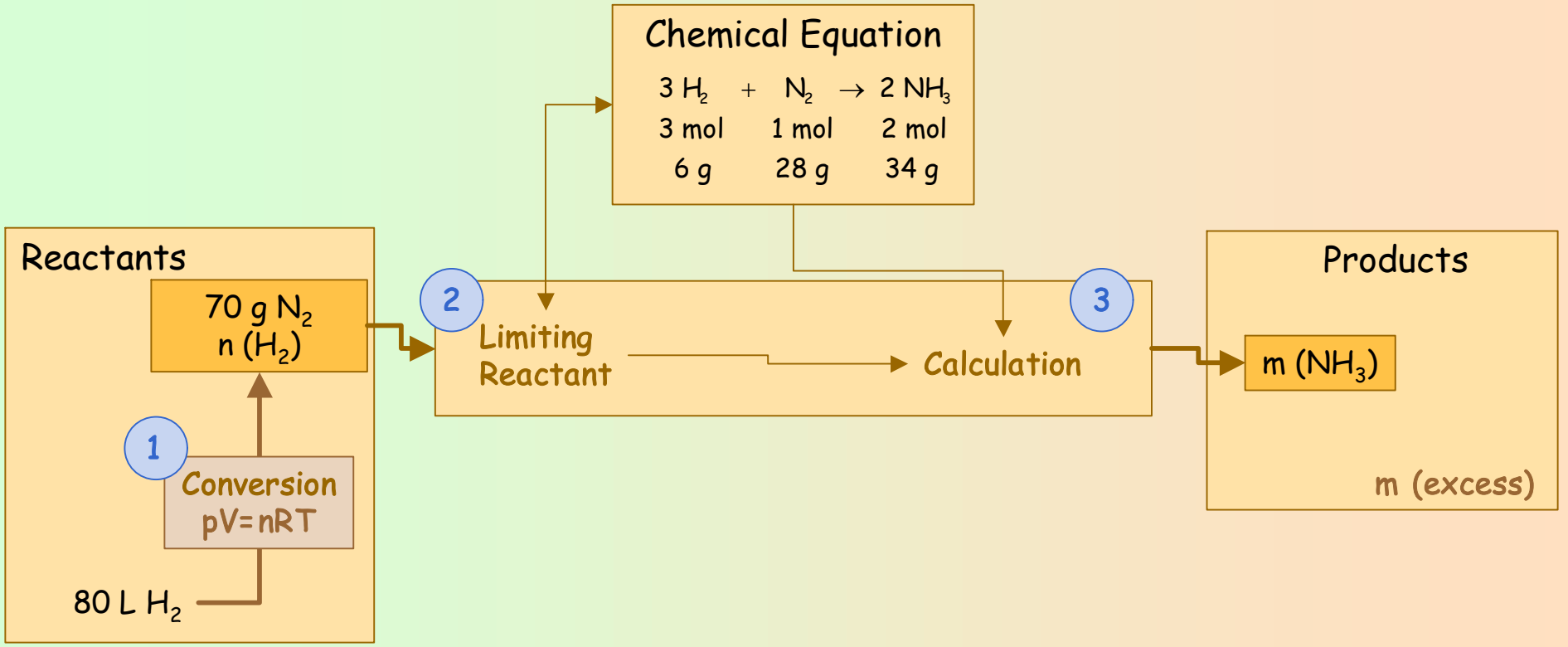
Rafa Muñoa
Lizardi Institutua
Zarautz

Chemical Calculus: Example

When hydrogen gas and nitrogen gas combine together, we get ammonia. In a container, we have 70 g of nitrogen and 80 L of hydrogen (at P=2 atm and T=17ºC)

a) **Write the balanced chemical equation**
b) **Determine the limiting reactant**
c) **Calculate the amount of ammonia in grams**
d) **Calculate the amount of the reactant in excess (in grams)**

Atomic weights: N=14; H=1; $R = 0.082 \frac{atm.L}{K.mol}$



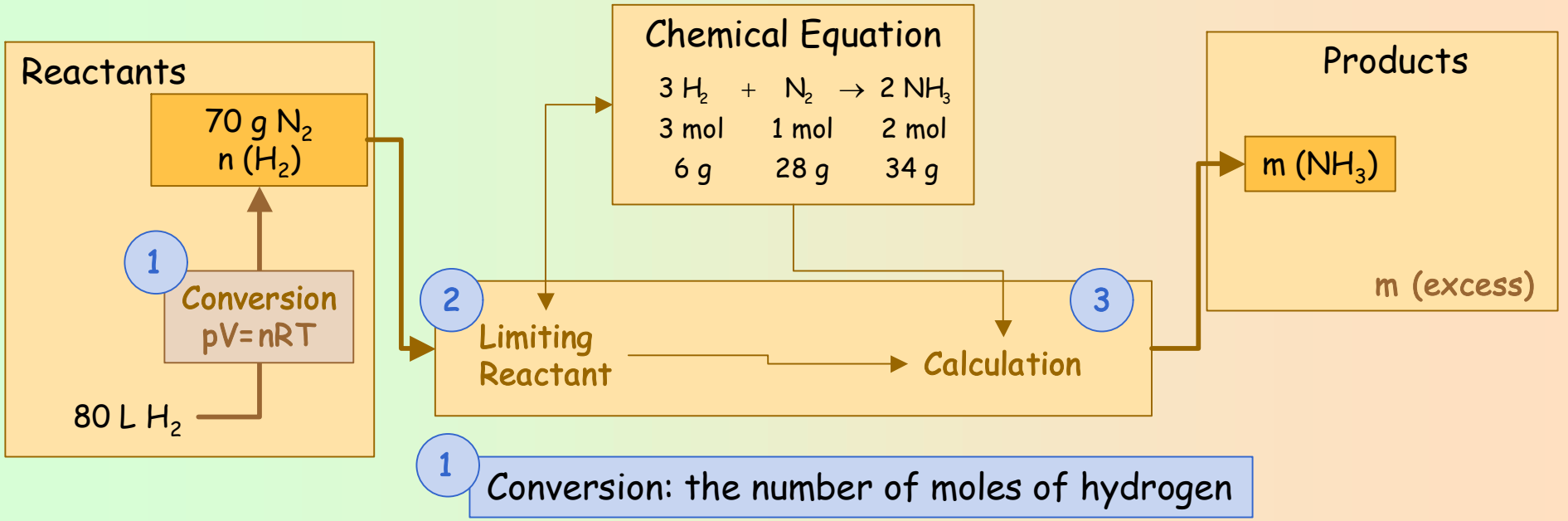
Rafa Muñoa
Lizardi Institutua
Zarautz

Chemical Calculus: Example

When hydrogen gas and nitrogen gas combine together, we get ammonia. In a container, we have 70 g of nitrogen and 80 L of hydrogen (at P=2 atm and T=17ºC)

a) **Write the balanced chemical equation**
b) **Determine the limiting reactant**
c) **Calculate the amount of ammonia in grams**
d) **Calculate the amount of the reactant in excess (in grams)**

Atomic weights: N=14; H=1; $R = 0.082 \frac{atm.L}{K.mol}$



1 Conversion: the number of moles of hydrogen

$$n(H_2) = \frac{PV}{RT} = \frac{2\ atm * 80\ L}{0.082\ \frac{atm.L}{K.mol}(273 + 17)\ K} = 6.73\ mol\ H_2$$

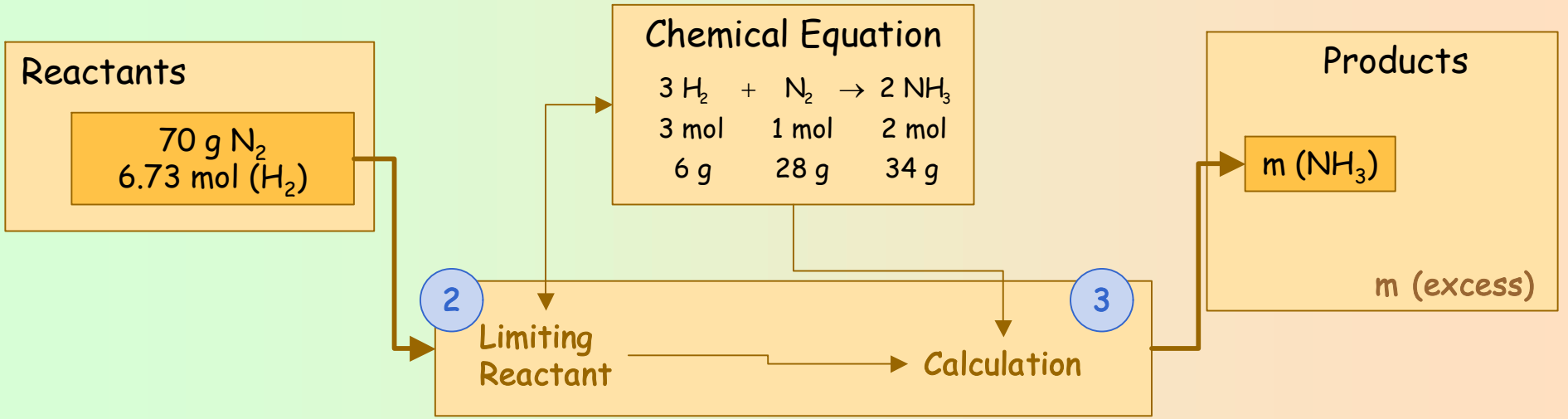
Rafa Muñoa
Lizardi Institutua
Zarautz

Chemical Calculus: Example

When hydrogen gas and nitrogen gas combine together, we get ammonia. In a container, we have 70 g of nitrogen and 80 L of hydrogen (at P=2 atm and T=17ºC)

a) **Write the balanced chemical equation**
b) **Determine the limiting reactant**
c) **Calculate the amount of ammonia in grams**
d) **Calculate the amount of the reactant in excess (in grams)**

Atomic weights: N=14; H=1; $R = 0.082 \frac{atm.L}{K.mol}$



2 Limiting Reactant

$$x(N_2) = \frac{70\ g\ N_2}{28\ g\ N_2} = 2.5 \text{ times}$$

$$x(H_2) = \frac{6.73\ mol\ H_2}{3\ mol\ H_2} = 2.24 \text{ times} \rightarrow \textbf{limiting reactant}$$

Rafa Muñoa
Lizardi Institutua
Zarautz

Chemical Calculus: Example

Chemical Equation

$3\ H_2 + N_2 \rightarrow 2\ NH_3$

3 mol 1 mol 2 mol

6 g 28 g 34 g

When hydrogen gas and nitrogen gas combine together, we get ammonia. In a container, we have 70 g of nitrogen and 80 L of hydrogen (at P=2 atm and T=17ºC)

a) Write the balanced chemical equation
b) Determine the limiting reactant
c) Calculate the amount of ammonia in grams
d) Calculate the amount of the reactant in excess (in grams)

Reactants

6.73 mol (H_2)

70 g N_2

6.73 mol H_2

62.8 g N_2

3 Calculation

Products

76.3 g NH_3

7.2 g N_2

4 N_2 (excess)

3 Calculation

$$m(NH_3) = 6.73\ mol\ H_2 \frac{34\ g\ NH_3}{3\ mol\ H_2} = 76.3\ g\ NH_3$$

4 Excess of reactant

$$\underbrace{m(N_2)}_{\text{reacts}} = \underbrace{6.73\ mol\ H_2}_{\text{hydrogen spent}} \underbrace{\frac{28\ g\ N_2}{3\ mol\ H_2}}_{\text{proportion}} = \underbrace{62.8\ g\ N_2}_{\text{nitrogen spent}}$$

$$\underbrace{m(N_2)}_{\text{excess}} = \underbrace{70\ g\ N_2}_{\text{nitrogen initial}} - \underbrace{62.8\ g\ N_2}_{\text{nitrogen spent}} = \underbrace{7.2\ g\ N_2}_{\text{nitrogen in excess}}$$