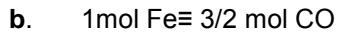
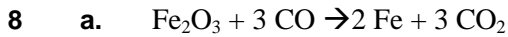


- 1 $\text{Ca(OH)}_2 \rightarrow \text{CaO} + \text{H}_2\text{O}$
 1 mol $\text{Ca(OH)}_2 \equiv 1$ mol CaO
 $2,500 \times 10^3 \text{ kg Ca(OH)}_2 = 2,500 \times 10^3 \text{ kg} : 74,09 \text{ kg/kmol} = 33,743 \text{ kmol}$
 $33,743 \text{ kmol Ca(OH)}_2 \equiv 33,743 \text{ kmol CaO} = 33,743 \text{ kmol} \times 56,08 \text{ kg/kmol} = \underline{1,892 \cdot 10^3 \text{ kg CaO}}$
- 2 $2 \text{Al}_2\text{O}_3 (\text{s}) + 3 \text{C} (\text{s}) \rightarrow 4 \text{Al} (\text{l}) + 3 \text{CO}_2 (\text{g})$
 1 mol $\text{Al} \equiv \frac{1}{2}$ mol $\text{Al}_2\text{O}_3 \equiv \frac{3}{4}$ mol CO_2
- a $1,00 \times 10^3 \text{ kg Al} = 1,00 \times 10^3 \text{ kg} : 26,98 \text{ kg/kmol} = 37,064 \text{ kmol Al}$
 $37,064 \text{ kmol Al} \equiv \frac{1}{2} \times 37,064 \text{ kmol Al}_2\text{O}_3 = 18,532 \text{ kmol Al}_2\text{O}_3$
 $18,532 \text{ kmol Al}_2\text{O}_3 = 18,532 \text{ kmol} \times 102,0 \text{ kg/kmol} = \underline{1,89 \cdot 10^3 \text{ kg Al}_2\text{O}_3}$
- b $37,064 \text{ kmol Al} \equiv \frac{3}{4} \times 37,064 \text{ kmol CO}_2 = 27,798 \text{ kmol} \times 22,4 \text{ m}^3/\text{kmol} = \underline{6,23 \cdot 10^2 \text{ m}^3 \text{ CO}_2}$
- c Benodigde hoeveelheid bauxiet $100/75 \times 1,89 \cdot 10^3 \text{ kg} = \underline{2,52 \cdot 10^3 \text{ kg}}$.
- d Massapercentage aluminium in aluminiumoxide $= 2 \times 26,98/102,0 \times 100\% = 52,90$ massa-%.
- 3 $2 \text{Al} + 3 \text{Br}_2 \rightarrow 2 \text{AlBr}_3$.
- a 1 mol $\text{Br}_2 \equiv \frac{2}{3}$ mol $\text{Al} \equiv \frac{2}{3}$ mol AlBr_3
 $6,00 \text{ g Al} = 6,00 \text{ g} : 26,98 \text{ g/mol} = 0,2224 \text{ mol Al}$. Dit reageert precies met $1\frac{1}{2} \times 0,2224 = 0,3336$ mol Br_2 . Beschikbaar is $26,0 \text{ g} : 159,8 \text{ g/mol} = 0,1627 \text{ mol Br}_2$. Aluminium is dus in overmaat aanwezig.
- b $0,1627 \text{ mol Br}_2$ reageert met $\frac{2}{3} \times 0,1627 \text{ mol Al} = \frac{2}{3} \times 0,1627 \text{ mol} \times 26,98 \text{ g/mol} = 2,93 \text{ g Al}$. Over is dan $6,00 - 2,93 = \underline{3,07 \text{ g Al}}$
- c $0,1627 \text{ mol Br}_2 \equiv \frac{2}{3} \times 0,1627 \text{ mol AlBr}_3 = \frac{2}{3} \times 0,1627 \text{ mol} \times 266,68 \text{ g/mol} = \underline{28,9 \text{ g AlBr}_3}$
- 4 a. $0,820 \text{ g N}_2/1,00 \text{ L} : 28,02 \text{ g/mol} = 0,02926 \text{ mol}/1,00 \text{ L}$. Dus $1,00 \text{ mol N}_2 \equiv 1,00 \text{ L} : 0,02926 \text{ mol/L} = \underline{34,2 \text{ L}}$
- b. $5,50 \text{ L CO}_2 = 5,50 : 34,2 = 0,1608 \text{ mol} = 0,1608 \text{ mol} \times 44,01 \text{ g/mol} = \underline{7,08 \text{ g CO}_2}$
- c. $\rho(\text{CO}_2) = 7,08 \text{ g} : 5,50 \text{ L} = \underline{1,29 \text{ g/L}}$
- 5 a. $\text{CaC}_2(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}^{2+}(\text{aq}) + 2 \text{OH}^-(\text{aq}) + \text{C}_2\text{H}_2(\text{g})$
- b. 1 mol $\text{CaC}_2 \equiv 2$ mol $\text{H}_2\text{O} \equiv 1$ mol C_2H_4
 $75,05 \text{ g} : 64,1 = 1,170 \text{ mol CaC}_2 \equiv 2 \times 1,170 \text{ mol H}_2\text{O} = 2 \times 1,170 \text{ mol} \times 18,02 \text{ g/mol} = \underline{42,2 \text{ g H}_2\text{O}}$
- c. $V_m = 22,4 \text{ L} \times (273 + 15) : 273 = 23,6 \text{ L}$. Er ontstaat $1,170 \text{ mol C}_2\text{H}_4 = 1,170 \text{ mol} \times 23,6 \text{ L/mol} = \underline{27,6 \text{ L}}$
- 6 1 mol $\text{C}_{12}\text{H}_{22}\text{O}_{11} \equiv 4$ mol $\text{C}_2\text{H}_6\text{O} \equiv 4$ mol CO_2
- a. 100 kg suikerbieten bevat $0,15 \times 100 = 15 \text{ kg suiker} = 15000 \text{ g}$
 $15000 \text{ g suiker} = 15000 \text{ g} : 342,3 \text{ g/mol suiker} = 43,82 \text{ mol}$
 $43,82 \text{ mol suiker} \equiv 43,82 \text{ mol} \times 4 = 175,28 \text{ mol C}_2\text{H}_6\text{O} =$
 $175,28 \text{ mol} \times 46,07 \text{ g/mol} = 8,075 \cdot 10^3 \text{ g} = 8,075 \text{ kg C}_2\text{H}_6\text{O}$
 Aantal L $\text{C}_2\text{H}_6\text{O} = 8,075 \text{ kg} : 0,800 \cdot 10^3 \text{ kg}/10^3 \text{ L} = \underline{10,1 \text{ L}}$
- b. $43,82 \text{ mol suiker} \equiv 43,82 \text{ mol} \times 4 = 175,28 \text{ mol CO}_2 = 175,28 \text{ mol} \times 2,45 \cdot 10^{-2} \text{ m}^3/\text{mol} = \underline{4,29 \text{ mol CO}_2}$
- 7 1 mol $\text{C}_4\text{H}_8 \equiv 1$ mol $\text{C}_5\text{H}_{12}\text{O}$

- a. $50 \text{ g C}_4\text{H}_8 = 50 \text{ g} : 56,10 \text{ g/mol} = 0,891 \text{ mol}$ $75 \text{ g C}_5\text{H}_{12}\text{O} = 75 \text{ g} : 88,15 \text{ g/mol} = 0,851 \text{ mol}$
 Rendement = $0,851 : 0,891 \times 100\% = \underline{95,5\%}$



$500 \text{ kg Fe} = 5,00 \times 10^5 \text{ g} = 5,00 \times 10^5 \text{ g} : 55,85 \text{ g/mol} = 8,953 \times 10^3 \text{ mol Fe}$

$8,953 \times 10^3 \text{ mol Fe} \equiv 3/2 \times 8,953 \times 10^3 \text{ mol CO} = 1,343 \times 10^4 \text{ mol CO}$

$1,343 \times 10^4 \text{ mol CO} = 1,343 \times 10^4 \text{ mol} \times 22,4 \text{ L/mol} = \underline{301 \text{ m}^3}$

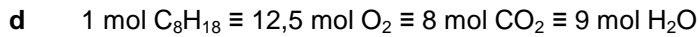
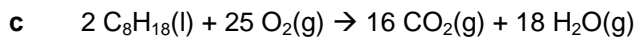
- 9 In het toilet is de concentratie $15 \text{ mg}/1,0 \times 1,5 \times 2,6 \text{ m}^3 = 3,8 \text{ mg/m}^3$. De MAC-waarde is dus overschreden.

- 10 a Het brandstofverbruik is $100 \text{ km}/5,1 \text{ L} = 19,6 \text{ km/L}$. Dus het gegeven is correct.

- b Per km wordt $5,1/100 = 0,051 \text{ L}$ benzine verbruikt, dus verbruik = $0,051 \text{ L/km} = 51 \text{ mL/km}$.

$\rho_{\text{benzine}} = 0,72 \cdot 10^3 \text{ kg} \cdot \text{m}^{-3} = 0,72 \text{ g/mL}$

$51 \text{ mL/km} \equiv 51 \text{ mL} \times 0,72 \text{ g/mL} = 36,7 \text{ g benzine/km}$



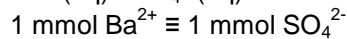
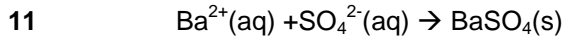
aantal mol benzine = $36,7 \text{ g}/114,26 \text{ g/mol} = 0,329 \text{ mol}$.

$0,329 \times 1 \text{ mol C}_8\text{H}_{18} \equiv 0,329 \times 12,5 \text{ mol O}_2 \equiv 0,329 \times 8 \text{ mol CO}_2 \equiv 0,329 \times 9 \text{ mol H}_2\text{O}$

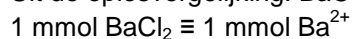
$0,329 \times 8 \text{ mol CO}_2 = 2,633 \text{ mol CO}_2$. $2,633 \text{ mol CO}_2 \equiv 2,633 \text{ mol} \times 44,01 \text{ g/mol} = 115,9 \text{ g CO}_2$

$\rho_{\text{CO}_2} = 1,986 \text{ kg/m}^3 = 1,986 \text{ g/dm}^3$

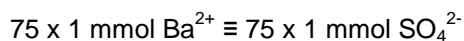
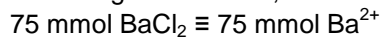
- e Aantal L $\text{CO}_2 = \text{massa CO}_2 / \rho_{\text{CO}_2} = 115,9 \text{ g}/1,986 \text{ g/dm}^3 = 58,4 \text{ L}$.



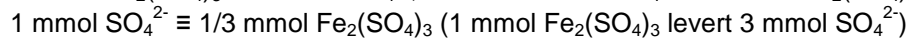
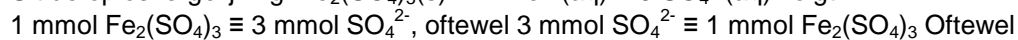
Uit de oplosvergelijking: $\text{BaCl}_2(\text{s}) \rightarrow \text{Ba}^{2+}(\text{aq}) + 2 \text{ Cl}^-(\text{aq})$ volgt:



Aanwezig: $150 \text{ mL} \times 0,50 \text{ mmol BaCl}_2 = 75 \text{ mmol BaCl}_2$, dus:



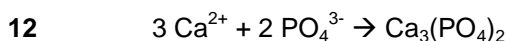
Uit de oplosvergelijking: $\text{Fe}_2(\text{SO}_4)_3(\text{s}) \rightarrow 2 \text{ Fe}^{3+}(\text{aq}) + 3 \text{ SO}_4^{2-}(\text{aq})$ volgt:



dus $75 \text{ mmol SO}_4^{2-} \equiv 75/3 \text{ mmol Fe}_2(\text{SO}_4)_3 = 25 \text{ mmol Fe}_2(\text{SO}_4)_3$.

1 mL 0,35 M $\text{Fe}_2(\text{SO}_4)_3$ -oplossing bevat 0,35 mmol/mL. Het aantal mL dat overeenkomt met 25 mmol is dan: $25 \text{ mmol}/0,35 \text{ mmol/mL} = 71 \text{ mL}$.

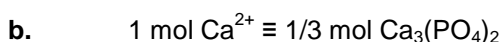
Het antwoord luidt: 71 ml 0,35 M ijzer(III)sulfaatoplossing kan dus reageren met 150 mL 0,50 M magnesiumchlorideoplossing.



$50,0 \text{ mL } 0,135 \text{ M calciumchloride} \equiv 50,0 \times 0,135 = 6,750 \text{ mmol Ca}^{2+}$

$45,0 \text{ mL } 0,115 \text{ M natriumfosfaat} \equiv 45,0 \times 0,115 = 5,175 \text{ mmol PO}_4^{3-}$

Voor $6,750 \text{ mmol Ca}^{2+}$ is $2/3 \times 6,750 \text{ mmol PO}_4^{3-} = 4,500 \text{ mmol}$ nodig. Beschikbaar is $5,175 \text{ mmol PO}_4^{3-}$, dus is in overmaat aanwezig: $5,175 \text{ mmol} - 4,500 \text{ mmol} = 0,675 \text{ mmol PO}_4^{3-}$.



$6,750 \text{ mmol Ca}^{2+} \equiv 1/3 \times 6,750 \text{ mmol Ca}_3(\text{PO}_4)_2 = 2,250 \text{ mmol} = 2,250 \times 310,2 \text{ g/mol} = 698 \text{ mg}$

- 12 a. $1 \text{ mol Fe}^{3+} \equiv \frac{1}{2} \text{ mol Fe}_2(\text{SO}_4)_3$
 $0,0633 \text{ mol Fe}^{3+}/\text{L} = 0,00633 \text{ mol}/100\text{mL} \equiv \frac{1}{2} \times 0,00633 \text{ mol Fe}_2(\text{SO}_4)_3 = 3,165 \cdot 10^{-3} \text{ mol Fe}_2(\text{SO}_4)_3$
 $3,165 \cdot 10^{-3} \text{ mol} \times 399,88 \text{ g/mol} (1) = 1,27 \text{ g Fe}_2(\text{SO}_4)_3$

Aan de ijzer(III)sulfaatoplossing voegt hij vervolgens een verzadigde bariumnitraatoplossing toe. Deze oplossing bevat 87,0 g bariumnitraat per liter. Er ontstaat een neerslag van bariumsulfaat.

- b. $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$
- c. $0,00633 \text{ mol Fe}^{3+} \equiv \frac{3}{2} \times 0,00633 \text{ mol SO}_4^{2-} = 9,495 \cdot 10^{-3} \text{ mol SO}_4^{2-} \equiv 9,495 \cdot 10^{-3} \text{ mol BaSO}_4 (1)$
 $9,495 \cdot 10^{-3} \text{ mol BaSO}_4 \equiv 9,495 \cdot 10^{-3} \text{ mol Ba}(\text{NO}_3)_2 (1)$
 $87,0 \text{ g Ba}(\text{NO}_3)_2/\text{L} = 87,0 : 261,3 \text{ g/mol} = 0,3330 \text{ mol Ba}(\text{NO}_3)_2/\text{L} = 0,3330 \text{ mmol Ba}(\text{NO}_3)_2/\text{mL}$
Benodigd aantal mL = $9,495 \text{ mmol} : 0,3330 \text{ mmol/mL} = 28,5 \text{ mL}$
- d. $[\text{Fe}^{3+}(\text{aq})] = 0,00633 \text{ mol}/0,250 \text{ L} = 0,0253 \text{ M}$