

## Eenheden

Oef 1

$$V = 35,1 \text{ mL} = 0,0351 \text{ L}$$

$$m = 30,5 \text{ g}$$

$$\rho = \frac{m}{V} = \frac{35,1 \text{ mL}}{30,5 \text{ g}} = 0,869 \text{ g/mL} \rightarrow \text{Toluene}$$

Oef 2

$$m = 43,7 \text{ g}$$

$$\rho = 0,785 \text{ g/mL}$$

$$V = \frac{m}{\rho} = \frac{43,7 \text{ g}}{0,785 \text{ g/mL}} = 55,7 \text{ mL}$$

Oef 3

$$V = 65,7 \text{ mL} - 51,2 \text{ mL} = 14,5 \text{ mL}$$

$$m = 38,4 \text{ g}$$

$$\rho = \frac{m}{V} = \frac{38,4 \text{ g}}{14,5 \text{ mL}} = 2,65 \text{ g/mL}$$

Oef 4

$$m_w = 105,50 \text{ g} - 43,50 \text{ g} = 62,00 \text{ g}$$

$$\rho_w = 1 \text{ g/mL}$$

$$V = \frac{m}{\rho} = \frac{62,00 \text{ g}}{1 \text{ g/mL}} = 62,00 \text{ mL}$$

$$m_v = 96,75 \text{ g} - 43,50 \text{ g} = 53,25 \text{ g}$$

$$\rho = \frac{m}{V} = \frac{53,25 \text{ g}}{62,00 \text{ mL}} = 0,8589 \text{ g/mL}$$

### Oef 5

$$a) 4,82 \text{ nm} = 4,82 \cdot 10^3 \text{ pm}$$

$$d) 2,66 \text{ g/cm}^3 = 2,66 \cdot 10^3 \text{ kg/m}^3$$

$$b) 1,83 \text{ mL/min} = 30,5 \text{ mm}^3/\text{s}$$

$$e) 0,044 \text{ g/L} = 0,044 \text{ mg/cm}^3$$

$$c) 1,88 \text{ ng} = 1,88 \cdot 10^{-12} \text{ kg}$$

### Oef 6

$$V = 67,6 \text{ A}^3 \quad 1 \text{ A} = 10^{-10} \text{ m}$$

$$= 67,6 \cdot 10^{-30} \text{ m}^3$$

$$= 67,6 \cdot 10^{-27} \text{ dm}^3$$

### Oef 7

$$1 \text{ in} = 2,54 \text{ cm}$$

$$1 \text{ yd} = 36 \text{ in}$$

$$3,54 \text{ yd} = 127,44 \text{ in}$$

$$= 323,6976 \text{ cm}$$

$$= 3,234 \text{ m}$$

### Oef 8

$$\text{Brons} = 67\% \text{ koper} + 33\% \text{ zink}$$

$$l = 1,62 \text{ in} = 4,11 \text{ cm}$$

$$r = 0,653 \text{ cm}$$

$$V = r^2 \pi \cdot h = 5,51 \text{ cm}^3$$

$$\text{koper} \\ \text{Bronze} = 5,51 \cdot 0,67 = 3,69 \text{ cm}^3$$

$$\text{zink} = 5,51 \cdot 0,33 = 1,82 \text{ cm}^3$$

$$m_B = m_k + m_z$$

$$= 3,69 \text{ cm}^3 \cdot 8,92 \text{ g/cm}^3 + 1,82 \text{ cm}^3 \cdot 7,14 \text{ g/cm}^3$$

$$= 45,9 \text{ g}$$

## Nomenclatuur

### Oef 1

- a)  $\text{BaCl}_2$  - bariumchloride  
 b)  $\text{CrCl}_3$  - chroom(III)chloride  
 c)  $\text{P}_2\text{S}$  - goedulfide  
 d)  $\text{Fe}_2\text{O}_3$  - ijzer(III)oxide  
 e)  $\text{CsF}$  - cesiumfluoride  
 f)  $\text{K}_2\text{O}$  - kaliumoxide  
 g)  $\text{CuO}$  - koper(II)oxide  
 h)  $\text{BaS}$  - bariumsulfide  
 i)  $\text{BeBr}_2$  - Berylliumbromide
- j)  $\text{PCl}_3$  - fosfortrichloride  
 k)  $\text{N}_2\text{O}_3$  - diatikortetroxide  
 l)  $\text{P}_4\text{O}_7$  - tetroxydachepoxide  
 m)  $\text{BrF}_3$  - broomtafluoride  
 n)  $\text{NCl}_3$  - stikotrichloride  
 o)  $\text{P}_4\text{O}_6$  - tetroxydohexoxide  
 p)  $\text{SeF}_2$  - diselenedifluoride  
 q)  $\text{SeO}_2$  - seleendioxide

Allemachtlineaire ionaire verbindingen ( $M+nM'$ ). Eerst metool (kation), dan  $nM'$  (anion) - stam + side

### Oef 2

- a) Magnesiumfluoride -  $\text{MgF}_2$   
 b) Tin(IV)oxide -  $\text{Sn}_2\text{O}_3$   
 c) IJzer(III)sulfide -  $\text{Fe}_2\text{S}_3$   
 d) Vanadium(IV)chloride -  $\text{VCl}_3$   
 e) Manganese(IV)oxide -  $\text{MnO}_2$
- f) Koper(II)sulfide -  $\text{CuS}$   
 g) Aluminiumoxide -  $\text{Al}_2\text{O}_3$   
 h) Diselenedichloride -  $\text{SeCl}_2$   
 i) Joodmonochloride -  $\text{ICl}$   
 j) Stikotrijodide -  $\text{NI}_3$

Allemachtlineaire ionaire verbindingen.

### Oef 3

- a)  $\text{LiNO}_3$  - lithiumnitraat  
 b)  $\text{KHSO}_4$  - kaliumwaterstofsulfaat  
 c)  $\text{CuCO}_3^{(\text{II})}$  - kopercarbonaat  
 d)  $\text{Fe}(\text{ClO}_4)_3$  - ijzer(III)perchloraat
- e)  $\text{Ca}(\text{ClO})_2$  - calciumdihypochloriet  
 f)  $\text{Ag}_2\text{S}_2\text{O}_3$  - diwerthiosulfaat  
 g)  $\text{Na}_2\text{HPO}_4$  - natriumdiwaterstofaat  
 h)  $\text{Sn}(\text{NO}_3)_2$  - tin(II)nitraat



Oef 4

- a) Kaliumhypochloriet -  $\text{KClO}$       e) Magnesiumwaterstofsulfaat -  $\text{Mg}(\text{HSO}_4)_2$   
b) zuurk (I)chromaat -  $\text{Ag}_2\text{CrO}_4$       f) Mangaan (II) nitraat -  $\text{Mn}(\text{NO}_3)_2$   
c) ijzer (III)carbonaat -  $\text{Fe}_2(\text{CO}_3)_3$       g) chroom (III) sulfaat -  $\text{Cr}_2(\text{SO}_4)_3$   
d) lithiumfosfaat -  $\text{LiPO}_4$

Oef 5

- a)  $\text{IO}_3^-$  - hypoiodiet anion  
b)  $\text{H}_2\text{AsO}_4^-$  - diwaterstofarsenaat  
c)  $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$  - chroomtrichloride hexahydraat  
d)  $\text{Ba}(\text{ClO}_4)_2$  - bariumdiperchloraat  
e)  $\text{NiCl}_2 \cdot 2\text{H}_2\text{O}$  - nikkel (II) chloride dihydraat  
f)  $\text{AlF}_3$  - aluminiumfluoride  
g)  $\text{Mn}(\text{IO}_4)_2$  - mangaan (I) iodiet  
h)  $\text{AuCl}_3$  - goud (II)chloride  
i)  $\text{CaS}$  - calciumsulfide  
j)  $\text{Mn}_2\text{O}_3$  - mangaan (III) oxide  
k)  $\text{Mg}_3\text{N}_2$  - magnesiumnitridide  
l)  $\text{CrSO}_4$  - chroom (II) sulfaat  
m)  $\text{CaO}$  - calciumoxide  
n)  $\text{PbCrO}_4$  - lood (I)chromaat  
o)  $\text{N}_2\text{O}_4$  - diazikaatetroxide

Oef 6

- a) waterstofsulfietion -  $\text{HSO}_3^-$   
b) chloroation -  $\text{ClO}_3^-$

- c) cobalt (II) chloride hexahydrat -  $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$
- d) dittoxidisulfide -  $\text{S}_2\text{S}_3$
- e) vanadium (V) oxide -  $\text{V}_2\text{O}_5$
- f) calciumcarbide -  $\text{CaC}_2$
- g) germaniumtetrafluoride -  $\text{GeF}_4$
- h) dinitrogentrioxide -  $\text{N}_2\text{O}_3$
- i) cesiumsulfide tetrahydronat -  $\text{CsS} \cdot 4\text{H}_2\text{O}$
- j) mangaan (VII) oxide -  $\text{Mn}_2\text{O}_7$
- k) ijzer (II) fosfaat -  $\text{Fe}_2(\text{PO}_4)_3$
- l) lood (II) chromaat -  $\text{Pb}(\text{CrO}_4)_2$
- m) thallium (III) nitraat -  $\text{Tl}(\text{NO}_3)_3$
- n) disulferdichloride -  $\text{S}_2\text{Cl}_2$
- o) tetratofototrisulfide -  $\text{P}_4\text{S}_3$

Oef 7

- a) Seleensuur,  $\text{H}_2\text{SeO}_4$  -  $\text{SeO}_4^{2-}$  (selenaat)
- b) Perbromineurk,  $\text{HBrO}_4$  -  $\text{BrO}_4^-$  (bromaat)

Oef 8

- a) zink en fluoride-ioniën -  $\text{ZnF}_2$
- b) barium en nitraat-ioniën -  $\text{BaNO}_3$
- c) zilver en jodide-ioniën -  $\text{AgI}$
- d) lithium en nitride-ioniën -  $\text{Li}(\text{NO}_2)_3$
- e) chroom (III) en sulfide-ioniën -  $\text{Cr}_2\text{S}_3$

Oef 9

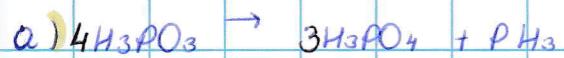
- a)  $\text{CuCO}_3$ : koper (II) carbonaat
- b)  $\text{K}_2\text{SO}_3$ : dikaliumtrisulfaat
- c)  $\text{LiCl}$ : lithiumchloride

Oef 10

- a) Natriumsulfaat:  $\text{Na}_2\text{SO}_4$
- b) Magnesiumchloriet:  $\text{Mg}(\text{ClO}_4)_2$
- c) Fosfor (V) oxide:  $\text{P}_2\text{O}_5$

## Schrijven en uitbalanceren van chemische reacties

Def 1



$$\left\{ \begin{array}{l} 3a = 3\theta + 3c \\ a = \theta + c \end{array} \right.$$

$$3a = 4\theta$$

$$\left\{ \begin{array}{l} 3\theta + 3c = 4\theta \\ \theta = 3c \end{array} \right.$$

$$a = \theta + c$$

$$\left\{ \begin{array}{l} \theta = 3 \\ c = 1 \\ a = 4 \end{array} \right.$$



$$a = c$$

$$2\theta = 2c + 2d$$

$$\theta = 2c$$

$$a = 1$$

$$\theta = 2$$

$$c = 1$$

$$d = 1$$



$$2a = d$$

$$3a = e$$

$$12a + c = 3d + 4e \Rightarrow c = 6$$

$$\theta = 2e$$

$$3\theta + 2c = 3d + 8e$$

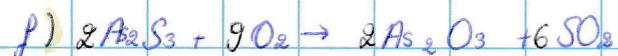
$$a = 1$$

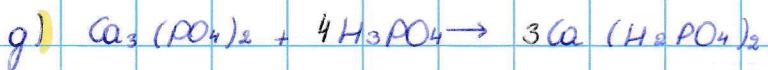
$$\theta = 6$$

$$c = 6$$

$$d = 2$$

$$e = 3$$





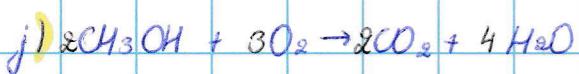
$$\begin{cases} 3a = c \\ 2a + b = 2c \\ 8a + 4b = 8c \end{cases} \Rightarrow \begin{cases} c = 3 \\ a = 1 \\ b = 2 \end{cases}$$



$$\begin{cases} a = c \\ b = 2c \\ b = 2d \end{cases} \Rightarrow \begin{cases} a = 1 \\ b = 2 \\ c = 1 \\ d = 1 \end{cases}$$

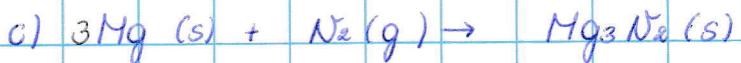
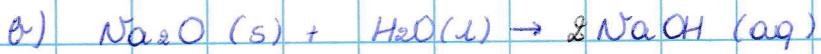
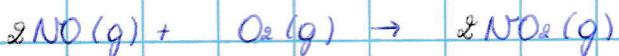
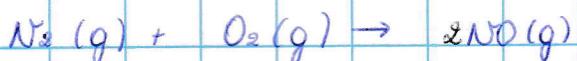
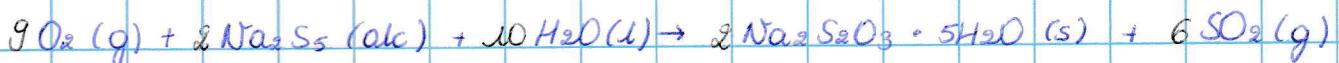


$$\begin{cases} a = 2c \\ 3b = d \\ 4b = 30 \end{cases} \Rightarrow \begin{cases} a = 8 \\ b = 3 \\ d = 9 \\ c = 4 \end{cases}$$



$$\begin{cases} a = c \\ 4a = 2d \\ a + 2b = 2c + d \end{cases} \Rightarrow \begin{cases} a = 1 \\ b = 3/2 \\ c = 1 \\ d = 2 \end{cases} \Rightarrow \begin{cases} a = 2 \\ b = 3 \\ c = 2 \\ d = 4 \end{cases}$$



Oef 2Oef 3Oef 4Oef 5

## Chemisch tekenen: Molen molaire massa

### Def 1

a)  $m = At \cdot n$

$$= 1,66 \cdot 10^{-24} g \cdot 22,99 \\ = 3,81 \cdot 10^{-23} g$$

b)  $m = At \cdot n$

$$= 1,66 \cdot 10^{-24} g \cdot 32,06 \\ = 5,32 \cdot 10^{-23} g$$

c)  $m = At \cdot n$

$$= 1,66 \cdot 10^{-24} g \cdot (62,01 + 3 \cdot 1,01 + 35,45) \\ = 8,38 \cdot 10^{-23} g$$

d)  $m = At \cdot n$

$$= 1,66 \cdot 10^{-24} g \cdot (2 \cdot 22,99 + 2 \cdot 32,06 + 3 \cdot 16,0) \\ = 2,62 \cdot 10^{-22} g$$

### Def 2

a)  $m = n \cdot M$

$$= 0,15 \text{ mol} \cdot 22,99 \text{ g/mol} \\ = 3,4 \text{ g}$$

b)  $m = n \cdot M$

$$= 0,594 \text{ mol} \cdot 32,06 \text{ g/mol} \\ = 19,0 \text{ g}$$

$$c) m = n \cdot M$$

$$= 2,78 \text{ mol} \cdot (12,01 + 3 \cdot 1,01 + 35,45) \text{ g/mol}$$
$$= 140,4 \text{ g}$$

$$d) m = n \cdot M$$

$$= 38 \text{ mol} \cdot (2 \cdot 22,99 + 2 \cdot 32,06 + 3 \cdot 16,0)$$
$$= 60 \cdot 10^2 \text{ g}$$

Oef 3

$$a) n = \frac{m}{M}$$

M

$$= \underline{\underline{7,46 \text{ g}}}$$

6,94 g/mol

$$= 1,07 \text{ mol}$$

$$N = n \cdot N_A$$

$$= 1,07 \text{ mol} \cdot 6,02 \cdot 10^{23} \text{ deeltjes/mol}$$
$$= 6,44 \cdot 10^{23} \text{ atomen}$$

$$b) n = \frac{m}{M} = \frac{32,0 \text{ g}}{79,9 \text{ g/mol}} = 0,401 \text{ mol}$$

M

$$N = n \cdot N_A$$

$$= 0,401 \text{ mol} \cdot 6,02 \cdot 10^{23} \text{ deeltjes/mol}$$
$$= 2,41 \cdot 10^{23} \text{ atomen}$$

$$c) N = \frac{m}{M} \cdot N_A = \frac{43 \text{ g}}{(14,01 + 3 \cdot 1,01) \text{ g/mol}} \cdot 6,02 \cdot 10^{23} \text{ deeltjes/mol}$$

M

$$= 1,5 \cdot 10^{24} \text{ moleculen}$$

$$d) \frac{N}{M} = \frac{m \cdot N_A}{(207,2 + 51,00 + 4 \cdot 16,00) g/mol} = \frac{159 g \cdot 6,02 \cdot 10^{23} \text{ deeltjes/mol}}{(207,2 + 51,00 + 4 \cdot 16,00) g/mol} = 3,01 \cdot 10^{23} \text{ deeltjes}$$

$$e) \frac{N}{M} = \frac{m \cdot 3 \cdot N_A}{(51,00 \cdot 2 + 3 \cdot 32,07 + 12 \cdot 16,00) g/mol} = \frac{14,3 g \cdot 3 \cdot 6,02 \cdot 10^{23} \text{ deeltjes/mol}}{(51,00 \cdot 2 + 3 \cdot 32,07 + 12 \cdot 16,00) g/mol} = 6,69 \cdot 10^{22} \text{ ionen}$$

Oef 4

$$\begin{aligned} m &= n \cdot M \\ &= 0,0654 \text{ mol} \cdot (65,38 + 2 \cdot 16,90) g/mol \\ &= 20,89 \text{ g} \end{aligned}$$

Oef 5

$$\begin{aligned} m &= n \cdot M \\ &= 0,909 \text{ mol} \cdot (2 \cdot 1,01 + 2 \cdot 16,00) g/mol \\ &= 30,9 \text{ g} \end{aligned}$$

Oef 6

$$\begin{aligned} n &= \frac{m}{M} = \frac{45,6 \text{ g}}{(207,2 + 51,00 + 4 \cdot 16,00) g/mol} = 0,142 \text{ mol} \end{aligned}$$

Oef 7

$$\begin{aligned} N &= \frac{m \cdot N_A}{M} = \frac{3,46 g \cdot 6,02 \cdot 10^{23} \text{ deeltjes/mol}}{(1,01 + 35,45) g/mol} = 5,41 \cdot 10^{22} \text{ deeltjes} \end{aligned}$$

Oef 8

$$\begin{aligned} N &= \frac{m \cdot N_A}{M} = \frac{56 \cdot 10^{-3} g \cdot 6,02 \cdot 10^{23} \text{ deeltjes/mol}}{(1,01 + 12,01 + 14,01) g/mol} = 1,25 \cdot 10^{21} \text{ deeltjes} \end{aligned}$$

### Oef 9

$$n = \frac{N}{N_A} = \frac{1,29 \cdot 10^{24} \text{ deeltjes}}{6,02 \cdot 10^{23} \text{ deeltjes/mol}} = 2,14 \text{ mol}$$

### Oef 10

$$n(H) = 6,28 \text{ mol}$$

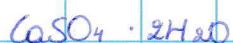
$$N = n \cdot N_A$$

$$= 6,28 \text{ mol} \cdot 6,02 \cdot 10^{23} \text{ deeltjes/mol}$$
$$= 3,78 \cdot 10^{24} \text{ atomen}$$

### Oef 11

$$N = \frac{m \cdot N_A}{M} = \frac{1,00 \cdot 10^3 \text{ g} \cdot 6,02 \cdot 10^{23} \text{ deeltjes/mol}}{(40,08 + 2 \cdot 16,00 + 2 \cdot 1,01) \text{ g/mol}} = 8,12 \cdot 10^{24} \text{ deeltjes}$$

### Oef 12



$$n(\text{CaSO}_4) = \frac{m}{M} = \frac{0,491 \text{ g}}{(40,08 + 32,06 + 4 \cdot 16) \text{ g/mol}} = 0,00581 \text{ mol}$$

$$n(\text{H}_2\text{O}) = \frac{m}{M} = \frac{0,209 \text{ g}}{(1,01 \cdot 2 + 16,00) \text{ g/mol}} = 11,6 \cdot 10^{-3} \text{ mol}$$

### Oef 13

a)  $n = \frac{m}{M} = \frac{3,20 \text{ g}}{63,55 \text{ g/mol}} = 0,0504 \text{ mol}$

b)  $N = n \cdot N_A$

$$= 0,0504 \text{ mol} \cdot 6,02 \cdot 10^{23} \text{ deeltjes/mol}$$
$$= 3,03 \cdot 10^{22} \text{ deeltjes}$$

## Oef 14

$$m = 0,4577 \cdot 5,807 \cdot 10^{-23} g + 0,2423 \cdot 6,139 \cdot 10^{-23} g \\ = 5,887 \cdot 10^{-23} g$$

$$M = n \cdot m$$

$$= 6,02 \cdot 10^{23} \cdot 5,887 \cdot 10^{-23} g \\ = 35,44 \text{ g / mol}$$

## Oef 15

$$1 \text{ mol Ag} = N_A$$

$$6,02 \cdot 10^{23} \text{ deeltjes} \cdot 288 \text{ pm} = 2,73 \cdot 10^{-14} \text{ m}$$

## Oef 16

$$\text{Begin: } 6,02 \cdot 10^{23} \text{ ddolok}$$

$$10^9 \cdot 60 \cdot 60 \cdot 24 = 8,64 \cdot 10^{13}$$

$$4 \cdot 365 \cdot 90 = 2,83824 \cdot 10^{18}$$

$$6,02 \cdot 10^{23} - 2,83824 \cdot 10^{18} = 99,9995 \%$$

## Oef 17

$$6,02 \cdot 10^{23} = 6,02 \cdot 10^6 \text{ km}^2$$

$$10^{-12}$$

$$A = 3,6 \cdot 10^6 \text{ m}^2 \cdot 1,61^2$$

$$= 9,365 \cdot 10^6 \text{ km}^2$$

$$h = 6,02 \cdot 10^5 \text{ km}^2$$

$$9,365 \cdot 10^6 \text{ km}^2$$

$$= 84 \text{ m}$$

Oef 18

a)  $M = m \cdot N_A$

$$= (0,0742 \cdot 9,988 \cdot 10^{-24} + 0,9258 \cdot 1,165 \cdot 10^{-23}) g \cdot 6,02 \cdot 10^{23}$$
$$= 6,94 \text{ g/mol}$$

b)  $M = m \cdot N_A$

$$= (0,0564 \cdot 9,988 \cdot 10^{-24} + 0,9433 \cdot 1,165 \cdot 10^{-23}) g \cdot 6,02 \cdot 10^{23}$$
$$= 6,96 \text{ g/mol}$$

Oef 19

$$M = m \cdot N_A$$

$$10,81 = (x \cdot 10,013 \text{ g/mol} + (1-x) 11,093 \text{ g/mol})$$

$$10,81 \text{ g/mol} = 11,093 \text{ g/mol} - 1,08 \text{ g/mol} \cdot x$$

$$\therefore x = 0,262$$

↳ 26,2%  $^{10}B$  en 73,8% "B"

Oef 20

$$1,00 \cdot 10^3 \text{ ton} = 1,00 \cdot 10^{10} \text{ g}$$

$$x = 60 \text{ m} = 6,0 \cdot 10^2 \text{ cm}$$

$$\rho_{\text{W}} = 1 \text{ g/cm}^3$$

a)  $M(\text{O}_2\text{O}) = 2 \cdot 2,014 \text{ g/mol} + 16,00 \text{ g/mol}$   
= 20,03 g/mol

b)  $V = \frac{4}{3} \pi r^3$

$$= \frac{4}{3} \pi \cdot 6,0 \cdot 10^2 \text{ cm}$$

$$= 90 \cdot 10^7 \text{ cm}^3$$

$$\rho = \frac{m}{V} = \frac{1,00 \cdot 10^9 \text{ g}}{90 \cdot 10^7 \text{ cm}^3} = 1,11 \text{ g/cm}^3$$

c)  $V = \frac{m}{\rho} = \frac{1,00 \cdot 10^3 \text{ g}}{1,11 \text{ g/cm}^3} = 900 \text{ cm}^3$

d) Ja, de veronderstelling is aanwezig.

## Chemisch tekenen : Bepaling chemische formules

### Oef 1



N	H	O
2 mol	4 mol	3 mol

$$m(N) = 2 \cdot 14,01 = 28,02 \text{ g}$$

$$m(H) = 4 \cdot 1,01 = 4,04 \text{ g}$$

$$m(O) = 3 \cdot 16,0 = 48 \text{ g}$$

$$m\%(\text{N}) = \frac{m(N)}{m(\text{NH}_4\text{NO}_3)} = \frac{28,02}{80,06} = 35,0\%$$

$$m \quad 80,06$$

$$m\%(\text{H}) = \frac{m(H)}{m(\text{NH}_4\text{NO}_3)} = \frac{4,04}{80,06} = 5,05\%$$

$$80,06$$

$$m\%(\text{O}) = \frac{m(O)}{m(\text{NH}_4\text{NO}_3)} = \frac{48}{80,06} = 59,96\%$$

$$80,06$$

### Oef 2

$$m\%(\text{N}) = 35,0\%$$

$$m(\text{NH}_4\text{NO}_3) = 48,5 \text{ g}$$

$$m(\text{N}) = m\%(\text{N}) \cdot m(\text{NH}_4\text{NO}_3) = \frac{35,0}{100} \cdot 48,5 \text{ g} = 16,98 \text{ g}$$

$$100 \qquad \qquad 100$$

### Oef 3

$$m(\text{asyneen}) = 4,24 \cdot 10^{-3} \text{ g}$$

$$m(\text{CO}_2) = 6,21 \cdot 10^{-3} \text{ g}$$

$$m(\text{H}_2\text{O}) = 2,54 \cdot 10^{-3} \text{ g}$$

C	O	H
1 mol	3 mol	2 mol

$$\bullet m(C) = 1 \cdot 12,01 = 12,01 \text{ g} \quad \left. \begin{array}{l} \\ \end{array} \right\} 44,01 \text{ g}$$

$$m(O) = 2 \text{ mol} \cdot 16,0 \text{ g/mol} = 32,0 \text{ g} \quad \left. \begin{array}{l} \\ \end{array} \right\} 44,01 \text{ g}$$

$$\bullet m(CC) = 12,01 : 44,01 \cdot 6,21 \cdot 10^{-3} \\ = 1,69 \cdot 10^{-3} \text{ g}$$

$$m(CO) = 32,0 : 44,01 \cdot 6,21 \cdot 10^{-3} \\ = 4,51 \cdot 10^{-3} \text{ g}$$

$$\bullet m(H) = 2 \text{ mol} \cdot 1,01 \text{ g/mol} \quad \left. \begin{array}{l} \\ \end{array} \right\} 18,02 \text{ g}$$

$$m(O) = 1 \text{ mol} \cdot 16,0 \text{ g/mol} \quad \left. \begin{array}{l} \\ \end{array} \right\} 16,0 \text{ g}$$

$$\bullet m(H) = 2,02 : 18,02 \cdot 2,54 \cdot 10^{-3} \\ = 0,28 \cdot 10^{-3} \text{ g}$$

$$m(O) = 16,0 : 18,02 \cdot 2,54 \cdot 10^{-3} \\ = 2,26 \cdot 10^{-3} \text{ g}$$

$$\bullet m\% (C) = \frac{100 \cdot m(C)}{m} = \frac{100 \cdot 1,69 \cdot 10^{-3}}{4,24 \cdot 10^{-3}} = 39,86\%$$

$$m\% (H) = \frac{100 \cdot m(H)}{m} = \frac{100 \cdot 0,28 \cdot 10^{-3}}{4,24 \cdot 10^{-3}} = 6,60\%$$

$$m\% (O) = 100\% - 39,86\% - 6,60\%$$

$$= 54\%$$

#### Oef 4

$$m(X) = 1,587 \text{ g}$$

$$m(N) = 0,483 \text{ g}$$

$$m(O) = 1,104 \text{ g}$$

$$\bullet n(N) = \frac{m}{M} = \frac{0,483 \text{ g}}{14,01 \text{ g/mol}} = 0,0345 \text{ mol} \rightarrow 1$$

$$\cdot n(O) = \frac{m}{M} = \frac{1,104 \text{ g}}{16,0 \text{ g/mol}} = 0,069 \text{ mol} \rightarrow 2$$

Empirische Formule: NO2

Oef 5

$$m\%(\text{Na}) = 17,5\%$$

$$m\%(\text{Ar}) = 39,7\%$$

$$m\%(\text{O}) = 42,8\%$$

$$\cdot n(\text{Na}) = \frac{m}{M} = \frac{17,5 \text{ g}}{22,99 \text{ g/mol}} = 0,762 \text{ mol} \rightarrow 1$$

$$\cdot n(\text{Ar}) = \frac{39,7 \text{ g}}{52,0 \text{ g/mol}} = 0,763 \text{ mol} \rightarrow 1$$

$$\cdot n(\text{O}) = \frac{m}{M} = \frac{42,8 \text{ g}}{16,0 \text{ g/mol}} = 2,645 \text{ mol} \rightarrow 3,5$$

Empirische Formule: Na2Cr2O7

Oef 6

$$\cdot m\%(\text{C}) = 68,8\%$$

$$m\%(\text{H}) = 5,0\%$$

$$m\%(\text{O}) = 26,8\%$$

$$\cdot n(\text{C}) = \frac{m}{M} = \frac{68,8 \text{ g}}{12,01 \text{ g/mol}} = 5,73 \text{ mol} \rightarrow 3,5$$

$$\cdot n(\text{O}) = \frac{m}{M} = \frac{26,8 \text{ g}}{16,0 \text{ g/mol}} = 1,64 \text{ mol} \rightarrow 1$$

$$\cdot n(\text{H}) = \frac{m}{M} = \frac{5,0 \text{ g}}{1,01 \text{ g/mol}} = 4,95 \text{ mol} \rightarrow 3$$

Empirische Formule: C7H6O2

### Oef 7

- $m\% \text{ (C)} = 39,9\%$       |  
 $m\% \text{ (H)} = 6,7\%$       |  
 $m\% \text{ (O)} = 53,4\%$       | 100g
- $n(C) = \frac{m}{M} = \frac{39,9 \text{ g}}{12,01 \text{ g/mol}} = 3,32 \text{ mol} \rightarrow 1$
- $n(H) = \frac{m}{M} = \frac{6,7 \text{ g}}{1,01 \text{ g/mol}} = 6,6 \text{ mol} \rightarrow 2$
- $n(O) = \frac{m}{M} = \frac{53,4 \text{ g}}{16,0 \text{ g/mol}} = 3,34 \text{ mol} \rightarrow 1$

Empirische formule:  $\text{CH}_2\text{O}$

Moleculiformule:  $M = \frac{60,0 \text{ g/mol}}{(12,01 + 2 \cdot 1,01 + 16) \text{ g/mol}} = 2$   
 $\text{C}_2\text{H}_4\text{O}_2$

### Oef 8

$$M(x) = 176,12 \text{ g/mol}$$

Empirische formule:  $\text{C}_3\text{H}_4\text{O}_3$

Moleculiformule:  $M = \frac{176 \text{ g/mol}}{(3 \cdot 12,01 + 4 \cdot 1,01 + 3 \cdot 16) \text{ g/mol}} = 2$   
 $\text{C}_6\text{H}_8\text{O}_6$

Oef 9

- $C_2H_4$  (ethene)

$$m(C) = 12 \cdot 2 = 24 \text{ g} \quad \left. \begin{array}{l} \\ \end{array} \right\} 28,04 \text{ g}$$

$$m(H) = 1 \cdot 1,01 = 1,04 \text{ g} \quad \left. \begin{array}{l} \\ \end{array} \right\}$$

$$m\%(\text{C}) = \frac{24 \text{ g}}{28,04 \text{ g}} \cdot 100 = 86\%$$

- $C_3H_7OH$  (propanol)

$$m(C) = 12 \cdot 3 = 36 \text{ g} \quad \left. \begin{array}{l} \\ \end{array} \right\}$$

$$m(H) = 1 \cdot 1,01 = 1,08 \text{ g} \quad \left. \begin{array}{l} \\ \end{array} \right\} 60,08 \text{ g}$$

$$m(O) = 16 \text{ g} \quad \left. \begin{array}{l} \\ \end{array} \right\}$$

$$m\%(\text{C}) = \frac{36 \text{ g}}{60,08 \text{ g}} \cdot 100 = 60\%$$

- $C_7H_{16}$  (heptane)

$$m(C) = 12 \cdot 7 = 84 \text{ g} \quad \left. \begin{array}{l} \\ \end{array} \right\} 100,16 \text{ g}$$

$$m(H) = 1 \cdot 1,01 = 1,16 \text{ g} \quad \left. \begin{array}{l} \\ \end{array} \right\}$$

$$m\%(\text{C}) = \frac{84 \text{ g}}{100,16 \text{ g}} \cdot 100 = 84\%$$

Etheen > heptaan > propanol

Oef 10

$$M(KBr) = 19,00 \text{ g/mol}$$

$$M(K_2S) = 110,26 \text{ g/mol}$$

$$m(KBr) + m(K_2S) = 8,02 \text{ g}$$

$$m(K) = 4,50 \text{ g}$$

$$n(K) = 0,115 \text{ mol}$$

$$x = \text{# mol KBr}$$

$$y = \text{# mol K}_2\text{S}$$

$$\Rightarrow x + 2y = 0,115 \text{ mol}$$

$$x \cdot 119 \text{ g/mol} + y \cdot 110,26 \text{ g/mol} = 8,02 \text{ g}$$

$$x = 2,6 \cdot 10^{-2} \text{ mol}$$

$$\text{m } \% (\text{KBr}) = 100 \cdot n \cdot M(\text{Br})$$

$$8,02 \text{ g}$$

$$= 39 \%$$

## Chemisch rekenen: Concentraties

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Oef 1

$$m(\text{NaNO}_3) = 0,38\text{ g}$$

$$V = 50,0 \cdot 10^{-3}\text{ L}$$

$$c = \frac{m}{M}$$

V

$$= \frac{0,38\text{ g}}{(22,99 + 14,0 + 3 \cdot 16,00)\text{ g/mol}}$$

$$50,0 \cdot 10^{-3}\text{ L}$$

$$= 0,089\text{ M}$$

Oef 2

$$m(\text{C}_{12}\text{H}_{22}\text{O}_11) = 10,0\text{ g}$$

$$V = 200 \cdot 10^{-3}\text{ L}$$

$$\text{a)} c = \frac{m}{M}$$

V

$$= \frac{10,0\text{ g}}{(12 \cdot 12,01 + 22 \cdot 1,01 + 11 \cdot 16,00)\text{ g/mol}}$$

$$200 \cdot 10^{-3}\text{ L}$$

$$= 0,146\text{ M}$$

$$\text{b)} c = \frac{m}{M}$$

V

$$= \frac{20,0\text{ g}}{(12 \cdot 12,01 + 22 \cdot 1,01 + 11 \cdot 16,00)\text{ g/mol}}$$

$$200 \cdot 10^{-3}\text{ L}$$

$$= 0,290\text{ mol/L}$$

### Oef 3

$$m(\text{Na}_2\text{SO}_4) = 15,5 \text{ g}$$

$$V = 350 \cdot 10^{-3} \text{ L}$$

$$c = \frac{m/M}{V} = \frac{15,5 \text{ g} / (2 \cdot 22,99 + 32,06 + 4 \cdot 16,00) \text{ g/mol}}{350 \cdot 10^{-3} \text{ L}} = 0,312 \text{ M}$$

### Oef 4

$$V = 50,00 \cdot 10^{-3} \text{ L}$$

$$c = 0,125 \text{ M}$$

$$m(\text{C}_2\text{H}_2\text{O}_4) = c \cdot V \cdot M = 0,125 \text{ M} \cdot 50,00 \cdot 10^{-3} \text{ L} \cdot (2 \cdot 12,01 + 2 \cdot 1,01 + 4 \cdot 16,00) \text{ g/mol}$$
$$= 0,563 \text{ g}$$

### Oef 5

$$c = 0,0380 \text{ M}$$

$$n(\text{CH}_3\text{COOH}) = 0,460 \cdot 10^{-3} \text{ mol}$$

$$V = \frac{n}{c} = \frac{0,460 \cdot 10^{-3} \text{ mol}}{0,0380 \text{ M}} = 0,0200 \text{ L}$$

### Oef 6

$$c(\text{C}_6\text{H}_{12}\text{O}_6) = 1,25 \cdot 10^{-3} \text{ M}$$

$$n(\text{C}_6\text{H}_{12}\text{O}_6) = 1,44 \cdot 10^{-6} \text{ mol}$$

$$V = \frac{n}{c} = \frac{1,44 \cdot 10^{-6} \text{ mol}}{1,25 \cdot 10^{-3} \text{ M}} = 0,00115 \text{ L}$$

### Oef 7

$$c_1(\text{HCl}) = 0,0155 \text{ M}$$

$$V_2 = 100 \cdot 10^{-3} \text{ L}$$

$$c_2 = 5,23 \cdot 10^{-4} \text{ M}$$

$$\Rightarrow C_1 V_1 = C_2 V_2$$

$$\frac{V_1}{C_1} = \frac{C_2 V_2}{0,0155 M} = \frac{5,23 \cdot 10^{-4} M \cdot 100 \cdot 10^{-3} L}{0,0155 M} = 0,00337 L$$

### Oef 8

$$c(\text{CuSO}_4) = 0,20 M$$

$$V = 250,0 \cdot 10^{-3} L$$

$$\text{a)} m(\text{CuSO}_4) = c \cdot V \cdot M$$

$$= 0,20 M \cdot 250,0 \cdot 10^{-3} L \cdot (63,55 + 32,06 + 4 \cdot 16,00) \text{ g/mol}$$

$$= 9,98 \text{ g}$$

$$\text{b)} m(\text{CuSO}_4 \cdot 5\text{H}_2\text{O}) = c \cdot V \cdot M$$

$$= 0,20 M \cdot 250,0 \cdot 10^{-3} L \cdot (63,55 + 32,06 + 9 \cdot 16,00 + 10 \cdot 1,0) \text{ g/mol}$$

$$= 12,49 \text{ g}$$

### Oef 9

$$c(\text{HCl}) = 0,358 M$$

$$n(\text{HCl}) = 2,55 \cdot 10^{-3} \text{ mol}$$

$$\frac{V}{c} = \frac{n}{0,358 M} = \frac{2,55 \cdot 10^{-3} \text{ mol}}{0,358 M} = 0,00712 L$$

### Oef 10



$$m_n = 2,111 \text{ g}$$

$$V_1 = 0,2500 L$$



$$n_2 = \underline{2,45 \cdot 10^{-3} \text{ mol}}$$

g

$$c = \underline{n_1}$$

V<sub>1</sub>

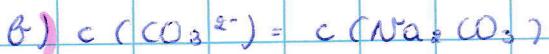
$$= \underline{m_1 / M}$$

V<sub>1</sub>

$$= 0,04967 \text{ M}$$

$$V_2 = \underline{n_2} = \underline{0,01349 \text{ L}}$$

c



$$= \underline{0,04992}$$

$$250 \cdot 10^{-3}$$

$$= 0,0497 \text{ M}$$

$$V = \underline{n} = \underline{4,98 \cdot 10^{-3} \text{ mol}} = \underline{62,5 \text{ mL}}$$

c

$$0,0497 \text{ M}$$

$$c) n = \underline{m} = \underline{50,0 \cdot 10^{-3} \text{ g}} = 4,42 \cdot 10^{-4} \text{ mol}$$

$$M (\text{g} \cdot \text{mol}^{-1}) = (2 \cdot 22,99 + 12,01 + 3 \cdot 16,00) \text{ g/mol}$$

$$c = \underline{n} = \underline{c_1}$$

V

$$V = \underline{n} = \underline{4,42 \cdot 10^{-4} \text{ mol}} = \underline{0,00592 \text{ L}} = \underline{5,92 \text{ mL}}$$

$$c = 0,04967 \text{ M}$$

**Oef 11**

$$n = \frac{m}{M} = \frac{85,5 \text{ g}}{(3 \cdot 1,01 + 30,07 + 4 \cdot 16,00) \text{ g/mol}} = 0,881 \text{ mol}$$

$$M = (3 \cdot 1,01 + 30,07 + 4 \cdot 16,00) \text{ g/mol}$$

$$p = \frac{m}{V} \Leftrightarrow V = \frac{m}{p}$$

 $V$  $p$ 

$$= \frac{100 \text{ g}}{1,69 \text{ g/L}}$$

$$1,69 \text{ g/L}$$

$$= 59,2 \text{ mL}$$

$$c = \frac{n}{V} = \frac{0,881 \text{ mol}}{59,2 \cdot 10^{-3} \text{ L}} = 14,8 \text{ M}$$

$$V_{\text{conc}} = c \cdot V_{\text{verd}} =$$

$$\frac{14,8 \text{ M} \cdot 1 \text{ L}}{14,8 \text{ M}} = 67,6 \text{ mL}$$

 $c_{\text{conc}}$  $14,8 \text{ M}$ **Oef 12**

$$\text{a)} 28 \text{ mL } \text{NH}_3 = \frac{28 \text{ g } \text{NH}_3}{100 \text{ g}}$$

$$n(\text{NH}_3) = \frac{m}{M} = \frac{28 \text{ g}}{(14,0 + 3 \cdot 1,0) \text{ g/mol}} = 1,6 \text{ mol}$$

$$M = (14,0 + 3 \cdot 1,0) \text{ g/mol}$$

$$p = 0,899 \text{ g/L}$$

$$V = \frac{m}{p} = \frac{100 \text{ g}}{0,899 \text{ g/L}} = 111 \text{ mL}$$

$$p = 0,899 \text{ g/L}$$

$$c = \frac{n}{V} = \frac{1,6 \text{ mol}}{111 \text{ mL}} = 15 \text{ M}$$

$$V = 111 \text{ mL}$$

$$\text{b)} V_1 = C_1 V_2 = \frac{0,250 \text{ M} \cdot 500 \text{ mL}}{15 \text{ M}} = 8,3 \text{ mL}$$

 $C_1$  $15 \text{ M}$

### Oef 13

CoCl

$$40\% \text{ CoCl} = 40 \text{ g CoCl}$$

100g qpl

$$\rho = 1,43 \text{ g/mL}$$

$$\text{a) } n = \frac{m}{M} = \frac{40 \text{ g}}{(132,91 + 35,45) \text{ g/mol}} = 0,24 \text{ mol}$$

$$V = \frac{m}{\rho} = \frac{100 \text{ g}}{1,43 \text{ g/mL}} = 69,9 \text{ mL}$$

$$c = \frac{n}{V} = \frac{0,24 \text{ mol}}{69,9 \text{ mL}} = 3,4 \text{ M}$$

$$\text{b) } V_1 = \frac{c_1 V_2}{c_2} = \frac{0,100 \text{ M} \cdot 500 \text{ mL}}{3,4 \text{ M}} = 15 \text{ mL}$$

### Oef 14

HBr

$$48,0 \text{ mL} = 48,0 \text{ g HBr}$$

100g qpl

$$\rho = 1,50 \text{ g/mL}$$

$$\text{a) } m = V \rho = 1,00 \text{ L} \cdot 1,50 \text{ g/mL} = 1500 \text{ g}$$

$$\text{b) } 1500 \text{ g} \cdot 0,480 = 720 \text{ g HBr}$$

$$\text{c) } n = \frac{m}{M} = \frac{48,0 \text{ g}}{(1,01 + 79,90) \text{ g/mol}} = 0,593 \text{ mol}$$

$$V = \frac{m}{\rho} = \frac{100 \text{ g}}{1,50 \text{ g/mL}} = 66,7 \text{ mL}$$

$$c = \frac{n}{V} = \frac{0,593 \text{ mol}}{66,7 \text{ mL}} = 8,90 \text{ M}$$

$$V = 66,7 \text{ mL}$$

$$\text{d)} V_1 = \frac{c_2 V_2}{c_1} = \frac{0,160 \text{ M} \cdot 0,250 \text{ L}}{8,90 \text{ M}} = 0,00449 \text{ L}$$

Oef 15



$$98\% = 98 \text{ g H}_2\text{SO}_4$$

$$100 \text{ g qpl}$$

$$c = 18,0 \text{ M}$$

$$\text{a)} V_1 = \frac{c_2 V_2}{c_1} = \frac{1 \text{ M} \cdot 1 \text{ L}}{18,0 \text{ M}} = 0,056 \text{ L} = 56,0 \text{ mL}$$

$$\text{b)} n = \frac{m}{M} = \frac{98 \text{ g}}{(2 \cdot 1,01 + 32,06 + 4 \cdot 16,00) \text{ g/mol}} = 0,999 \text{ mol}$$

$$V = \frac{n}{c} = \frac{0,999 \text{ mol}}{18,0 \text{ M}} = 0,0555 \text{ L}$$

$$\rho = \frac{m}{V} = \frac{100 \text{ g}}{0,0555 \text{ L}} = 1,80 \text{ g/mL}$$

Oef 16



$$m(\text{KCl}) = 0,500 \text{ g}$$

$$m(\text{K}_2\text{S}) = 0,500 \text{ g}$$

$$m(\text{K}_3\text{PO}_4) = 0,500 \text{ g}$$

$$V = 500,00 \text{ mL}$$

a)  $n(\text{KCl}) = \frac{m}{M} = \frac{0,500\text{g}}{(39,10 + 35,45)\text{g/mol}} = 0,00670\text{ mol}$

$n(\text{K}_2\text{S}) = \frac{m}{M} = \frac{0,500\text{g}}{(2 \cdot 39,10 + 32,06)\text{g/mol}} = 0,00453\text{ mol}$

$n(\text{K}_3\text{PO}_4) = \frac{m}{M} = \frac{0,500\text{g}}{(3 \cdot 39,10 + 30,97 + 4 \cdot 16,00)\text{g/mol}} = 0,00236\text{ mol}$

$n(\text{totaal K}) = 0,00670\text{ mol} + 2 \cdot 0,00453\text{ mol} + 3 \cdot 0,00236\text{ mol}$   
 $= 0,0228\text{ mol}$

$c(\text{K-ionen}) = \frac{n}{V} = \frac{0,0228\text{ mol}}{0,500\text{00 L}} = 0,0457\text{ M}$

b)  $c(\text{S-ionen}) = \frac{n}{V} = \frac{0,00453\text{ mol}}{0,500\text{00 L}} = 0,00907\text{ M}$

Oef 17

$V = 100\text{ mL}$

$m(\text{NaCl}) = 0,50\text{g}$

$m(\text{KCl}) = 0,30\text{g}$

$n(\text{NaCl}) = \frac{m}{M} = \frac{0,50\text{g}}{(22,99 + 35,45)\text{g/mol}} = 0,0086\text{ mol}$

$n(\text{KCl}) = \frac{m}{M} = \frac{0,30\text{g}}{(39,10 + 35,45)\text{g/mol}} = 0,0040\text{ mol}$

$c = \frac{n}{V} = \frac{0,0086\text{ mol} + 0,0040\text{ mol}}{0,100\text{ L}} = 0,126\text{ M}$

Oef 18

$$c = 34 \text{ ppb} = 34 \cdot 10^{-6} \text{ g}$$

$$n = \frac{m}{M} = \frac{34 \cdot 10^{-6} \text{ g}}{= 8,3 \cdot 10^{-8} \text{ mol}}$$

$$M = (29 \cdot 12,01 + 60 \cdot 1,01) \text{ g/mol}$$

$$c = \frac{n}{V} = \frac{8,3 \cdot 10^{-8} \text{ mol}}{1 \text{ L}} = 8,3 \cdot 10^{-8} \text{ M}$$

Oef 19

$$35 \text{ ppm} = \frac{x}{1,39} \cdot 10^6$$

$$1,39$$

$$x = \frac{35 \cdot 1,39}{10^6} = 45,5 \cdot 10^{-6} \text{ g/L}$$

Oef 20

$$c = 50 \text{ ng/L} = 50 \cdot 10^{-9} \text{ g/L}$$

a)

$$\frac{50 \cdot 10^{-9} \text{ g/L}}{1,025 \text{ g/L}} = 0,0488 \cdot 10^{-9} = 49 \cdot 10^{-3} \text{ ppb}$$

b)

$$M = (16 \cdot 12,01 + 21 \cdot 1,01 + 14,01 + 2 \cdot 16,00) \text{ g/mol}$$

$$= 259,38 \text{ g/mol}$$

$$c = \frac{c}{M}$$

$$M$$

$$= \frac{50 \cdot 10^{-9} \text{ g/L}}{259,38 \text{ g/mol}}$$

$$259,38 \text{ g/mol}$$

$$= 1,9 \cdot 10^{-10} \text{ M}$$

## Oef 21

$$c = 1,0 \text{ M}$$



$$V = \pi r^2 h \rightarrow r = 50 \text{ m}, h = 20 \text{ m}$$

$$c = 1,2 \text{ ppm F}^-$$

$$\text{a) } V = \pi r^2 h = \pi \cdot (50 \text{ m})^2 \cdot 20 \text{ m} = 16 \cdot 10^4 \text{ m}^3 = 16 \cdot 10^7 \text{ L}$$

$$1,2 \text{ ppm} = 1,2 \text{ mg/kg}$$

$$= 1,2 \text{ mg F}^- / \text{L}$$

$$= 6,31 \cdot 10^{-3} \text{ mol/L F}^- \text{-ionen} \rightarrow 16 \cdot 10^7 \text{ L} = 9,9 \cdot 10^3 \text{ mol F}^-$$

1 mol  $\text{H}_2\text{SiF}_6$  liefert 6 mol  $\text{F}^-$ ,  $1,65 \cdot 10^3 \text{ mol H}_2\text{SiF}_6$  liefert  $9,9 \cdot 10^3 \text{ mol F}^-$

$$V = \frac{n}{c} = \frac{1,65 \cdot 10^3 \text{ mol}}{1,0 \text{ M}} = 1,65 \cdot 10^3 \text{ L}$$

$$\text{b) } m = n \cdot M$$

$$= 1,65 \cdot 10^3 \text{ mol} \cdot (2 \cdot 1,01 + 28,09 + 6 \cdot 19,00) \text{ g/mol} = 2,38 \cdot 10^5 \text{ g}$$

## Oef 22

$$\text{a) } 10 \text{ ppm (KI)} = 10 \cdot 10^{-3} \text{ g/L}$$

$$n(\text{KI}) = \frac{10 \cdot 10^{-3} \text{ g}}{(39,10 + 126,90) \text{ g/mol}} = 6,0 \cdot 10^{-5} \text{ mol}$$

$$c(\text{KI}) = \frac{n}{V} = \frac{6,0 \cdot 10^{-5} \text{ mol}}{1 \text{ L}} = 6,0 \cdot 10^{-5} \text{ M}$$

$$10000 \text{ ppm} = 10000 \cdot 10^{-6} \text{ g/L}$$

$$n(\text{KBr}) = \frac{10000 \cdot 10^{-6} \text{ g}}{(39,10 + 79,90) \text{ g/mol}} = 8,40 \cdot 10^{-5} \text{ mol}$$

$$c(\text{KBr}) = \frac{n}{V} = \frac{8,40 \cdot 10^{-5} \text{ mol}}{1 \text{ L}} = 8,40 \cdot 10^{-5} \text{ M} \rightarrow \text{hoogte}$$

$$\text{t1) } 0,25 \text{ m.l.} = 0,25 \text{ g} / 100 \text{ g}$$

$$2,5 \text{ g} / \text{L}$$

$$n = \frac{m}{M} = \frac{2,5 \text{ g}}{(35,45 + 39,10) \text{ g/mol}} = 0,034 \text{ mol}$$

$$c = \frac{n}{V} = \frac{0,034 \text{ mol}}{1 \text{ L}} = 0,034 \text{ M} \rightarrow \text{hoog}$$

$$2,5 \text{ g C}_6\text{H}_2\text{O}_7 / \text{L}$$

$$n = \frac{m}{M} = \frac{2,5 \text{ g}}{(6 \cdot 12,01 + 8 \cdot 1,01 + 7 \cdot 16,00) \text{ g/mol}} = 0,013 \text{ mol}$$

$$c = \frac{n}{V} = \frac{0,013 \text{ mol}}{1 \text{ L}} = 0,013 \text{ M}$$

### Oef 23

$$10 \text{ ppd} = 10 \cdot 10^{-6} \text{ g/L} \quad \rho = 1,00 \text{ g/cm}^3 = 1,00 \cdot 10^{-3} \text{ g/L}$$

$$n = \frac{10 \cdot 10^{-6} \text{ g}}{(207,20) \text{ g/mol}} = 4,8 \cdot 10^{-8} \text{ mol}$$

$$V = \frac{m}{\rho} = \frac{10 \cdot 10^{-6} \text{ g}}{1,00 \cdot 10^{-3} \text{ g/L}} = 1,0 \cdot 10^{-2} \text{ L}$$

$$c = 4,8 \cdot 10^{-8} \text{ M} \rightarrow \text{Bruikbaar}$$

### Oef 24

$$p(O_3) = p_{\text{tot}} \cdot x(O_3)$$

$$x(O_3) = n(O_3) / n_{\text{tot}}$$

$$x(O_3) = 1,23 \cdot 10^{-7}$$

Stiel n<sub>tot</sub> = 1 mol

$$n(O_3) = x(O_3) \cdot n_{tot}$$
$$= 1,2 \cdot 10^{-7} \text{ mol}$$

$$\text{ppm} = \frac{m_{\text{comp}}}{m_{\text{tot}}} \cdot 10^6$$

m<sub>tot</sub>

$$m(O_3) = nM$$

$$= 5,46 \cdot 10^{-6} \text{ g}$$

$$m_{\text{tot}} = 29 \text{ g}$$

$$\text{ppm} = 0,20 \text{ ppm}$$

## Chemisch rekenen: Stoichiometrie

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Oef 1



1	4	5	4
---	---	---	---

0,15	0,60	0,45	0,60
------	------	------	------

$$n(\text{CO}_2) = 0,60 \text{ mol}$$

✓

Oef 2



$$m(\text{Fe}_2\text{O}_3) = 1,00 \cdot 10^3 \text{ g}$$

1	3	2	3
---	---	---	---

6,26	12,52		
------	-------	--	--

$$n(\text{Fe}_2\text{O}_3) = 1,00 \cdot 10^3 \text{ g/mol}$$

$$(2 \cdot 55,85 + 3 \cdot 16,00) \text{ g/mol}$$

$$= 6,26 \text{ mol}$$

$$n(\text{Fe}) = 12,52 \text{ mol}$$

$$m(\text{Fe}) = n \cdot M$$

$$= 12,5 \text{ mol} \cdot 55,85 \text{ g/mol}$$

$$= 699 \text{ g}$$

Oef 3



$$m(\text{H}_2) = 7,81 \text{ g}$$

2	2	1	2
---	---	---	---

7,75	3,87		
------	------	--	--

$$n(\text{H}_2) = 7,81 \text{ g/mol}$$

$$(2 \cdot 1,01) \text{ g/mol}$$

$$= 3,87 \text{ mol}$$

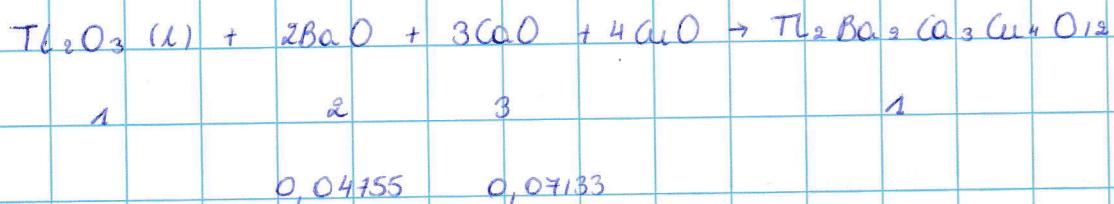
$$m(\text{Na}) = n \cdot M$$

$$= 7,75 \text{ mol} \cdot 22,99 \text{ g/mol}$$

$$= 178 \text{ g}$$

✓

#### Oef 4



$$m(\text{CaO}) = 4,0 \text{ g}$$

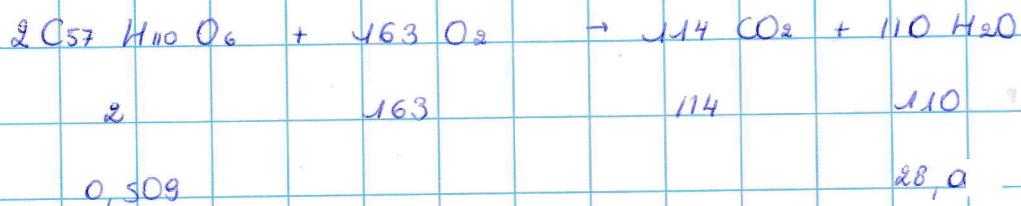
$$n(\text{CaO}) = \frac{4,0 \text{ g}}{(40,08 + 16,00) \text{ g/mol}} = 0,071 \text{ mol}$$

$$n(\text{BaO}) = 0,048 \text{ mol}$$

$$n(\text{CuO}) = 0,40 \text{ mol}$$

$$m(\text{CuO}) = 0,40 \text{ mol} (63,55 + 16,00) \text{ g/mol} = 32 \text{ g}$$

#### Oef 5



$$n(\text{ret}) = \frac{m}{M} = \frac{0,454 \text{ g}}{(57 \cdot 12,01 + 110 \cdot 1,01 + 6 \cdot 16,00) \text{ g/mol}} = 0,509 \text{ mol}$$

$$m(\text{H}_2\text{O}) = n \cdot M$$
$$= 28,0 \text{ mol} \cdot (2 \cdot 1,01 + 16,0) \text{ g/mol}$$
$$= 505 \text{ g}$$

$$n(\text{O}_2) = 163 \text{ mol}$$

$$m(\text{O}_2) = n \cdot M = 163 \text{ mol} \cdot 2 \cdot 16,00 \text{ g/mol}$$
$$= 1324 \text{ g} \quad \checkmark$$

Oef 6

2 3 1

0,1467 0,220 0,07335

$$n(\text{NH}_3) = \frac{m}{M} = \frac{2,5\text{ g}}{(14,01 + 3 \cdot 1,01)\text{ g/mol}} = 0,1467\text{ mol}$$

$$m(\text{N}_2) = nM = 0,0733\text{ mol} \cdot 2 \cdot 14,01\text{ g/mol} = 2,19\text{ g}$$

$$m(\text{H}_2) = nM = 0,220\text{ mol} \cdot 2 \cdot 1,01\text{ g/mol} = 0,449\text{ g}$$

Oef 7

3 1 2 1

0,119 0,07934

$$n(\text{HNO}_3) = \frac{m}{M} = \frac{5,00\text{ g}}{(1,01 + 14,01 + 3 \cdot 16,00)\text{ g/mol}} = 0,04937\text{ mol}$$

$$m(\text{NO}_2) = n \cdot M = 0,119\text{ mol} \cdot (14,01 + 2 \cdot 16,00)\text{ g/mol} = 5,48\text{ g}$$

Oef 8

$$n(\text{CaCO}_3) = \frac{400 \cdot 10^{-3}\text{ g}}{(40,08 + 42,01 + 3 \cdot 16,01)\text{ g/mol}} = 0,0039400\text{ mol}$$

$$m(\text{HCl}) = 0,00499 \cdot (1,01 + 35,45)\text{ g/mol} = 0,00899\text{ g} \quad 0,291\text{ g}$$

$$n(\text{Mg}(\text{OH})_2) = \frac{150 \cdot 10^{-3}\text{ g}}{(24,31 + 2 \cdot 16,00 + 2 \cdot 1,01)\text{ g/mol}} = 0,00237\text{ mol}$$

$$m(\text{HCl}) = 0,00514 \text{ mol} \cdot (1,01 + 35,45) \text{ g/mol} = 0,188 \text{ g}$$

$$\begin{aligned}m_{\text{tot}}(\text{HCl}) &= 0,291 \text{ g} + 0,188 \text{ g} \\&= 0,479 \text{ g} \quad \checkmark\end{aligned}$$

Oef 9



$$n(\text{Al}) = 0,15 \text{ mol}$$

$$n(\text{AlCl}_3) = 0,35 \text{ mol}$$

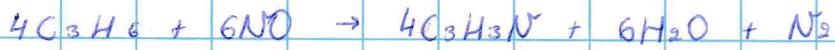


$$0,15 \quad 0,35$$

$$0,12 \quad 0,35 \quad 0,42 \quad \checkmark$$

↳ limiterend reagens

Oef 10



$$155 \cdot 10^2 \quad \text{aermaat} \quad 155 \cdot 10^2$$

$$m(\text{C}_3\text{H}_6) = 6,51 \cdot 10^3 \text{ g}$$

$$n(\text{C}_3\text{H}_6) = \frac{m}{M} = \frac{651 \cdot 10^3 \text{ g}}{(3 \cdot 12,01 + 6 \cdot 1,01) \text{ g/mol}} = 155 \cdot 10^2 \text{ mol}$$

$$m(\text{C}_3\text{H}_3\text{N}) = n \cdot M$$

$$\begin{aligned}&= 155 \cdot 10^2 \text{ mol} \cdot (3 \cdot 12,01 + 3 \cdot 1,01 + 14,01) \text{ g/mol} \\&= 821 \cdot 10^3 \text{ g}\end{aligned}$$

Oef 11



$$2 \quad 1 \quad 2$$

$$0,454 \quad 0,227 \quad 0,464$$

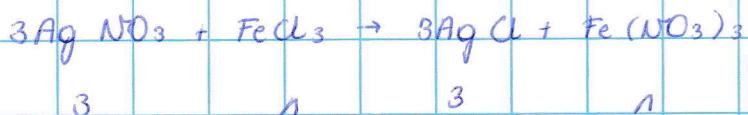
$$n(\text{CH}_3\text{CHO}) = \frac{m}{M} = \frac{20,0\text{ g}}{(2 \cdot 12,01 + 4 \cdot 1,01 + 16,00)\text{ g/mol}} = 0,454\text{ mol}$$

$$n(\text{O}_2) = \frac{m}{M} = \frac{10,0\text{ g}}{(2 \cdot 16,00)\text{ g/mol}} = 0,313\text{ mol}$$

$$\begin{aligned} m(\text{O}_2) &= n \cdot M \\ &= 0,454\text{ mol} \cdot 2 \cdot 16,00\text{ g/mol} \\ &= 2,74\text{ g} \quad \checkmark \end{aligned}$$

$$\begin{aligned} m(\text{HC}_2\text{H}_3\text{O}_2) &= n \cdot M \\ &= 0,454\text{ mol} \cdot (4 \cdot 1,01 + 2 \cdot 12,01 + 2 \cdot 16)\text{ g/mol} \\ &= 24,3\text{ g} \quad \checkmark \end{aligned}$$

### Oef 12



$$0,106\text{ mol} : 0,20\text{ mol}$$

$$0,106\text{ mol} : 0,0353\text{ mol}$$

$$n(\text{AgNO}_3) = \frac{m}{M} = \frac{48,0\text{ g}}{(107,87 + 3 \cdot 16,00 + 14,01)\text{ g/mol}} = 0,106\text{ mol}$$

$$n(\text{FeCl}_3) = \frac{m}{M} = \frac{32,4\text{ g}}{(55,85 + 3 \cdot 35,45)\text{ g/mol}} = 0,1998\text{ mol}$$

$$\begin{aligned} n(\text{FeCl}_3) &= 0,200\text{ mol} - 0,0353\text{ mol} \\ &= 0,164\text{ mol} \end{aligned}$$

$$\begin{aligned} m(\text{FeCl}_3) &= n \cdot M \\ &= 0,164\text{ mol} \cdot (55,85 + 3 \cdot 35,45)\text{ g/mol} \\ &= 26,4\text{ g} \quad \checkmark \end{aligned}$$

### Oef 13



4	5	6	4
---	---	---	---

0,420	0,140		
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0,412	0,140		
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	0,142		
--	-------	--	--

$\text{O}_2$  Limiterend reagens

✓

$$m(\text{NO}) = n \cdot M$$

$$= 0,112 \text{ mol} \cdot (14,01 + 16,00) \text{ g/mol}$$

$$= 3,36 \text{ g}$$

✓

### Oef 14



1	2	1	1	1
---	---	---	---	---

0,0235	0,0645		
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0,0235	0,0470		
--------	--------	--	--

	0,0235		
--	--------	--	--

$\text{CaCO}_3$  LR

✓

$$n(\text{CaCO}_3) = \frac{m}{M} = \frac{2,35 \text{ g}}{(40,08 + 12,01 + 3 \cdot 16,00) \text{ g/mol}} = 0,0235 \text{ mol}$$

$$n(\text{HCl}) = \frac{m}{M} = \frac{2,35 \text{ g}}{(1,01 + 35,45) \text{ g/mol}} = 0,0645 \text{ mol}$$

$$V(\text{CO}_2) = n \cdot 22,4 \text{ L}$$

$$= 0,0235 \text{ mol} \cdot 22,4 \text{ L}$$

$$= 0,526 \text{ L}$$

✓

### Oef 15



0,0520	0,472	0,0956	
--------	-------	--------	--

0,0478	0,0638	0,0956	0,0478
--------	--------	--------	--------

$\text{Cl}_2$  LR

$$n(\text{TiO}_2) = \frac{m}{M} = \frac{4,15 \text{ g}}{(47,88 + 2 \cdot 16,00) \text{ g/mol}} = 0,0520 \text{ mol}$$

$$n(\text{C}) = \frac{m}{M} = \frac{5,67 \text{ g}}{(12,01) \text{ g/mol}} = 0,472 \text{ mol}$$

$$n(\text{Cl}_2) = \frac{m}{M} = \frac{6,48 \text{ g}}{2 \cdot 35,45 \text{ g/mol}} = 0,0956$$

$$m(\text{TiCl}_4) = n \cdot M = 0,0478 \text{ mol} \cdot (47,88 + 4 \cdot 35,45) \text{ g/mol} = 9,07 \text{ g} \quad \checkmark$$

### Oef J6



2 3 2 2 6

0,675 0,313 0,654

0,208 0,313 0,208 0,208

$\text{O}_2$  LR

$$n(\text{NH}_3) = \frac{11,5 \text{ g}}{(14,01 + 3 \cdot 1,01) \text{ g/mol}} = 0,675 \text{ mol}$$

$$n(\text{O}_2) = \frac{40,0 \text{ g}}{(2 \cdot 16,00) \text{ g/mol}} = 0,313 \text{ mol}$$

$$n(\text{CH}_4) = \frac{40,5 \text{ g}}{(12,01 + 4 \cdot 1,01) \text{ g/mol}} = 0,654 \text{ mol}$$

$$m(\text{HCN}) = n \cdot M = 0,208 \text{ mol} \cdot (12,01 + 13,01 + 14,01) \text{ g/mol} = 5,63 \text{ g} \quad \checkmark$$

### Oef J7



0,202 0,218 0,333

0,202 0,202 0,202 0,202

$\text{C}_4\text{H}_9\text{OH}$  LR

$$n(\text{C}_4\text{H}_9\text{OH}) = \frac{15,0 \text{ g}}{(4 \cdot 12,01 + 10 \cdot 1,01 + 16,00) \text{ g/mol}} = 0,202 \text{ mol}$$

$$n(\text{NaBr}) = \frac{22,4 \text{ g}}{(22,99 + 79,80) \text{ g/mol}} = 0,218 \text{ mol}$$

$$n(\text{H}_2\text{SO}_4) = \frac{32,7 \text{ g}}{(2 \cdot 1,01 + 32,06 + 4 \cdot 16,00) \text{ g/mol}} = 0,333 \text{ mol}$$

$$m(\text{C}_4\text{H}_9\text{Br}) = n \cdot M = 0,202 \text{ mol} \cdot (4 \cdot 12,01 + 9 \cdot 1,01 + 79,90) \text{ g/mol} = 27,49 \text{ g} \quad \checkmark$$

### Oef 18



1 2 1 1 1

reel 1,46 10,4

0,882 1,46 0,882 0,882

$\text{Cl}_2$  LR  $\checkmark$

$$n(\text{Cl}_2) = \frac{125 \text{ g}}{(35,45 \cdot 2) \text{ g/mol}} = 1,46 \text{ mol}$$

$$n(\text{C}) = \frac{125 \text{ g}}{12,01 \text{ g/mol}} = 10,4 \text{ mol}$$

$$m(\text{TiCl}_4) = nM = 0,882 \text{ mol} \cdot (4 \cdot 35,45 + 47,88) \text{ g/mol} = 164 \text{ g} \quad \checkmark$$

### Oef 19



2 2

0,234 0,237

$$n(\text{KNO}_3) = \frac{m}{M} = \frac{24,0 \text{ g}}{(39,10 + 14,01 + 3 \cdot 16,00) \text{ g/mol}} = 0,234 \text{ mol}$$

$$m(\text{KNO}_2) = nM = 0,234 \text{ mol} \cdot (39,10 + 14,01 + 2 \cdot 16,00) \text{ g/mol} = 20,2 \text{ g}$$

$$\text{opbrengst} = \frac{13,8 \text{ g}}{20,2 \text{ g}} \cdot 100 = 68,3\% \quad \checkmark$$

Oef 20

$$0,609 \quad 0,545$$

$$0,609 \quad 0,203 \quad 0,406$$

$$n(\text{NO}_2) = \frac{m}{M} = \frac{28\text{g}}{(14,01 + 2 \cdot 16,00)\text{g/mol}} = 0,609 \text{ mol}$$

$$n(\text{H}_2\text{O}) = \frac{m}{M} = \frac{18\text{g}}{(1,01 + 2 \cdot 16,00)\text{g/mol}} = 0,545 \text{ mol}$$

$$m(\text{HNO}_3) = nM = 0,406 \text{ mol} \cdot (1,01 + 14,01 + 3 \cdot 16,00)\text{g/mol} = 25,6 \text{ g}$$

$$\text{optrengst} = \frac{25,6 \text{ g}}{25,6 \text{ g}} \cdot 100 = 100\%$$

Oef 21

$$0,468 \quad 0,357$$

$$0,357 \quad 0,357 \quad 0,357$$

$$n(\text{CH}_3\text{OH}) = \frac{m}{M} = \frac{15,0\text{g}}{(12,01 + 4 \cdot 1,01 + 16,00)\text{g/mol}} = 0,468 \text{ mol}$$

$$n(\text{CO}) = \frac{m}{M} = \frac{10,0\text{g}}{(12,01 + 16,00)\text{g/mol}} = 0,357 \text{ mol}$$

$$m(\text{HC}_2\text{H}_3\text{O}_2) = nM = 0,357 \text{ mol} \cdot (4 \cdot 1,01 + 3 \cdot 12,01 + 2 \cdot 16,00)\text{g/mol} = 25,7 \text{ g}$$

$$\text{optrengst} = \frac{25,7 \text{ g}}{25,7 \text{ g}} \cdot 100 = 100\%$$

Oef 22

$$0,0145 \quad 0,0392$$

$$0,0145 \quad 0,0145 \quad 0,0145$$

$$n(\text{C}_7\text{H}_6\text{O}_3) = \frac{m}{M} = \frac{2,00\text{g}}{(8 \cdot 1,01 + 7 \cdot 12,01 + 3 \cdot 16,00)}$$

$$= 0,145 \text{ mol}$$

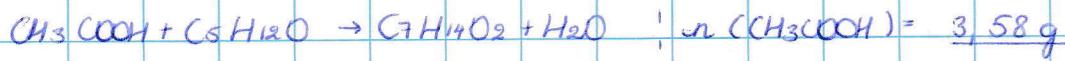
$$n(C_4H_6O_3) = \frac{m}{M} = \frac{4,00g}{(4 \cdot 12,01 + 6 \cdot 1,01 + 3 \cdot 16,00) g/mol} = 0,0392 \text{ mol}$$

$$M = (4 \cdot 12,01 + 6 \cdot 1,01 + 3 \cdot 16,00) g/mol$$

$$m(C_9H_8O_4) = n \cdot M = 0,045 \text{ mol} \cdot (9 \cdot 12,01 + 8 \cdot 1,01 + 4 \cdot 16,00) g/mol = 26,19 \text{ g}$$

oerengst =  $\frac{2,10g}{2,61g} \cdot 100 = 80,4\%$  ✓  
 $2,61g$

Oef 23



$$0,0596 \quad 0,0539$$

$$0,0539 \quad 0,0539 \quad 0,0539$$

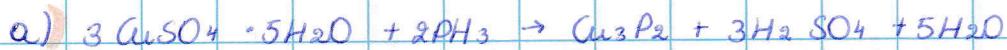
$$n(C_6H_{12}O) = m = \frac{4,75g}{(5 \cdot 12,01 + 12 \cdot 1,01 + 46,00) g/mol} = 0,0539 \text{ mol}$$

$$M = (5 \cdot 12,01 + 12 \cdot 1,01 + 46,00) g/mol$$

$$m(C_7H_{14}O_2) = n \cdot M = 0,0539 \text{ mol} \cdot (7 \cdot 12,01 + 14 \cdot 1,01 + 2 \cdot 16,00) g/mol = 7,019 \text{ g}$$

oerengst =  $\frac{7,01g}{10g} \cdot 0,45 = 3,16g$  ✓

Oef 24



$$0,441 \quad 0,424 \text{ mol}$$

$$0,185 \quad 0,424 \text{ mol} \quad 0,0618$$

b)  $n(CuSO_4 \cdot 5H_2O) = \frac{m}{M} = \frac{110g}{(63,55 + 32,06 + 9 \cdot 16,00 + 10 \cdot 1,01) g/mol} = 0,441 \text{ mol}$

$$M = (63,55 + 32,06 + 9 \cdot 16,00 + 10 \cdot 1,01) g/mol$$

$$n(PH_3) = \frac{4,94g}{(30,97 + 3 \cdot 1,01) g/mol} = 0,124 \text{ mol} \rightarrow \text{limiterend}$$

c)  $m(Cu_3P_2) = n \cdot M$

$$= 0,0618 \text{ mol} \cdot (3 \cdot 63,55 + 2 \cdot 30,97) g/mol$$

$$= 15,6g$$

oerengst =  $15,6g \cdot 0,0631 = 0,984g$  ✓

## Elektronenconfiguratie

Oej 1

- a) geëxciteerd
  - b) geëxciteerd
  - c) geëxciteerd
  - d) grondtoestand

Oej 2

- a)  $l$  kan alleen 0 zijn ✓
  - b)  $m_1$  kan alleen -1, 0 of 1 zijn ✓
  - c) mogelijk ✓
  - d)  $m_2$  kan alleen  $-1/2$  of  $1/2$  zijn ✓
  - e)  $n$  kan geen 0 zijn ✓
  - f)  $l$  kan alleen 0 of 1 zijn ✓

Oef 3

- a)  $1s \quad 1s \quad 1s \quad r \quad v$
  - b)  $1s \quad 1s \quad v$
  - c) Er kunnen geen 3 elektronen in de 1s orbitaal zitten.  $v$
  - d) De 2s orbitaal moet eerst volledig opgevuld zijn, max 6e<sup>-</sup> in 2p.
  - e)  $1s \quad 1s \quad v$
  - f) 1s orbitaal is niet gevuld (kan bij geëxciteerde toestand)

Obj 4

- a)  $T_L T_L T_L T_L T_L$   $T_L$   $T_L T_L T_L$   $T_L$   $T_L T_L T_L T_L T_L$   $T$   
 $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^1$  ✓  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4p^6$

e)  $T_L$   $T_L$   $T_L T_L T_L$   $T_L$   $T_L T_L T_L$   $T_L$   $E$   $T$   $T$   $T$   $T$   $T$   
 $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$  ✓  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$

c)  $1s^2$   $1s^2$   $1s^2 2s^2$   $1s^2$   $1s^2 2s^2 2p^6$   $1s^2$   $1s^2 2s^2 2p^6$   $1s^2$   
 $1s^2 2s^2 2p^6$   $1s^2 2s^2 2p^6 3s^2$   $1s^2 2s^2 2p^6 3s^2 3p^6$   $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$   $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$   
 $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$   $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10}$   $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2$   $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^4$

d)  $1s^2$   $1s^2$   $1s^2 2s^2$   $1s^2$   $1s^2 2s^2 2p^6$   $1s^2$   $1s^2 2s^2 2p^6 3s^2$   $1s^2$   $1s^2 2s^2 2p^6 3s^2 3p^6$   $1s^2$   $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2$   $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$

### Oef 5

- a) Tellurium (Te) ✓ c) Kodstof (C) ✓  
 b) Vanadium (V) ✓ d) Thorium (Th) ✓

### Oef 6

- a)  $1s^2 2s^2 2p^6$  ✓  
 b)  $1s^2 2s^2 2p^6 3s^2 3p^6$  ✓  
 c)  $1s^2 2s^2 2p^6 3s^2 3p^6$  ✓  
 d)  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 \cancel{5p^6} 4p^{14} 5s^2 5p^6 5d^{10} 6s^2$

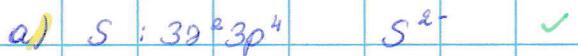
### Oef 7

- a)  $4p$  b)  $6s$  c)  $6s$  ✓

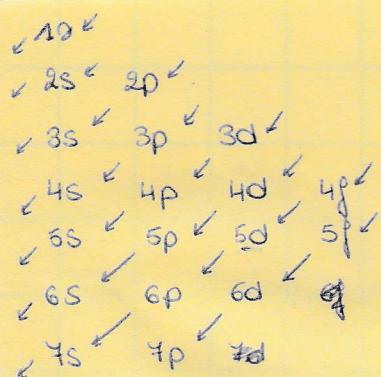
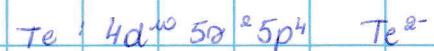
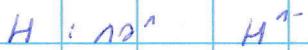
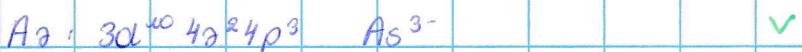
### Oef 8

- a)  $6p^3$  ↑ ↑ ↑ 3 ongepaarde e- ✓  
 b)  $3p^2$  ↑ ↑ 2 ongepaarde e- ✓  
 c)  $5d^3$  ↑ ↑ ↑ 3 ongepaarde e- ✓

## Oef 9



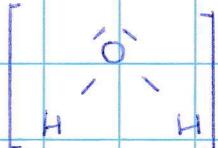
## Oef 10



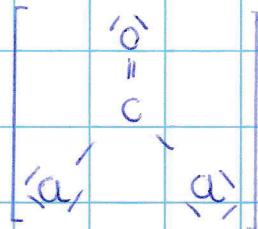
## Lewisstrukturen

Oef 1

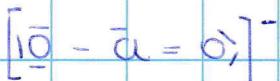
a) water ( $H_2O$ )



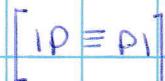
g)  $COCl_2$



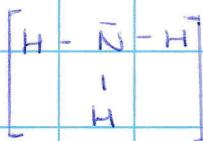
b) chloroetion ( $ClO_2^-$ )



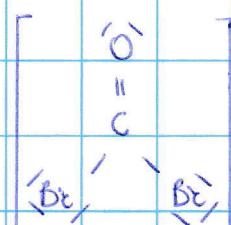
h)  $P_2$



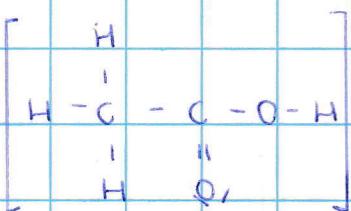
c) ammoniak ( $NH_3$ )



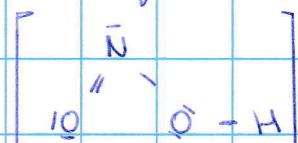
i)  $COBr_2$



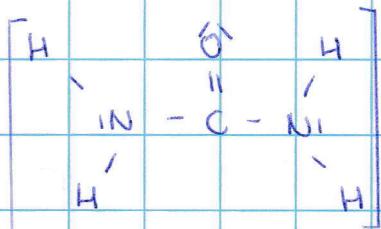
d) acrylaat ( $CH_3COOH$ )



j) waterstofniet ( $HNO_2$ )



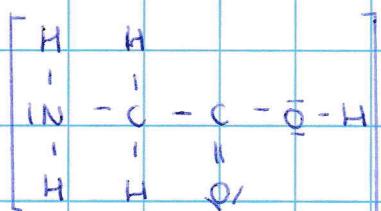
e) ureum ( $(NH_2)_2CO$ )



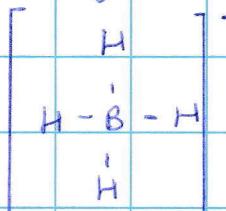
k) cyanation ( $CNO^-$ )



l) glycine ( $HOOC(NH_2)COOH$ )



l) tetrahydroloratoz ( $BH_4^-$ )



m) hydroxide ion ( $\text{HO}^-$ )



o)  $\text{I}_3^-$

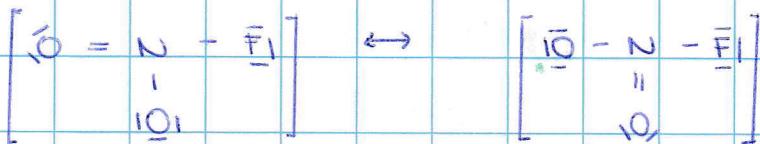


n) amide ion ( $\text{NH}_2^-$ )

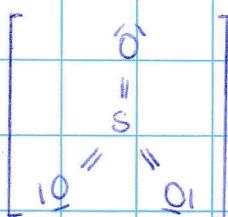


Oef 2

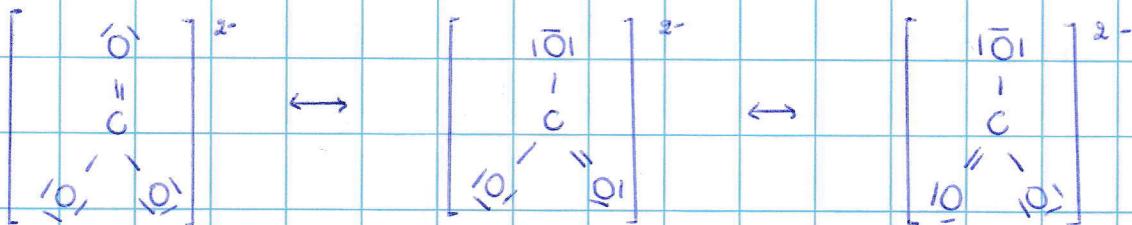
a)  $\text{FNO}_2$



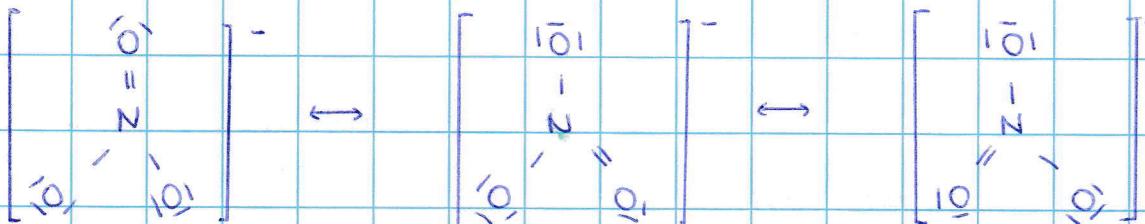
b)  $\text{SO}_3$

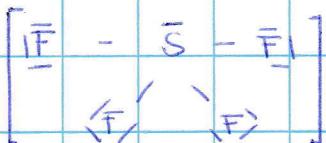
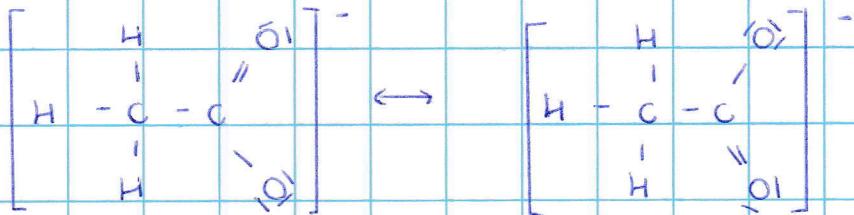
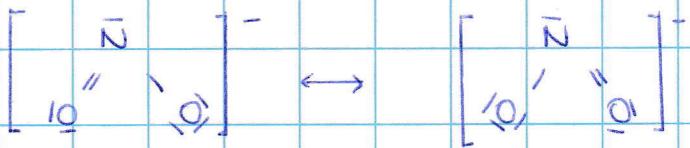
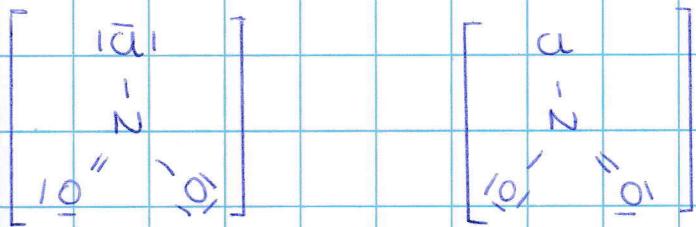


c)  $\text{CO}_3^{2-}$



d)  $\text{NO}_3^-$



e)  $\text{XeF}_4$ f)  $\text{SF}_4$ g)  $\text{ozone} (\text{O}_3)$ h) acetoacetate ( $\text{C}_2\text{H}_3\text{O}_2^-$ )i) Nitroen ( $\text{N}_2\text{O}^-$ )j)  $\text{CuNO}_2$ 

### Def 3

$$[\bar{S} = C = N]^{+-} \leftrightarrow [\bar{S}^{+-} - C \equiv N]^- \leftrightarrow [S^{+-} \equiv C - \bar{N}]^{--}$$

b) meest logische want N heeft hoogste EN waarde

### Def 4

a)  $SOF_2$

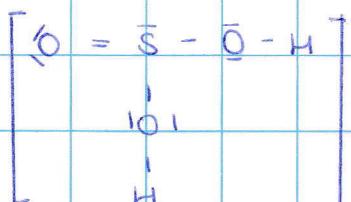


$$F: F = 4 - 6 - 1 = 0$$

$$S: F = 6 - 2 - 4 = 0$$

$$O: F = 6 - 4 - 2 = 0$$

b)  $H_2SO_3$

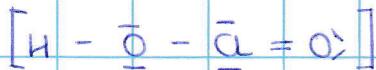


$$O: F = 6 - 4 - 2 = 0$$

$$S: F = 6 - 2 - 4 = 0$$

$$H: F = 1 - 0 - 1 = 0$$

c)  $HClO_4$



$$H: F = 1 - 0 - 1 = 0$$

$$O: F = 6 - 4 - 2 = 0$$

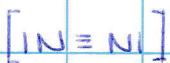
$$Cl: F = 7 - 4 - 3 = 0$$

## Def 5

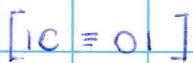
a)  $\text{NO}^+$ 

$$\text{N : F} = 5 - 2 - 3$$

$$\text{O : F} = 6 - 2 - 3 + 1$$

b)  $\text{N}_2$ 

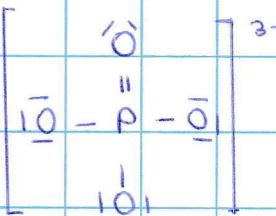
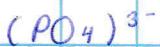
$$\text{N : F} = 5 - 2 - 3 = 0$$

c)  $\text{CO}$ 

$$\text{C : F} = 4 - 2 - 3 = -1$$

$$\text{O : F} = 6 - 2 - 3 = +1$$

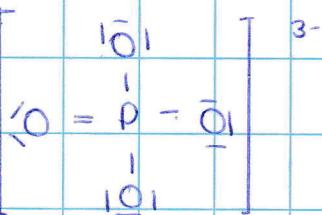
## Def 6



$$\text{O : F} = 6 - 4 - 2 = 0$$

$$\text{O : F} = 6 - 6 - 1 = -1$$

$$\text{P : F} = 5 - 0 - 5 = 0$$



zeerde FL

d)  $\text{C}_2^{2-}$ 

$$\text{C : F} = 4 - 2 - 3 = -1$$

e)  $\text{Cr}^-$ 

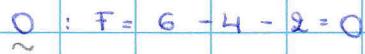
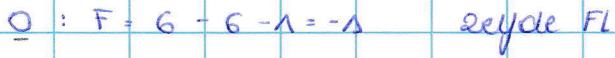
$$\text{C : F} = 4 - 2 - 3 = -1$$

$$\text{N : F} = 5 - 2 - 3 = 0$$

- structuur met laagste FL
- 1 hoge FL beter dan meerdere FL
- FL met zevende teken op ionische atomen = onwaarschijnlijk
- negatieve FL op meeste EN atoom

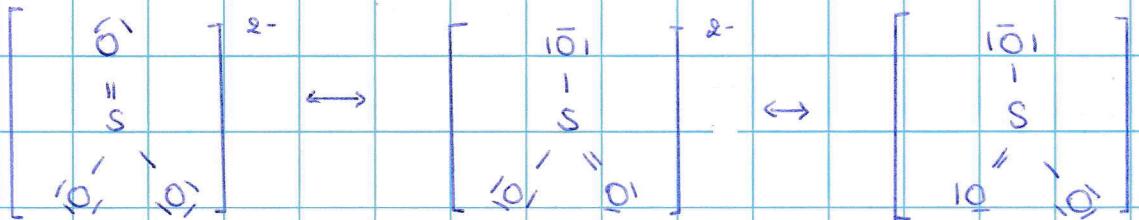
### Oef 7

$\text{O}_2\text{O}(\text{O}_3)$

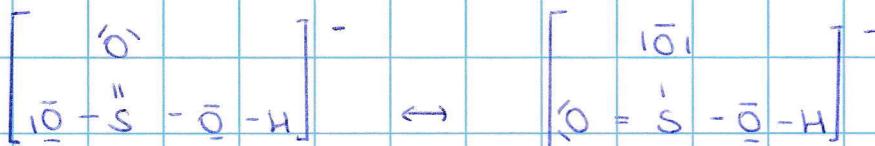


### Oef 8

a)  $\text{SO}_3^{2-}$



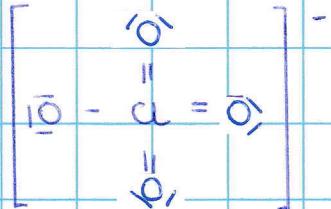
b)  $\text{HSO}_3^-$

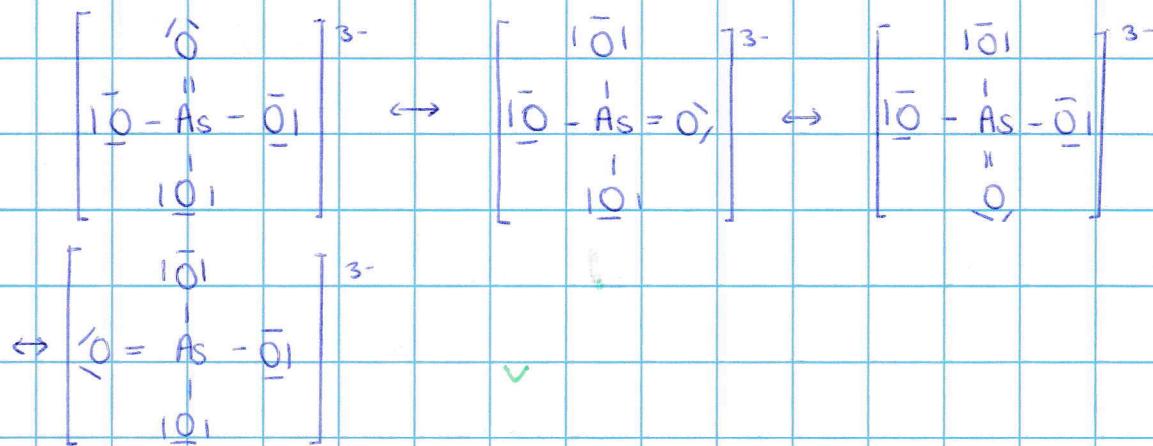


c)  $\text{BrO}_2^-$



d) perchlorato  $\text{ClO}_4^-$

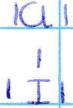


e)  $\text{AsO}_4^{3-}$ 

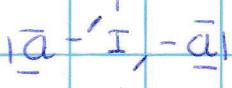
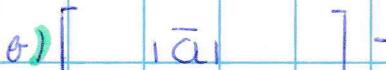
Oef 9



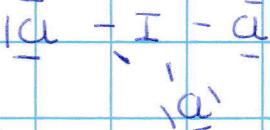
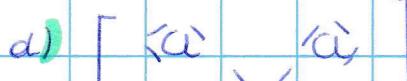
2 bindende -2VEP



3 bindende -2VEP

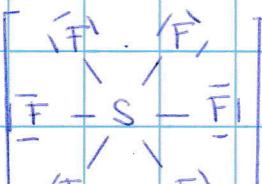
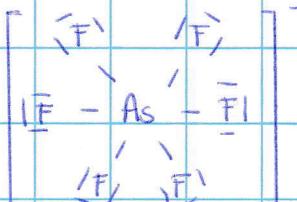


4 bindende -2VEP

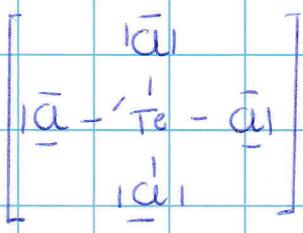


5 bindende -1VEP

Oef 10

42 e<sup>-</sup>42 e<sup>-</sup>40 e<sup>-</sup>

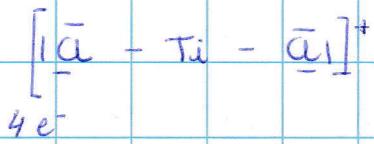
d)  $\text{TeCl}_4$



$10 e^-$

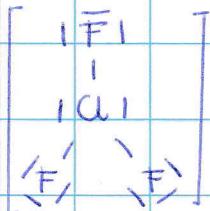
✓

f)  $\text{TiCl}_2^+$



✓

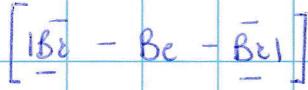
e)  $\text{AlF}_3$



$10 e^-$

✓

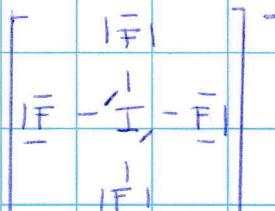
g)  $\text{BeBr}_2$



$4e^-$

✓

h)  $\text{IF}_4^-$

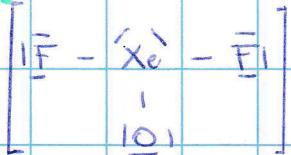


$12 e^-$

✓

Oef 11

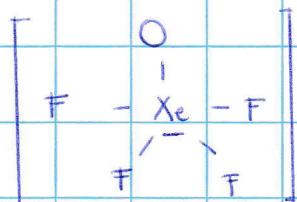
a)  $\text{XeOF}_2$



& VEP

✓

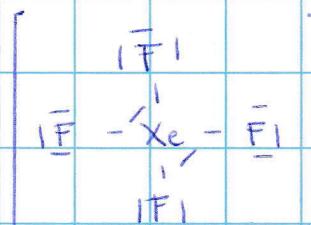
c)  $\text{XeOF}_4$



& VEP

✓

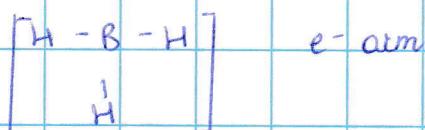
f)  $\text{XeF}_4$



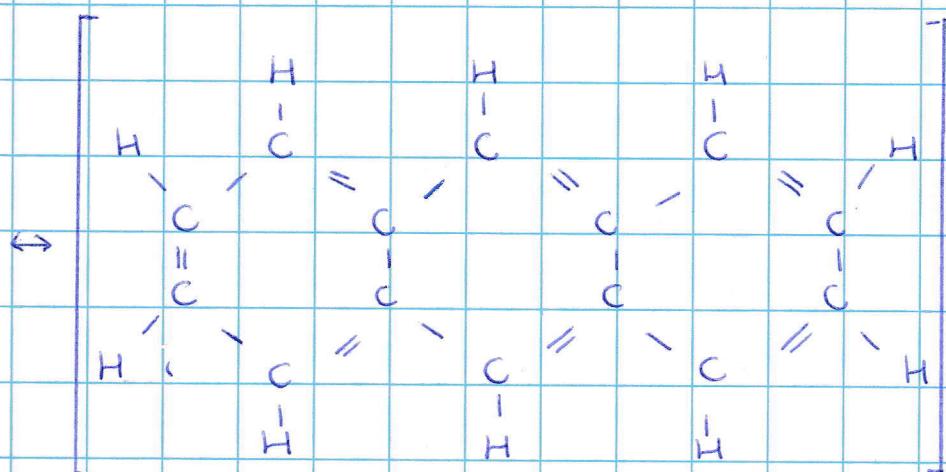
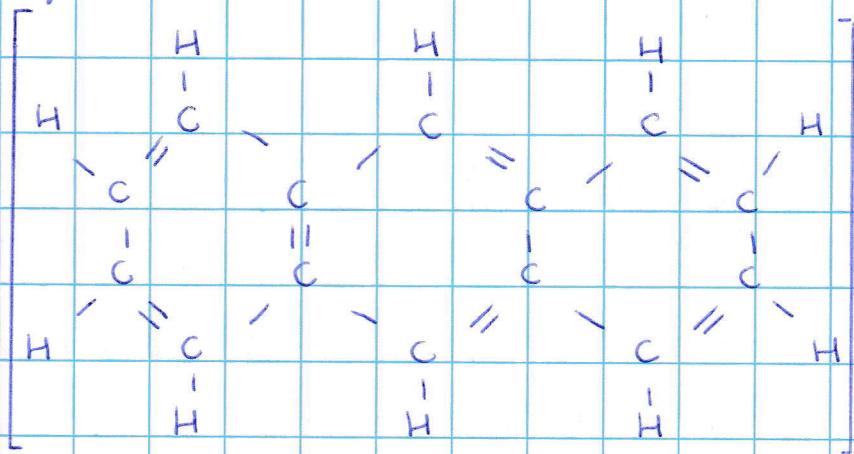
& VEP

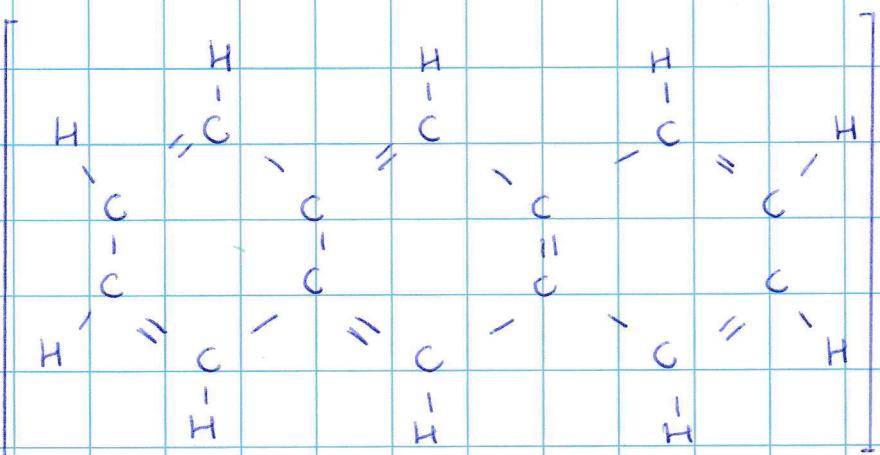
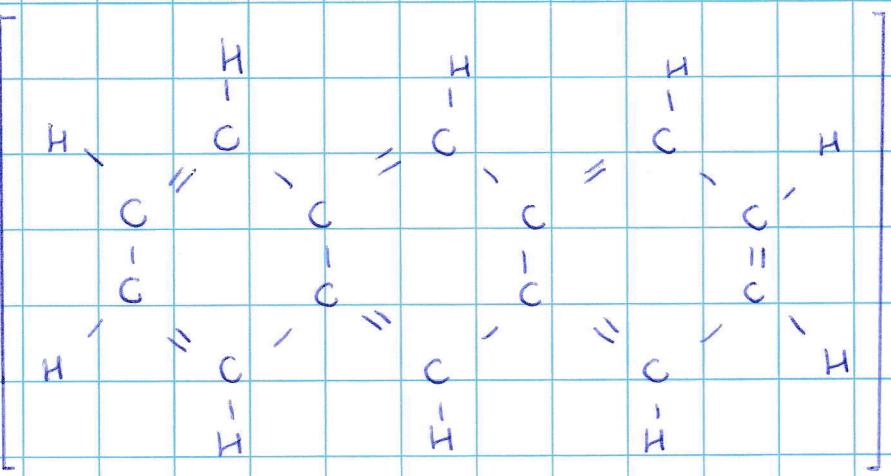
✓

## Oej 12



## Oej 13





### Oef 14

a)  $\begin{bmatrix} \bar{O} = \bar{C} - \bar{O}_1 \\ = \\ O_1 \quad H \end{bmatrix}$

$$\begin{bmatrix} \bar{O}_S - \bar{C} - \bar{O}_1 \\ = \\ \bar{O}_1 \quad H \end{bmatrix}$$

O:  $F = 6 - 4 - 2 = 0$

O:  $F = 6 - 4 - 2 = 0$

en O:  $F = 6 - 6 - 1 = -1$

C:  $F = 7 - 2 - 5 = 0$

C:  $F = 7 - 2 - 3 = +2$

H:  $F = 1 - 0 - 1 = 0$

H:  $F = 1 - 0 - 1 = 0$

laagste energie.

e)  $\begin{bmatrix} \bar{O} = C = S_1 \end{bmatrix}$

$$\begin{bmatrix} \bar{O} - C = S_1 \end{bmatrix}$$

S:  $F = 6 - 4 - 2 = 0$

O:  $F = 6 - 6 - 1 = -1$

C:  $F = 4 - 0 - 4 = 0$

C:  $F = 4 - 0 - 4 = 0$

O:  $F = 6 - 4 - 2 = 0$

S:  $F = 6 - 2 - 3 = +1$

laagste energie



$$H : F = 1 - 0 - 1 = 0$$

$$C : F = 4 - 0 - 4 = 0$$

$$NI : F = 5 - 2 - 3 = 0$$



$$H : F = 1 - 0 - 1 = 0$$

$$C : F = 4 - 2 - 3 = -1$$

$$N : F = 5 - 4 - 2 = -1$$

laagste energie

✓

Oef 15



$$F : F = 7 - 6 - 1 = 0$$

$$Xe : F = 8 - 6 - 2 = 0$$

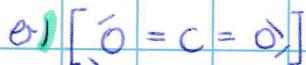


$$F : F = 7 - 6 - 1 = 0$$

$$Xe : F = 8 - 6 - 4 = -2$$

meest waarschijnlijke

✓



$$O : F = 6 - 4 - 2 = 0$$

$$C : F = 4 - 0 - 4 = 0$$



$$O : F = 6 - 6 - 1 = -1$$

meest waarschijnlijke

✓

$$O : F = 6 - 2 - 3 = +1$$

# Valentiebindingstheorie + VSEPR model

Oef 1

a)  $\text{BeCl}_2$

$\text{AX}_2$  - lineair lineair

i)  $\text{AsF}_3$

$\text{AX}_3\text{E}$  - tetraëder trigonale

bipamide

b)  $\text{NO}_2^-$

$\text{AX}_2\text{E}$  - vlak trigonaal hoekig

j)  $\text{AlCl}_3$

$\text{AX}_3$  - vlak trigonaal vlak trigonaal

c)  $\text{SiCl}_4$

$\text{AX}_4$  - tetraëder tetraëder

k)  $\text{TlCl}_2^+$

$\text{AX}_2$  - lineair lineair

d)  $\text{ClO}_3^-$

$\text{AX}_3\text{E}$  - tetraëder trigonale

l)  $\text{AsF}_5$

bipamide

$\text{AX}_5$  - trigonale bipiramide trigonale

bipiramide

e)  $\text{OF}_2$

$\text{AX}_2\text{E}_2$  - tetraëder hoekig

m)  $\text{NH}_2^-$

$\text{AX}_2\text{E}_2$  - tetraëder hoekig

f)  $\text{SiF}_4$

$\text{AX}_4$  - tetraëder tetraëder

n)  $\text{TeCl}_4$

$\text{AX}_4\text{E}$  - trigonale bipamide axiaal

g)  $\text{CCl}_4$

$\text{AX}_4$  - tetraëder tetraëder

o)  $\text{PF}_5$

$\text{AX}_5$  - trigonale bipiramide

trigonale bipiramide

h)  $\text{H}_2\text{Se}$

$\text{AX}_2\text{E}_2$  - tetraëder hoekig

p)  $\text{BrF}_3$

$\text{AX}_3\text{E}_2$  - trigonale Lipitamide

T-vorm

d)  $\text{PF}_6^+$

$\text{AX}_6$  - octaëder octaëder

q)  $\text{BrF}_5$

$\text{AX}_5\text{E}$  - octaëder tetragonale

Lipitamide

t)  $\text{ClF}_2^-$

$\text{AX}_2\text{E}_3$  - trigonale Lipitamide

lineair

x)  $\text{SnCl}_5^-$

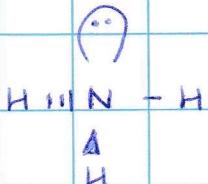
$\text{AX}_5$  - trigonale Lipitamide

trigonale Lipitamide

Oef 2

a)  $\text{NH}_3$

3 Bindungspartners, 1 VEP  $\rightarrow \text{AX}_3\text{E}$  - tetraëder trigonale piramide



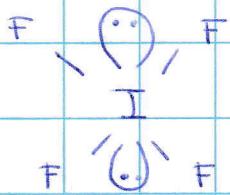
b)  $\text{ClO}_2^-$

2 Bindungspartners, 2 VEP  $\rightarrow \text{AX}_2\text{E}_2$  - tetraëder hoekig

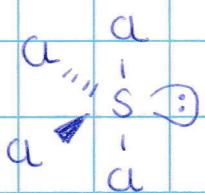


c)  $\text{IF}_4^-$

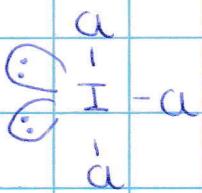
4 Bindungspartners, 2 VEP  $\rightarrow \text{AX}_4\text{E}_2$  - octaëder vierkant

d)  $\text{SCl}_4$ 

4 bindingspartners, 1 VEP  $\rightarrow \text{AX}_4\text{E}$  - trigonale bipitamide schommel

e)  $\text{ICl}_3$ 

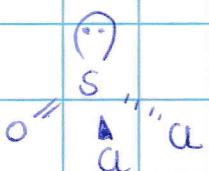
3 bindingspartners, 2 VEP  $\rightarrow \text{AX}_3\text{E}_2$  - trigonale bipitamide T-vorm



Oef 3

a)  $\text{SOCl}_2$ 

3 bindingspartners, 1 VEP  $\rightarrow$  tetroeder trigonale piramide

b) 2 bindingshoeken, 2 dixelyde.  $\text{CSO}$  en n hoek  $\text{CSCl}$ c)  $107^\circ$  en  $109^\circ$

Oef 4

a)  $\text{ICl}_2^-$

2 bindingspartners, 3 VEP  $\rightarrow \text{AX}_2\text{E}_3$  - trigonale piramide lineair



b)  $180^\circ$

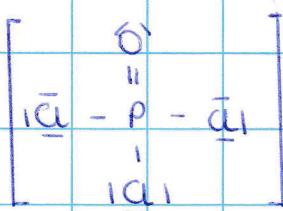
Oef 5

a)  $\text{I}_3^-$



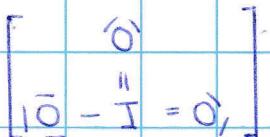
$180^\circ$ ,  $\text{AX}_2\text{E}_3$  - trigonale piramide lineair

b)  $\text{POCl}_3$



$109^\circ$ ,  $\text{AX}_4$  - tetraëder tetraëder

c)  $\text{IO}_3^-$

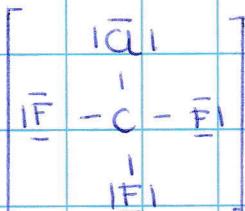
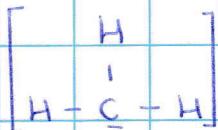


$109^\circ$ ,  $\text{AX}_3\text{E}$  - tetraëder trigonale piramide

d)  $\text{N}_3^-$

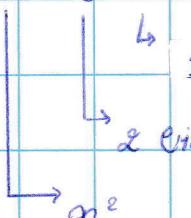


$180^\circ$ ,  $\text{AX}_2$  - lineair lineair

e)  $\text{CF}_3\text{Cl}$  $109^\circ$ ,  $\text{AX}_4^-$  - tetraeder tetraederf)  $\text{COF}_2$  $120^\circ$ ,  $\text{AX}_3$  - stark trigonal stark trigonalg)  $\text{CH}_3^-$  $109^\circ$ ,  $\text{AX}_3\text{E}^-$  - tetraeder trigonale Pyramide

Og 6

a) fosfor in fosfor pentafluorid

5 Bindungspartners, OVP  $\rightarrow$  trigonale Pyramide  $\rightarrow \text{sp}^3\text{d}$ b)  $\text{CH}_2\text{O}$ 3 Bindungspartners  $\rightarrow$  stark trigonal  $\rightarrow \text{sp}^2$ c)  $\text{H}_2\text{C}=\text{C}=\text{CH}_2$ 3 Bindungspartners  $\rightarrow$  stark trigonal  $\rightarrow \text{sp}^2$ 2 Bindungspartners  $\rightarrow$  linear  $\rightarrow \text{sp}$

d) BeCl<sub>2</sub>

2 Bindungspartner → lineär → sp

e) BH<sub>3</sub>

3 Bindungspartner → vlak trigonaal → sp<sup>2</sup>

f) BH<sub>4</sub><sup>-</sup>

4 Bindungspartner → tetraëder → sp<sup>3</sup>

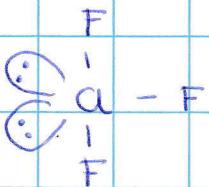
g) SiF<sub>4</sub>

4 Bindungspartner → tetraëder → sp<sup>3</sup>

Oef 7

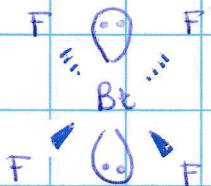
a) ClF<sub>3</sub>

3 Bindungspartner, 2 VEP → trigonale bipyramide T-vorm - sp<sup>3</sup>d



b) BzF<sub>4</sub><sup>-</sup>

4 Bindungspartner, 2 VEP → octaëder vierkant → sp<sup>3</sup>d<sup>2</sup>



## Gassen

### Oef 1

$$h(\text{Hg}) = 760 \text{ mm} = 0,760 \text{ m}$$

$$T = 15^\circ\text{C}$$

$$\rho(\text{Hg}) = 13,595 \text{ g/cm}^3 = 13,595 \cdot 10^3 \text{ kg/m}^3$$

$$g = 9,80665 \text{ m/s}^2$$

a)  $p = \rho gh$

$$= 13,595 \cdot 10^3 \text{ kg/m}^3 \cdot 9,80665 \text{ m/s}^2 \cdot 0,760 \text{ m}$$

$$= 101 \cdot 10^3 \text{ Pa}$$

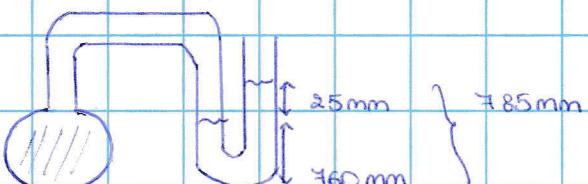
b)  $h(\text{Hg}) = 0,756 \text{ m}$

$$p = \rho gh$$

$$= 13,595 \cdot 10^3 \text{ kg/m}^3 \cdot 9,80665 \text{ m/s}^2 \cdot 0,756 \text{ m}$$

$$= 101 \cdot 10^3 \text{ Pa}$$

### Oef 2



$$p = \rho hg$$

$$= 13,595 \cdot 10^3 \text{ kg/m}^3 \cdot 0,785 \text{ m} \cdot 9,80665 \text{ m/s}^2$$

$$= 105 \cdot 10^3 \text{ Pa}$$

### Oef 3

$$p = 760 \text{ mm Hg} = 1 \text{ atm} = 1,01 \cdot 10^5 \text{ Pa}$$

$$\rho(\text{H}_2\text{O}) = 0,99987 \text{ g/cm}^3 = 0,99987 \text{ kg/m}^3 \cdot 10^3$$

$$\rho(\text{Hg}) = 13,596 \text{ g/cm}^3 = 13,596 \cdot 10^3 \text{ kg/m}^3$$

$$h = \frac{p}{\rho g} = \frac{1,01 \cdot 10^5 \text{ Pa}}{0,99987 \text{ kg/m}^3 \cdot 10^3 \cdot 9,80665 \text{ m/g}^2} = 10,3 \text{ m}$$

### Oef 4

$$V_1 (\text{CO}_2) = 20,0 \text{ L}$$

$$T = 23,0^\circ\text{C}$$

$$p_2 = 0,830 \text{ atm}$$

$$p_1 = 1,00 \text{ atm}$$

$$p \cdot V = \text{cte}$$

$$1,00 \text{ atm} \cdot 20,0 \text{ L} = 20,0$$

$$p_1 V_1 = p_2 V_2$$

$$V_2 = \frac{p_1 V_1}{p_2}$$

$$\frac{V_2}{p} = \frac{20,0}{0,830 \text{ atm}} = 24,1 \text{ L}$$

### Oef 5

$$p_1 = 760 \text{ mmHg} = 1,01325 \cdot 10^5 \text{ Pa} = 1,01 \cdot 10^5 \text{ Pa}$$

$$T_1 = 20^\circ\text{C} = 293 \text{ K}$$

$$T_2 = 300^\circ\text{C} = 573 \text{ K}$$

$$V = \text{cte}$$

$$\frac{p_1}{T_1} = \frac{p_2}{T_2}$$

$$p_2 = \frac{p_1 T_2}{T_1} = \frac{1,01 \cdot 10^5 \text{ Pa} \cdot 573 \text{ K}}{293 \text{ K}} = 1,98 \cdot 10^5 \text{ Pa}$$

### Oef 6

$$p = \text{cte}$$

$$V_1 = 48,5 \text{ L}$$

$$T_1 = 21^\circ\text{C} = 294 \text{ K}$$

$$T_2 = 28^\circ\text{C} = 301 \text{ K}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{V_2}{T_2} = \frac{V_1 T_2}{T_1} = \frac{485 L \cdot 301 K}{294 K} = 803 L$$

Oef 7

$$V = 2,5 \cdot 10^4 L$$

$$n = n_A \cdot 10^3 \text{ mol He}$$

$$\frac{V_m}{n} = \frac{V}{n_A} = \frac{2,5 \cdot 10^4 L}{1,2 \cdot 10^3 \text{ mol}} = 21 L/\text{mol}$$

Oef 8

$$n_A = 200 \text{ mol}$$

$$p_A = 1,20 \text{ atm}$$

$$n_A = 300 \text{ mol}$$

$$\frac{p_1}{n_1} = \frac{p_2}{n_2}$$

$$\frac{n_1}{n_2} = \frac{p_1}{p_2}$$

$$\frac{p_2}{n_2} = \frac{p_1 \cdot n_2}{n_1} = \frac{1,20 \text{ atm} \cdot 300 \text{ mol}}{200 \text{ mol}} = 1,80 \text{ atm}$$

Oef 9

$$V = 5,0 L = 5,0 \cdot 10^{-3} m^3$$

$$T = 23^\circ C = 296$$

$$m(N_2) = 0,10 \mu g = 0,10 \cdot 10^{-6} g$$

$$\frac{n(N_2)}{M} = \frac{m}{M} = \frac{0,10 \cdot 10^{-6} g}{(2 \cdot 14,01) g/mol} = 0,40 \cdot 10^{-8} \text{ mol}$$

$$\frac{p}{V} = \frac{nRT}{V} = \frac{0,40 \cdot 10^{-8} \text{ mol} \cdot 8,31 J/K \cdot \text{mol} \cdot 296 K}{5,0 \cdot 10^{-3} m^3} = 1,7 \cdot 10^{-8} \text{ atm}$$

### Oef 10

$$V_1 = 500 \text{ mL} = 0,500 \cdot 10^{-3} \text{ m}^3$$

$$T_1 = 28^\circ\text{C} = 301 \text{ K}$$

$$p_1 = 92,0 \text{ kPa}$$

$$V_2 = 300 \text{ mL} = 0,300 \cdot 10^{-3} \text{ m}^3$$

$$T_2 = -5^\circ\text{C} = 268 \text{ K}$$

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$$

$$\frac{p_2}{T_2} = \frac{p_1 V_1 T_2}{T_1 V_2} = \frac{92,0 \cdot 10^3 \text{ Pa} \cdot 0,500 \cdot 10^{-3} \text{ m}^3 \cdot 268 \text{ K}}{301 \text{ K} \cdot 0,300 \cdot 10^{-3} \text{ m}^3} = 137 \text{ kPa}$$

### Oef 11

$$T = 190^\circ\text{C} = 463 \text{ K}$$

$$P = 60,0 \text{ Torr}$$

$$R = 62,3637 \text{ L Torr/K mol}$$

$$\rho = 0,320 \text{ g/L}$$

$$\rho = \frac{PM}{RT}$$

$$M = \frac{\rho RT}{P} = \frac{0,320 \text{ g/L} \cdot 62,3637 \text{ L Torr/K mol} \cdot 463 \text{ K}}{60,0 \text{ Torr}} = 1154 \text{ g/mol}$$

### Oef 12

$$T = 21^\circ\text{C} = 294 \text{ K}$$

$$P = 752 \text{ mmHg} = 100 \cdot 10^3 \text{ Pa}$$

$$\rho (\text{lucht}) = 1,188 \text{ g/L}$$

$$\rho (\text{He}) = \frac{PM}{RT} = \frac{100 \cdot 10^3 \text{ Pa} \cdot 4,00 \text{ g/mol}}{8,31 \text{ J/K mol} \cdot 294 \text{ K}} = 164 \text{ kg/L} = 0,164 \text{ g/L}$$

$$\rightarrow \text{verachil: } 1,188 \text{ g} - 0,164 \text{ g} = 1,024 \text{ g verachil}$$

Def 13

$$V = 1,00 \text{ L}$$

$$T = 25^\circ \text{C} = 298 \text{ K}$$

$$p = 786 \text{ mmHg} = 1,03 \text{ atm}$$

$$m = 0,925 \text{ g}$$

$$\text{a) } n(\text{Ne}) = \frac{m}{M} = \frac{0,925 \text{ g}}{2 \cdot 14,0 \text{ g/mol}} = 0,0330 \text{ mol}$$

$$p = \frac{nRT}{V} = \frac{0,0330 \text{ mol} \cdot 298 \text{ K} \cdot 0,0820578 \text{ L atm/K mol}}{1,00 \text{ L}} = 0,807 \text{ atm}$$

$= 613 \text{ mmHg}$

$$\text{b) } n(\text{lucht}) = \frac{pV}{RT} = \frac{1,03 \text{ atm} \cdot 1,00 \text{ L}}{0,0820578 \text{ L atm/K mol} \cdot 298 \text{ K}} = 0,0423 \text{ mol}$$

$$x_A = \frac{n_A}{n} = \frac{0,0330 \text{ mol}}{0,0423 \text{ mol}} = 0,780 \rightarrow 78,0\%$$

Def 14

$$m(\text{O}_2) = 141,2 \text{ g}$$

$$m(\text{Ne}) = 335,0 \text{ g}$$

$$p = 50,0 \text{ atm}$$

$$n(\text{O}) = \frac{m}{M} = \frac{141,2 \text{ g}}{32,0 \text{ g/mol}} = 4,41 \text{ mol}$$

$$\left. \begin{array}{l} \\ \end{array} \right\} n = 21,01 \text{ mol}$$

$$n(\text{Ne}) = \frac{m}{M} = \frac{335,0 \text{ g}}{20,18 \text{ g/mol}} = 16,60 \text{ mol}$$

$$x(\text{O}) = \frac{n(\text{O})}{n} = \frac{4,41 \text{ mol}}{21,01 \text{ mol}} = 0,210$$

$$p(\text{O}) = x(\text{O}) \cdot p$$

$$= 0,210 \cdot 50,0 \text{ atm} = 10,5 \text{ atm}$$

### Qey 15

$$\text{eff A} = \sqrt{M_B}$$

$$\text{eff B} = \sqrt{M_A}$$

$$1 = \sqrt{M_B} \rightarrow H_2$$

$$4,67 \quad \sqrt{M_A} \rightarrow \text{gas}$$

$$\sqrt{M_A} = \sqrt{M_B} \cdot 4,67$$

$$\sqrt{M_A} = \sqrt{2,02 \text{ g/mol}} \cdot 4,67$$

$$M_A = 2,02 \text{ g/mol} \cdot 21,8$$

$$= 44,1 \text{ g/mol}$$

$$M(H_2) = 1,01 \cdot 2 \text{ g/mol}$$

$$= 2,02 \text{ g/mol}$$

### Qey 16

$$n = 1,000 \text{ mol}$$

$$V = 22,41 \text{ L}$$

$$T = 0,0^\circ\text{C} = 273 \text{ K}$$

$$p = \frac{nRT}{V-nb} - a \frac{n^2}{V^2}$$

$$= \frac{1,000 \text{ mol} \cdot 0,0820578 \text{ L atm/K mol} \cdot 273 \text{ K}}{22,41 \text{ L} - 1,000 \text{ mol} \cdot 0,06499 \text{ L/mol}} - 5,570 \text{ atm L}^2/\text{mol}^2 (1,000 \text{ mol})^2$$

$$= 0,991 \text{ atm}$$

$$p = \frac{nRT}{V} = \frac{1,000 \text{ mol} \cdot 0,0820578 \text{ L atm/K mol} \cdot 273 \text{ K}}{22,41 \text{ L}}$$

$$= 1,00 \text{ atm}$$

Oef 17

$$a) p = \frac{nRT}{V} = \frac{1,00 \text{ mol} \cdot 0,0820578 \text{ L atm/K mol} \cdot 298 \text{ K}}{15,0 \text{ L}}$$

$$= \frac{24,5 \text{ atm L}}{15,0 \text{ L}}$$

$$= \frac{1,63 \text{ atm}}{}$$

$$p = \frac{nRT}{V-nb} - \frac{an^2}{V^2}$$

$$= \frac{24,5 \text{ L atm}}{15,0 \text{ L} - 1,00 \text{ mol} \cdot 0,04286 \text{ L/mol}}$$

$$= \frac{1,62 \text{ atm}}{}$$

$$- 3,658 \text{ L}^2 \text{ atm/mol}^2 \cdot (1,00 \text{ mol})^2$$

$$(15,0 \text{ L})^2$$

$$b) p = \frac{nRT}{V} = \frac{24,5 \text{ L}}{0,500 \text{ L}} = \frac{49,0 \text{ atm}}{}$$

$$p = \frac{nRT}{V-nb} - \frac{an^2}{V^2}$$

$$= \frac{24,5 \text{ L atm}}{0,500 \text{ L} - 1,00 \text{ mol} \cdot 0,04286 \text{ L/mol}}$$

$$= \frac{41,1 \text{ atm}}{}$$

$$- 3,658 \text{ L}^2 \text{ atm/mol}^2 \cdot (1,00 \text{ mol})^2$$

$$(0,500 \text{ L})^2$$

$$c) p = \frac{nRT}{V} = \frac{24,5 \text{ L}}{0,0500 \text{ L}} = \frac{490 \text{ atm}}{}$$

$$p = \frac{nRT}{V-nb} - \frac{an^2}{V^2}$$

$$= \frac{25,5 \text{ L atm}}{0,0500 \text{ L} - 0,04286 \text{ L}/\text{mol} \cdot 1,00 \text{ mol}}$$

$$- 3,658 \text{ L}^2 \text{ atm}/\text{mol}^2 \cdot (1,00 \text{ mol})^2$$

$$(0,0500 \text{ L})^2$$

$$\approx 2108 \text{ atm}$$

$$\approx 211 \cdot 10 \text{ atm}$$

## Thermodynamica

Oef 1

$$V_1 = 12,0 \text{ L} = 12,0 \cdot 10^{-3} \text{ m}^3$$

$$V_2 = 14,5 \text{ L} = 14,5 \cdot 10^{-3} \text{ m}^3$$

$$p = 5,0 \text{ atm} = 506625 \text{ Pa} = 5,1 \cdot 10^5 \text{ Pa}$$

$$w = -p_{\text{ex}} \cdot \Delta V$$

$$= -5,1 \cdot 10^5 \text{ Pa} \cdot (14,5 \cdot 10^{-3} \text{ m}^3 - 12,0 \cdot 10^{-3} \text{ m}^3)$$

$$= -1,3 \text{ kJ}$$

Oef 2

$$\Delta V = 500 \text{ mL} = 0,500 \cdot 10^{-3} \text{ m}^3$$

$$p = 1,20 \text{ atm} = 1,22 \cdot 10^5 \text{ Pa}$$

$$\text{a) } w = -p_{\text{ex}} \cdot \Delta V$$

$$= -1,22 \cdot 10^5 \text{ Pa} \cdot 0,500 \cdot 10^{-3} \text{ m}^3$$

$$= -60,8 \text{ J}$$

$$\text{b) } \Delta V = w + q$$

$$= -60,8 \text{ J} + 0$$

$$= -60,8 \text{ J}$$

Oef 3

$$\Delta V = 6,00 \text{ L} = 6,00 \cdot 10^{-3} \text{ m}^3$$

$$p_{\text{ex}} = 0,975 \text{ atm} = 0,988 \cdot 10^5 \text{ Pa}$$

$$V_{\text{cil}} = \pi r^2 h$$

$$1 \text{ L atm} = 101,325 \text{ J}$$

$$r = 8,50 \text{ cm}$$

$$\text{a) } w = -p_{\text{ex}} \Delta V = -0,988 \cdot 10^5 \text{ Pa} \cdot 6,00 \cdot 10^{-3} \text{ m}^3$$

$$= -593 \text{ J}$$

$$8) \Delta V = A \cdot \Delta x$$

$$\Delta V = \Delta x$$

$$\pi r^2$$

$$\Delta x = \underline{9,00\text{cm}} = 2,64\text{dm}$$

$$\pi \cdot (0,850\text{ dm})^2$$

Oef 4

$$n = 0,100 \text{ mol At}$$

$$V = 1,00\text{L}$$

$$T = 25^\circ\text{C} = 298\text{K}$$

$$a) \Delta V = 1,00\text{L} = 1,00 \cdot 10^{-3}\text{m}^3$$

$$p_{\text{ex}} = 1,01 \text{ atm} = 1,01 \cdot 10^5\text{Pa}$$

$$w = -p_{\text{ex}} \cdot \Delta V$$

$$= -1,01 \cdot 10^5\text{Pa} \cdot 1,00 \cdot 10^{-3}\text{m}^3 = -101\text{J}$$

$$b) \Delta V = 1,00 \cdot 10^{-3}\text{m}^3$$

$$w = -nRT \ln \frac{V_f}{V_i}$$

V<sub>i</sub>

$$= 0,100 \text{ mol} \cdot 8,314 \text{ J/mol K} \cdot 298\text{K} \cdot \frac{\ln 2 \cdot 10^{-3}\text{m}^3}{1 \cdot 10^{-3}\text{m}^3}$$

$$= -172\text{J} \rightarrow \text{meeste arbeid}$$

Oef 5

$$V_1 = 2,00\text{L} = 2,00 \cdot 10^{-3}\text{m}^3$$

$$V_2 = 4,00\text{L} = 4,00 \cdot 10^{-3}\text{m}^3$$

$$n = 1,00 \text{ mol}$$

$$T = 30^\circ\text{C} = 303\text{K}$$

$$a) p = 1,00 \text{ atm} = 1,01 \cdot 10^5\text{Pa}$$

$$w = -p_{\text{ex}} \cdot \Delta V = -1,01 \cdot 10^5\text{Pa} \cdot 2,00 \cdot 10^{-3}\text{m}^3 = -202\text{J}$$

$$\text{8) } w = -nRT \ln \frac{V_f}{V_i} = -1,00 \text{ mol} \cdot 8,314 \text{ J/molK} \cdot 303 \text{ K} \cdot \ln \frac{2,00}{4,00}$$

$$= 1,75 \text{ kJ}$$

Oef 6

- a)  $\Delta U = 0$  : waar als geen arbeid wordt uitgewisseld
- b)  $q = 0$  : altijd
- c)  $q < 0$  : nooit
- d)  $\Delta U = q$  : waar als  $w = 0$ , gevuld  $\Delta U = 0$
- e)  $\Delta U = w$  : altijd

Oef 7

$$m = 10,0 \text{ g}$$

$$T_1 = 25^\circ\text{C} = 298 \text{ K}$$

$$T_2 = 900^\circ\text{C} = 1173 \text{ K}$$

$$c = 0,8111 \text{ J/Kg}$$

$$q = c \Delta T = cm \Delta T = 0,8111 \text{ J/Kg} \cdot 10,0 \text{ g} \cdot (1173 \text{ K} - 298 \text{ K}) = 7,40 \text{ kJ}$$

Oef 8

$$q = 1,78 \text{ kJ}$$

$$V = 0,100 \text{ l}$$

$$\Delta T_1 = 3,65^\circ\text{C} = 3,65 \text{ K}$$

$$\Delta T_2 = 1,26^\circ\text{C} = 1,26 \text{ K}$$

$$\Delta U = q$$

$$q = c \Delta T$$

$$c = \frac{q}{\Delta T} = \frac{1,78 \cdot 10^3 \text{ J}}{3,65 \text{ K}} = 488 \text{ J/K}$$

$$q = 488 \text{ J/K} \cdot 1,26 \text{ K} = 614 \text{ J} = \Delta U$$

### Oej 9

$$q = 4,16 \text{ kJ}$$

$$\Delta T = 3,24^\circ\text{C} = 3,24 \text{ K}$$

$$0,200 \text{ L} = 0,200 \text{ kg} = m$$

$$c = \frac{q}{m \cdot \Delta T} = \frac{4,16 \cdot 10^3}{3,24} = 1,28 \text{ J/K}$$

$$c = \frac{C}{m} = \frac{1,28 \text{ J/K}}{200 \text{ g}} = 6,42 \cdot 10^{-3} \text{ J/g K}$$

### Oej 10

$$V = 20,0 \text{ mL}$$

$$c = 4,18 \text{ J/g°C}$$

$$\rho = 1,00 \text{ g/mL}$$

$$\Delta T = 32,6^\circ\text{C} - 25,0^\circ\text{C} = 7,6^\circ\text{C}$$

$$q = -c \Delta T = -mc \Delta T = -V \rho c \Delta T$$

$$= -20,0 \text{ mL} \cdot 1,00 \text{ g/mL} \cdot 4,18 \text{ J/g°C} \cdot 7,6^\circ\text{C} = -64 \cdot 10^3 \text{ J}$$

$$\Delta U = \Delta H = -64 \cdot 10^3 \text{ J} \text{ over } 0,0100 \text{ mol}$$
$$= -64 \text{ kJ/mol}$$

### Oej 11

a)  $m_1 = 500,0 \text{ g}$

$$T_1 = 22,0^\circ\text{C}$$

$$T_2 = 100^\circ\text{C}$$

$$m_2 = 400,0 \text{ g}$$

$$\Delta T = 78,0^\circ\text{C}$$

$$c(\text{H}_2\text{O}) = 4,18 \text{ J/g°C}$$

$$c(\text{Cu}) = 0,38 \text{ J/g°C}$$

$$q_{\text{cu}} = mc\Delta T = 500,0 \text{ g} \cdot 0,38 \text{ J/g°C} \cdot 78,0^\circ\text{C} = 14820 \text{ J}$$

$$q_{\text{H}_2\text{O}} = mc\Delta T = 400,0 \text{ g} \cdot 4,18 \text{ J/g°C} \cdot 78,0^\circ\text{C} = 130416 \text{ J}$$

$$q_{\text{tot}} = 14820 \text{ J} + 130416 \text{ J} = 145236 \text{ J}$$

b) % wärmete rück H<sub>2</sub>O =  $\frac{130416 \text{ J}}{145236 \text{ J}} = 0,898 \Rightarrow 89,8\%$

### Üpf 12

$$m_{\text{cu}} = 20,0 \text{ g}$$

$$T_{\text{cu}} = 100^\circ\text{C}$$

$$m_{\text{H}_2\text{O}} = 50,7 \text{ g}$$

$$T_{\text{H}_2\text{O}} = 22,0^\circ\text{C}$$

$$c_{\text{cu}} = 0,38 \text{ J/g°C}$$

$$c_{\text{H}_2\text{O}} = 4,18 \text{ J/g°C}$$

$$q_{\text{cu}} = -q_{\text{H}_2\text{O}}$$

$$m_{\text{cu}} \cdot c_{\text{cu}} \cdot \Delta T = -m_{\text{H}_2\text{O}} \cdot c_{\text{H}_2\text{O}} \cdot \Delta T$$

$$m_{\text{cu}} \cdot c_{\text{cu}} \cdot (T_e - 100^\circ\text{C}) = -m_{\text{H}_2\text{O}} \cdot c_{\text{H}_2\text{O}} \cdot (T_e - 22^\circ\text{C})$$

$$20,0 \text{ g} \cdot 0,38 \text{ J/g°C} \cdot (T_e - 100^\circ\text{C}) = -50,7 \text{ g} \cdot 4,18 \text{ J/g°C} \cdot (T_e - 22^\circ\text{C})$$

$$T_e \cdot 28,885 = 713,47^\circ\text{C}$$

$$T_e = 25^\circ\text{C}$$

### Üpf 13

$$n = 2,00 \text{ mol}$$

$$p_{\text{ext}} = 2,00 \text{ atm}$$

$$T = 300 \text{ K}$$

a)  $w = -nRT \ln V_f = -2,00 \text{ mol} \cdot 8,314 \text{ J/molK} \cdot 300 \text{ K} \ln \frac{1}{2}$

$$V_i$$

$$= 346 \cdot 10 \text{ J}$$

b)  $\Delta U = q + w \Leftrightarrow q = -w = -346 \cdot 10 \text{ J}$

### Oef 14

$$q = 1,00 \text{ kJ}$$

$$p = 2,00 \text{ atm} = 2,02 \cdot 10^5 \text{ Pa}$$

$$\Delta V = 2,00 \text{ L} = 2,00 \cdot 10^{-3} \text{ m}^3$$

$$w = -p_{\text{ex}} \cdot \Delta V = -2,02 \cdot 10^5 \text{ Pa} \cdot 2,00 \cdot 10^{-3} \text{ m}^3 = -404 \text{ J}$$

$$\Delta U = w + q = -404 \text{ J} + 1,00 \cdot 10^3 \text{ J} = 596 \text{ J}$$

### Oef 15

$$q = 50 \text{ kJ}$$

$$w = 20 \text{ kJ}$$

$$\Delta U = q + w$$

$$= 50 \text{ kJ} + 20 \text{ kJ}$$

$$= 70 \text{ kJ}$$

$$\Delta H = q = 50 \text{ kJ}$$

### Oef 16

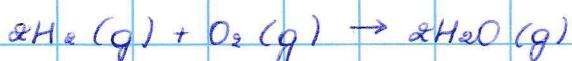
$$\Delta H^\circ = 484 \text{ kJ}$$

$$n(\text{H}_2) = 0,50 \text{ mol}$$

$$n(\text{O}_2) = 0,25 \text{ mol}$$

$$\Delta V = -5,6 \text{ L} = -5,6 \cdot 10^{-3} \text{ m}^3$$

$$\Delta H = \Delta U + p \Delta V$$



$$\text{a)} w = -p_{\text{ex}} \cdot \Delta V$$

$$= -101325 \text{ Pa} \cdot (-5,6 \cdot 10^{-3} \text{ m}^3)$$

$$= 0,57 \text{ kJ}$$

8)  $\Delta H = -484 \text{ kJ}$  voor 2 mol  $\text{H}_2$

$$\downarrow$$

$\Delta H = -121 \text{ kJ}$  voor 0,5 mol  $\text{H}_2$

$$\Delta U = \Delta H - p\Delta V$$

$$= -121 \text{ kJ} - (-0,57 \text{ kJ})$$

$$= -120,43 \text{ kJ}$$

$$= -12 \cdot 10 \text{ kJ}$$

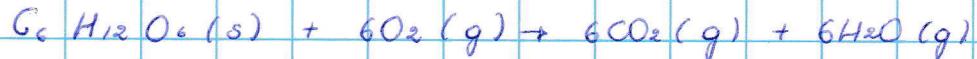
Oef 17

$$n = 1,000 \text{ mol } \text{C}_6\text{H}_{12}\text{O}_6$$

$$T = 298 \text{ K}$$

$$\Delta U = -2559 \text{ kJ}$$

$$q = 2559 \text{ kJ}$$



$$\Delta H = \Delta U + p\Delta V$$

$$= \Delta U + n\text{RT}$$

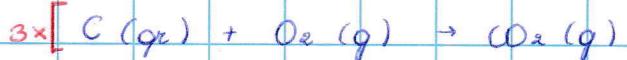
$$= -2559 \text{ kJ} + 1,000 \text{ mol} \cdot 8,314472 \text{ J/K mol} \cdot 298 \text{ K}$$

$$= -8129 \cdot 10 \text{ J} = -81,29 \text{ kJ}$$

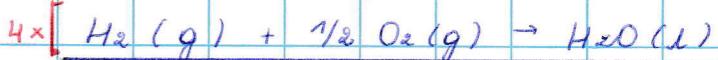
Oef 18



$$\Delta H^\circ = -2220 \text{ kJ}$$



$$\Delta H^\circ = -394 \text{ kJ}$$



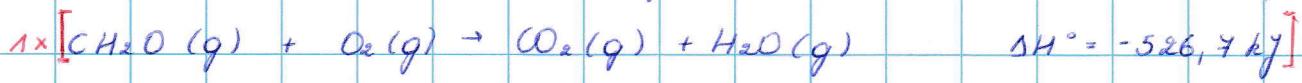
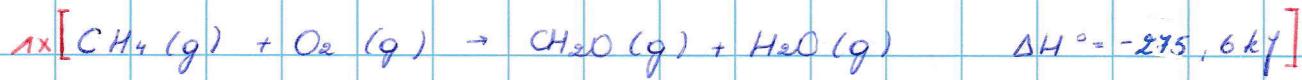
$$\Delta H^\circ = -286 \text{ kJ}$$



$$\Delta H^\circ = 2220 + 3(-394) + 4 \cdot (-286)$$

$$= -106 \text{ kJ}$$

Oef 19



$$\Delta H^\circ = -275,6 \text{ kJ} + (-526,7 \text{ kJ}) + (-2)(44,0 \text{ kJ})$$

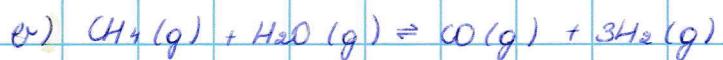
$$= -890,3 \text{ kJ}$$

## Chemisch Gleichgewicht

Übung 1



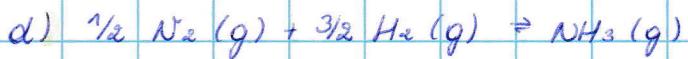
$$K_p = \frac{p_{\text{CH}_4} \cdot p_{\text{H}_2\text{O}}}{p_{\text{CO}} \cdot (p_{\text{H}_2})^3}$$



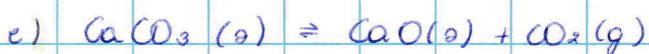
$$K_p = \frac{p_{\text{CO}} \cdot (p_{\text{H}_2})^3}{p_{\text{CH}_4} \cdot p_{\text{H}_2\text{O}}}$$



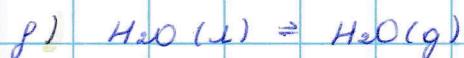
$$K_p = \frac{(p_{\text{NH}_3})^2}{p_{\text{N}_2} \cdot (p_{\text{H}_2})^3}$$



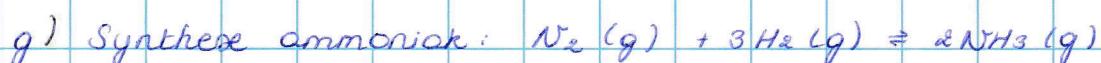
$$K_p = \frac{p_{\text{NH}_3}}{(p_{\text{N}_2})^{1/2} \cdot (p_{\text{H}_2})^{3/2}}$$



$$K_p = p_{\text{CO}_2}$$



$$K_p = p_{\text{H}_2\text{O}}$$



$$K_p = \frac{(p_{\text{NH}_3})^2}{p_{\text{N}_2} \cdot (p_{\text{H}_2})^3}$$

h) Verandering van ammoniakgas tot stikstofoxidegas en waterdamp



$$K_p = \frac{(\rho_{\text{NO}})^4 \cdot (\rho_{\text{H}_2\text{O}})^6}{(\rho_{\text{NH}_3})^4 \cdot (\rho_{\text{O}_2})^5}$$

i) Verandering van waterstofsulfidegas tot zwaveldioxidegas en waterdamp



$$K_p = \frac{(\rho_{\text{SO}_2})^2 \cdot (\rho_{\text{H}_2\text{O}})^2}{(\rho_{\text{H}_2\text{S}})^2 \cdot (\rho_{\text{O}_2})^3}$$

Oef 3

$$\rho = 55 \text{ kPa} = 0,55 \text{ bar}$$

$$\Phi = \frac{(\partial \text{H}_2)^2}{(\partial \text{H}_2)(\partial \text{I}_2)} = \frac{0,55^2}{0,55 \cdot 0,55} = 1$$

$$K_p = 46$$

$\Phi < K_p \rightarrow$  reactie richting producten

Oef 4



$$1 \qquad 3 \qquad 0,5 \qquad n(\text{mol})$$

$$0,02 \qquad 0,06 \qquad 0,01 \qquad c (\text{mol/L})$$

$$\Phi = \frac{0,01^2}{0,02 \cdot 0,06^3} = 23,1$$

$\Phi > K_c \rightarrow$  reactie naar links: ontleding

Oef 5

$$K_c = 3,26 \cdot 10^{-2}$$

$$T = 191^\circ\text{C} = 464\text{K}$$

$$R = 8,314 \cdot 10^{-2} \text{ L bar / mol K}$$

$$\Delta n = 1+1-1=1$$

$$K_p = K_c (RT)^{\Delta n} = 1,26$$

Oef 6

$K_c = 4,0 \cdot 10^{13} \rightarrow$  hogedrakelijk reactieproducten

$$K_c = \frac{[\text{NO}_2]^2}{[\text{NO}]^2 \cdot [\text{O}_2]} = \frac{[\text{NO}_2]^2}{[2,0 \cdot 10^{-6}]^2 [2,0 \cdot 10^{-6}]} = 4,0 \cdot 10^{13}$$

$$[\text{NO}_2] = 0,048\text{M}$$

Oef 7

- 4,00

- - -

t.o.: n(mol)

- 2,0,442

+ 0,442

reactie: n(mol)

3,116

0,442

evenwicht: n(mol)

0,6232

0,0884

0 (mol/L)

$$K_c = \frac{[\text{H}_2] \cdot [\text{I}_2]}{[\text{HI}]^2} = \frac{0,0884 \cdot 0,0884}{0,6232^2} = 0,0201$$

### Oef 8

$$m(\text{PCl}_5) = 3,42 \text{ g}$$

$$n = 0,0150 \text{ mol}$$

$$T = 523 \text{ K}$$

$$V = 0,500 \text{ L}$$

$$pV = nRT \rightarrow p = 1,30 \text{ bar}$$



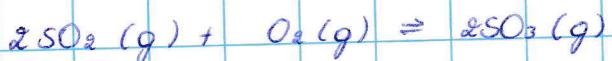
1,30	-	-		to: $p$ (bar)
-x	+x	+x		reactie
1,30-x	x	x		evenwicht

$$K_p = \frac{x^2}{1,30-x} = 78,3 \rightarrow x = 1,28 \text{ bar}$$

$$c(\text{Cl}_2) = c(\text{PCl}_3) = \frac{n}{V} = \frac{p}{RT} = 0,0294 \text{ M}$$

$$c(\text{PCl}_5) = 4,59 \cdot 10^{-4} \text{ M}$$

### Oef 9



$$K_p = 3,1 \cdot 10^4 = K_c \cdot (RT)^{\Delta n}$$

$$T = 673$$

$$\Delta n = -1$$

$$K_c = 1,7 \cdot 10^6$$

### Oef 10

Links: ontleding (Le Chatelier)

Oef 11

Stel: verdubeling van druk

a)  $\varnothing = \frac{p_{CO_2}}{p_{CO} \cdot p_{O_2}}$

$$p_{CO} \cdot p_{O_2}$$

evenwicht:  $\varnothing = K_p$

verdubbeling v/d druk:  $\varnothing$  daalt,  $\varnothing < K_p \rightarrow$  afname van hoeveelheid product

b)  $\varnothing = \frac{(p_{H_2})^2 \cdot (p_{S_2})}{(p_{H_2S})^2}$

evenwicht:  $\varnothing = K_p$

verdubbeling v/d druk:  $\varnothing$  stijgt,  $\varnothing > K_p \rightarrow$  daling van hoeveelheid product

c)  $\varnothing = \frac{p_{S_2}}{p_{S_2}}$

$$p_{S_2}$$

evenwicht:  $\varnothing = K_p$

verdubbeling v/d druk:  $\varnothing$  blijft  $\rightarrow$  geen verandering

Oef 12

$\Delta H^\circ > 0 \rightarrow$  endotherme reactie

$T \uparrow \rightarrow$  meer productvorming

Oef 13

a)  $N_2$  toevoegen  $\rightarrow$  warmte reagentia stijgt

b)  $NH_3$  verwijderen  $\rightarrow$  warmte reagentia stijgt

c)  $H_2O$  verwijderen  $\rightarrow$  warmte producten stijgt

### Oef 14

$$p(Cl_2) = nRT/V = 0,870 \text{ bar}$$



0,02

1,28

1,28

evenwicht:  $p(Cl_2)$

+ 0,870

toevoegen  $Cl_2$

2,15

+ x

-x

-x

reactie

0,02 + x

1,28 - x

2,15 - x

evenwicht

$$K_p = \frac{(1,28-x)(2,15-x)}{0,02+x} = 48,3 \rightarrow x = 0,0145 \text{ bar}$$

$$p(PCl_5) = 0,03 \text{ bar} \rightarrow c(PCl_5) = 8 \cdot 10^{-4} \text{ M}$$

$$p(PCl_3) = 1,27 \text{ bar} \rightarrow c(PCl_3) = 0,029 \text{ M}$$

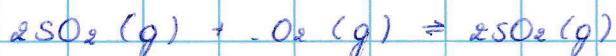
$$p(Cl_2) = 2,14 \text{ bar} \rightarrow c(Cl_2) = 0,049 \text{ M}$$

### Oef 15

a) richting producten

b) geen verandering

### Oef 16



$$\Delta H^\circ = 2 \Delta H^\circ_f(SO_3(g)) - 2 \Delta H^\circ_f(SO_2(g))$$

$$= 2(-395,72 \text{ kJ/mol}) - 2(-296,83 \text{ kJ/mol})$$

$$= -197,78 \text{ kJ}$$

exotherme reactie

T  $\uparrow \rightarrow$  ontleding van  $SO_3$

Obj 17



$$\Delta H^\circ = 2\Delta H^\circ_f(NH_3(g)) = -92,22 \text{ kJ}$$

$$K_1 = 6,8 \cdot 10^5$$

$$T_1 = 298 \text{ K}$$

$$T_2 = 400 \text{ K}$$

$$\ln \frac{K_2}{K_1} = \frac{\Delta H^\circ}{R} \left( \frac{1}{T_1} - \frac{1}{T_2} \right)$$

$$\rightarrow K_2 = 51$$