

Chimie inorganique

1

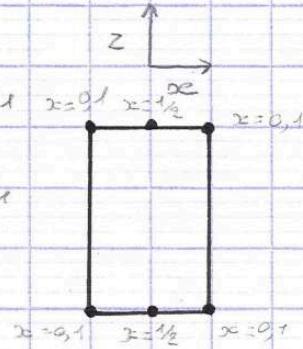
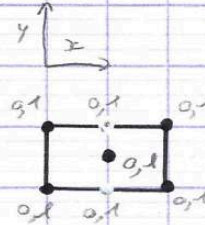
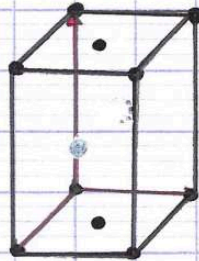
I - Notion de Cristallographie

Exercice 3

$$a = 2c$$

$$b = 2c$$

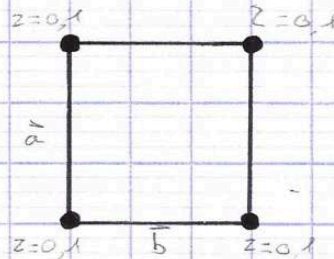
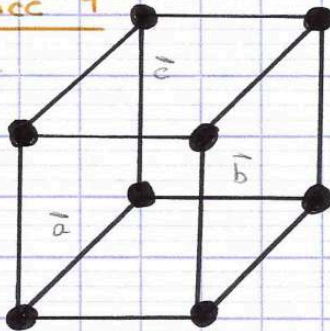
$$c = 2c$$



$$Z = 8 \cdot \frac{1}{8} + 2 \cdot \frac{1}{2} = 2 \quad \text{base ccm free}$$

Exercice 4

a)



$$a = b = c$$

$$\alpha = \beta = \gamma$$

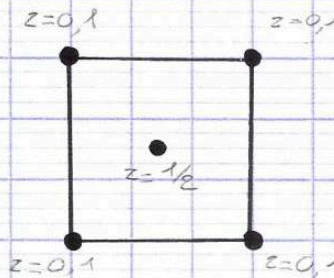
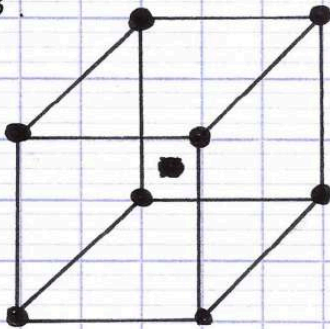
$$Z = 1$$

$$2R = a$$

$$C = \frac{4}{3} \pi R^3 \cdot \frac{1}{a^3} = 0,52$$

$$c = 6$$

b)

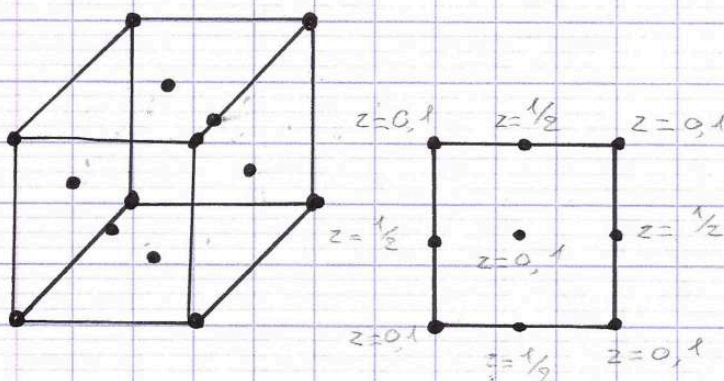


$$Z = 2$$

$$\sqrt{3}a = 4R$$

$$C = 2 \cdot \frac{4}{3} \pi R^3 \cdot \frac{1}{a^3} = 0,68$$

$$c = 8$$



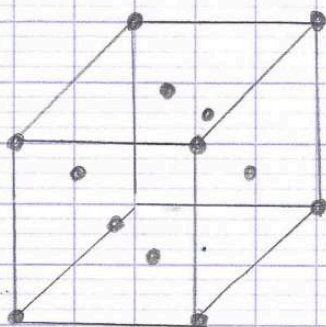
$$Z = 4$$

$$\sqrt{2}a = 4R$$

$$C = 0,72$$

$$c = 12$$

Exercice 2.1



Multiple $Z = 4$

$$(000) \left(\frac{1}{2} \frac{1}{2} 0\right) \left(\frac{1}{2} 0 \frac{1}{2}\right) \left(0 \frac{1}{2} \frac{1}{2}\right)$$

$$\rho = \frac{Z \cdot M}{N_A \cdot a^3} = 8,97 \text{ g.cm}^{-3}$$

$$d = 8,97$$

Exercice 1.5



- Placer dans le creux type ABAB (Hexagonal compact)

$$[12]$$

- Placer dans le creux de la couche B type ABCABC (Cubique face centrée)

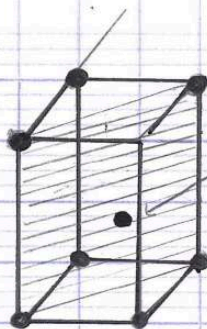
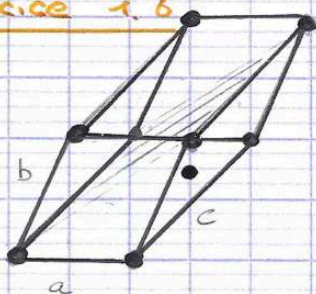
$$[12]$$

Imagerie

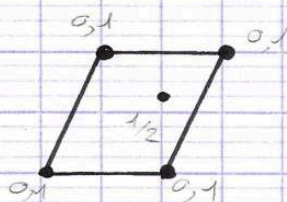
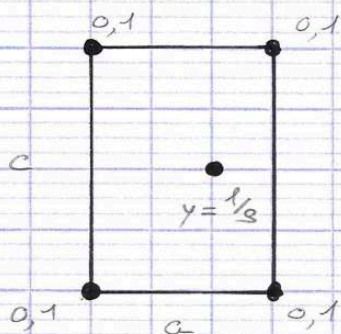
Exercice 1.6

2

1a)



$(\frac{1}{3} \quad \frac{2}{3} \quad \frac{1}{2})$



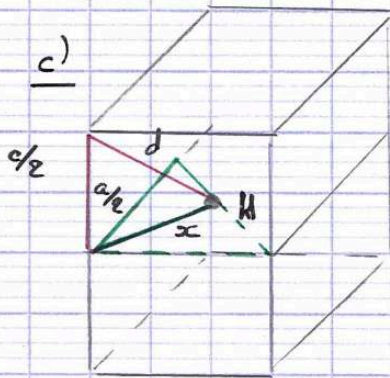
$$Z = 4 \times \frac{1}{6} + 4 \times \frac{1}{12} + 1 = 2$$

$$x = \frac{1}{\sqrt{3}} a$$

Exercice 1.6

$$\begin{aligned} a^2 - x^2 &= \frac{2}{3} a^2 \\ -x^2 &= -\frac{1}{3} a^2 \end{aligned} \quad (1)$$

1) b) Les atomes sont en contact le long d'une même arête $\Rightarrow a = 2R$



$$a^2 = d^2 = x^2 + \frac{c^2}{4} \Rightarrow x^2 = a^2 - \frac{c^2}{4}$$

H est une hauteur d'un triangle équilatéral donc H est une médiane

$$\cos(30^\circ) = \frac{a/2}{x} \Rightarrow x = \frac{a}{\sqrt{3}}$$

$$\Rightarrow \frac{a^2}{3} = a^2 - \frac{c^2}{4} \Leftrightarrow \frac{c^2}{4} = \frac{2a^2}{3}$$

$$\Rightarrow \frac{c^2}{a^2} = \frac{8}{3}$$

d) $z = 2$

$$a = 2R$$

e)

$$\begin{aligned} V_{HC} &= A_{HC} \cdot c \\ A_{HC} &= l \cdot A_{\text{triangle}} \\ &= 3h = ah \end{aligned}$$

$$a^2 = h^2 + \frac{a^2}{4}$$

$$h^2 = \frac{3a^2}{4} \Rightarrow h = \frac{\sqrt{3}a}{2}$$

$$V_{HC} = \frac{\sqrt{3}}{2} a^2 \cdot \frac{\sqrt{3}}{2} a$$

$$= \frac{2\sqrt{3}}{2\sqrt{3}} a^3 = \sqrt{2} a^3$$

$$\begin{aligned} C &= \frac{z \cdot \frac{4}{3} \pi R^3}{V_{HC}} \\ &= \frac{\sqrt{2} \cdot \frac{4}{3} \pi a^3 / 8}{a^3} \\ &= \frac{\sqrt{2}}{6} \pi \approx 0,74 \end{aligned}$$

Exercice 2.3

b) $Z = 4 \times \frac{1}{6} + 4 \times \frac{1}{12} + 1 = 2$

c) $(000) \left(\frac{1}{3} \frac{2}{3} \frac{1}{2} \right)$

d) $a = 2R$
 $= 2,50 \text{ \AA}$

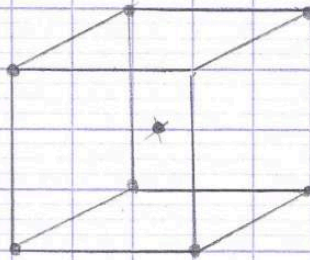
$c/a = \sqrt{\frac{8}{3}} \Leftrightarrow c = 4,08 \text{ \AA}$

e) $V = \sqrt{2} a^3$

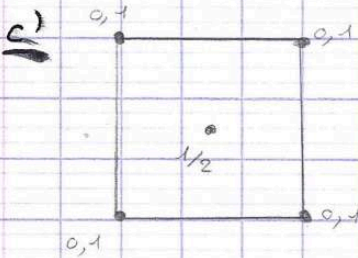
$\rho = \frac{M \cdot Z}{N_A \cdot V} \approx 8,86 \text{ g.cm}^{-3}$

Exercice 2.2

Pour a)



b) Multiple
 $Z = 2$



d) $\rho = \frac{Z \cdot M}{N_A \cdot V}$
 $a^3 = \frac{Z \cdot M}{N_A \cdot \rho}$
 $a = 4,28 \text{ \AA}$

$\sqrt{3}a = 4R$
 $R = \frac{\sqrt{3}}{4} a$
 $= 1,86 \text{ \AA}$

Exercice 1.7.1

$$C_u = 6 \times \frac{1}{2} = 3$$

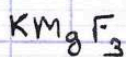
$$a = 3,75$$

$$A_u = 8 \times \frac{1}{8} = 1$$

P (justification avec translation élémentaire)

Exercice 1.7.2

$$K^+ : \frac{1}{8} \times 8 = 1$$



$$F^- : 6 \times \frac{1}{2} = 3$$

$$Mg^{2+} : 1$$

Exercice 2.4

$$\rho = \frac{Z \cdot M}{N_A \cdot a^3}$$

$$CFC \quad Z = 4$$

$$\sqrt{2}a = 4R$$

$$M = \frac{\rho \cdot N_A \cdot a^3}{Z}$$

$$a = 3,85 \text{ \AA}$$

$$= 192,5 \text{ g} \cdot \text{mol}^{-1}$$

Irridium

Exercice 2.5

$$Z = 1$$

$$d = 4,43$$

$$Z = 2$$

$$d = 5,83$$

✓

$$Z = 4$$

$$d = 6,35$$

Exercice 2.7

$$\begin{aligned} \text{[cub]} \quad a\sqrt{3} &= 2R + 2R & a &= 2R \\ R\sqrt{3} &= R + R \\ \frac{R}{R} &= (\sqrt{3} - 1) = 0,732 \end{aligned}$$

$$\begin{aligned} \text{[0]} \quad a &= 2R + 2R & \frac{a\sqrt{2}}{2} &= 2R \\ \frac{4}{\sqrt{2}} R - 2R &= 2R & a &= \frac{4}{\sqrt{2}} R \\ R(\sqrt{2} - 1) &= R \\ \frac{R}{R} &= \sqrt{2} - 1 = 0,414 \end{aligned}$$

$$\begin{aligned} \text{[T]} \quad a\sqrt{2} &= 2R \\ \frac{a\sqrt{3}}{2} &= R + R \Rightarrow \frac{R}{R} \left(\frac{\sqrt{3}}{\sqrt{2}} - 1 \right) = 1 \\ &\Rightarrow \frac{R}{R} = 0,225 \end{aligned}$$

Exercice 2.8

$$\begin{aligned} \underline{a)} \quad \text{[0]} \quad a &= 2R + 2R & \text{[T]} \quad a\sqrt{2} &= 2R \\ a\frac{\sqrt{2}}{2} &= 2R & \frac{a\sqrt{3}}{2} &= R + R_T \\ R\left(\frac{\sqrt{2}}{2} - 1\right) &= R & \Rightarrow R\left(\frac{\sqrt{3}}{\sqrt{2}} - 1\right) &= R_T \\ R_0 &= 0,414 R & \Rightarrow R_T &= 0,225 R \end{aligned}$$

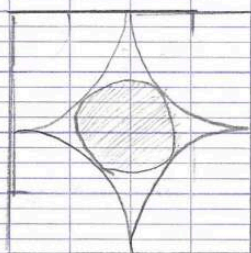
$$\begin{aligned} \underline{b)} \quad \text{Si [0]} \quad 0,414 R &= 0,6624 \text{ \AA} & \checkmark \\ 0,225 R &= 0,36 \text{ \AA} & \times \end{aligned}$$

c) Il y a 8 sites [T] par maille cfc donc 8 atomes H par maille $\Rightarrow \text{Zn}_4\text{H}_8 \Leftrightarrow 4(\text{ZnH}_2)/\text{maille}$

III - Étude de cristaux ioniques

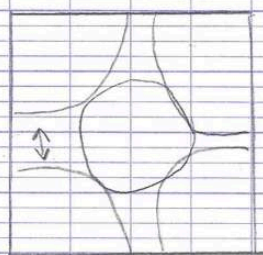
Exercice 3.1

[cub] $\frac{R}{R} = 0,732$



$\frac{R}{R} \leq 0,732$

contact A-A



$\frac{R}{R} > 0,732$

contact A-C

$\sqrt{2} a = 2R + 2R, a = 2R$

$2\sqrt{2}R - 2R = 2R$

$R(\sqrt{2} - 1) = R$

$\frac{R}{R} = 0,732$

Exercice 3.2

nbr de O^{2-} / maille : 4

nbr de Li^+ / maille : 8

nbr de sites [O] / maille = 4

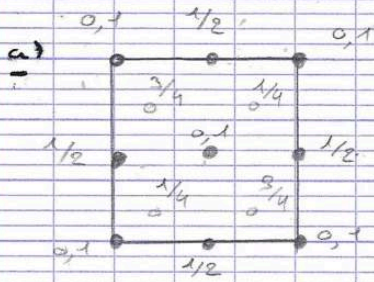
nbr de sites [T] / maille = 8

Li se met met en [T]

Type Na_2O : $\frac{h\sqrt{3}}{2} = R^+ + R^- \Rightarrow \frac{a\sqrt{3}}{4} = R^+ + R^-$
 $R^+ = 0,539 \text{ \AA}$

$\rho = \frac{4 \cdot M_{Li_2O}}{N_A a^3} = 2,03 \text{ g.cm}^{-3}$

Exercice 3.4



cubique cfc

empilement [T] 50%

4 unités formulaire / maille

$$b) \quad a\sqrt{2} = 4R$$

$$a \frac{\sqrt{3}}{4} = R + R$$

$$R = 0,31 \text{ \AA}$$

$$a = 3,95 \text{ \AA}$$

$$c) \quad V_{\text{at}} = 11,5 \text{ \AA}^3$$

$$V_{\text{at}} = 0,18 \text{ \AA}^3$$

$$V_{\text{Tot}} = 61,6 \text{ \AA}^3$$

$$C = 74,9\%$$

$$d) \quad a-a : 4:12$$

$$a-c : 4$$

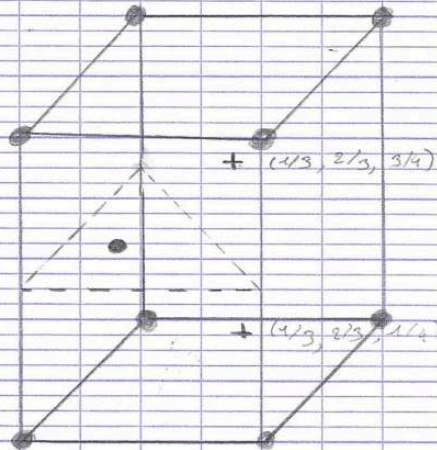
Exercice 3.6

$$a) \quad \text{Ni}^{2+} \quad [0] \quad 100\% \Rightarrow 2$$

$$\text{Te}^{2-} \quad \text{en HC}$$

$$\Rightarrow 2/\text{maille}$$

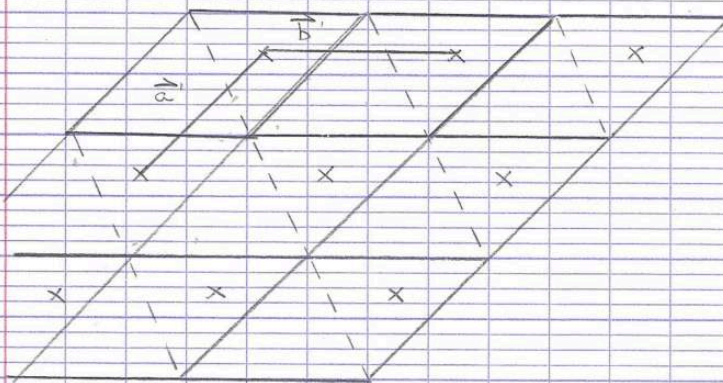
contact Te^{2-} par les arêtes $\Rightarrow a = 2R_{\text{Te}^{2-}}$



$$\text{coord' membra} \quad \text{Te}^{2-} - \text{Te}^{2-} : [6] [12] \text{ HC}$$

$$\text{Ni}^{2+} - \text{Te}^{2-} : [6]$$

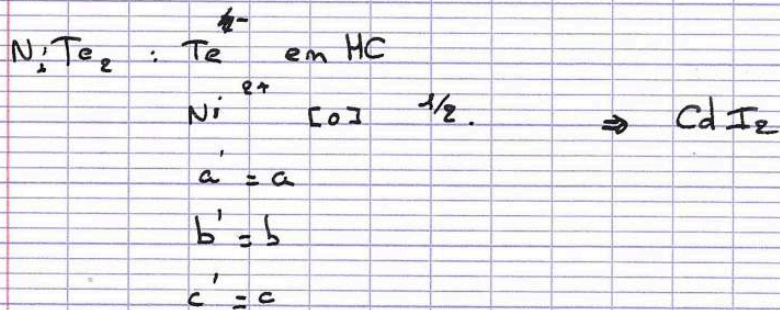
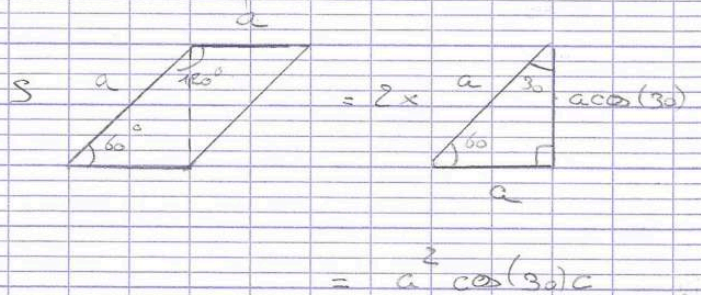
$$b) \quad \text{projection (001) } \frac{1}{\sqrt{2}} \text{ } x \text{ } y$$



$$\begin{aligned} a' &= a \\ b' &= b \\ c' &= c/2 \end{aligned}$$

$$\rho = \frac{UF \cdot M_{NiTe}}{N_a \text{ Maille}} = \frac{2 M_{NiTe}}{N_a a^2 \cos 30^\circ c}$$

$$d = 8,49$$



Exercice 3.8

b) HC

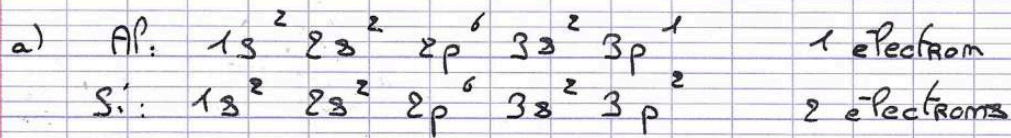
c) $a \gg I^- - I^-$

d) $(00\frac{3}{8})$

$$e) \frac{3}{8} c = R_{Ag} + R_I$$

$$g) \sqrt{\frac{8}{3}} \approx \frac{c}{a} \Rightarrow \text{HC régulier.}$$

Exercice 4.1

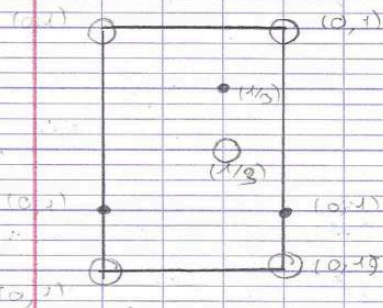


b) CFC d'AP, Si: $\begin{cases} 50\% [T] \\ CFC \end{cases}$

c) $\rho = \frac{M \cdot Z}{Na \cdot a^3}$ $\Rightarrow \begin{cases} AP = 2,70 \text{ g.cm}^{-3} [12] & 74\% \\ Si = 2,83 \text{ g.cm}^{-3} [4] & 34\% \end{cases}$

d) Les sites tétra déforment le cube.

Exercice 4.3



Si	000	1/3	2/3	1/2
AP	003/8	1/3	2/3	3/8

Wüztite

Si/C [4]

→ tétra

Si/Si [12]

hybridation sp^3

$d_{Si-C} = \frac{3}{8} C = 1,89 \text{ Å}$

$R_{Si} + R_C = 2,2 \text{ Å}$

$\rightarrow d_{Si-C} < R_{Si} + R_C$

car il y a recouvrement entre les nuages électroniques du Si et du C.

$C = 41,7\%$

$\rho = 3,219 \text{ g.cm}^{-3}$

Matériau réfractaire car hybridation sp^3 du C et du Si + différence d'électronegativité $\Rightarrow$ formation de 4 liaisons covalentes fortes.

Exercice 2.6

Il s'agit de déterminer si l'or (Au) cristallise dans un système CFC ou cubique centré (CC). Même question pour le tungstène (W). Les deux métaux ont deux masses volumiques proches = 19.3 g/cm³.

Données :

$$r(\text{Au}) = 1,44 \text{ \AA}$$

$$M(\text{Au}) = 196.97 \text{ g/mol}$$

$$r(\text{W}) = 1,37 \text{ \AA}$$

$$M(\text{W}) = 183.85 \text{ g/mol}$$

$$\text{Système CC : } Z = 2 \text{ et } \sqrt{3}a = 4r$$

$$\text{Système CFC : } Z = 4 \text{ et } a = 2\sqrt{2}r$$

$$\text{Pour une maille cubique } V = a^3$$

$$\rho = \frac{ZM}{N_A a^3} = 19,3 \text{ g/cm}^3$$

Pour l'or :

$$a_{\text{Au}} = 4,07 \text{ \AA}$$

Si CC

$$r(\text{Au}) = 1,76 \text{ \AA}, \text{ ce qui ne correspond pas à la valeur attendue}$$

si CFC

$$r(\text{Au}) = 1,44 \text{ \AA}, \text{ donc l'or cristallise dans un système CFC}$$

Pour le tungstène :

$$a_{\text{W}} = 3,16 \text{ \AA}$$

Si CC

$$r(\text{W}) = 1,37 \text{ \AA}$$

Si CFC

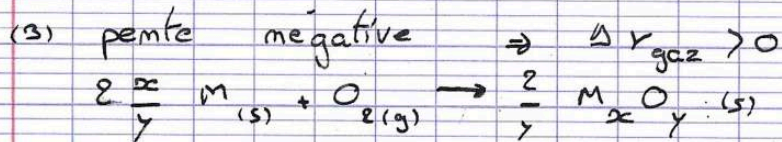
$$r(\text{W}) = 1,11 \text{ \AA} \text{ donc le système est CC pour W}$$

3) pente négative

2

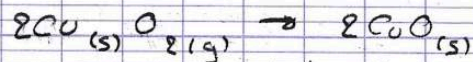
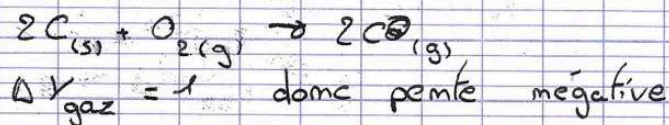
Diagrammes d'Ellingham

Exercice 1



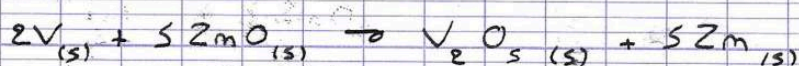
$$\Delta Y_{\text{gaz}} = -1$$

Sauf pour CO/C



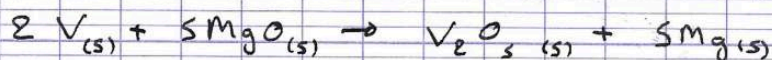
Donc CuO est le moins stable des stables
donc il est "au dessus". De plus il ne croise
aucune autre courbe $\Rightarrow \odot$

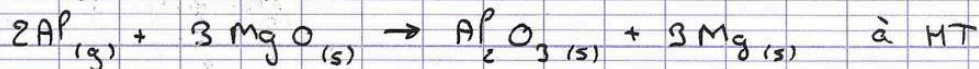
Le Ca Calcium ne croise aucune courbe et CaO
est le plus stable des oxydes donc $\odot$



$\nabla T \Rightarrow$ Pas de croisement

Les 2 courbes se croisent (V_2O_5/V et MgO/Mg)





NiO/Ni et ZnO/Zn se croisent et ZnO/Zn

"au dessus" de NiO/Ni à HT

$\text{Al}_2\text{O}_3/\text{Al}$ et MgO/Mg se croisent et MgO/Mg

"au dessus" de $\text{Al}_2\text{O}_3/\text{Al}$ à HT

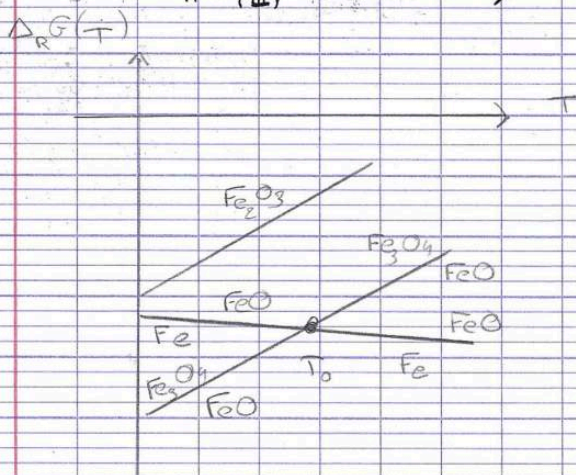
$\Rightarrow \text{MgO/Mg}$ croise 2x donc $\odot$

Exercice 2

(1) On utilise l'approximation d'Ellingham
ainsi $\Delta_R H^\circ$ et $\Delta_R S^\circ$ indépendantes de la
température

$$\Delta_R G^\circ = \Delta_R H^\circ - T \Delta_R S^\circ$$

$$\begin{cases} \Delta_R G_{(I)}^\circ = -532,2 + T \cdot 0,1409 \\ \Delta_R G_{(II)}^\circ = -653,4 + T \cdot 0,2314 \\ \Delta_R G_{(III)}^\circ = -470,4 + T \cdot 0,2662 \end{cases}$$

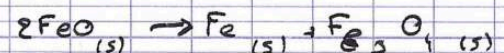


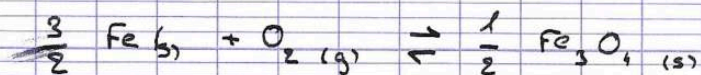
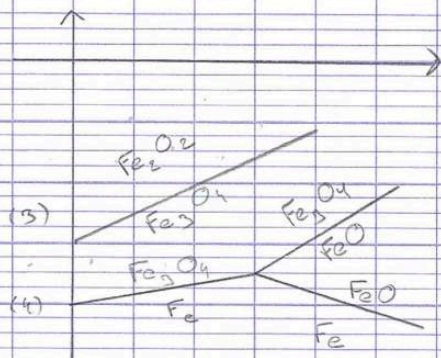
Avant T_0 on considère
entre (1) et (2)

(1) meilleur oxydant $\text{FeO}_{(s)}$

(2) meilleur réducteur $\text{FeO}_{(s)}$

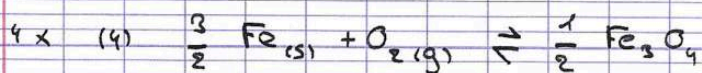
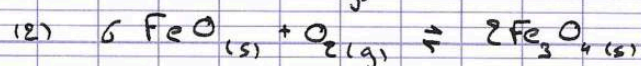
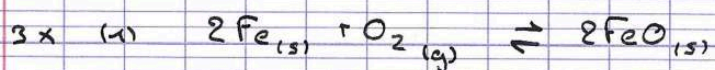
$\Rightarrow$ réaction de dismutation





On cherche (4) = x(1) + y(2) + z(3)

$$(4) = \frac{3}{4}(1) + \frac{1}{4}(2)$$



$$\Rightarrow (4) = \frac{3}{4}(1) + \frac{1}{4}(2)$$

$$\Rightarrow \Delta_R G^\circ_{(4)} = -564 + T \times 0,1784$$

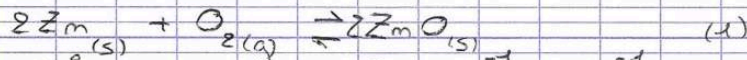
$$h) \quad \text{IP} \quad \text{par} \quad \Delta_R G^\circ_{(4)} = \Delta_R G^\circ_{(1)} \\ \sim T_0 = 845 \text{ K}$$

Exercice 3

Exercice 3 - suite

• Pour ZnO/Zn

- $T < T_F$

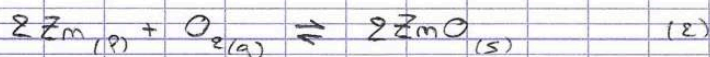


$$\Delta_R S^\circ = 2S_{ZnO}^\circ - 2S_{Zn}^\circ - S_{O_2}^\circ = -0,201 \text{ kJ} \cdot K^{-1} \cdot mol^{-1}$$

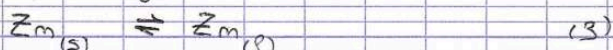
$$\Delta_R H_{Co}^\circ = 2H_{ZnO}^\circ = -696,6 \text{ kJ} \cdot mol^{-1}$$

Donc $\Delta_R G^\circ = -696,6 + 0,201 T$

- $\frac{T_F}{T} < T < \frac{T_F}{T_F}$



On pose



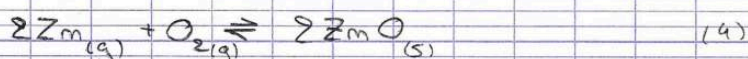
ainsi $(2) = (1) - 2(3)$

$$\Delta_R H^\circ = \Delta_R H_{(1)}^\circ - 2\Delta_R H_{3/2}^\circ = -710,0 \text{ kJ} \cdot mol^{-1}$$

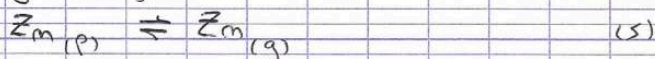
$$\Delta_R S^\circ = \Delta_R S_{(1)}^\circ - 2\Delta_R S_{(3)}^\circ = \Delta_R S_{(1)}^\circ - 2 \frac{\Delta H_{fus}}{T_{fus}} = -0,2204 \text{ kJ} \cdot K^{-1} \cdot mol^{-1}$$

donc $\Delta_R G^\circ = -714,4 + 0,2204 T$

- $\frac{T}{T_F} > T_F$



On pose



ainsi $(4) = (2) - 2(5)$

$$\Delta_R H^\circ = \Delta_R H_{(2)}^\circ - 2\Delta_R H_{eb}^\circ = -944 \text{ kJ} \cdot mol^{-1}$$

$$\Delta_R S^\circ = \Delta_R S_{(2)}^\circ - 2 \frac{\Delta H_{eb}}{T_{eb}} = -0,415 \text{ kJ} \cdot K^{-1} \cdot mol^{-1}$$

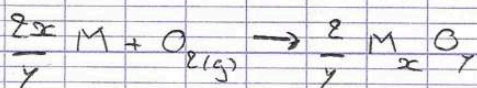
donc $\Delta_R G^\circ = -944 + 0,415 T$

Soit T_F la température au point d'intersection entre la droite du couple CO/C et celle du couple ZnO/Zn (on prend la droite où $T > T_F$)

$$\Delta_R G_{(4)}^\circ = \Delta_R G^\circ$$

$$\Rightarrow -944 + 0,415 T = -221 - 0,1788 T$$

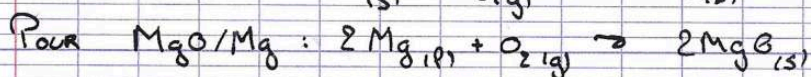
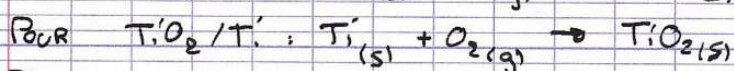
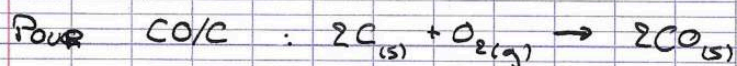
$$\Rightarrow T = +1218 K$$

Exercice 4

Ainsi $\Delta_R G^\circ = \Delta_R H^\circ - \Delta_R S^\circ$

où $\Delta_R H^\circ = \sum \nu_i \Delta_f H^\circ$

$\Delta_R S^\circ = \sum \nu_i S^\circ$



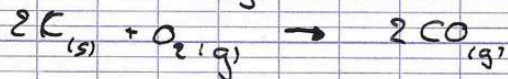
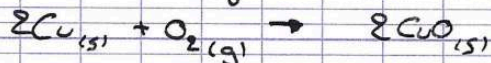
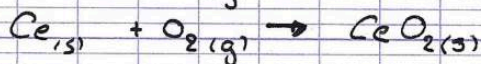
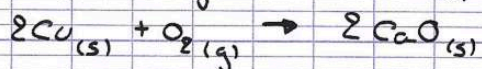
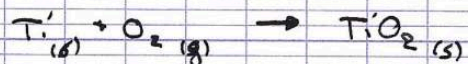
Le changement de pente en 4) implique que le magnésium passe de l'état liquide à gazeux

Si $T < 1650K$

TiO₂/Ti et MgO/Mg réduisent CO/C

MgO/Mg réduit TiO₂/Ti

Si $T > 1650K$ CO/C et TiO₂/Ti réduisent MgO/Mg, CO/C réduit TiO₂/Ti

Exercice 5

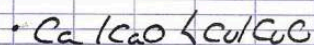
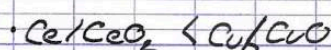
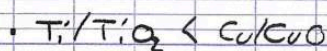
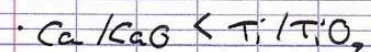
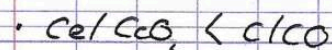
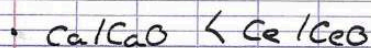
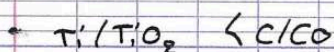
$$\Delta \gamma_{\text{gaz}} = -1$$

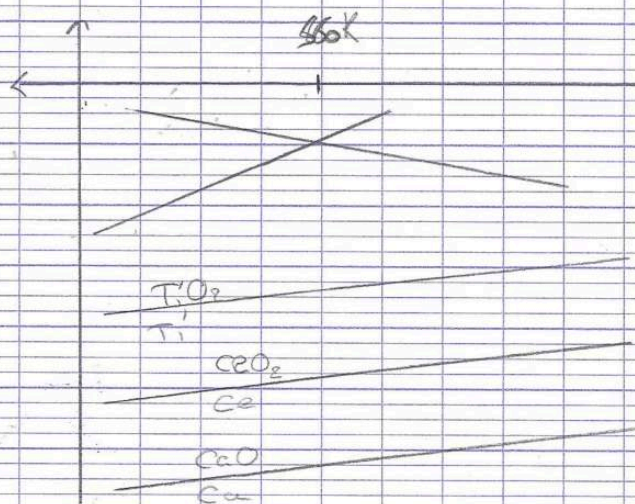
$$= -1$$

$$= -1$$

$$= -1$$

$$= 1$$





Diagrammes de phases

Exercice 1

- (1) $\hat{m}$ structure
- (2) $\hat{m}$ rayon atomique
- (3) $\hat{m}$ électro-négativité
- (4) $\hat{m}$ valence

alors le paramètre de maille de la solution solide (ss) évolue linéairement avec x

$$a_{ss} = a_A x + a_B (1-x)$$

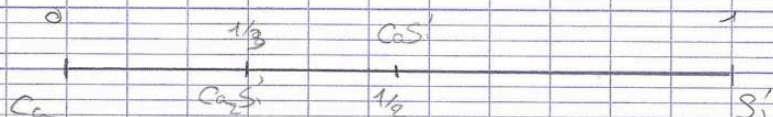
$AuPt$

$$x_{Au} = \frac{n_{Au}}{n_{tot}} = 0,5 \Rightarrow a_{AuPt} = 4 \text{ \AA}$$

Au_3Pt

$$x_{Au} = \frac{3}{4} \Rightarrow a_{Au_3Pt} = 3,96 \text{ \AA}$$

Exercice 2



$$x_{Ca} = 2/3$$

$$x_{Si} = 1/3$$

$$P_{Si} = 0,41$$

$$P_{Si} = \frac{x_{Si} M_{Si}}{x_{Si} M_{Si} + x_{Ca} M_{Ca}} = 0,26$$

Exercice 3

Conversion de fraction massique p_B en molaire

$$p_B = \frac{m_B}{m_A + m_B} = \frac{m_B M_B}{m_A M_A + m_B M_B} \times 1 = \frac{m_B M_B}{m_A M_A + m_B M_B} \times \frac{m_A + m_B}{m_A + m_B}$$
$$= \frac{x_B M_B}{x_A M_A + x_B M_B}$$

$$x_A = 1 - x_B$$

$$\rightarrow p_B = \frac{x_B M_B}{(1 - x_B) M_A + x_B M_B}$$

$$= \frac{x_B M_B}{x_B (M_B - M_A) + M_A} \Rightarrow x_B = \frac{p_B M_A}{p_B M_A + M_B - p_B M_B}$$

$$x_{\text{NaCl}} = \frac{1}{3}$$

$$\text{et donc } x_{\text{H}_2\text{O}} = \frac{2}{3}$$

Le composé est donc $\text{NaCl} \cdot (\text{H}_2\text{O})_2$

Exercice 4

Pour faire SiAl_2O_5 il faut $2\text{Al}_2\text{O}_3$ et SiO_2

$$\text{et donc } x_{\text{Al}_2\text{O}_3} = \frac{2}{3}$$

$$x_{\text{SiO}_2} = \frac{1}{3}$$

$$p_{\text{SiO}_2} = \frac{x_{\text{SiO}_2} M_{\text{SiO}_2}}{x_{\text{SiO}_2} M_{\text{SiO}_2} + x_{\text{Al}_2\text{O}_3} M_{\text{Al}_2\text{O}_3}} = 0,287$$

2 molécules d'eau en moins. $Al_2Si_2O_7$
 et comme $2SiO_2 + Al_2O_3 = Al_2Si_2O_7$
 $x_{SiO_2} = 2/3$ $x_{Al_2O_3} = 1/3$

$$P_{SiO_2} = \frac{2(28 + 2 \times 16)}{2(28 + 2 \times 16) + 1(27 \times 2 + 16 \times 3)} = 0,51 \rightarrow \text{pour } 100 \text{ g} \rightarrow 51,1 \text{ g de } SiO_2$$

$$P_{Al_2O_3} = 1 - P_{SiO_2} = 0,49 \rightarrow \text{pour } 100 \text{ g} \rightarrow 48,9 \text{ g de } Al_2O_3$$

L'EXERCICE 5

- $T > T_N$ et/ou $0 < x < x_m$
 une seule phase liquide

- $T = T_N$ et/ou $x = x_m$

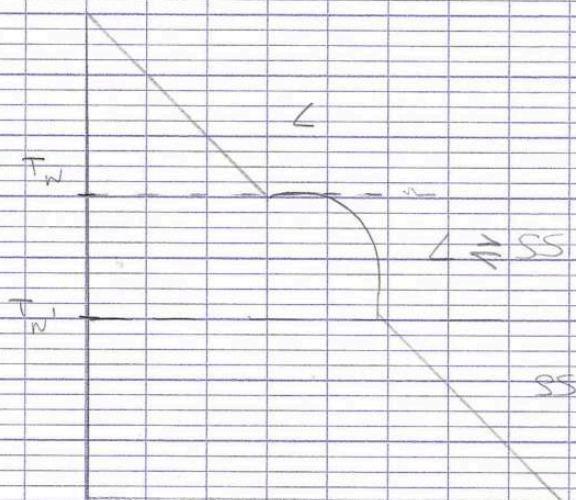
Apparition des premières cristaux de sel solide *germinet*

- $T_N > T > T_N'$ ou $x_m < x < x_m'$

2 phases en équilibre $L \rightleftharpoons SS$

Quand $x \nearrow$, il y a de $\oplus$ en $\oplus$ de solide, et
 $\ominus$ en $\ominus$ de liquide

Quand $T \searrow$, il y a de $\oplus$ en $\oplus$ de solide "



Exercice 6

- limite de solubilité de Sn dans Pb
- limite de solubilité de Pb dans Sn

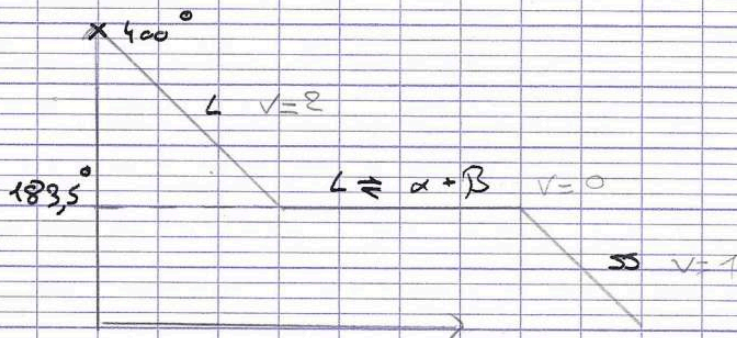
c) L - eutectique
 $P_{Sn} = 61,9\%$

$T > 183^\circ C$: Une phase liquide

$T = 183^\circ C$ 3 phases en équilibre $\alpha + \beta \rightleftharpoons L$

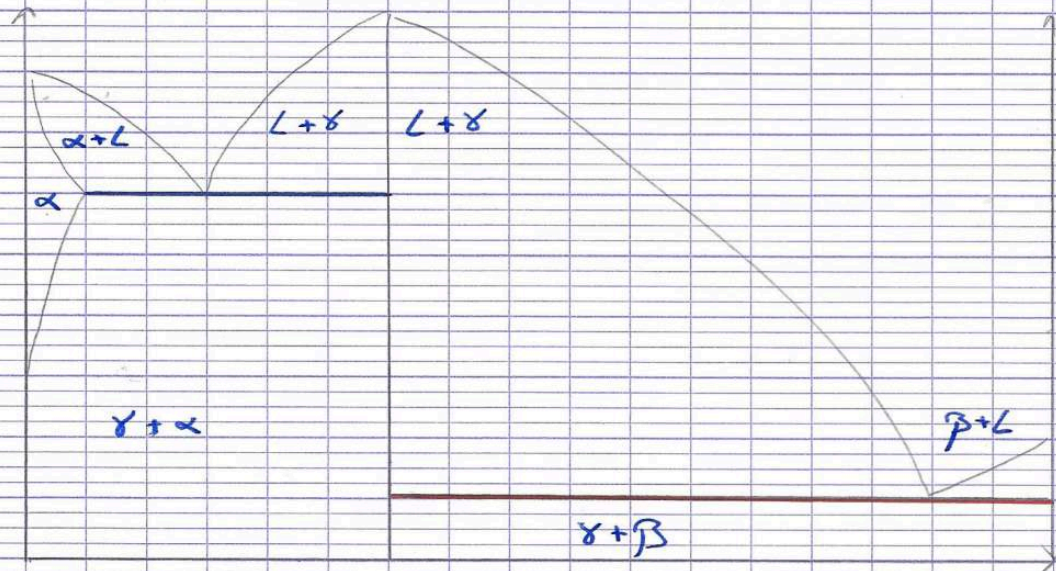
$T < 183^\circ C$ SS ($\alpha + \beta$)
 2 phases en équilibre

variance : nb de facteurs d'équation indépendants
 aux quels on peut donner une valeur
 arbitraire sans modifier l'état du système.



- d) Une $T > T_N$: une seule phase L
 $T_N \approx 183^\circ C$: apparition des premiers cristaux de α
 = germination
 $T = 183^\circ C$: équilibre $\alpha + \beta \rightleftharpoons L$
 $T < 183^\circ C$: disparition $\alpha \rightleftharpoons \beta$

Exercice 7



0 773 K
~~300~~ 200 K

a) $Mg_{0.88}Sm$

b) Voir graphe

c) plateau eutectique à 203°C
 " " " à 561°C

d) $P_{Sm} = \frac{71,22}{71,22 + 9,72} = 0,88$

($x_{Sn} = 60$)

$P_{Sm}(A) = 0,88$

$P_{Sm}(M) = 0,71$

$P_{Sm}(M') = 0,93$

$\% P_{\delta} = \frac{AM}{MM'} = \frac{0,88 - 0,71}{0,93 - 0,71}$

$\% \alpha_P = \frac{AM'}{MM'} = \frac{0,93 - 0,88}{0,93 - 0,71}$

71,22 g Sm

9,72 g Mg

$P_{Sm} = 0,88$

$P_{Mg} = 0,12$

1100 K $\rightarrow$ 1000 K

887 K $\Rightarrow$ 127°C

