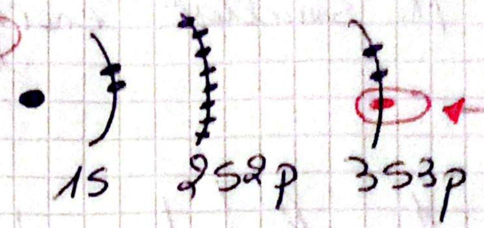
# The final Exam Correction

## Exercise 1 (2pts)

The effective nuclear charge $Z^*$ for 3p electron of Al:

$_{13}Al : 1s^2 2s^2 2p^6 / 3s^2 3p^1$ 0,5




$Z^*_{eff} = Z - \Sigma \sigma_i$ 1

$= 13 - (2 \times 0,35) - (8 \times 0,85) - (2 \times 1)$

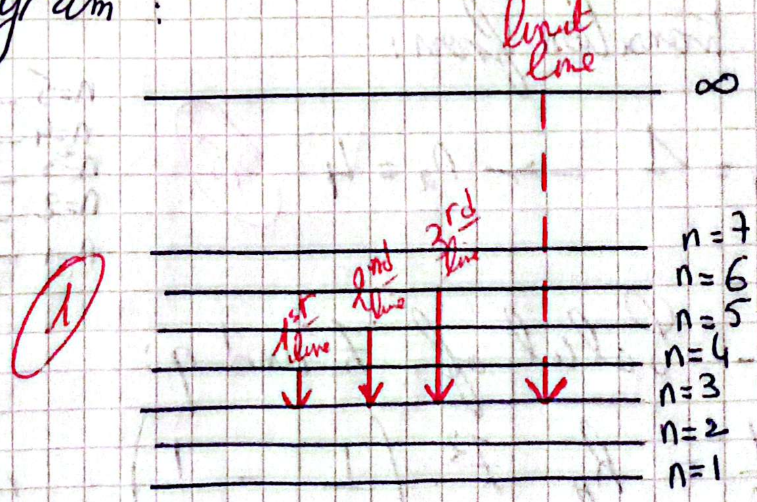
$= 3,5$ 0,5

## Exercise 2 (7,5pts)

Paschen Series $\Rightarrow n_1 = 3$

Paschen Series corresponds to the Infrared rang of the electromagnetic Spectrum 0,5

2 _ the energetic diagram :




1

3 - The longest wavelength in this Series :

The wave length and the energy are inversly proportional :

0,5 $\Delta E = \frac{hc}{\lambda}$ , So the longest $\lambda$ corresponds to the smallest energy $\Delta E_{min}$ , So , the transition

$$n_2 = 4 \longrightarrow n_1 = 3$$

$$\frac{1}{\lambda_1} = R_H \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \quad n_2 > n_1$$ 0,5

$$= 1{,}1 . 10^7 \left( \frac{1}{3^2} - \frac{1}{4^2} \right)$$ 0,5

$$= 5{,}33623 . 10^5 \ m^{-1}$$

$$\Rightarrow \lambda_1 = 1870{,}247 . 10^{-9} \ m$$

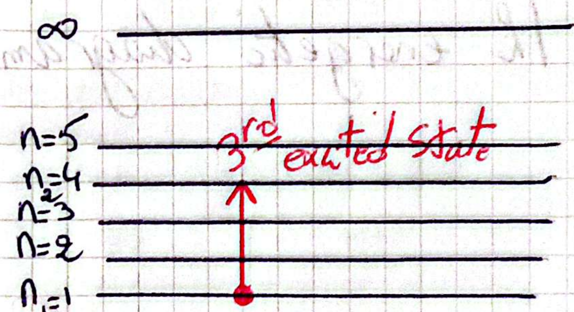
0,5

$$= 1870{,}247 \ nm$$

II _ 1 _ The Corresponding electronic Transition :

The transition from :

$n_1 = 1 \longrightarrow n_2 = 4$ 0,5




2 - Calcul of Z and q :

$$\frac{1}{\lambda} = R_H . Z^2 . \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \quad n_2 > n_1$$

$$= R_H . Z^2 \left( \frac{1}{1} - \frac{1}{16} \right)$$ 0,5

$$\frac{1}{\lambda} = R_H \cdot Z^2 \left(\frac{15}{16}\right)$$

So, $Z = \sqrt{\dfrac{16}{15 \cdot \lambda \cdot R_H}} = \sqrt{\dfrac{16}{15 \cdot 107{,}7 \cdot 10^{-10} \cdot 1{,}1 \cdot 10^{7}}}$

0,5

$Z = 3$. 0,5

hydrogen like-ion $\Rightarrow$ nbr. of its electron = 1

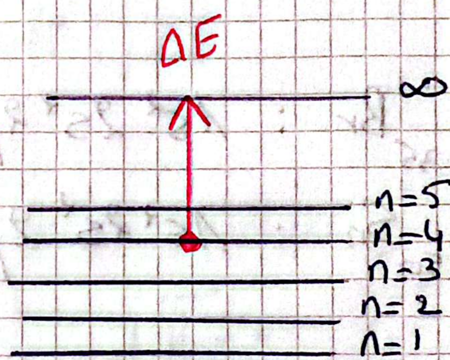
nbr. of electron = $Z - q$ 0,5

$q = Z - 1 = 2$ , So, ${}_{Z}X^{q+} \equiv {}_{3}X^{2+}$

0,5

3 - The ionization energy in (e.V):

from its third excited state:




$\Delta E = \cancel{E_\infty}^{\,0} - E_4$ 0,5

$\Delta E = - E_4$

$= -\left( -13{,}6 \cdot \dfrac{Z^2}{n^2} \right)$

$= 13{,}6 \cdot \dfrac{3^2}{4^2}$

$\Delta E = 7{,}65$ e.V 0,5

Exercise 3 (1,5 pts)

A - 1 - the three rules for filling orbitals :

- Klechkowski rule 0,25
- Hund rule 0,25
- Pauli Principle 0,25

2 - the electronic Configuration of elements :

$_{37}Rb$ : $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 / 5s^1$ 0,5

$_{42}Mo$ : $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 / 5s^2 4d^4$

$5s^1 4d^5$ 0,5

(more stable)

$_{35}Br$ : $1s^2 2s^2 2p^6 3s^2 3p^6 / 4s^2 3d^{10} 4p^5$ 0,5

$_{50}Sn$ : $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 / 5s^2 4d^{10}$ 0,5

$5p^2$

3 -

| Elements | Period | Group/SubG | Block | |
|---|---|---|---|---|
| $_{37}Rb$ | 5 | $I_A$ | s | 0,5 |
| $_{42}Mo$ | 5 | $VI_B$ | d | 0,5 |
| $_{35}Br$ | 4 | $VII_A$ | P | 0,5 |
| $_{50}Sn$ | 5 | $IV_A$ | P | 0,5 |

B - 1 - Ionization energy is the energy required to remove an electron from its state to infinity. 0,5

2 - The elements Rb, Mo and Sn have the same Period
($P=5$) ($n=5$)

in the same Period, when $Z \nearrow \Rightarrow IE \nearrow$ 0,5

$IE_{Rb} < EI_{Mo} < IE_{Sn}$ 0,5 So,

$IE_{Rb} = 403$ KJ/mol 0,25

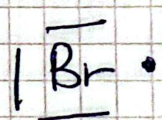
$IE_{Mo} = 684,3$ KJ/mol 0,25

$IE_{Sn} = 708,6$ KJ/mol 0,25

C - 1 - Lewis Structure for the elements:

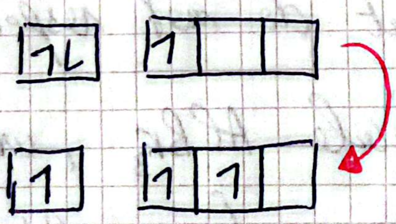
$AlBr_3$

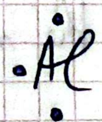
${}_{35}Br$ : $1s\,[Ar]\,3d^{10}\,4s^2\,4p^5$



0,25

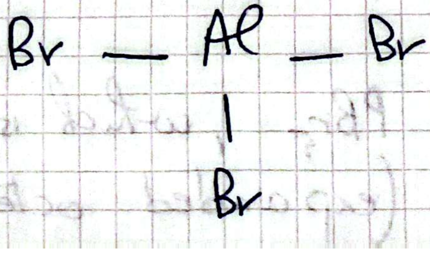
${}_{13}Al$ : $1s^2\,2s^2\,2p^6\,3s^2\,3p^1$





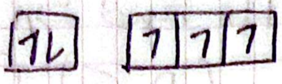
0,25

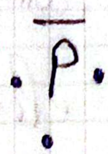
0,5

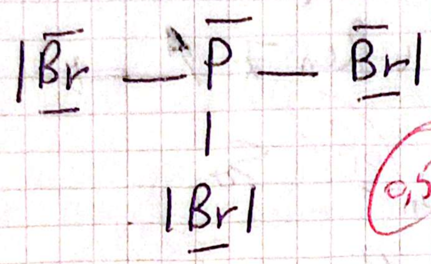


$PBr_3$

$_{15}P : 1s^2 2s^2 2p^6 3s^2 3p^3$



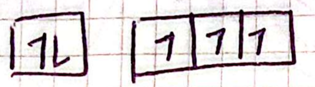
0,25 

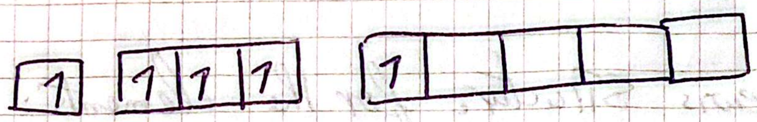


0,5

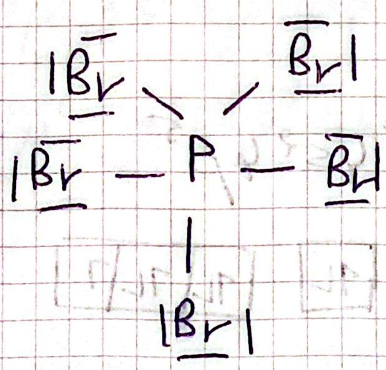
$PBr_5$

$_{15}P$ :





0,25



0,5

2- The elements that do not respect the octet rule are:

- Al in the molecule $AlBr_3$, which is surrounded by six electrons (incomplet octet) 0,5

- P in the molecule $PBr_5$, which is surrounded by ten electrons (expanded octet). 0,5