University of Oum El Bouaghi
Institute of Applied Technical Sciences
Département de Sciences Alimentaires
Fundamentals of chemistry module

First year
Date: 20/01/2025
Duration: 1h 30min

Exam

Exercise 01 (4.5 Ppts)

Calculate the wavelength in m, in nm and the frequency in Hz of the line corresponding to the transition between the levels n = 2 and n = 1:

a) In the case of the hydrogen atom (^1_1H),
b) In the case of the ion $^4_2He^+$.
We give $R_H = 1{,}097.107 m^{-1}$.

Exercise 02 ((5.5 Ppts)

1. Give, in table form, the electronic configuration, period and group of the following elements: $_{13}Al$, $_{49}In$, $_{9}F$, $_{8}O$, $_{14}Si$, $_{16}S$.
2. Classify these elements in ascending order of atomic radius.

Exercice 03 (11 Ppts)

1. What is the pH value of an aqueous solution containing 2, 28. $10^{-3} mol.l^{-1}$ of H_3O^+ ions?
2. What is the pH value of an aqueous solution containing 5, 32.$10^{-4} mol.l^{-1}$ of HO^- ions?
3. What is the concentration of H_3O^+ ions in a solution with a pH of 3.24?
4. Calculate the pH of an aqueous solution of acetic acid at concentration: 9, $6.10^{-3} mol.l^{-1}$.
   The pKa of the couple: pKa (CH_3COOH/CH_3COO^-) = 4, 8.
5. 5. The solubility product of silver nitrate (low solubility salt) in water at 25°C is equal to; Ks = 7, 23.10^{-4} mol^2/l^2. What is the solubility of this salt in water at this temperature? Express the result in mol/l.

Good Luck

Dr. MEGHLAOUI F/Z

Université d'Oum El Bouaghi — 1ière Année

Institut des Sciences Technique Appliquées — Date : 20/01/2025

Département de Sciences Alimentaires — Durée : 1h 30

Module Bases de chimie

Correction du contrôle

Exercice 01 :

- Pour l'atome d'hydrogène : $n_1=1$; $n_2=2$; $R_H = 1{,}097.10^7 m^{-1}$

En remplaçant dans l'équation suivante :

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

$$\frac{1}{\lambda} = 0.82275.10^7 \ m^{-1}$$

$donc : \lambda = 1{,}215.10^{-7}\ m = 1{,}215.10^{+2}\ nm$

- pour l'ion hydrogénoïde $^4_2He^+$

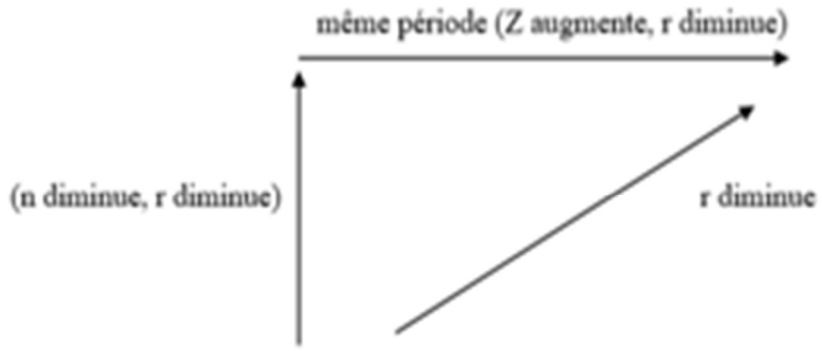
$$\frac{1}{\lambda} = R_H . Z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) ; n_2 > n_1 ; Z = 2$$

$$\frac{1}{\lambda} = 3{,}291.10^7 \ m^{-1}$$

$donc\ \lambda = 0{,}3039.10^{-7}\ m = 0{,}3039.10^{+2}\ nm$

Exercice 02:

Elément	Configuration électronique	Période	Groupe
$_{13}$**Al**	$1s^2 2s^2 2p^6 3s^2 3p^1$	3	IIIA
$_{49}$**In**	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^1$	5	IIIA
$_{9}$**F**	$1s^2 2s^2 2p^5$	2	VIIA
$_{8}$**O**	$1s^2 2s^2 2p^4$	2	VIA
$_{14}$**Si**	$1s^2 2s^2 2p^6 3s^2 3p^2$	3	IVA
$_{16}$**S**	$1s^2 2s^2 2p^6 3s^2 3p^4$	3	VIA



Même période: $r_{9}F < r_{8}O$; $r_{16}S < r_{14}Si < r_{13}Al$

Même groupe : $r_{8}O < r_{16}S$; $r_{13}Al < r_{49}In$

Classement croissant final : $r_{9}F < r_{8}O < r_{16}S < r_{14}Si < r_{13}Al < r_{49}In$

Exercice 03:

a) Solution d'ions H_3O^+ est une solution d'acide fort donc :

$$pH = -\log [H_3O^+] = -\log 2{,}28.10^{-3} = +2{,}64$$

b) Solution d'ions OH^- est une solution de base forte donc :

$$pH = 14 + \log [OH^-] = 14 + \log 5{,}32.10^{-4} = 10{,}72$$

c) Solution d'ions H_3O^+ est une solution d'acide fort donc

$$pH = -\log [H_3O^+] = -\log Ca = 34 \Longrightarrow Ca = 10^{-pH} = 10^{-3{,}24} = 5{,}7.10^{-5} \text{ mol/l}$$

d) La solution de CH_3COOH est une solution d'acide faible :

$$pH = 1/2\ pka - 1/2 \log Ca = 1/2 \times 4{,}8 - 1/2 \log 9{,}6.10^{-3} = 3{,}41$$

e)

$$AgNO_2(s) \rightleftarrows Ag^+ + NO^{2-}$$

$Ks = [Ag^+]\,[NO^{2-}] = S.S = S^2 = 7,23 .10\text{-}4 \text{ mol}^2/l^2.$

$\Longrightarrow S = \sqrt{Ks} = \sqrt{7,23 .10 - 4} = 2,69.\ 10\text{-}2 \text{ mol/l}.$ ($M_{AgNO2} = 153,88$ g/l)

$S = 2{,}69.10^{-2} \times 153{,}88 = 4{,}13$ g/l