الجمهورية الجزائرية الديمقراطية الشعبية
République Algérienne Démocratique et Populaire

Ministère de l'Enseignement Supérieur et de la Recherche Scientifique

وزارة التعليم العالي و البحث العلمي

Université de Boumerdes

جامعة بومرداس

Institut national de Génie Electrique et Electronique

Date: 8th of Jan. 2015

LO1 Final exam: Atomistic, EE 173 **Teacher: Mr. A Benlefki**

Exam time: 1hr 30 min

Ex1 (4marks)

One of the steps in the commercial process for converting ammonia to nitric acid is the conversion of NH_3 to NO:

$$4\ NH_3\ (g) + 5\ O_2\ (g) \rightarrow 4\ NO\ (g) + 6\ H_2O\ (g)$$

In a certain experiment, 1.50 g of NH_3 reacts with 2.75 g of O_2.

a. Which is the limiting reactant?
b. How many grams of NO and of H_2O form?
c. How many grams of the excess reactant remain after the limiting reactant is completely consumed?
d. Show that your calculations in parts (b) and (c) are consistent with the law of conservation of mass.

Ex2 (3marks)

a) Use t h e Rydberg formula for the hydrogen atom to calculate the wavelength for the transition from n = 5 to n = 1.
b) What is the name given to the spectroscopic series to which this transition belongs?
c) Determine the region of the spectrum in which the transition takes place. If the change takes place in the visible region of the spectrum, what color will be emitted?

Ex3 (5marks)

The elements $_{7}N$, $_{15}P$, $_{33}As$, $_{51}Sb$, and $_{83}Bi$ belong to the same group in the periodic table.

1. Write the electron configuration expected for the ground-state atoms of these elements and predict how many unpaired electrons, if any, each atom has.
2. Give the sets of quantum numbers of the last unpaired electrons for these elements.

Ex4 (8marks)

The ternary transition material oxides (TMO) are good candidates for electronics semiconductor materials. These elements constituting the TMO are ionized and analysed by mass spectroscopy, the following individual particular masses of transition metals are obtained: $m_1=1.972\times10^{-22}g$, $m_2=1.906\times10^{-22}g$ and $m_3=1.0858\times10^{-22}g$

1. Find the molar masses of these elements

Excitation of the last electron in the outermost shell of these atoms to next level of energy emits different electromagnetic radiation of wavelength corresponding to: $\lambda_1=233.00nm$ for $n_1=5$, $\lambda_2=297.52nm$ for $n_1=5$, $\lambda_3=213.52nm$ for $n_1=4$ respectively.

2. Determine the charge number (Z number) of these transition metals. The shielding constants are: $S_1=44.35$, $S_2=44.0$ and $S_3=25.65$ respectively
3. calculate the first ionization energy for these transition metals
4. Elementary analysis of 5.00g of the TMO leads to the following masses of elements $X_1=1.202g$, $X_2=2.325g$, $x_3=0.662g$. Find the molecular formula if the determined molecular weight Mw=493.71g/mol.

Good Luck

Data: $\mathcal{N}_a=6.023\times10^{23}$, $R_H=1,1\times10^{7}\ m^{-1}$, $c=3\times10^{8}m/s$, $^{1}_{1}H$, $^{16}_{8}O$, $^{14}_{7}N$,

Institut national de Génie Electrique et Electronique

Date: 12th of Oct. 2013

LO1 Make up exam: Atomistic, EE 173 **Teacher: Mr. A Benlefki**

Exam time: 1hr 30 min

Ex1 (7pts)

a) Calculate and compare the atomic radii for $^{32}_{16}S$ and $^{23}_{11}Na$.
Give the decreasing order of radii of the corresponding ions: S^{-1} and Na^{+1}.

b) What do you conclude for the ionised atoms?

Ex3 (5pts)

An element is characterized by a subshell $4d^1$.

a) Give the set of four quantum number of this electron in this element.
b) Is it in the transition state?
c) How many electrons does this element contain?
d) Class the element in the periodic table

Ex2 (8pts)

1. Write the quantum formula in a core shell structure for:
   $^{27}_{13}Al$, $^{31}_{15}P$ and $^{16}_{8}O$

These elements combine to form $AlPO_4$.

2. What types of chemical bondings are involved in this compound?
3. Hydrogen (H_2) combines with P and O to form H_2PO_4, What kind of bonds are added in this compound?
4. Predict the geometry of this molecule.
5. Phosphorous element is excited from the ground state to next excitation state. Give the type of light emitted from this transition.
6. Calculate the first and second ionisation energies of Phosporous.
7. What do you conclude from the two ionisations?

Good luck

$R_H=1.1x10^7m^{-1}$, $r_0=0.53Å$, $E_0=13.6ev$, $V_0=2.18x10^6m/s$, 1 ev= $1.6x10^{-19}J$

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Institut national de Génie Electrique et Electronique
Date: Nov.2016
Teacher: Mr. A Benlefki

LO1 test-Control exam: Atomistic, EE173
Exam time: 1hr 30 min

Ex1 (4 marks)

Classify each of the following as a pure substance, compound or a mixture; if a mixture, indicate whether it is homogeneous or heterogeneous:

1. paint
2. seawater
3. magnesium
4. gasoline
5. gold
6. milk
7. sugar
8. vinaigrette dressing with herbs

Ex2 (2marks)

Given the following formula, to characterise fluid flows in a pipe:

$$\mathcal{R}_e = \frac{\rho.V.D}{\mu}$$ where, ρ is the density, μ is the kinematic viscosity in $N.sec.m^{-2}$

V is the velocity and D is the diameter. What is the unit of measurement of $\mathcal{R}_e$?

Ex3 (4marks)

Determine the empirical and molecular formulas of each of the following substances:

1. monosodium glutamate (MSG), a flavor enhancer in certain foods that contains 35.51% C, 4.77% H, 37.85% O, 8.29% N, and 13.60% Na, and has a molar mass of 169 g/mol
2. 32.90% Na, 12.82% Al, and 54.30% F and a molar mass of 210 g/mol. propose its molecular structure.

Ex4 (10 marks)

The III-V compounds semi conductors are used in various device applications. A compound is analysed and characterized simultaneously by chemical analysis and mass spectroscopy.

1. the compound is introduced and ionized positively in the mass spectrometer , two masse-to- charge ratios are obtained: $r_1 = 7.233 \times 10^{-4}$ g/cb and $r_2 = 1.453 \times 10^{-4}$ g/cb
2. 10 g of this compound is treated (or reacted) with H_3PO_4 a solid precipitant and a gas, are formed.

a) Determine the atomic weight of the elements forming the compound.

b) If the ionised compound is passed through two parallel plate capacitor, having 2 cm gap opening and 10cm length, at a velocity of $V = 3 \times 10^4$ m/s and an applied voltage of 5000 volts.

What would be the deviations (y_1, y_2) of the two particles at the exit of the two plates?

c) How much volume of (0.5 N) H_3PO_4 is needed to complete reaction with the 10 g of semi conductor compound, knowing that its molar mass M_w =83.7 g/ mol and the oxidation number x= 1?

d) Give the % composition of the compound.

Data: $\mathcal{N}a=6,023 \times 10^{23}$, $e=1.6 \times 10^{-19}$Cb, ^{12}C, ^{1}H, ^{14}N, ^{16}O, ^{19}F, ^{23}Na, ^{27}Al, ^{31}P.

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Date: Jan.2017

LO1 Final exam: Atomistic, EE173 **Teacher: Mr. A Benlefki**
Exam time: 1hr 30 min

Ex1 (4marks)

Aluminum hydroxide $Al(OH)_3$ reacts with sulfuric acid H_2SO_4 to form aluminium sulfate $Al_2(SO_4)_3$:

1. How much $Al_2(SO_4)_3$ can be formed, when 0.500 M $Al(OH)_3$ 0.500 M H_2SO_4 are allowed to react?
2. How many moles of the excess reactant remain after the completion of the reaction?

Ex2 (4 marks)

When an electron beam strikes a block of copper, x-rays with a frequency of 1.2×10^{17} Hz are emitted. How much energy is emitted at this wavelength by:

1. an excited copper atom when it generates an x-ray photon;
2. 2.00 mol of excited copper atoms;
3. 2.00g of copper atoms?

Ex3 (4marks)

The following properties are observed for an unknown element. Identify the element from its properties.

a) The neutral atom has two unpaired electrons.
b) The last valence electrons in the ground state atom has $m_l = +1$.
c) The most common oxidation state is +4.
d) If an electron in a hydrogen atom in the ground state were excited to the same principal quantum level, n, as the valence electrons in an atom of this element, the photon emitted would have transition energy of 1.94×10^{-18} J.

Ex4 (8 marks)

Binary elements (III-V) semiconductor, when excited from the ground state to the next state, emits two electromagnetic radiations corresponding to λ_1=161.61 nm, λ_2=81.17 nm. The first ionization energies of the two elements are IE_1=21.25 ev and IE_2=34.816 ev.

1. Determine the total charge number Z of the two elements if the electron of interest in the first element has quantum numbers l= 1 , m_l=-1 and the second has quantum numbers l=1, m_l=+1
2. Deduce the set of quantum numbers for the unpaired electrons in both elements
3. Calculate the second ionization energies for the two elements

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Data: $\mathcal{N}a=6{,}023\times10^{23}$, $e=1.6\times10^{-19}$Cb, $^{1}_{1}H$, $^{14}_{7}N$, $^{16}_{8}O$, $^{19}_{9}F$, $^{32}_{16}S$, $^{23}_{11}Na$, $^{27}_{13}Al$, $^{31}_{15}P$, $^{63.5}_{29}Cu$ $^{69.72}_{31}Ga$, $^{52}_{24}Cr$, $^{58.7}_{27}Ni$, $R_H= 1.1\times10^{7}m^{-1}$, $h=6{,}62\times10^{-34}$ J.s, $|E_0|=13.6$ ev.

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Date: 25th of Jan. 2015

LO5 Exam: Atomistic, EE173

Teacher: Mr. A Benlefki

Exam time: 1hr 30 min

Ex1

Two isotopes of copper occur naturally, ^{63}Cu (atomic mass = 62.9296 amu; abundance 69.17%) and ^{65}Cu (atomic mass = 64.9278; abundance 30.83%).
Calculate the atomic weight (average atomic mass) of copper.

Ex2

Write the electron configurations (quantum formula) for Ca, Ti, Ge and Se.

Ex3

Write equations for the first and fourth ionization energies of titanium (Ti).
Calculate the first ionization energy in Kj/mol.

Ex4

Consider the lithium atom $^{7}_{3}Li$.

1. Extraction of two electrons from this atom leads to Li^{+2}.
   a) Give the name of this type of ion.
   b) Calculate the wavelength λ of the first excitation corresponding to the Balmer series of this ion.
2. Give the domain of the electromagnetic radiation emitted.
3. If the last electron is totally separated from Li^{+2}, calculate the energy needed for this extraction. What's the name of this energy?

Good Luck

Take $R_H=1.1x10^{7}m^{-1}$, $c=3x10^{8}m/s$, $h = 6.62x10^{-34}$ J.s, $E_o=13.6$ ev$=2.18x10^{-18}$Joules

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Date: 25th of Jan.2016

LO1test Exam: Atomistic, EE173 **Teacher: Mr. A Benlefki**

Final Exam time: 1hr 40 min

Ex1 (8marks)

Green chemistry methods, which use nontoxic chemicals, are replacing elemental chlorine for the bleaching of paper pulp. Chlorine causes problems because it is a strong oxidizing agent that reacts with organic compounds to form toxic byproducts such as furan and dioxins.

(a) Write the electron configuration of a chlorine atom in its ground state. How many unpaired electrons are present in the atom? Write the electron configuration you expect a chloride ion to have. The electron configuration of the chloride ion is identical to that of a neutral atom of what other element?

(b) When a chlorine atom is excited by heat or light, one of its valence electrons may be promoted to a higher energy level. Predict the most likely electron configuration for the lowest possible excited state for an excited chlorine atom.

(c) Estimate the wavelength (in nm) of the energy that needs to be absorbed for the electron to reach the excited state in part (b) and give its domain.

(d) What is the value of the energy required in part (c) in kilojoules per mole and electron-volts?

(e) The proportion of ^{37}Cl in a typical sample is 75.77%, with the remainder being ^{35}Cl. What would the molar mass of a sample of chlorine atoms be if the proportion of ^{37}Cl were reduced to half its current value? The mass of an atom o f ^{35}Cl is 5.807×10^{-23} g and that of an atom of ^{37}Cl is 6.139×10^{-23} g.

(f) What are the oxidation numbers of chlorine in the oxidizing agents $KClO_3$ and $NaClO_4$?

(g) How much $NaClO_4$ is needed to neutralize 10g of H_3PO_4?

Ex2 (4marks)

The following properties are observed for an unknown element. Identify the element from its properties.

(a) The neutral atom has two unpaired electrons.

(b) One of the unpaired valence electrons in the ground state atom has $m_l=+1$.

(c) The most common oxidation state is +2.

(d) If an electron in a hydrogen atom were excited to the same principal quantum level, n, as the valence electrons in an atom of this element, the energy of this electron would have a value of $1.96 \times 1\ 0^{-17}$ J.

Ex1 (8marks)

A binary elements semi-conductor, based on lead tellurium (PbTe) is characterized by mass spectroscopy (MS) and light emission spectra analysis.

1. What would be the deviation of the doubly ionized (+2) elements if the particles are subjected to an external voltage of V= $10x10^3$ volts and magnetic Field B=0.5 tesla. Consider the length of the trajectory between the two parallel plates L=15 cm and the gap opening d=5 cm
2. Draw the expected MS spectrum, assuming no isotopes are present for the two elements. (100% abundance)
3. Give the three first possible spectrum lines for a series of excitation of the last outer electrons in the ground state for the two elements.
4. The series belong to which domain?
5. give the sets of quantum numbers for the unpaired electrons for both elements
6. calculate the first ionization energy in electron volts (eV) for both elements
7. Assign the following electronegativity value(EN) for the two elements, 2,1 and 2,33 knowing that the electronegativity of polonium ($^{209}_{84}Po$) EN=2.0

Good luck

Data: use the periodic table and the colour light diagram, $R_H=1.1x10^7m^{-1}$, $e=1.6x10^{-19}Cb$, $E_0= 2,18x10^{-18}$ J=13.6eV, $h=6.62x10^{-34}$, $C=3x10^8m/s$, $\mathcal{N}a=6,023x10^{23}$.