Université M'Hamed Bouguerra Boumerdes
Electric and electronic engineering Institute

25th of Oct, 2018

Atomistics-Recitation N°1

Ex1

Convert the following units of measurements of the indicated terms to or from metric system or English units:

Term or property	Metric system	English system
1. viscosity (η)	100 Pa.sec	
2. density (ρ)	900 kg/m^3	
3. electrical field (E)	4.10^4 V/m	
4. Gas constant $\mathcal{R}$		
5. Entropy		0.144 BTU/lb°R
6. Pressure		182 lbf/in^2
7. molar enthalpy	298,5 kJ/mol	? Kcal/mol,? BTU/mol
8. Molar heat capacity Cp	? Kj/mol °C,	6.06 BTU /mo °k

Ex2

1) Aluminum has a density of 2.70g/cm^3 calculate the volume of a piece weighing 35gr. In (ft^3).
2) If a combustion reaction of butane (C_4H_{10}) generates 20 cal/100gr. Calculate the energy in BTU/mol.
3) Convert the heat capacity of water at 1 atm and 25°C to BRU/lb.°K; if the value is 1.0cal/gr.°C.
4) The viscosity of a liquid at 30°C is 100mPa-sec, (mN/mm^2)-sec; convert the value to lb$_f$ /ft2.sec.
5- A melt polymer is sheared at $\gamma = 0.001\ sec^{-1}$, its melt viscosity (η) is about 2.5x105 poises. Calculate the shear stress (τ) in Mega Pascal (MPa) and in PSI (lbf/in^2). Take $\tau = \eta x\ \gamma$ 1centi-poise = 3.64Kg/m.hr

Ex3

Calculate the energy in joules, calories and BTU for 1 kg of viscous polymer with heat capacity Cp = 0.4cal/gr.°C if the temperature passes form 25 °C to 220°C.
Apply the formula $Q = mCp\ \Delta T$.

Ex4

Hydrogen and oxygen combine to give water but, under different experimental Conditions, to give hydrogen peroxide. In water, 1.0g of hydrogen is combined with 7.93g of oxygen, while hydrogen peroxide, 1.0g of hydrogen is combined with 15.9g of oxygen. Show that these data are consistent with the law of multiple proportions.

Ex5

Two different compounds of nitrogen and hydrogen have been found to have the following mass compositions: one compound contains 41.62g of nitrogen combined with 1.00g of hydrogen; the second compound contains 4.64g of nitrogen combined with 1.00g of hydrogen. Show from these data that the two compounds are in agreement with the law of multiple proportions.

Ex6

One of the ores of copper is malachite, a bright green mineral which has the simplest formula $Cu_2CO_5H_2$.

a) What is the percentage composition of the malachite
b) How much copper can be obtained from 340g of malachite.

5th of Nov, 2018

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Atomistics-Recitation N°2

Ex1

Classify the following as colloids (emulsions), suspensions, aerosols or solutions, and indicate which one is homogenous or heterogenous?

Mud
Paint
Catch up
Honey
Blood
Liquid concrete
Plastic foam
Crude petroleum
Flour and water
Hcl in water at 40%
Magma of volcanoes

Ex2

Given the following formula $(NH_4)_2CO_3$, $Cu(NO_3)_2$, PbC_2O_4

Determine the percentage composition of each compound

Ex3

A compound is found to consist of 34.8 % sodium, 16.7 % boron, and 48.5 % oxygen. Determine its simplest formula.

Calculate the number of atoms of sodium in 10 grams of this compound

Ex4

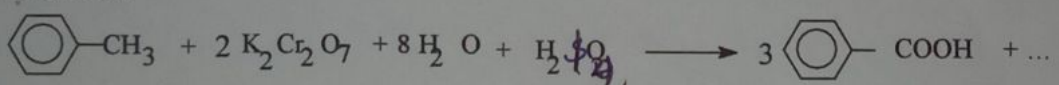
2. Calculate the mass of $K_2Cr_2O_7$ that should be dissolved to obtain $2NK_2Cr_2O_7$ aqueous solution, based on the following Redox reaction:

$Cr_2O_7^{-2}$ ⟶ Cr+3 or CrVI ⟶ CrIII ⟷ $n=6$

2. If 50ml of 2N $K_2Cr_2O_7$ are treated with 0.5N H_2SO_4 acid solution, calculate the mass of The acid H_2SO_4 reacted

3. Toluene  -CH_3 is reacted with a mixture of 50 ml potassium chromate, sulphuric

Acid and hydrogen peroxide, calculate the mass of benzoic acid formed based on the following oxidation reaction:



Ex

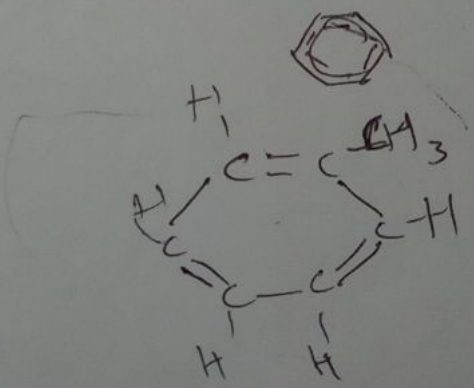
Combustion of 10 grams of a compound containing Ca, Fe, C and N, leads to 1,918 grams of solid iron (Fe), 2.740 grams of solid calcium (Ca), 9.040 grams of CO_2 and 9.450 grams of NO_2.

- Determine the empirical formula of the compound.
- How many atoms for each chemical element forming the compound

$N = \frac{m(solute)}{GEW}$ $N = \frac{n_{eq}}{V_T}$

$GEW = M$ $n_{eq} = \frac{m(solute)}{GEW}$

$GEW = \frac{n}{M_W}$



15th of Nov, 2018

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Atomistics-Recitation N°3

Ex1

The analysis of a pure mineral leads the following percentage composition: 14,27 of k, 38,89 Cl and 8.41 of Mg; the rest corresponds to water. The molecular weight of the mineral is 277.9gmol^{-1}. Determine the molecular formula.

Ex2

- Describe how to prepare the following aqueous solutions of K_2SO_4:

a) 500 cm^3 of solution with **molarity** M = 0.02 mol dm^{-3}.
b) Solution with **molality** M_l = 0.01 mol kg^{-1} containing 250 g of water.

- Consider preparing the solution (liquid mixture) composed of two liquids, acetone (1) and methanol (2); $M1$ = 58.8 g mol^{-1}, $M2$ = 32.04 g mol^{-1}.

a) If we mix together 5 g of each of the liquids, what are the **molar fractions** (x_1, x_2) of these components in the prepared mixture?
b) What is x_2 in the mixture with x_1 = 0.4? How do you prepare 0.5 mol, (total amount) of this mixture?

Concentrated hydrochloric acid is aqueous solution of about 36% HCl (w/w) and the density of this solution is 1180 kg m^{-3}. The relative molecular weights are: HCl 36.46 and H_2O 18.02. Calculate:

1) molality M_l (mol kg-1) and b) molarity M (mol dm-3) of HCl; c) molar fractions X of HCl and H_2O in the concentrated solution.
2) Using the concentrated solution, how do you prepare 1 dm^3 (1 l) of the aqueous solutions of HCl with the following molarities: 0.5, 0.1, 0.05.

Ex3

In a parabolic distribution mass spectrometer; the electrical field (E) deviates the particles from the y axe and the magnetic field B deviates them from the x axe.

1) calculate the charge to mass ratio if the x=1cm and y= 2cm and the total trajectory L=10cm
2) Calculate the mass and the mass number of the particle.

Take: E =3.21x 105V/m ; B = 0.2tesla

Ex4

In milikan experiment, an oil droplet is observed to fall drown in air from a height of 4mm in 12.4 seconds. Based on following data: ρ_{oil}=0.9g/l, ρo=1.29g/l, η=1.82.10^{-5}MKSA, g=9.81m/s^2.

1) Calculate the radius and the mass of the oil droplet and estimate the error made if the Archimede force is neglected.
2) Neglecting the air force onto the oil droplet, 9000volts is applied on 2 cm gap distance of two plate's capacitor. The droplet moves up by 4mm in 14.0 seconds. Calculate the electrical charge q of the droplet.
3) This droplet is immobilized by applying a voltage of 3950 v.
   - Deduce the new charge q' of the droplet.
   - Which elementary charge the two charges q, q' correspond

Ex5

A compound used as a superconductor material is constituted from unknown X1, X2 chemical elements and oxygen O.

1. Mass spectroscopy is performed on the unknown elements X1 and X2, the obtained charges to masses ratios are: **[q/m]** $_{X1}$**= 7.02x10^{5}cb/kg** and **[q/m]** $_{X2}$ **= 4.63x10^5 cb/kg.**
2. The percentage compositions are: $\%x_1$= 34.82% $\%x_2$= 53% and % O= 12.17%. Determine the empirical and molecular formula of the product if the molecular weight M_w is 393.3 g/mol.

8th of Dec, 2018

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Atomistics-Recitation N°4

Ex1

$_3Li^{+2}$ ion is a Hydrogenoid atom, find the ionization energy corresponding to the first excited state in kilojoules per mole (KJ/mol)

Give the mathematical expression for the series of excitation of the remaining electron in this hydrogenoïd atom $\lambda = f(n)$.

Ex2

a) A magnesium surface has an energy function of 3.68 eV. Electromagnetic waves with a wavelength of 215 nm strike the surface and eject electrons. Find the maximum kinetic energy of the ejected electrons. Express your answer in electron volts.

b) Find the mathematical series of excitation of the last electron in the valence shell for magnesium atom

Ex3

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.

Ex4

a) The energy required to break a C-C bond in a molecule is 348 kj - mol^{-1}. Will visible light be able to break this bond? If yes, what is the colour of that light? If not, what type of electromagnetic radiation will be suitable?

b) The argon ion has strong emission at 485 nm and 512 nm.

1. What is the colour of these emissions?
2. Give the transition states assuming that these emissions correspond to the last ground state electron.
3. What is the energy associated with these emissions in Kj/mol
4. Are these energies sufficient to break down the C-C bond?

Ex5

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 $V = 10 \times 10^3$ 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