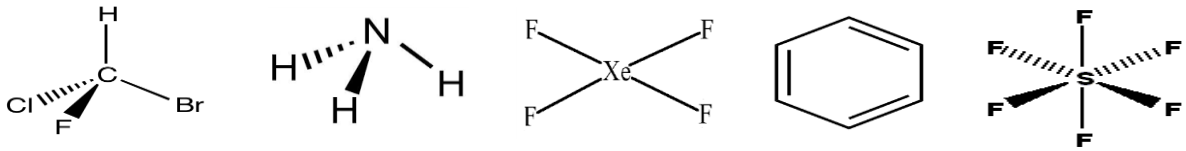
Benha university	**3rd year students**	**Date : 15.05.2019**
Faculty of science	**Inorganic chemistry (3)**	**Time: 3 hours**
Chemistry department		**Code: Ch326**

Answer the Questions: (80 Marks)

Qu.1: (20 Marks)

A. (10 Marks) List the symmetry elements for the following molecules:



B. (10 Marks) Compare between optical and electron microscopes (Source, Lens, Sample, Magnification, Resolution).

Qu.2: (20 Marks)

A. (10 Marks) Mention the methods which used in the fabrication of inorganic compounds and explain **ONLY ONE** method with example.

B. (10 Marks) Mention the applications of optical and electron microscopes with explain two applications.

Qu.3: (20 Marks)

A. (10 Marks) What mean of applied inorganic chemistry? Write short note about its branches?

B. (10 Marks) What are the metal oxides? Write short note about usages?

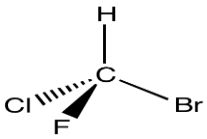
Qu.4: (20 Marks)

A. (10 Marks) Discuss the properties of both: Metal toxicity and Zeolites?

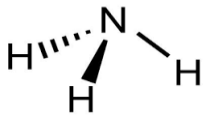
B. (10 Marks) Write on; Biological usages of some minerals in our cyclic life; Cobalt; Copper; Potassium Iron; Iodine; Zinc; Manganese.

With Best Wishes,

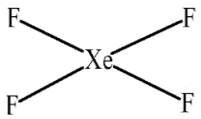
Prof. El-Mossalamy and Dr. Ayman Abdel Razik



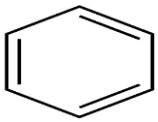
E



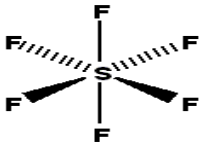
E, C^1_3, $3\sigma v\ 3c_2$



E, C^2_4, C^1_4, $4C_2$, σ_h, $2\sigma v$, $2\sigma d$



E $2C_6$ $2C_3$ C_2 $3C_2'$ $3C_2''$ *i* $2S_3$ $2S_6$ $\sigma_h 3\sigma_d$ $3\sigma_v$



E, C^2_4, C^1_4, $4C_2$, σ_h, $2\sigma v$, $2\sigma d$

A. Compare between optical and electron microscopes (Source, Lens, Sample, Magnification, Resolution).

	optical microscopy	electron microscopy
Source	light	electrons
Lens	glass	Electron magnetic wave
Sample	Depend on the type	Depend on the type
Magnification	1500-60000X	Millon X
Resolution	0.3-0.7 µm	0.0001 µm
price	Not expensive	expensive
energy	$E=hc/\lambda$	$E=h/(2mev)^{1/2}$

Mention the methods which used in the fabrication of inorganic compounds and explain **ONLY ONE** method with example.

1. Solid state method
2. Sol gel
3. Combustion method
4. Hydrothermal method
5. Citrate method
6. Microwave method
7. Ultrasonication
8. Freezing method

Hydrothermal synthesis is a process that utilizes single or heterogeneous phase reactions in aqueous media at elevated temperature and pressure to crystallize anhydrous ceramic materials directly from solutions. Hydrothermal techniques are widely used in industrial processes for the dissolution for bauxite and for the preparation of aluminosilicate zeolites. This synthesis offers a low-temperature, direct route to oxide powders with a narrow size distribution avoiding the calcination step. Additional merits of this technology are attributed to the low costs for instrumentation, energy and precursors. Recently this method has been exploited for the synthesis of nanocrystalline oxide powders, such as zinc aluminate. Basically, the mechanism of hydrothermal reactions follows a liquid nucleation model. Detailed principles are comprised of theories of chemical equilibrium, chemical kinetics and thermodynamic properties of aqueous systems under hydrothermal conditions. However, in supercritical region of water, little data are available at present, except those for pure water and simple salt-water solutions. Thus, a complete mechanism still has not been well founded and present studies contain a lot of inconsistencies. Furthermore, in various cases, hydrothermal mechanisms are different from one another. For example, in $CoAl_2O_4$ and $ZnAl_2O_4$ preparation, Z. Chen *et al.* proposed that the final product precipitated from precursors, Layered Double Hydroxides (LDHs), with the formula $\mathbf{[M^{2+}_{1-x}M^{3+}_{x}(OH)_2]\cdot[A^{m-}]_{x/m}.}n\mathbf{H_2O}$. A series of chemical reactions are expressed as following:

$$CO_2+2OH^- \rightarrow CO_3^{2-}+H_2O$$

$$Co^{2+}+2Al^{3+}+(8-3y)OH^-+(3y/2)CO_3^{2-}+nH_2O \rightarrow [CoAl_2(OH)_2][CO_3^{2-}]_{3y/2}\cdot nH_2O+(2-y)Al(OH)_3$$

$$\beta\text{-}Al(OH)_3 \rightarrow \gamma\text{-}AlO(OH)+H_2O$$

$$[CoAl_2(OH)_2][CO_3^{2-}]_{3y/2}\cdot nH_2O+(2-y)\gamma\text{-}AlO(OH)+3yOH^- \rightarrow CoAl_2O_4+(3y/2)CO_3^{2-}+(2+n+y)H_2O$$

mechanism involves either reactions of barium at the surface of the titania particles to form an inwardly growing shell of barium titanate, or the diffusion of barium ions within the amorphous titania, followed by dehydration, rearrangement of the titania network and finally the nucleation of barium titanate. The dissolution-precipitation

mechanism has been suggested by Ovramenko et al. and recently by Eckert. In fact, these last authors observe that the mechanism evolves from a dissolution-precipitation process at the beginning of the reaction to an in-situ mechanism for longer reaction times. Applied to ceramic powders, the process involves heating metal salts, oxides or hydroxides as a solution or suspension in a liquid at controlled temperature and pressure for about 20 hr. Typically the temperature in a hydrothermal process falls between the boiling point of water and the critical temperature (Tc = 374°C), while the pressure is over 100 kPa. The product is washed by de-ionized water to get rid of ions in the solvent and other impurities. After drying in air, fairly well-dispersible ceramic nanoparticles are obtained. For instance, to prepare $ZnAl_2O_4$, we could start with $ZnCl_2$ and $AlCl_3$, in NaOH solution while $Ba(OH)_2$ and α-FeOOH are used to prepare $BaFe_{12}O_{19}$.

$MgAl_2O_4$ is used as white ceramic pigment and can be prepared by sol gel method as the following:

$Mg(NO_3)_2 + Al(NO_3)_3 \xrightarrow{NaOH}$ sol $\xrightarrow{60^oC}$ Gel $\xrightarrow{120^oC}$ dry materials.

The synthesis of magnesium aluminate from aluminum oxide and magnesium oxide at 1400^oC for 12 hour.

$$Al_2O_3 + MgO \longrightarrow MgAl_2O_4$$

$Mg(NO_3)_2 + Al(NO_3)_3 \xrightarrow{Fuel} MgAl_2O_4$ combustion method

Mention the applications of optical and electron microscopes with explain two applications.

1. Study and determine the particle size and shape
2. Study the texture and surface details of materials
3. The study of crystal defects in the crystal of different materials
4. Chemical analysis
5. Structure determination
6. The study of precipitation and phase transitions in materials