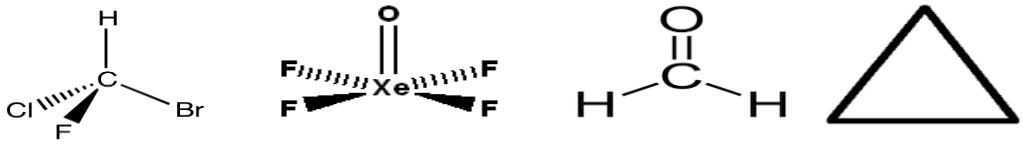
Benha university	**3rd year students**	**Date : 12.06.2019**
Faculty of science	**Inorganic chemistry and its applications**	**Time: 2 hours**
Chemistry department	**(Special chemistry)**	**Code: Ch320**

Answer the Questions: (48 Marks)

Qu.1: (12 Marks)

A. (4 Marks) List the symmetry elements for the following molecules:



B. (4 Marks) Calculate the wavelength (nm) in optical microscopy with energy equal to 20×10^{-16} J. ($h=6.63\times10^{-34}$ J.s, $C= 3\times10^{8}$ m/s)

C. (4 Marks) Discuss the basic components of transmission electron microscopy and explain your answer with schematic diagram.

Qu.2: (12 Marks)

A. (6 Marks) Write short notes on **TWO** only with example from the following:

1. Ceramic method
2. Hydrothermal method
3. Co-precipitation method

B. (3x2 Marks) Explain how can fabricate the following inorganic compounds with give only one application in our life for each one:

1. $YBa_2Cu_3O_7$
2. $MgAl_2O_4$
3. Lithium silicate

Qu.3: (12 Marks)

A. (6 Marks) Draw schematic diagram for elements according to their action in the biological system

B. (6 Marks) Write short note about the Metal ions their excess and deficiency. Comment three elements only?

Qu.4: (12 Marks) Answer only two from the following:

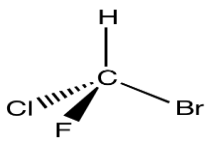
A. (6 Marks) Mechanism of the toxicity of metals is very complicated. What are the generally toxicity of metals causes?

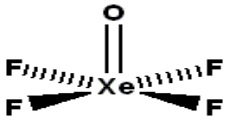
B. (6 Marks) Treatment of Metal poisoning detoxification by chelating agents: Write three examples of biological complexing agents?

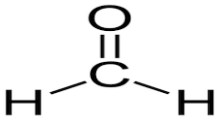
C. (6 Marks) Explain one method for preparation of Iron and draw schematic diagram for blast fernous

***With Best Wishes,* Prof. El-Mossalamy and Dr. Ayman Abdel Razik**

D. (4 Marks) List the symmetry elements for the following molecules:







E

E, C^3_4, C^2_4, C^1_4, 2σv , 2σd

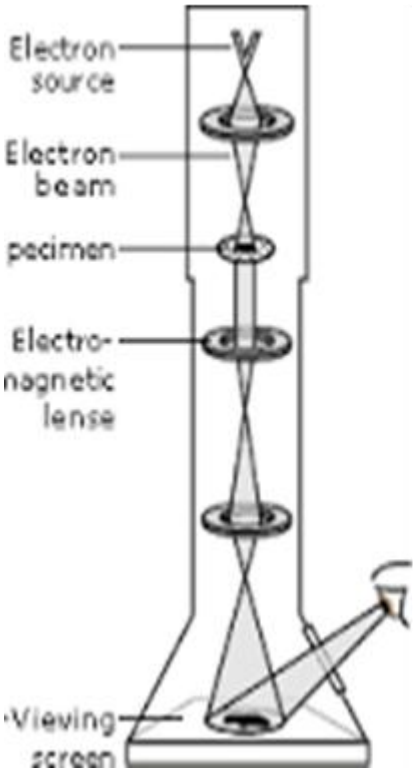
E, C^2_2, C^1_2, σ_h, σv

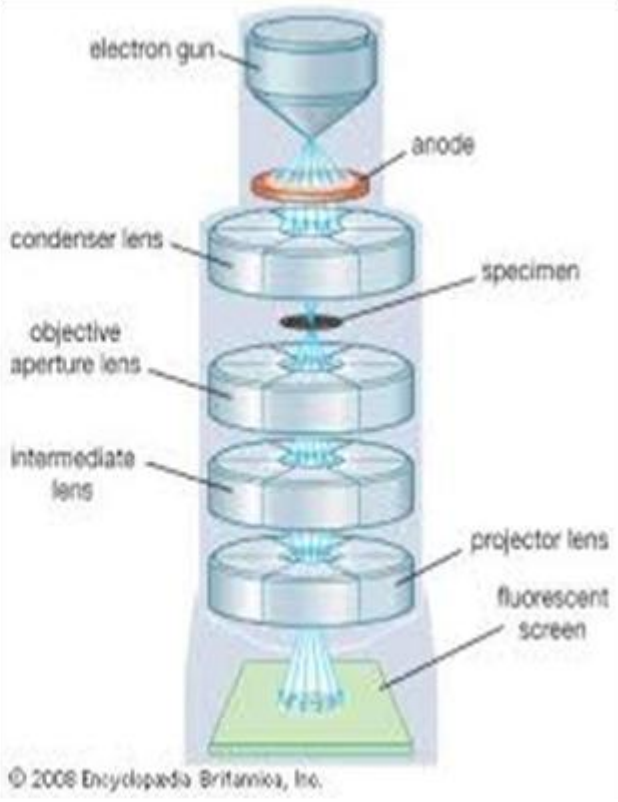
E, C^2_3, C^1_3, $3C_2$, σ_h, 3σv

E. 4 Marks) Calculate the wavelength (nm) in optical microscopy with energy equal to 20 x 10^{-16} J. (h=6.63x10^{-34} J.s, C= 3x10^8 m/s)

$E=hc/\lambda=$ nm

F. Discuss the basic components of transmission electron microscopy and explain your answer with schematic diagram.





C. (6 Marks) Write short notes on **TWO** only with example from the following:

4. Ceramic method
5. Hydrothermal method
6. Co-precipitation method

1. Ceramic method

It is one of the oldest, simplest methods which used in the preparation of inorganic materials. It depends on the reaction between the reactants in solid state for long time under high certain temperature and for example as the following:

The synthesis of magnesium aluminate from aluminum oxide and magnesium oxide at 1400^{o}C for 12 hour.

$$Al_2O_3 + MgO \longrightarrow MgAl_2O_4$$

The factor affects the method:

1. Particle size
2. Grinding time
3. Nature of reactants
4. Temperature
5. Time

Advantage of the method:

Simple method, Easy method, Low contamination, low pollution

Disadvantage of the method:

It needs to high temperature, long time, high particle size and two phase production.

The sol-gel process may be the most widely used and developed one among various synthetic powder preparation methods. The sol-gel method offers specific advantages in preparations of multi-component oxide ceramics. The early formation of a gel provides a high degree of homogeneity and reduces the need of atomic diffusion during the solid-state calcinations. Moreover, the processing often starts with metal alkoxides, many of which are liquids or volatile solids that can easily be purified, providing extremely pure oxide precursors. This factor is important for electroceramics synthesis. However, the relative high costs of the metal alkoxides may be prohibitive for certain applications, and the release of large amounts of alcohol during the calcination step requires special safety considerations. In sol-gel preparation, a solution of the appropriate precursors (metal salts or metal organic compounds) is formed first, followed by conversion into homogeneous oxide

networks (gel) after hydrolysis and condensation. Drying and subsequent calcination of the gel yields an oxide product. Usually, for preparation of multi-component oxides, alkoxides are mixed together in alcohol. Components for which no alkoxides are available are introduced as salts, such as acetates. Hydrolysis is carried out under controlled temperature, PH and concentration of alkoxides, added water and alcohol. Hydrolysis and condensation to polymeric species are represented by the following reaction equations (use alkoxides as an example): Metal oxygen metal (M -0- M) bonds are formed in solution by self-condensation or by cross-condensation when different alkoxides are used. After calcination, the organic group, R, is removed, leaving metal oxides. If the sol-gel process is carried out with a mixture of alkoxides with different hydrolysis and condensation rates, the molecular homogeneity in the initial stage can thus be lost during hydrolysis. The hydrolysis rate, which can be adjusted by the selection of OR ligands and reaction conditions, affects particle formation, growth and aggregation. Subsequent drying steps also influence the purity and morphology of the final product.

This is essentially a normal precipitation method but taking place in the confinement of small aqueous solution bubbles dispersed in an oil medium. This method provides the particular advantage of avoiding agglomeration of the particles formed in the individual bubbles. This, in tum, makes possible subsequent processing routes at unusually low temperatures. To take full advantage of the method for multi-component oxides, precipitation routes need to be designed so that an intimate mixture of atoms is formed during precipitation and chemical homogeneity is maintained during subsequent processing. This offers special challenges since emulsion co-precipitations tend to be carried out with sample precursors that do not affect emulsion stability but generally show a tendency to precipitate at different rates, leading to at least partial phase segregation. A solution to this problem is presented in, for modified emulsion precipitation of $BaTiO_3$. This method involves the preparation of thermally stable emulsion systems prepared by adding appropriate amounts of surfactants to a water oil system *(w/o).* Within the emulsion system, there are a small number of atoms per droplet. It is necessary that exchange of reactive

species takes place between droplets in order to form a stable precipitate (nucleus). From the Einstein-Smoluchowski equation, the normal rate of the particle growth is faster than the equivalent rate of exchange between droplets. Therefore, the nucleation and growth in emulsions are retarded in comparison to those in homogeneous solution, avoiding the formation of large particles. Multi-surfactants are effective in forming a thermally stable emulsion and controlling droplet size. Other additives plays role as steric particle stabilizer after removal of water. Before the particle dispersion can be used, excess organic additives such as surfactants must be removed from the dispersion by filtration or decantation of the organic phase.

(3x2 Marks) Explain how can fabricate the following inorganic compounds with give only one application in our life for each one:

1) $YBa_2Cu_3O_7$
2) $MgAl_2O_4$
3) Lithium silicate

$YBa_2Cu_3O_7$ prepared using ceramic method from oxides at 930 ^oC and cooling gradually to 350^oC in the presence of O_2. It si used as superconductor materials

$$Y_2O_3 + 4\,BaO + 6\,CuO + \tfrac{1}{2}\,O_2 \longrightarrow YBa_2Cu_3O_7$$

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

$$Mg(NO_3)_2 + Al(NO_3)_3 \xrightarrow{NaOH} \text{sol} \xrightarrow{60^oC} \text{Gel} \xrightarrow{120^oC} \text{dry materials } MgAl_2O_4$$

1. Li_4SiO_4 prepared using ceramic method from oxides at 800-900^oC and using as conductor material

$$Li_2CO_3 + SiO_2 \xrightarrow{800^oC/24\ h} Li_4SiO_4 + 2CO_2$$