9. The following data were obtained by liquid-chromatography on a 30 cm packed column and 0.293 mL/min flow rate. (5 points)

	t_R, min	W, min
Nonretained	2.9	—
A	6.4	0.46
B	14.3	1.17

Calculate and comment on the results when necessary.
a) The average number of plates from the data.
b) The plate height for the column.
c) The capacity factor for A and B.
d) The resolution, R_s.
e) The selectivity factor, α.

7. The following cyclic voltammogram was recorded for a reversible couple:
   Calculate the number of electrons transferred and the formal potential for the couple? (2 points)

$E_{Pa} = 155$ mV

$E_{Pc} = 99$ mV

I / µA

E / V vs. Ag/AgCl

140   70   0   -70   -140

-0.2   0.0   0.2   0.4
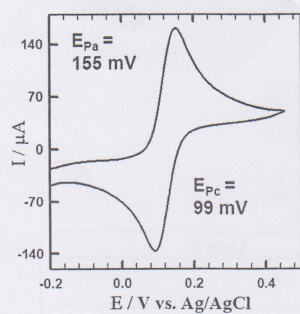
8. The concentration of copper in a sample of sea water is determined by anodic stripping voltammetry using the method of standard additions. The analysis of a 50.0-mL sample gives a peak current of 0.886 µA. After adding a 5-mL spike of 10.0 ppm Cu^{2+}, the peak current increases to 2.215 µA. Calculate the ppm copper in the sample of sea water.   (2 points)

4. Analysis of a compound by liquid chromatography shows below the presence of four components, A, B, C and D. **(2 points)**
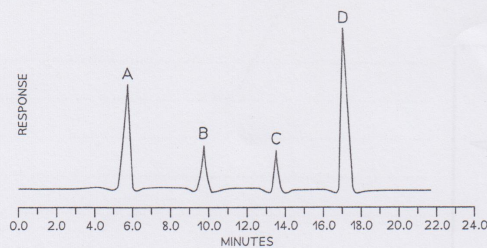
Question	Answer
a) Which compound is present in the greatest quantity?	....
b) Which compounds were present in equal amounts?	....
c) Which compound had the strongest interaction with the stationary phase?	....
d) Which compound had the weakest interaction with the stationary phase?	....

5. Explain why it is necessary for all polarographic measurements to be conducted in oxygen-free solutions. **(1½ points)**

....
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....

6. Draw the schematic cross-section of a hollow cathode lamp, the most common source for atomic absorption measurements, and label each component. **(2 points)**
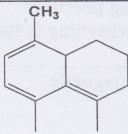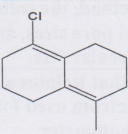
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[1]			[9]	
[2]			[10]	
[3]			[11]	
[4]			[12]	
[5]			[13]	
[6]			[14]	
[7]			[15]	
[8]				

Part III: Problems and Questions   (20 points)

1. Using woodward-Fieser rule, calculate the wavelength of absorption maximum (λ_{max}) of the following compounds: (2 points)

Compound (I)	Compound (II)
CH_3 $\lambda_{max} =$	Cl $\lambda_{max} =$ ....

2. Describe the disadvantages of the Graphite Furnace Technique.   (1½ points)

   • ....
   • ....
   • ....
   • ....
   • ....

3. What is the role and significance of using a supporting electrolyte in voltammetry? (2 points)

   • ....
   • ....
   • ....
   • ....
   • ....
   • ....

Part II: Enter in the appropriate box the expressions you would select to define each of the phenomena Labeled 1-15 inclusive. (15 points)

Expression	Phenomena
Partition chromatography	[1] This method is based on the interaction between the solute (Analyte) molecules and active sites on the stationary phase. This attachment or interaction depends on the polarity of solutes.
Size-exclusion chromatography	[2] It is the time takes after sample injection for the analyte to reach the detector.
Residual current	[3] It is the time for an unretained species to reach the detector.
Ion-Exchange chromatography	[4] In that the absorbance (A) is directly proportional to the concentration of the absorbing species (c) and the path length (b) of the absorbing medium.
Retention time (t_R)	[5] In this method the separation is based mainly on differences between the solubility of the sample components in the stationary phase or on differences between the solubility of the components in the mobile and stationary phases.
Zeeman effect	[6] In this method, the stationary phase has an ionically charged surface of opposite charge to the sample ions. This technique is used almost exclusively with ionic or ionizable samples.
Adsorption chromatography	[7] In this method, the column is filled with material having precisely controlled pore sizes, and the particles are separated according to its their molecular size.
Auxiliary (counter) electrode	[8] A device that isolates a restricted region of the electromagnetic (EM) spectrum used for measurement in the UV-Vis spectrophotometer.
Voltammetry	[9] A method is used for the determination of analytes in a complex matrix where interferences for the analyte will occur i.e. blood, sediment, human serum, etc.
Migration	[10] It is used for background correction in AAS by place flame polarized light through sample in magnetic field get absorbance (atom+molecule) or absorbance (molecule) depending on how light is polarized.
Standard addition method	[11] An electrochemical method in which information about an analyte is obtained by measuring current (I) as a function of applied potential (V).
Dead time (t_M)	[12] The number of waves per cm in units of cm^{-1} and equal to $1/\lambda$.
Wavelength selector	[13] Pt wire that completes circuit in voltammetry, conducts e^- from signal source through solution to the working electrode.
Wavenumber ($\bar{v}$)	[14] The current resulting from the reduction of trace impurities present in the blank solution or from the charging current
Beer's law	[15] A transport mechanism occurs in voltammetry which involves the movement of oppositely charged ions towards electrode due to electrostatic attractions.

8. In some quantitative chromatographic methods, the concentration of the analyte is found from the ratio of its peak area to the total area of all eluted peaks. What the name of this method?
   a) The internal standard method.
   b) The calibration method.
   c) The area-normalization method.
   d) None of these.

9. Supporting electrolyte is used in voltammetry to suppress_____.
   a) Diffusion current   b) Migration current
   c) Convention current   d) All of these.

10. A reversed-phase HPLC separation is carried out using a mobile phase of 40% v/v water and 60% v/v methanol. What is the mobile phase's polarity index? (Where $P'_{H2O} = 10.2$ and $P'_{CH3OH} = 5.1$).
    a) 4.08   b) 3.06
    c) 7.14   d) 8.2

11. What is the advantage of electroanalytical methods over other analytical techniques?
    a) They are expensive than most techniques.
    b) They provide information about oxidation state of an analyte.
    c) Measuring temperature changes in reactions.
    d) Determining the pH of solutions.

12. A device for converting solution into fine spray or droplets in AAS is _____.
    a) Atomizer   b) Nebulizer
    c) Computerize   d) None of these

13. Cold vapor technique is an atomization method used only to the determination of _____.
    a) Cadmium   b) Lead
    c) Aluminum   d) Mercury

14. Which of the following is a likely method for determining the half-wave potential $(E_{1/2})$ of Cu^{2+} ions in a sample solution?
    a) Spectrophotometry   b) Chromatography
    c) voltammetry   d) Potentiometric titration

15. In voltammetry, which transport mechanism involves the movement of ions due to concentration gradients?
    a) Migration   b) Diffusion
    c) Convection   d) Electrodeposition

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Assiut University   Date: 4 Jan 2025

Faculty of Science   Time: 2 hours

Chemistry Department   Instructor: Prof. Dr. M. S. Ibrahim

Instrumental Analysis (Chem-301)

(Final Exam., First Semester 2024-2025)

****

Answer the following questions: :   **(50 points)**

Part I: Choose the correct answer: **(15 points)**

1. Rank each of the following molecules from highest to lowest λ_{max} for the $\pi \rightarrow \pi^*$ transition.
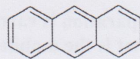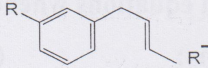
Benzene   Naphthalene   Anthracene

    a) Naphthalene > Benzene > Anthracene

    b) Benzene > Anthracene > Naphthalene

    c) Anthracene > Naphthalene > Benzene

    d) Naphthalene > Anthracene > Benzene

2. The efficiency of chromatographic column increases _____.

    a) as the number of plates becomes greater.

    b) as the plate height becomes smaller.

    c) by decreasing the particle size of column packing.

    d) All of these.

3. Which is the correct order of AAS instrumentation?

    a) Atomization − Lines source − Monochromator − Detector − Read-out

    b) Lines source − Monochromator − Atomization − Detector − Read-out

    c) Lines source − Atomization − Monochromator − Detector − Read-out

    d) Lines source − Atomization − Read-out − Monochromator − Detector

4. In liquid chromatography, the use of a single mobile phase during the entire elution process is called _____.

    a) normal elution.   b) reverse elution.

    c) isocratic elution.   d) frontal elution.

5. Which of the following is the atomization method used for highly toxic elements such as arsenic (As), antimony (Sb) and lead (Pb)?

    a) Flame method.   b) Hydride generation method.

    c) Electrothermal method.   d) Cold-Vapor method.

6. The retention factor (k') is an important parameter that is widely used to describe the migration rates of solutes on columns. For a solute A, when k'_A is < 1.0.

    a) The separation is poor.   b) The separation is slow.

    c) The separation is optimum.   d) None of these.

7. In voltammetry, which of the following describes a Faradaic process?

    a) A process that involves only the charging of the electrode.

    b) A process that involves electron transfer and obeys Faraday's Law.

    c) A process with no electron transfer across the electrode interface.

    d) A process that occurs without any change in current.

III| Complete the following equations and <u>Discuss</u> the reaction mechanism:
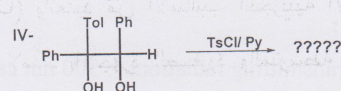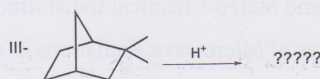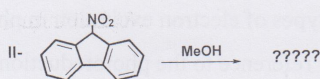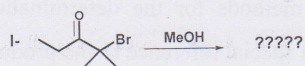
(5 X 2= 10 Marks)

a -   1,3-n-hexadiene $\xrightarrow{hv \ / \ O_2}$?

b- $6\ CO_2\ +\ 6\ H_2O$ $\xrightarrow{Sun\ light}$?

c-   2,5-Hexadione + CH3NH2 $\xrightarrow{Microwave}$?

d-   [structure: R-substituted benzene with CH=CH chain and R⁻] $\xrightarrow{hv}$?

e-   1,3-cyclopentadiene + Diazomethane $\xrightarrow{hv}$?

Section (B): Reactive Intermediates: (25 Marks)

Answer on the Following Questions:

1) Suggest the suitable mechanism and products for <u>*Only Three*</u> of the following reactions. Write the name of the suggested mechanism indicating each step using arrows.

(3 x 5 =15 Marks)

I-   [structure: ketone with C(CH3)2Br group] $\xrightarrow{MeOH}$?????

II-   [structure: fluorene with NO2 group] $\xrightarrow{MeOH}$?????

III-   [structure: bicyclic with OH] $\xrightarrow{H^+}$?????

IV-   [structure: Ph-C(Tol)(OH)-C(Ph)(OH)-H] $\xrightarrow{TsCl/ Py}$?????

2) Write on <u>*two only*</u> of the following (use equations & structures):

(2 x 5 =10 Marks)

a. Nitrenes have both singlet and triplet electronic configurations.
b. Polymerization of ethylene (using AIBN) takes place through three steps.
c. There are two reasonable structures for alkyl carbanions, a planar sp2 hybridized configuration and a pyramidal sp3 hybridized configuration, but one of them is the most reasonable one.

Prof. Dr. Aboel-Magd A. Abdel- Wahab & Prof. Dr. Mona A. Abdel -Rahman   *Good Luck*

Faculty of Science

Chemistry Department

Jan 14, 2025

Time : 3 Hours

Photochemistry and Reactive intermediates (313 C)

Final Exam for The 3rd level Students

Note: Support your answer with Chemical equations whenever possible

Answer on the Following <u>Two</u> Sections: (50 Marks)

Section (A): Photochemistry: (25 Marks)

Answer on the Following Questions:

I]- Answer on <u>Only Four</u> of the following :   (4 X 2 = 8 Marks)

1-Describe briefly the photodimerization of 1,3-butadiene in the presence of biacetyl photosensitizer.

2-Explain the possible methods for the determination of the photo chemical reaction mechanism with special reference to the product quantum yield method.

3-Discuss the different types of electron excitation in photochemical reactions with special reference to the photoreduction of Michler's Ketone.

4- Describe the Photo- and Stereo-Chemical transformations in the vision process.

5- Indicate the advantages of Microwave Radiations in organic synthesis.

II] – Mark right (√) or wrong (X) on <u>Only Four</u> of the following statements, and Explain your answer :   (4 X 2 = 8 Marks)

1- Windows Glass transmitting radiations $\geq$ 300 nm can be used in U.V. light photolysis of organic compounds.   (   )

2- Solar light is a result of fission of Hydrogen Gas.   (   )

3- Concerted Mechanism includes a cyclic transition state.   (   )

4- Photochromism is a Photo-irreversible process.   (   )

5- The microwave radiations have a higher frequency than visible light.   (   )

ملحوظة هامة : الأسئلة صفحتان

1

(c) Which of the following pairs identical, enantiomers, diastereomers, or constitutional isomers? **(4 Marks)**

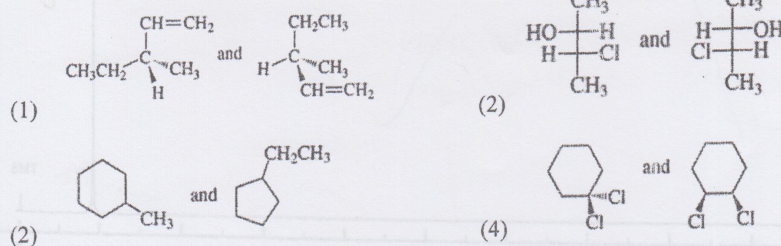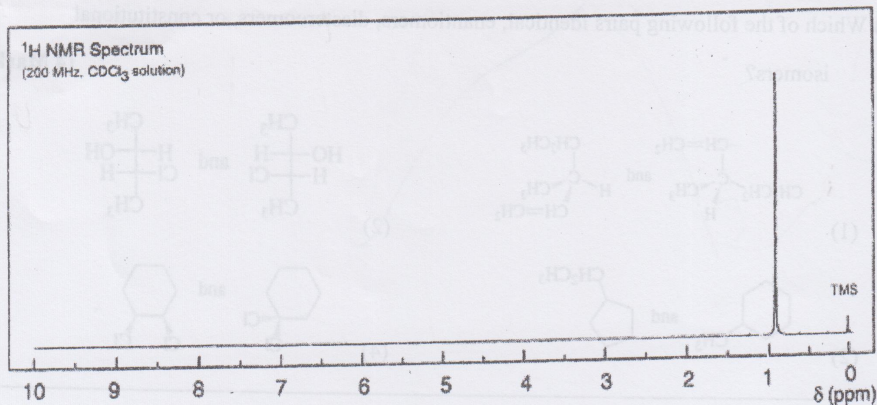
(1)   (2)

(2)   (4)

Table 3.9   Woodward–Fieser rules for enone absorption

(1) $\overset{\beta}{>}C=\overset{\alpha}{C}-C=O$

(2) $>\overset{\delta}{C}=\overset{\gamma}{C}-\overset{\beta}{C}=\overset{\alpha}{C}-C=O$

		λ (nm)
Parent enone in an acyclic or six-membered ring		215
Parent enone in a five-membered ring		202
Parent $\alpha\beta$-unsaturated aldehyde		207
Increments for:		
Double bond extending conjugation		30
Alkyl substituent or ring residue	α	10
	β	12
	γ and higher	18
Polar groupings: —OH	α	35
	β	30
	γ	50
—O·CO·CH$_3$	α, β, γ	6
—OCH$_3$	α	35
	β	30
	γ	17
	δ	31
—Cl	α	15
	β	12
—Br	α	25
	β	30
—NR$_2$	β	95
Exo double bond		5
Homodiene component		39
Solvent correction (see Table 3.10)		—

Woodward-Fieser Rule:	Homoannular (cisoid)	Heteroannular (transoid)
Parent	$\lambda = 253$ nm	$\lambda = 214$ nm
Increments for:		
Double-bond-extending conjugation	30	30
Alkyl substituent or ring residue	5	5
Exocyclic double bond	5	5
Polar groupings:		
—OCOCH$_3$	0	0
—OR	6	6
—Cl, —Br	5	5
—NR$_2$	60	60

ChemistNotes.com

Good Luck

Dr. Ahmed Abdou O. Abeed

¹H NMR Spectrum
(200 MHz. CDCl₃ solution)

TMS

| 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

δ (ppm)

Section B (Stereochemistry)

Q4 (a) Define the following terms with giving an example: **(4 Marks)**

    (i) Conformational isomerism.   (ii) Functional group isomerism.

    (iii) Diastereomers.   (iv) Positional Isomerism.

(b) What are enantiomers and the main difference between enantiomers? **(3 Marks)**

Q5 (a) Identify all the chiral centers in each molecule and determine its absolute configuration as **(4 Marks)**

    R or *S*:

      i.   Bromofloromethan.
      ii. $CH_3CHBrCl$.
      iii. $CNCH(OH)CH_2NH_2$.
      iv. 1-Bromocyclohexanol

(b) Define the formula of specific rotation, showing how to calculate specific rotation of the racemic mixture? **(3 Marks)**

Q6. (a) Draw the stereoisomers of 4-methyl-2-hexanol and give the relationship of each to the others? **(4 Marks)**

(b) Draw all of the stereoisomers of 1,4-dibromo-1,4-diphenylbutane, give the *R, S* designation of each chiral center, and give the relationship of each to the others. **(3 Marks)**

Q3 (a) Using the provided tables rules of diene and enone absorption, calculate the wavelength of maximum absorption for the compounds, 1,4-dimethylcyclohex-1,3-diene and 4,4-dimethyl-2-cyclopenten-1-one. **(2 Marks)**

(b) You are provided with IR, Mass and ^{1}H-NMR spectra of an organic compound having the molecular formula C_8H_{18}. Assign the suitable structure which agrees with the provided spectra, give reasons for your assignment and show the MS fragmentation pattern which confirm your answer. **(3 Marks)**

IR Spectrum
(liquid film)

4000   3000   2000   1600   1200   800

V (cm^{-1})

Mass Spectrum

100
80
60   57
40      $M^{+\cdot} = 114$ (< 1%)
20   99
            C_8H_{18}

% of base peak

40   80   120   160   200   240   280

m/e

Assiut University
Faculty of Science
Chemistry Department

Date: 14/1/2025
Time: 3 hrs.
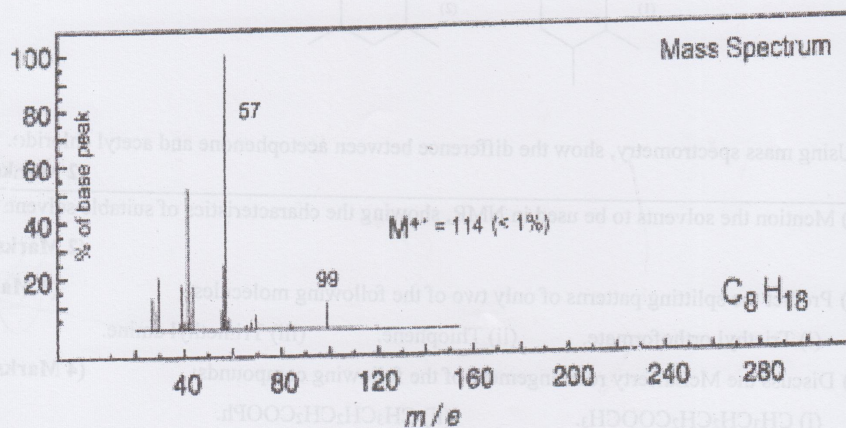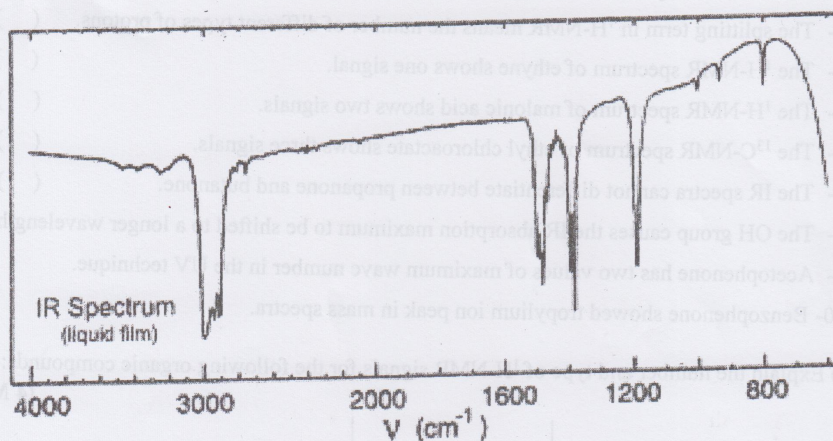
Final Exam in Spectroscopy and Stereochemistry for 3rd Level Students (C-311)

Section A (Spectroscopy)

Answer on the following questions:

Q1 (a) <u>Choose (T) for the true sentence or (F) for the false sentence</u>: **(5 Marks)**

1- The relative areas of peaks in a triplet spin-spin splitting pattern is 1:3:1. ( )

2- The ^{13}C-NMR spectrum of CCl_3CCl_3 showed one singlet signal. ( )

3- The splitting term in ^1H-NMR means the number of different types of protons. ( )

4- The ^1H-NMR spectrum of ethyne shows one signal. ( )

5- The ^1H-NMR spectrum of malonic acid shows two signals. ( )

6- The ^{13}C-NMR spectrum of ethyl chloroactate shows three signals. ( )

7- The IR spectra cannot differentiate between propanone and butanone. ( )

8- The OH group causes the IR absorption maximum to be shifted to a longer wavelength. ( )

9- Acetophenone has two values of maximum wave number in the UV technique. ( )

10- Benzophenone showed tropylium ion peak in mass spectra. ( )

(b) Explain the number and type of ^1H-NMR signals for the following organic compounds:

(4 Marks)

(1)   (2)
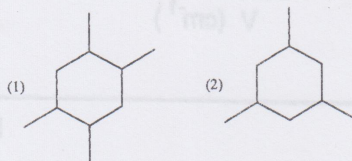
(c) Using mass spectrometry, show the difference between acetophenone and acetyl chloride.

(2 Marks)

Q2 (a) Mention the solvents to be used in NMR, showing the characteristics of suitable solvents.

(2 Marks)

(b) Predict the splitting patterns of only two of the following molecules: **(3 Marks)**

   (i) Triethyl orthoformate.   (ii) Thiophene.   (iii) Trimethyl amine.

(c) Discuss the McLafferty rearrangement of the following compounds: **(4 Marks)**

   (i) $CH_3CH_2CH_2COOCH_3$.   (ii) $CH_3CH_2CH_2COOPh$.

الأسئلة فى أربع صفحات

10- What does the Basel Convention primarily regulate?

    a) Trans-boundary movement and disposal of hazardous wastes

    b) Domestic waste management

    c) Recycling of plastics

    d) Air quality standards

Q5. Complete the following statements:

1. To avoid the volatilization of ammonia, …………………should be added.
2. In order to transform the heavy metals to an extractible form, …………, ………… or …………….. are used.
3. Redox titrations can be used for environmental analysis determination of ……, ……
4. Atomic absorption spectrometry is used to determine ………… while molecular absorption spectrometry allows the determination of …………
5. Mass spectrometry is based on …………. and ……………

Q6. Answer the following questions:

a- Define the following items:

        i- Precision   **ii-** Limit of detection   **iii-** Robustness   **iv-** Trueness

b- Discuss the digestion techniques available for heavy metals analysis.

c- Write briefly on removal of Ceftriaxone and Cefotaxime antibiotics from industrial wastewater.

……………………………………………………………………………………………..

Good Luck

Prof. Dr. Hassan Sedaira

Prof. Dr. Elham Y. Hashem

Dr. Doaa Abd Elrahman

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2- Which of the following is an example of a toxic compound produced by Aspergillus Molds?

    a) PCBs   b) Aflatoxin B1   c) DDT   d) Mercury

3- Which of the following is a health risk associated with lead exposure?
    a) Increased fertility
    b) Improved cognitive function
    c) Lowered IQ and learning disabilities
    d) Enhanced muscle coordination

4- What is the role of sweat glands in chemical absorption?
    a) They have no role
    b) They can enhance absorption into the bloodstream
    c) They block absorption
    d) They absorb water only

5- What is the primary mechanism by which organochlorine pesticides like DDT affect wildlife?
    a) They enhance reproduction rates
    b) They cause calcium depletion leading to thin eggshells in birds
    c) They improve immune function
    d) They have no significant effect

6- What is biomagnification?

    a) The increase in pesticide use over time

    b) The process where the concentration of a substance increases along the food chain

    c) The breakdown of chemicals in the environment

    d) The natural selection of resistant pest species

7- Which hazardous substance is commonly found in electronic waste?

    a) Cadmium   b) Lead   c) Mercury   d) All of the abo

8- Which route of exposure involves inhaling vapours or gases?

    a) Ingestion   b) Skin absorption   c) Injection   d) Inhalation

9- What type of asphyxiants deprive tissues of oxygen?

    a) Simple asphyxiant   b) Chemical asphyxiants

    c) Irritants   d) Allergens

<u>**Answer five questions only from the following:**</u>　　　　(*50 Marks*)

Q1- a- Write briefly on:

　　　　　　　i- Winkler`s method　　　　　ii- Water hardness

　　b- A 50 ml sample of oxygenated water at 0°C is treated by Winkler`s method. The liberated $I_2$ is titrated against 0.01136 mol $L^{-1}$ $Na_2S_2O_3$, of which 8.11 ml are required to reduce all the $I_2$. Calculate the solubility of $O_2$ in water at 0°C in mol $L^{-1}$. and hence the Henry`s law constant for O_2 at 0°C (pO_2 = 0.21 atm.).

　　c- The hardness of water sample is determined by titrated 100 ml of sample against 0.01 mol L^{-1} EDTA solution. The Eriochrome Black T endpoint occurs at 11.20 ml EDTA solution. Calculate the hardness of water in mol L^{-1} of $CaCO_3$.

　　　　　　(At. Wits., Ca = 40, C = 12, O = 16)

Q2- a- Write briefly 0n "Coagulation "as a step of water treatment.

　　b- Contrast Cl_2 with ClO_2 as a disinfecting agent.

　　c- A 200 ml sample of water is treated with acidified KI and the I_2 liberated is titrated with 4.26×10^{-3} mol L^{-1} $Na_2S_2O_3$, of which 9.66 ml are needed to react with all the I_2. Calculate the concentration of ClO_2 in water.

Q3- a- Define toxicology and discuss its significance for environmental health.

　　b- Evaluate the impact of electronic waste (e-waste) on the environment and human health.

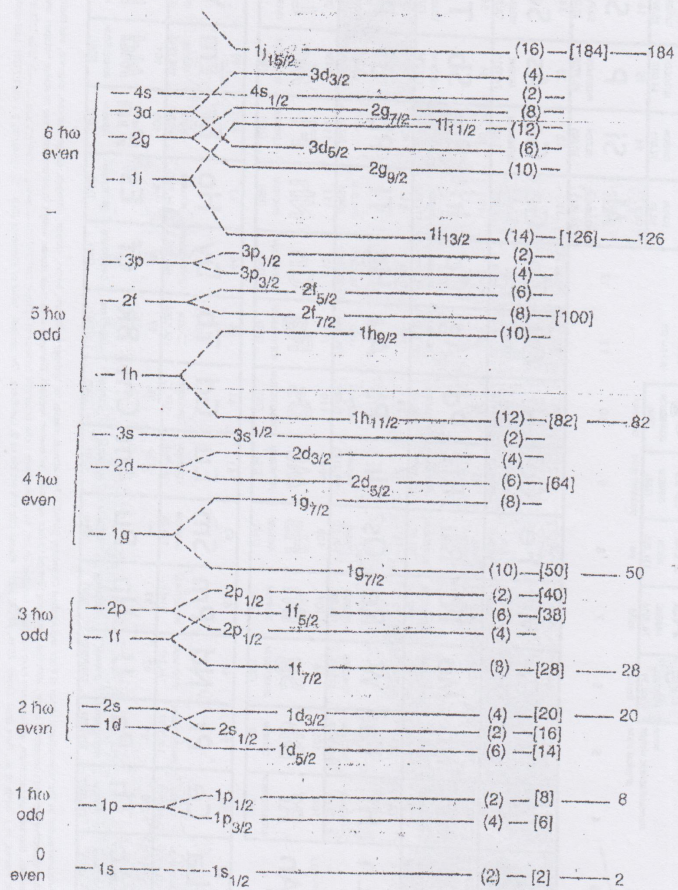　　**c-** Describe the four routes of exposure to toxic substances and give examples for each.

Q4 – <u>Choose the correct answer:</u>

　1- **What is the primary focus of environmental toxicology?**

　　　a) The study of chemical reactions in biology

　　　b) The harmful effects of chemical, biological, and physical on living organisms

　　　c) The development of new chemical compounds agents

　　　d) The study of environmental policies

Nuclear shell model energy level diagram:

Shell	Oscillator level	Split level	(occupancy)	[subtotal]	magic number
		$1j_{15/2}$	(16)	[184]	184
		$3d_{3/2}$	(4)		
6 ℏω even	4s	$4s_{1/2}$	(2)		
	3d	$2g_{7/2}$	(8)		
	2g	$1i_{11/2}$	(12)		
		$3d_{5/2}$	(6)		
	1i	$2g_{9/2}$	(10)		
		$1i_{13/2}$	(14)	[126]	126
	3p	$3p_{1/2}$	(2)		
		$3p_{3/2}$	(4)		
5 ℏω odd	2f	$2f_{5/2}$	(6)		
		$2f_{7/2}$	(8)	[100]	
		$1h_{9/2}$	(10)		
	1h	$1h_{11/2}$	(12)	[82]	82
	3s	$3s_{1/2}$	(2)		
4 ℏω even	2d	$2d_{3/2}$	(4)		
		$2d_{5/2}$	(6)	[64]	
		$1g_{7/2}$	(8)		
	1g	$1g_{7/2}$	(10)	[50]	50
	2p	$2p_{1/2}$	(2)	[40]	
3 ℏω odd		$1f_{5/2}$	(6)	[38]	
		$2p_{1/2}$	(4)		
	1f	$1f_{7/2}$	(8)	[28]	28
	2s	$1d_{3/2}$	(4)	[20]	20
2 ℏω even	1d	$2s_{1/2}$	(2)	[16]	
		$1d_{5/2}$	(6)	[14]	
1 ℏω odd	1p	$1p_{1/2}$	(2)	[8]	8
		$1p_{3/2}$	(4)	[6]	
0 even	1s	$1s_{1/2}$	(2)	[2]	2

The periodic table of elements

with conventional atomic weights scaled to A₍ᵣ₎(¹²C) = 12 and physical state (at STP 25 °C and 1 atm)*

Legend:
- class: metal / metalloid / nonmetal
- atomic number
- chemical symbol
- name
- standard atomic weight
- physical state: solid / liquid / gas, probable state
- sub-group 57–71 Ln (lanthanoids), likely metal / unknown

Group																		

Selected readable entries:

Group 1
- 1 H HYDROGEN 1.008
- 3 Li LITHIUM
- 11 Na SODIUM
- 19 K POTASSIUM
- 37 Rb RUBIDIUM 85.468
- 55 Cs CAESIUM 132.905
- 87 Fr FRANCIUM (223)

Group 2
- 4 Be BERYLLIUM 9.012
- 12 Mg MAGNESIUM
- 20 Ca CALCIUM 40.078
- 38 Sr STRONTIUM
- 56 Ba BARIUM 137.327
- 88 Ra RADIUM (226)

Group 13–18 (p-block)
- 5 B BORON 10.81
- 6 C CARBON 12.011
- 7 N NITROGEN 14.007
- 8 O OXYGEN 15.999
- 9 F FLUORINE 18.9984
- 2 He HELIUM 4.0026
- 13 Al ALUMINIUM 26.9815
- 14 Si SILICON 28.085
- 15 P PHOSPHORUS 30.9738
- 16 S SULFUR 32.06
- 17 Cl CHLORINE 35.45
- 10 Ne NEON 20.1797
- 31 Ga GALLIUM 69.723
- 32 Ge GERMANIUM 72.630
- 33 As ARSENIC 74.9216
- 34 Se SELENIUM 78.971
- 35 Br BROMINE 79.904
- 18 Ar ARGON 39.948
- 49 In INDIUM 114.818
- 50 Sn TIN
- 51 Sb ANTIMONY 121.760
- 52 Te TELLURIUM 127.60
- 53 I IODINE 126.9045
- 36 Kr KRYPTON 83.798
- 81 Tl THALLIUM 204.38
- 82 Pb LEAD 207.2
- 83 Bi BISMUTH 208.980
- 84 Po POLONIUM (209)
- 85 At ASTATINE (210)
- 54 Xe XENON 131.293
- 113 Nh NIHONIUM (285)
- 114 Fl FLEROVIUM (289)
- 115 Mc MOSCOVIUM (289)
- 116 Lv LIVERMORIUM (293)
- 117 Ts TENNESSINE (294)
- 86 Rn RADON (222)
- 118 Og OGANESSON (294)

Transition metals (selected)
- 21 Sc, 22 Ti, 23 V, 24 Cr, 25 Mn, 26 Fe IRON 55.845, 27 Co, 28 Ni, 29 Cu, 30 Zn
- 39 Y, 40 Zr, 41 Nb, 42 Mo, 43 Tc, 44 Ru RUTHENIUM 101.07, 45 Rh, 46 Pd PALLADIUM 106.42, 47 Ag SILVER 107.868, 48 Cd
- 57–71 La, 72 Hf HAFNIUM 178.49, 73 Ta, 74 W TUNGSTEN 183.84, 75 Re, 76 Os, 77 Ir IRIDIUM 192.217, 78 Pt PLATINUM 195.084, 79 Au GOLD 196.9666, 80 Hg MERCURY 200.592
- 89–103 Ac, 104 Rf, 105 Db, 106 Sg, 107 Bh, 108 Hs, 109 Mt, 110 Ds, 111 Rg, 112 Cn COPERNICIUM (285)

Lanthanoids (Ln), 57–71
- 57 La LANTHANUM 138.905
- 58 Ce CERIUM 140.116
- 59 Pr PRASEODYMIUM 140.907
- 60 Nd NEODYMIUM 144.242
- 61 Pm PROMETHIUM (145)
- 62 Sm SAMARIUM 150.36
- 63 Eu EUROPIUM 151.964
- 64 Gd GADOLINIUM 157.25
- 65 Tb TERBIUM 158.925
- 66 Dy DYSPROSIUM 162.500
- 67 Ho HOLMIUM 164.930
- 68 Er ERBIUM 167.259
- 69 Tm THULIUM 168.934
- 70 Yb YTTERBIUM 173.054
- 71 Lu LUTETIUM 174.9668

Actinoids (An), 89–103
- 89 Ac ACTINIUM (227)
- 90 Th THORIUM 232.0377
- 91 Pa PROTACTINIUM 231.0359
- 92 U URANIUM 238.0289
- 93 Np NEPTUNIUM (237)
- 94 Pu PLUTONIUM (244)
- 95 Am AMERICIUM (243)
- 96 Cm CURIUM (247)
- 97 Bk BERKELIUM (247)
- 98 Cf CALIFORNIUM (251)
- 99 Es EINSTEINIUM (252)
- 100 Fm FERMIUM (257)
- 101 Md MENDELEVIUM (258)
- 102 No NOBELIUM (259)
- 103 Lr LAWRENCIUM (266)

D- What is the minimum thickness of lead shielding required for reducing the radiation level from a-Co-60 source from 10 R hr^{-1} to 10 mR hr^{-1} (**HTV** = 1.25 cm for lead)   **(2 marks)**

Question No: 2

A- Consider the following semi-emperical equation

$$E.B = 15.6\ A - 17.23\ A^{2/3} - 0.75\ Z^2/A^{1/3} - 23.2\ (A-2Z)^2/A \pm \frac{12}{A}$$

Consider the nuclei $^{15}C,\ ^{15}N,\ ^{15}O$.

- Which of these nuclei is stable   **(1 marks)**
- What type(s) of radioactive decay would the other two undergo   **(2 marks)**
- Calculate the Coulomb barrier difference between ^{15}N, and ^{15}C.   **(3 marks)**

B- A sample of 1.00×10^{-10} g of Bi-210 ($T_{1/2}$= 5.01 d) is freshly purified at t =0

If the daughter of this nuclide is Po-210 ($T_{1/2}$ =183.3 d),

- what is the mode of Bi -210 decay ? .   **(2 marks)**
- Write the complete decay equation of this process   **(2 marks)**
- If this sample is left without further purification, what will the amount of Po-210 in it be a maximum   **(3 marks)**
- At that time of maximum growth, what will be the weight of Po-210 present, and the number of **micro Curie** of Po-210 present   **(3 marks)**

C- The dose rate at 2 m from a particular gamma source is 400 µ Sv/h. At what distance it give a dose rate of 25 µ Sv/h.   **(3 marks)**

The reaction $^{33}S\ (n,\ p)\ ^{33}P$ is exoergic by 0.533 MeV The mass of ^{33}S is 32.971458u. What is the mass of ^{33}P.   **(3 Marks)**

Constants: $m_p = 1.00727u$, $m_n = 1.00866u$, $N_A = 6.023 \times 1023$ mole-1, $1b = 1 \times 10-26\ cm^2$

$1\ Ci = 3.7 \times 10^{10} Bq$, $R_o = 1.2fm$, $1fm = 1 \times 10^{-13} cm$

Good Luck

Prof. R. M. Mahfouz

Final Exam. For Course No: 333C (Nuclear and Radiochemistry)

Answer the Following Two Questions

Question No. 1

A- From the following data given below

Na-22

2.60 y

B⁺ 0.54 ,...

γ = 1.28 MeV

➤ Sketch the decay scheme of Na-22   (2 marks)
➤ Write the decay equation of Na-22   (2 marks)
➤ How many Na-22 are present in 1m Ci of Na-22 activity   (2 marks)
➤ Insert the spin and parity of the parent and of the daughter nuclei (2 marks)
➤ What is the specific activity of carrier-free Na-22?   (2 marks)
➤ Calculate the activity of a Na-22 which gives a dose of 64 μ Sv/h at 1 m (2 marks)

B- Define the following items

G-value, Linear attenuation coefficient, annihilation process, absorbed dose, LET, cross section of a nuclear reaction, Compton scattering, exposure dose, and dose equivalent   (9 marks)

C- Calculate the number of *Co-60* ($T_{1/2}$ =5.3 y) produced in 10 mg of cobalt metal exposed for 2-minutes to a thermal neutron flux of **2.0 x 10¹³** n/ (cm². Sec) in a reactor ($\rho = 37$ b)   (5 marks)

Turn Over

Q2: Give <u>True</u> or <u>False</u> For the following (12 marks)

1- The pH of the environment does not affect corrosion.
2- Crevice corrosion occurs in open spaces on metal surfaces.
3- Microbial corrosion is unrelated to bacteria.
4-Tin is suitable for distilled water environments.
5-Cathodic protection applies a positive potential to the metal surface.
6- Platinum nanoparticles have a higher surface-to-volume ratio than bulk platinum.
7-Composite nanomaterials are created by embedding fibers or nanoparticles into a metal matrix.
8-Overpotentials increase fuel cell efficiency.
9-Annealing reduces the crystallinity of nanoparticles.
10-The use of chromate inhibitors is environmentally safe.
11-Anodic inhibitors form protective films at cathodic sites.
12- Oxygen scavengers are used to remove oxygen from neutral or alkaline environments.
13- Stainless steel is immune to pitting corrosion.
14-Tafel plots are used to measure corrosion rates.
15-Reducing water entry can help prevent corrosion.
16- Hydrogen embrittlement makes metals brittle.

Q3: Complete the following (12 marks)

1- High fluid velocity and corrosive liquids cause ....
2- ....cell has the same substance at both electrodes but with different concentrations.
3- Pt, H_2(1atm)|H^+(? M)|| (KCl sat)Hg_2Cl_2(s)|Hg This cell has a potential 1.0V, the pH of hydrogen electrode is .... ((KCl sat)Hg_2Cl_2(s)|Hg=0.242V)
4-Electrolyte is an ionic conductor where it conducts the electricity through the ....
5- Pure water at 25°C has a resistivity 1.82×10^5 Ω·m, thus its conductivity is ....
6- ....is the process in which an ion is surrounded by water molecules arranged in a specific manner.
7- Organic inhibitors are often ....than inorganic inhibitors.
8. Mixed-type inhibitors affect both .... and ....
9- .... and .... ions are abnormally good conductors.
10- Organic inhibitors like fatty acids ....on metal surfaces to prevent corrosion.
11- High temperature during deposition often leads to ....nanoparticles.
12- Electrical energy can be used to drive ....reaction.
13- Balancing electrons is necessary to ensure the conservation of charge in ....reactions.
14- One application of platinum nano-particles is ....
15- Polarization cell measurements consists of ...., ... and .... electrodes.
16- The electrolyte in a salt bridge must be ....

Part II Answer <u>Only one</u> from the following questions:

1) a) You are electrodepositing silver nanoparticles on a conductive substrate using a solution of 0.005 M silver nitrate ($AgNO_3$). A constant current of 0.1 A is applied for 5 minutes. Calculate the mass of silver deposited on the electrode. Assume 100% current efficiency. (5 marks)

b) Explain three types of Corrosion forms (9 marks)

2) a) Explain steps and factors involved in electrodeposition of silver nanoparticles. (7 marks)
b) b) Discuss the corrosion organic inhibitors. (7 marks)

مع اطيب التمنيات بالتوفيق..

الاستاذ الدكتور/ أبوالحجاج عبدالعزيز هرماس

Final Exam for Third Grad Students, Materials Science and Nanotechnology
Electrochemistry and Corrosion (Chem 303), 1st semester

(F=96485 C mol⁻¹, R=8.314 J K⁻¹ mol⁻¹)

Part I: Answer the following questions

Q1: Choose the correct answer   (12 marks)

1- Rust is a special name for the corrosion of:
a) Copper   b) Iron and steel   c) Aluminum   d) Gold

2-Stable oxide layers are:
a) Non-protective and porous   b) Strongly adherent and non-porous
c) Moderately protective   d) weak protective and brittle

3- Polarization is the process of:
a) Increasing the resistance of the metal   b) Changing the electrochemical potential of a metal
c) Increasing metal conductivity   d) Reducing oxygen availability

4- What is the primary advantage of nanoscale electrodeposition?
a) Cost reduction   b) High precision and control
c) Decreased reaction rates   d) Larger particle sizes

5- An example of a stable oxide layer is:
a) Aluminum Oxide   b) Iron Oxide   c) Lead Oxide   d) Silver Oxide

6- Which factor affects atmospheric corrosion?
a) pH of water   b) Dust particles   c) Oxygen concentration   d) All of the above

7- Platinum nanoparticles are used in fuel cells because they:
a) Have low catalytic activity   b) Reduce overpotentials for reactions
c) Are cost-effective   d) Prevent catalyst degradation

8- What reaction occurs at the cathode in fuel cells?
a) Hydrogen oxidation   b) Oxygen reduction   c) Hydrogen evolution   d) None of the above

9- What is intergranular corrosion?
a) Corrosion occurring in crevices   b) Corrosion along grain boundaries
c) Corrosion at grains and grain boundaries d) Corrosion occurring within grains

10- What is dezincification?
a) Removal of copper from brass   b) Removal of zinc from brass
c) Addition of zinc to brass   d) None of the above

11- What affects the morphology of nanoparticles during electrodeposition?
a) Substrate type   b) Voltage or current applied   c) Deposition time   d) All of the above

12- The unit of corrosion rate commonly used in industry is:
a) mpy   b) g/cm³   c) mm²/year   d) mol/m²

13- Which of the following contributes to overpotential?
a) Activation polarization   b) Concentration polarization
c) Resistance in the circuit   d) All of the above

14- According to Faraday's first law, the amount of substance produced during electrolysis is proportional to:
a) The cell voltage   b) The time of reaction
c) The amount of electricity passed   d) The molar mass of the substance

15- To produce 2 moles of H_2O in a hydrogen-oxygen fuel cell, how many moles of H_2 are consumed?
a) 1   b) 2   c) 3   d) 4

16- During the electrolysis of water, the reaction at the cathode is:
a) $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$ b) $4H^+ + 4e^- \rightarrow 2H_2$
c) $2H_2O + 2e- \rightarrow H_2 + 2OH^-$ d) $H_2O \rightarrow H^+ + OH^-$

<div dir="rtl">باقى الأسئلة بالخلف</div>

٢٦

3- Explain why for four only: (4 marks)

i-　Color of Co(II) ions change occurs when dissolved in conc. HCl

ii-　Ni(II) compounds which can easily from than Pt(II) compounds

iii-　The equivalent weight of potassium permanganate in strong basic medium equal=M.wt/1

iv-　Potassium ferrocyanide is used to test for between Fe^{2+} and Fe^{3+} ions,

v-　Cobalt chloride is used as a test for water

4- For four only write chemical formulae and calculate number of unpaired electrons of metal ions in: (4 marks)

　　i-chromyl chloride　　　　　　　　ii- sodium nicklate

　　iii- potassium ferric cyanide　　　iv- potassium alum

　　v-Disodium pentacyanonitrosyl ferrate

Section III: (16 mark)

A)Give reason(s) of the following:

i-Interstitial compounds have lower thermal and electrical conductance than their parent metals.

ii- Zr and Hf are used in nuclear reactors.

iii- Transition metals have strong tendency to form complexes.

iv- Transition metals have high melting and boiling points.

B)Complete the following:

i- Very slight variation in atomic radii from .... To .... is observed on the first transition series from left to right.

ii- Electronic configuration of Pt^{78} is ....

iii- Niobium is more .... than tantalum.

iv- Based on colour relationship theory, the secondary colours are ...... , ... and ......

C)Answer two only of the following:

1-a) Define and write briefly on the different types of magnetism of transition metals.

　　b) Calculate the volume susceptibility of CuC_2O_4 if you know that it's molar susceptibility equals 3.528×10^{-9} mol^{-1} m^3 and it's density is 6.57 g/cm^3

2-a) Write on the effect of water on vanadium metal in it's different oxidation states.

　　b)The energy associated with absorbed radiation of a complex is 265 kJmol^{-1} ,calculate it's frequency as a wave number.

3-a)Explain how pure titanium metal is produced from it's ores.

　　b)Show how unstable lower and higher oxidation states of transition metals can be stabilized.

(Atomic number :Cr=24; Mn=25; Fe=26; Co=27; Ni=28 ;Cu=29; Zn=30;Cd=48; Ag=47; }.(atomic weight:　C=12, O=16 and Cu=63.5).

الاستاذ الدكتور /سعيد ابراهيم – الاستاذ الدكتور / محمد الجهمي- الاستاذ الدكتورة / اسماء ابراهيم

Assiut university   Dec.2024   Time: 3H.
Faculty of science-chemistry department
Final Inorganic chemistry Exam.(321-C) for third level students
....

Answer the following questions:

Section I: (17mark)

a) Write the IUPAC name of the following complexes and show the kinds of isomerism they possess.   (6 marks)

(i) [Ni(NH$_3$)$_2$(ONO)$_2$].   (ii) [Co(en)$_2$NH$_3$Br]Cl   (iii) [Co(H$_2$O)$_4$Cl$_2$]
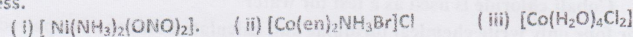
b) Write the formula of the following complexes.   (3 marks)

(i) μ-imido-μ-nitrobis[tetraamminecobalt(III)] nitrate

(ii) tetraaquadichlorochromium(III) chloride

(iii) tetramminedicyanoplatinum(IV)tetrachloroplatinate(II).

C) Put (√) or (x) in front of the following: (8 marks)

(i) In the complex [Co(NH$_3$)$_4$2Cl]Cl one chloride ions form the primary valance according to Werner's theory.

(ii) Superimposable mirror image isomers are chiral substances .

(iii) The reaction Cu$_2$S + H$_2$O = Cu$_2$O + H$_2$S prefers left direction .

(iv) The depression of freezing point increases as the number of particles in solution increases

(v) The complex [Fe(NH$_3$)$_5$Cl] Cl$_2$contains: 4 charges; 3 particles.

(vi) The EAN express the sum of electrons donated by ligands to the central metal ion in the complex .

(vii) The complex [Ni(NH$_3$)$_6$]Cl$_2$ does not obey the EAN rule.

(viii) The complex [Cu(CN)$_4$] $^{3-}$ obeys the EAN rule .

Section II: (17mark)

1- For two only Compare between :   (4 marks)

i-   Reaction of Cu metal with non-oxidizing and oxidizing acids

ii-   Cu^{+2}$_{aq}$ with CO$_3^-$$_{aq}$; NH$_3$$_{aq}$ and Cl$^-$

iii-   The reaction Zn^{+2} and Cd^{+2} ions with excess sodium hydroxide and ammonia solution

2- Write equation of these reactions: (5 marks)

i-   Cr^{+3} ions with excess ammonia solution

ii-   Zinc metal dissolve in sodium hydroxide

iii-   Effect of heating on hydrate ferric oxide

iv-   Reaction ferric oxide with sodium carbonate

v-   Reaction Potassium hexacyanoferrate (II) with chlorine

اقلب الصفحة

٢٥