Final Exam of Surface and Electrochemistry (C432) for 4th Level Students

Three Pages

Section (A): Electrochemistry (17 marks)

Q1 Complete the following sentences: (5 marks)

1- If the electrode is polarized to a greater potential than at equilibrium ($\eta = +$ ve), ... reaction takes place.

2- Activity *is the* effective concentration of ions depending on .... in solution.

3- The exchange current is the current of ....

4- Zeta potential is the potential at ....

5- Activity coefficient changes with .... and temperature or type of species.

6- The luggin capillary of the reference electrode minimizes any .... in the electrolyte associated with the passage of current in an electrochemical cell.

7- Orientation of water molecules on the electrode surface could be form a.................. potential.

8- Currents at Electrode Surfaces: .... current represents transfer of e⁻ to/from electrode by redox reactions.

9- Currents at Electrode Surfaces: .... current represents charging current.

10- The ....during electrochemical reaction is proportional to the amount of electricity (charge) passed.

Q2 Answer <u>Only three</u> of the following: (12 marks)

a) When Pt electrode is cathodically polarized in deaerated acid solution at 25°C the hydrogen overvoltage is 0.033 V at 0.01 A cm⁻² and 0.063 V at 0.1 Acm⁻², calculate the Tafel constants (a and b) and the exchange current density for discharge of H^+ on Pt under given condition.

b) Start with the First Law of thermodynamics and some standard thermodynamic relations; prove that the Gibbs function is at the heart of electrochemistry.

c) Discuss the theories you are studied for definition of the electric double layer.

d) What is the exchange current density for the evolution of hydrogen at platinum if the applied current density 0.850 Am⁻² at 298 K for an overpotential 5 mV

(F=96485 C mol⁻¹, R=8.313 JK-1mol⁻¹)

Section (B): Surface Chemistry (33 Marks)

<u>Answer the following questions:</u>

Q1-State which of the following sentence is true and which is false (24 Marks)

1. The activity of a catalyst refers to the rate at which it causes the reaction to proceed to chemical equilibrium.

2. The selectivity of a catalyst is a measure of the extent to which it accelerates the reaction to form one or more of the desired products

3. In homogenous catalysis, catalyst and reactants are of the same phase.
4. A catalyst poison is an impurity present in the feed stream that reduces catalyst activity.
5. Activation of activated carbon is the process that produces the porous structure essential for effective adsorption by oxidation of carbon with water vapor or CO_2.
6. A negative catalyst is a substance which decreases the rate of reaction. Graph between the amount adsorbed (x/m) and pressure of adsorbate gas at a constant temperature is known as adsorption isotherm.
7. The term fouling is generally used to describe a physical blockage such as the deposit of dust or fine powder or carbonaceous deposits (coke).
8. A textural promoter is an inert substance which inhibits the sintering of microcrystal of the active catalyst by being present in the form of very fine particles.
9. Mesopores exhibited pore diameter < 2 nm.
10. Schottky defect is a pair of oppositely charged ion vacancies.
11. The extent of adsorption increases with the decrease of surface area of the adsorbent.
12. APF of diamond structure is 0.34.
13. Physisorption isobar show a continuous increase with temperature.
14. Chemisorption is highly specific while physisorption is not.
15. Physisorption involved the formation of multilayers while chemisorption involved only a monolayer.
16. High temperature is favorable for the chemical adsorption while is not favorable for the physisorption.
17. Langmuir postulates that the surface of the adsorbent is uniform, that is, all the adsorption sites are equivalent.
18. In physisorption, the forces between the adsorbate molecules and adsorbent are weak Vander Waal's forces.
19. Relation between the amount adsorbed(x/m) and temperature at a constant equilibrium pressure or concentration of adsorbate molecules is known as adsorption isobar.
20. Adsorption from gas mixture depends on the partial pressures of the gases contained.
21. The term promoter is used to refer to a substance which added in relatively small amounts in the preparation of a catalyst, impartsbetter activity, selectivity or stability.
22. Desorption is the process of removal of an adsorbed substance from the surface on which it is absorbed.
23. Turnover frequency is the number of molecules that react per site per unit time.
24. Chemisorption is irreversible in nature while physisorption is not.

Q2-Answer <u>Only three</u> of the following: (9Marks)

a- Calculate the APF of body centered cubic structure.

b- Write short nots on the BET-theory and its uses in estimating the specific surface area solid material.

c- Write short notes on the adsorption from gas mixture.

d- Show you can estimate the value of heat of adsorption from Langmiur equation.

e- What are the similarities and differences between HCP and FCC structures?

Oral Exam (10 marks)

State which of the following sentence is true and which is false

1. Number of atoms per unit cell in bcc is 4.
2. Absorption occurs at a uniform rate while adsorption is rapid in the beginning and rate slowly decreases.
3. Activated carbon, as an adsorbent, can attracts the non-polar molecules such as hydrocarbons.
4. Langmuir isotherm could be mathematically expressed as $\frac{X}{m} = K(C)^{1/n} X$
5. In his assumptions, Langmuir assumed that at the maximum adsorption, only a monolayer is formed.
6. A face centered cubic has a coordination number of 12.
7. Bonding in metallic solids is related to covalent bonds.
8. Crystal structure is a combination of basis and space lattice.
9. The Galvani potential difference cannot be measure.
10. Zeta potential can be measured directly.
11. The salt effect on the reaction: $[Co(NH_3)_5Br]^{++} + OH^- \rightarrow [Co(NH_3)_5OH]^{++} + Br^-$ is positive.
12. The current produced from the electrochemical reaction at the working electrode is balanced by a current flowing in the opposite direction at the reference electrode.
13. Solvation is the process in which an ion is surrounded by solvent molecules arranged in a specific manner.
14. The ideality of solution gets good with greater charge on the ions or with increasing interaction.

Good Luck

Prof. Abou-Elhagag A. Hermas and Dr. Mohamed Nady Abd El-Hameed

Assuit University Faculty of Science Chemistry Department		Time: 2 hrs Course Code: C-413
Final Examination of Biochemistry (413 C) For Fourth Year Students		

Answer the following questions: (50 Marks)

Q1: Write True (T) or False (F) in front of the following statements in Table.

(15 marks, 1 Mark for each)

1- All carbohydrates are polyhydroxy aldehydes or ketones or compounds that hydrolyze to produce them.
2- Glucose provides energy for the brain and ½ of energy for muscles and tissues.
3- Monosaccharides contain chiral carbon atoms.
4- Diasteriomers are stereoisomers that are not enantiomers.
5- Epimers, two sugars that different only in the configuration around one carbon atom.
6- Chiral centers are carbon atoms which have 5 different atoms bonded to it.
7- A reducing sugar is a sugar with an aldehyde group that reduces a metallic oxidizing agent.
8- A strong oxidizing agent such as HNO_3 can oxidize the aldehyde and the alcohol groups.
9- Cellulose is a polymer of glucose that forms plant cell walls.
10- Maltose is a disaccharide with an a(1, 4) glycosidic link between (C_1 , C_4) OH of 2 glucoses.
11- Amino acids bind with each other by glycosidic bond to produce proteins.
12- Reduction of glucose by Tolen's reagent produces glyconic acid.
13- Glucose is a non-optically active compound.
14- Monosaccharide has 2^{n-1} stereoisomers.
15- The different in the rearrangement of the amino acid in any protein causes problems in genetic formula and diseases.

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

Q2: Show the difference between the following items : (Only three).

(12 Marks, 4 Mark for each)

A- Glycoproteins – Proteoglycans.
B- DNA – RNA.
C- Collagen – Elastin.
D- tRNA –rRNA.

Q3: Choose the correct answer and write it in the table (Only eleven).

(11 Marks, 1 Mark for each)

1- Lactose is a disaccharide, formed from........
a) 2 Glucose   b)2 Fructose   c)Glucose, Galactose   d)All of above

2- Glycine is a simple one of .... acids.
a) Halogen   b)Carboxyl   c) Amino   d)Hydroxyl

3- Reaction of glucose with Fehling solutions produces.......
a) Glyconic acid   b)Acetic acid   c)formic acid   d)Not react

4- Fructose is an optically active compound which contains............chiral carbon atoms.
a) 4   b) 5   c) 6   d) 3

5- Alanine is an .... amino acids.
a) Neutral   b) Acidic   c) More acidic   d) Basic

6- .... is a polysaccharide formed from poly glucose monomers in plants.
a) Ammonia   b) Lactose   c) Starch   d) Fructose

7- Maltose is a .... Sugars.
a) Reducing   b) Oxidizing   c) Basic   d) All of above.

8- Glucose has .... Isomers.
a) 17   b) 16   c) 12   d) 10

9- Monosaccharide can be oxidized by ....
a) Fehling solutions   b) Tolen's reagent   c) HNO_3 d) All of above

10-Sucrose is a disaccharide produces from binding glucose and fructose monomer by .... bond.
a) Ionic   b) Covalent   c) Glycosidic   d) Chelating

11-Monosaccharaides have .... as general formula.
a) $C_nH_{2n}-2$ b) $C_nH_{2n}O_n$ c) C_nH_{2n} d) $C_nH_{2n}N_2$

12-Amino acids have .... as function groups.
a) Carboxylic, Amino   b) Only Amino
b) Carboxylic, Amide   d) Only Carboxylic

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

Q4: Explain in details the following items: (Only Four)

(12 Marks, 3 Mark for each)

A- Toxic effects of free radicals.
B- Natural antioxidants.
C- Cellular distribution of Enzymes.
D- Mechanism of dental caries.
E- Treatment of Obesity.

انتهت الاسئلة............. بالتوفيق
الممتحن / د. أماني عبدالرحمن عثمان

2

Assiut University	Summer Course Final Examination	10/9/2022
Faculty of Science	Instrumental Analysis (C-445)	
Chemistry Department	Credit Hours System	Time: 2 hour

Section (A) (25 Marks)

Answer The Following Questions:

Question 1: ………………….. (12 Marks)

*Mark **True** (T) for right statement and **False** (F) for wrong statement.*

1- Solvents used in voltammetry should not undergo electrochemical reactions over a wide range of potential.

2- Current of polarizable electrode remains unchanged with changes in the electrode potential.

3- Hg is oxidized; it restricts the use of electrode as cathode.

4- Supporting electrolyte is a reactive electrolyte used in electrochemical cells.

5- The presence of O_2 often interferes with the accurate determination of other species.

6- Auxiliary electrode is used in polarography to reduce the residual current.

7- Heyrovsky-Ilkovic equation determines the number of electrons from the intercept.

8- For reversible systems E_{pa} and E_{pc} are independent on the scan rate.

9- Normal pulse is about 5-10 times more sensitive than differential pulse polarography.

10- The potentiostat's internal feedback circuits prevent current from flowing between the working electrode and reference electrode.

11- Working electrode does not enter in the redox reaction while it is so important in keeping a constant reference electrode potential.

12- The half wave potential ($E_{½}$) can be used to identify the analyte concentration.

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

Question 2: .... (7 Marks)

Choose the Correct Answer:

1- The principle function of a potentiostat is to control ....

    (a) Potential and measure current

    (b) Potential and measure time

    (c) Current and measure potential

2- Various functional groups, such as .... are reduced in the polarography.

    (a) $C=O$ and $-NO_2$

    (b) $C=O$ and $-OH$

    (c) $-N=N-$ and $-OH$

3- The diffusion current in polarography is expressed by ....

    (a) Randles-Sevcik equation

    (b) Ilkovic equation

    (c) Boltazmann equation

4- Current is sampled twice in ....

    (a) Normal pulse

    (b) Cyclic voltammetry

    (c) Differential pulse polarography

5- .... defined as a time at the end of the potential pulse in which current is measured.

    (a) Pulse amplitude

    (b) Pulse width

    (c) Sampling period

6- One of the advantages to measuring the difference current in square wave voltammetry is ....

    (a) Increase of the discrimination of the charging current

    (b) Decrease of the discrimination of the charging current

    (c) The output of the current response is a sigmoidal curve

7- The main instrumental parameter in the .... is the scan rate.

    (a) Differential pulse voltammetry

    (b) Cyclic voltammetry

    (c) Normal pulse

1	2	3	4	5	6	7

Question 3: ....(3 Marks)

The drug chlorpromazine, CPZ gives an adsorptive striping voltammetric peak at a carbon-paste electrode. A 50.0 mL sample containing CPZ yielded a peak height of 0.37 µA. When 2.0 mL of 3.0 µM CPZ was spiked to the sample, the peak increased to 0.80 µA. Find the concentration of chlorpromazine in the sample.

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Question 4: ....(3 Marks)

The oxidation of uric acid (UA) is a $2e^-$ process. A cyclic voltammetric anodic peak current (I_p) of 2.2 µA is observed for 0.4 mM solution of UA in phosphate buffer at carbon paste electrode of 2.6 mm^2 with a scan rate (v) of 25 mV/s.

What will I_p be for $v = 100$ mV/s and 1.2 mM UA?

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Answer The Following Questions:

Question 1: ………. (15 Marks)

(A) Define the following terms: (6 Marks)

- **Bioluminescence:**…………………………………………………………………………………………

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- **Fluorescence quantum yield:** …………………………………………………………………

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(B) Mention and define three forms of radiationless deactivation.   (6 Marks)

Form (A) is ……………………………………:…………………………………..

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Form (B) is …………………………………..:…………………………………

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Form (C) is …………………………………:……………………………………

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(C) Sketch the spectrophotometric titration curve for a reaction between an analyte
   (A) and a titrant (T) to give a product (P) if only T absorbs.   (3 Marks)

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Question 2: Answer <u>TWO</u> only from the following: (10 Marks)

(A) Calculate both of the energy and the wavenumber of a photon from the sodium D line at 589 nm (h = 6.626 x 10⁻³⁴ J.s and C = 3 x 10⁸ m/s).

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(B) The concentration of Cu(II) in a sample can be determined by reacting it with the ligand cuprizone and measuring its absorbance at 606 nm in a 1.00-cm cell. When a 5.00 ml sample was treated with cuprizone and diluted to 10.0 ml, the resulting solution had an absorbance of 0.118. When a second 5.00 ml sample was mixed with 0.5 ml of a 10.00 mg/l standard of Cu(II), treated with cuprizone and diluted to 20.00 ml, the absorbance was 0.140. Report the molar concentration of Cu(II) in the sample (At.wt. of Cu = 63.55).

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(C) A solution of 4.00×10^{-5} M 1,3-dihydroxynaphthalene in 2 M NaOH has a fluorescence intensity of 4.85 at the wavelength of 459 nm. Calculate the concentration of 1,3-dihydroxynaphthalene in a solution with a fluorescence intensity of 2.74 under identical conditions.

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**** GOOD LUCK ****

Examiners: Prof. Dr. Hossieny Ibrahim & Dr. Ahmed Bayoumi

Final Examination in Petroleum & Petrochemicals (451C) for the 4th Level
(Summer Term)

Date: Thursday, 15/9/2022   **Time: 2 hours.**

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

Question 1.
   a) Discuss the effect of sulfur compounds upon the Gasoline Product?
   b) Describe the Solvent Extraction methods for sulphur reaction.
   c) Explain the Carbide Theory for origin of the Petroleum and its defects.

Question 2.
   a) What you mean by Octane number & Oxygenate additives.
   b) Explain the Propane deasphalting.
   c) Discuss the Catalytic hydrodesulfurization process.

Question 3.
   a) Explain the Doctor's sweetening process ?
   b) Discuss the Isomerization mechanism (*n*-Alkanes into isoparaffins).
   c) Write short notes on :-Non- Hydrocarbons in crude Petroleum.

Question 4.

   a) Discuss the following terms:
      i)Aniline Point   ii) Additives   iii) Freezing Point of Aviation Fuels

   b) Starting from the following building blocks , discuss what are the petrochemicals
      can be produced from it :
      a) Methane
      b) Propene.

Good Luck
Examiner
Prof. Dr. Kamal Ibrahim Aly

Note: the exam in two pages.

Q1: Put (T) for the correct answer or (F) for the wrong statement (15 x 2= 30 marks)

1. The methyl red indicator is not suitable for the titration of strong acid with strong base.
2. Mohr method involved the formation of soluble red complex from silver chromate.
3. The equivalent weight of base is the molecular weight divided by the number of OH group.
4. Indicator range is the range of pH in which the indicator can work.
5. In Fajans method a red complex was formed between silver and the fluorescent indicator.
6. Mohr titration should be carried out at pH equal to 6.
7. Primary standard solution is the solution its concentration changes with time.
8. Back titration is used when the sample is not soluble in water.
9. Supporting electrolyte is a reactive electrolyte in voltametric cells.
10. The reciprocal of solution resistivity is conductivity.
11. Glass electrode is often used as reference electrode in potentiometric titrations.
12. The half wave potential ($E\frac{1}{2}$) can be used to identify the analyte concentration.
13. The decrease in conductance of the solution when NaOH is added to HCl is due to decrease in the concentration.
14. The diffusion current in polarography is expressed by Boltzmann equation.
15. In potentiometry the common parameter involves potential and ml of titrant.

Q2: Answer the following questions: (2 x 5 = 10 Marks)

a) Define Ilkovic equation and calculate the diffusion current (id) for the reduction of $5 \times 10-5$ M of Zn^{2+} which has diffusion coefficient D = $0.72 \times 10-5$ cm^{-2}. Sec., m 15 mg and t = 4 sec/ drop.

b) Write short notes on the determination of the equivalence point in potentiometric titrations (Two only).

Q3: Answer only (four) from the following questions: (2.5 x 4 = 10 Marks)

1. 74.5 ml of 2.61 M sodium hydroxide (NaOH) is added to 99.2 ml of acetic acid CH$_3$COOH), and the resulting solution is found to be basic. It required 12.7 ml of 1.25 M sulfuric acid (H_2SO_4) to reach neutrality. What is the molarity of the original acetic acid solution?

2. One type of calcium supplement tablet consists mainly of $CaCO_3$ but also contains several other substances (called fillers or binders). One such Ca tablet weighing 2.9072 g was added to 50.0 mL of 0.1 M HCl solution, which was in excess. Then the excess acid was titrated with 28.88 mL of 0.102 M NaOH solution. What is the percentage $CaCO_3$ in the Ca tablet?

3. The concentration of a sample of milk of magnesia, $Mg(OH)_2$ (sour stomach), was determined by titration with phosphoric acid (H_3PO_4). 30 mL of milk of magnesia required 54.8 mL of 0.5 M phosphoric acid to neutralize it. The equation for this reaction is shown: $2H_3PO_4 + 3Mg(OH)_2 \longrightarrow 6H_2O + Mg_3(PO_4)_2$, What was the concentration of the milk of magnesia?

4. What is the molarity of a solution that was prepared by dissolving 82.0 g of $CaCl_2$ (Molar mass = 111.1 g/mol) in enough water to make 812 mL of solution?

5. 50.00 ml of HCl was titrated with 0.01963 M $Ba(OH)_2$. The end point was reached (using bromocresol green as indicator) after 29.71 ml $Ba(OH)_2$ was added. What is the concentration of the HCl?

6. Calculate $[F^-]$ and pH of a solution that is 0.20 M in HF and 0.10 M in HCl ($Ka = 6.8 \times 10^{-4}$).

Second: Oral Exam (10 marks)

Answer the following questions (5 x 2= 10 marks):

Q1: Write a brief account on conductometric titration of acetic acid with sodium hydroxide solution.

Q2: For titration of 25 mL of 0.25 M NaOH with 0.34 M HCl. Calculate the pH after addition of 0.0, 15, 10, 25, 30 mL HCl.

With my best wishes, Dr. Gamal Abd El-Wahab and Dr. Mohamed Abd El-Aal