

الاسم الثلاثي	
كلية العلوم - قسم الكيمياء	
الرقم السري	

الامتحان التنافسي لقبول
طلبة الدكتوراه للعام
الدراسي 2018-2017



وزارة التعليم العالي والبحث العلمي
جامعة تكريت - كلية العلوم - قسم الكيمياء
الدراسات العليا



الرقم السري

الامتحان التنافسي لقبول طلبة الدكتوراه للعام الدراسي 2018-2017

يتضمن المواد التالية:

1. الكيمياء اللاعضوية
2. الكيمياء العضوية
3. الكيمياء الفيزيائية
4. الكيمياء الحياتية
5. الكيمياء الصناعية
6. الكيمياء التحليلية

- الزمن المسموح به ثلاث ساعات فقط لجميع المواد.
- الإجابة على ورقة الأسئلة.
- توزع الدرجة بالتساوي لكل تخصص ومن ثم تستخرج الدرجة الكلية، بجمع الدرجات لكافة التخصصات وتقسّم على (6) لكي يحصل الطالب على الدرجة التي تؤهله للتنافس في حال النجاح.

ت	الاختصاص	الدرجة رقما من 100	الدرجة كتابة	التوقيع
1.	الكيمياء اللاعضوية			
2.	الكيمياء العضوية			
3.	الكيمياء الفيزيائية			
4.	الكيمياء الحياتية			
5.	الكيمياء الصناعية			
6.	الكيمياء التحليلية			
	المجموع الكلي			

توقيع رئيس اللجنة:

الدرجة النهائية:

Dr. Ibrahim Fakad



Q1: Answer **two** of the following (40%)

- A.** Chromium(III) under forcing conditions forms $[\text{CrCl}_6]^{3-}$ but the corresponding complexes are never found in Mn(III) and Fe(III). Why? Cr= 24, Mn= 25, Fe= 26

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- B.** Explain why $\text{K}_3[\text{Fe}(\text{CN})_6]$ is considered to be a complex compound but $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$ is not.

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C. Explain, giving examples chelate effect in coordination compounds.

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D. Explain why Zn^{2+} salts are white but Cu^{2+} salts are blue.

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Q2: Choose the correct answer in the following (60%)

- 1- Oxidation number of Fe in $\text{Na}_2[\text{Fe}(\text{CO})_4]$ is
 - a. +2
 - b. -2
 - c. 0

- 2- EDTA^{4-} ligand is a
 - a. pentadentate
 - b. bidentate
 - c. hexadentate ligand

- 3- trans $[\text{NiBr}_2(\text{en})_2]$
 - a. has
 - b. has no optical isomers

- 4- Hybridization in $[\text{Ni}(\text{CO})_4]$ is
 - a. sp^3
 - b. dsp^2
 - c. sp^2d

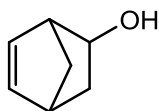
- 5- Identify the complex that show linkage isomerism from the following
 $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^{2+}$, $[\text{Co}(\text{H}_2\text{O})_5\text{CO}]^{3+}$
 $[\text{Fe}(\text{en})_2\text{Cl}_2]^+$, $[\text{Cr}(\text{NH}_3)_5\text{SCN}]^{2+}$

- 6- $[\text{Co}(\text{en})_3]^{+3}$ is
 - a. more stable
 - b. less stable than $[\text{Co}(\text{NH}_3)_6]^{+3}$

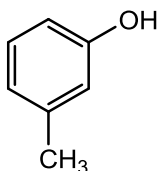


Q1: Answer the MCQ Equations?

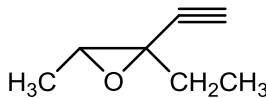
- 1- Three of the following compounds are isomer. Which one is not isomeric with the others?



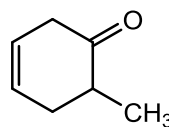
A



B



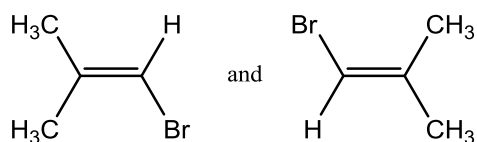
C



D

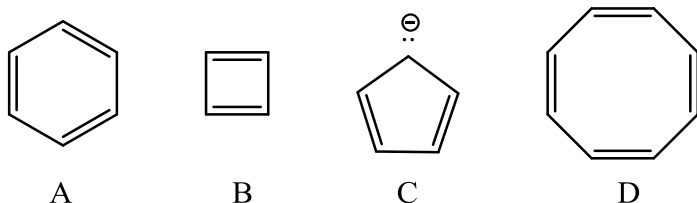
- 2- Markovnikov's Rule refers to.....
- A- The rate of hydrogen addition to an alkene with alkyl group substituents.
 - B- The temperature difference observed in the boiling point of cis and trans alkenes.
 - C- The ideal bond angle between substituents on a double bonds.
 - D- The orientation an unsymmetrical reagent will take when added to an unsymmetrical alkene.
- 3- The most common reactions involving aromatic are reactions.
- A- Elimination.
 - B- Oxidation.
 - C- Addition.
 - D- Substitution.
 - E- Reduction.
- 4- All of the following are common reactions of benzene except.....
- A- Nitration.
 - B- Bromination.
 - C- Sulfonation.
 - D- Chlorination.
 - E- Hydrogenation.
- 5- The separation process of a solid component of a mixture based on its properly to pass through heating direct from the solid phase into the gaseous phase, without melting is called;
- A- Crystallization.
 - B- Decantation.
 - C- Sublimation.
 - D- Distillation.
 - E- Extract.
- 6- If two compounds have the same empirical formula but different molecular formula, they most have
- A- Same viscosity.
 - B- Same vapor density.
 - C- Different percentage.
 - D- Different molecular weight.

7- What is the relationship between the following compounds?

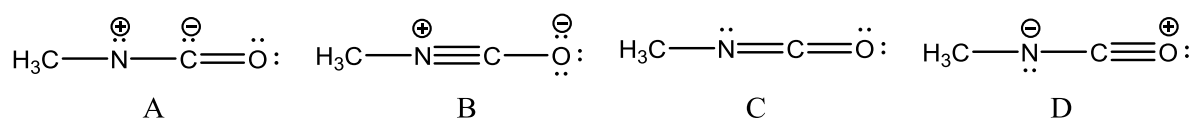


- A- Identical
- B- Diastereomers.
- C- Enantiomers.
- D- Constitutional isomers.

8- Which of these structures is/are not aromatic? Assume all structures are planar.



9- Which is the Lewis structure for the best resonance form of CH_3NCO



10- Which of the following statements is false?

- A- Both SN^1 & SN^2 reaction are exothermic.
- B- SN^1 means substitution nucleophilic reaction.
- C- If the reaction proceeds via a planar carbocation the reaction is not stereoselective.

Q2: Choose the item in **column 2** that best matches each item in **column 1**

A- SN^1	1- $\text{X}_2\text{CHCF}_3 \longrightarrow \text{X}_2\text{C}=\text{CF}_2$	A-
B- SN^2	2- $\text{R}_2\text{CHOH} + \text{SOCl}_2 \longrightarrow \text{R}_2\text{CHCl}$	B-
C- SN^i	3- $\text{RCH}_2\text{CH}_2\text{Br} \xrightarrow{\text{NH}_2^-} \text{RCH}=\text{CH}_2$	C-
D- E_1	4- $\text{RCH}_2\text{CH}_2\text{Br} \xrightarrow{\text{B}^-} \text{RCH}_2\text{CH}_2\text{B}$	D-
E- E_2	5- $(\text{CH}_3)_2\text{CH}-\text{C}(\text{CH}_3)_2\text{Cl} \xrightarrow{\text{OH}^-} (\text{CH}_3)_2\text{CH}-\text{C}(\text{CH}_3)_2\text{OH}$	E-
F- E_1C_β	6- $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)_2 \xrightarrow{\text{EtOH}} \text{CH}_3\text{CH}=\text{C}(\text{CH}_3)_2$	F-

Q3: Give the two general mechanism of alkene addition? (use >C=C< and A-B as a reactants).

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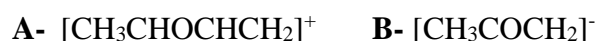
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Q4: Write resonance structure for the following



Q5: Check the correct or false.

- A-** In IR we can distinguish between (CH_3 & CH_2), (δ peak).
- B-** In Ms there are three isotropical different forms of p-dichlorobenzene.
- C-** The rang of chemical shifts in ^{13}C -NMR for (RCH_3) approximate (0-35).
- D-** The rang chemical shifts in ^1H -NMR for CH adjacent to ($\text{C}\equiv\text{N}$) approximate (2.1-2.3).



Q1: Choose the correct answer

- 1- The unit in which wave number is measured
 - a. hertz
 - b. sec^{-1}
 - c. nanometer
 - d. cm^{-1}
- 2- A CO_2 molecule contains two polar bonds but the net dipole moment is zero. It is because
 - a. The molecule has symmetrical linear geometry.
 - b. The molecule is non-linear.
 - c. The electronegativity difference between the two atoms is too large.
 - d. The electronegativity difference between the two atoms is too small
- 3- An isochoric process takes place at constant -----
 - a. Volume
 - b. Temperature
 - c. Pressure
 - d. Concentration
- 4- A system absorbs 100 kJ heat and performs 50 kJ work on the surroundings. The increase in internal energy of the system is
 - a. 50 kJ
 - b. 100 kJ
 - c. 150 kJ
 - d. 5000 kJ
- 5- In an endothermic reaction
 - a. $E_R > E_P$
 - b. $E_R < E_P$
 - c. $E_R = E_P$
 - d. None of these
- 6- The Kirchoff's equation is
 - a. $\Delta H_2 - \Delta H_1 = \Delta C_p (T_2 - T_1)$
 - b. $\Delta E_2 - \Delta E_1 = \Delta C_v (T_2 - T_1)$
 - c. Both
 - d. Neither (a) nor (b)
- 7- The enthalpy changes in the reaction $2 \text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$ is termed as
 - a. Enthalpy of reaction
 - b. Enthalpy of fusion
 - c. Enthalpy of formation
 - d. Enthalpy of combustion

- 8- The entropy of a pure crystal is zero at absolute zero. This is statement of
- First law of thermodynamics
 - Second law of thermodynamics
 - Third law of thermodynamics
 - None of these
- 9- Which of the following equation is used to calculate the heats of reaction when ΔG at two temperatures are given?
- Gibbs Helmholtz equation
 - Clapeyron equation
 - Kirchoff's equation
 - None of these
- 10- For one mole of a gas the kinetic energy is given by
- $E = 1/2 RT$
 - $E = 3/2 RT$
 - $E = 5/2 RT$
 - $E = 7/2 RT$
- 11- Viscosity of a liquid is a measure of
- Repulsive forces between the liquid molecules.
 - Frictional resistance.
 - Intermolecular forces between the molecules.
 - None of the above.
- 12- Association of molecules in water is due to
- Surface tension.
 - Viscosity.
 - Hydrogen bonding.
 - Optical activity.
- 13- The internal energy of a molecule is its
- Rotational energy.
 - Vibrational energy.
 - Translational energy.
 - All of these.
- 14- In the Raman spectrum, the middle line is called
- Raman line.
 - Rayleigh line.
 - Functional group line.
 - None of these
- 15- The Henry's law is applicable if
- The temperature and pressure are moderate.
 - The solubility of the gas in the solvent is low.
 - The gas does not react with the solvent to form a new species.
 - all of the above

- 16-** When a single phase is present in a two component system, the degree of freedom is
- Zero.
 - One.
 - Two.
 - Three.
- 17-** What are the units of the rate constant for a reaction in solution that has an overall reaction order of two? (M is molarity, s is seconds.)
- $\text{M}^{-1} \text{s}^{-1}$
 - M^{-1}
 - s^{-1}
 - M s^{-1}
- 18-** For a first-order reaction of the form $\text{A} \rightarrow \text{P}$, $t_{1/2} = 9$ hours. If the concentration of A is 0.0013 M right now, what is the best estimate of what it was the day before yesterday?
- 0.0026 M
 - 0.0065 M
 - 0.0052 M
 - 0.042 M
- 19-** From a plot or reasonable estimate, what is the instantaneous rate of change of A versus time at 10 min?
- | | | | | | | |
|------|-------|-------|-------|-------|-------|-------|
| Time | 0 | 2.50 | 5.00 | 7.50 | 10.0 | 12.5 |
| [A] | 0.500 | 0.389 | 0.303 | 0.236 | 0.184 | 0.143 |
- 0.0209
 - 0.0164
 - 0.0316
 - 0.0184
- 20-** A catalyst
- May be in same phase with the reactants or in a different phase.
 - May accelerate a reaction.
 - Affects a reaction without being consumed in the process.
 - All of the above.



Q1: Define: give the function and an example for each the following: **(40 marks)**

1- Heteropolysaccharide

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2- α -Helix of protein

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3- K_m and Inhibitor

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4- Exon and intron

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5- Prostaglandin

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Q2: Select the single best answer for each of the following questions: **(60 marks)**

- 1-** Isomers differing as a result of variations in configuration of the –OH and –H on carbon atoms 2, 3 and 4 of glucose are known as
 - a- Epimers.
 - b- Anomers.
 - c- Optical isomers.
 - d- Stereoisomers.

- 2-** α -D-glucose and β -D-glucose are
 - a. Stereoisomers.
 - b. Epimers.
 - c. Anomers.
 - d. Keto-aldo pairs.

- 3-** The monosaccharide units are linked by 1 \rightarrow 4 glycosidic linkage in
 - a. Maltose.
 - b. Sucrose.
 - c. Cellulose.
 - d. Cellobiose.

- 4-** Before pyruvic acid enters the TCA cycle it must be converted to
 - a. Acetyl CoA.
 - b. Lactate.
 - c. α -ketoglutarate.
 - d. Citrate.

- 5-** Since the pK values for aspartic acid are 2.0, 3.9 and 10.0, it follows that the isoelectric (pH) is
 - a. 3.0
 - b. 3.9
 - c. 5.9
 - d. 6.0

- 6-** The amino acid with a nonpolar side chain is
 - a. Serine.
 - b. Valine.
 - c. Asparagine.
 - d. Threonine.

- 7-** The technique for purification of proteins that can be made specific for a given protein is
- Gel filtration chromatography.
 - Ion exchange chromatography.
 - Electrophoresis.
 - Affinity chromatography.
- 8-** An amino acid that does not take part in α -helix formation is
- Histidine.
 - Tyrosine.
 - Proline.
 - Tryptophan.
- 9-** Primary structure of a protein is formed by
- Hydrogen bonds.
 - Peptide bonds.
 - Disulphide bonds.
 - All of these.
- 10-** Allosteric inhibition is also known as
- Competitive inhibition.
 - Non-competitive inhibition.
 - Feedback inhibition.
 - None of these.
- 11-** Phosphofructokinase key enzyme in glycolysis is inhibited by
- Citrate and ATP.
 - AMP.
 - ADP.
 - TMP.



Q1: What are the classification of Nanoparticles?

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Q2: Give reasonable process for desulfurization for petroleum cuts?

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Q3: Give the answer:

1. Polymer can be conductive due to
 - a. Conjdcation
 - b. The inductive group on the backbone
 - c. A and B.

2. Vinyl ether can be polymerizing by
 - a. Anionic
 - b. Cationic
 - c. F.R.

3. Tg is
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4. Polymer can be fabricating at
 - a. Tm
 - b. Tg
 - c. Not A and B.

5. Thermosets polymer are
 - a. Amorphous.
 - b. Crystalline.
 - c. Semi crystalline.

6. Petroleum treatments include
 - a. Thermal Cracking.
 - b. Cat. Thermal Cracking.
 - c. Remove the impurities.

7. The flash point is
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8. The n-type dopants are
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9. Nanoparticles should be in the dimensions
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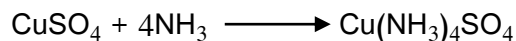
10. Quantum dots dimension is
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11. The API indicate the
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12. The main composition of Cement are
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13. Most Catalyst consists of
a. Support Materials.
b. The active materials.
c. Both A and B.
14. What is the chemical concept of Waxes?
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15. Catalysts required
a. Calcinations.
b. Evaporation.
c. Both a and b.
16. Light crude oil contain high percent of
a. Natural gas.
b. Of paraffin.
c. Both a and b
17. The most undesire impurities in petroleum cuts is
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18. Corrosion can be treated through.....
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19. The soliton is
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20. Ziegler-Natta catalysts consists of
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س1: اجب عن الأسئلة الآتية: (35 درجة)

1- احسب عدد مولات الامونيا NH_3 اللازمة للإنتاج (2.5mol) من $\text{Cu}(\text{NH}_3)_4\text{SO}_4$



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2- كم يبلغ عدد غرامات NaOH التي يمكن الحصول عليها بمفاعلة (1kg Na_2CO_3) مع $\text{Ca}(\text{OH})_2$ ؟

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3- اشرح لماذا يصح حساب $N_1V_1=N_2V_2$ ولكن لا يصح حساب $M_1V_1=M_2V_2$.

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4- ما هو عدد ايونات Ca^{2+} الناتجة من اذابة 5 غرام $CaCl_2$ ؟

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5- ما عدد غرامات ومولات والأوزان المكافئة التي تترسب من Ag عند مرور فاراداي واحد؟

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س2: أ- ما هو الأساس النظري للفصل في التقنيات الاتية: (35 درجة)

1- كروماتوغرافيا الجل

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2- التبادل الايوني

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3- الانتقال الكهربائي

ب- في التقنيات الاتية وضح ما الذي يطبق (أو يمرر) وما الذي يقاس وما المواد الممكن تقديرها.

1- البولاروغرافي

2- مطيافية الامتصاص الذري

3- مطيافية الأشعة المرئية

4- مطيافية الأشعة تحت الحمراء

س3: أ- احسب النسب المئوية للكبريت في نموذج وزنة 3 غرام إذ تم ترسيبه على هيئة $BaSO_4$ بوزن 0.5 غرام؟ (30 درجة)

ب- اكتب كلمة صح او خطأ امام العبارات الاتية:

1- الـ PH لكل من 0.1M HCl و 0.1M CH_3COOH متساوي.

2- ثابت حاصل الاذابة يطبق للأملح شحيحة الذوبان.

3- في الترسيب المتجانس يضاف العامل المرسب بشكل قطرات.

* H=1, O=16, N=14, S=32, Cu=63.5, Ag=108, Ca=40, Cl=35.5, Ba=137, C=12