國立中山大學114學年度
碩士班考試入學招生考試試題

科目名稱：普通化學【材光系碩士班選考、材料前瞻應材碩士班選考、材光聯合碩士班選考】

—作答注意事項—

考試時間：100分鐘

- **考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。**請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- **答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示**，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，請衡酌作答。
- 答案卡請以2B鉛筆劃記，不可使用修正液（帶）塗改，未使用2B鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶書籍、紙張（應考證不得做計算紙書寫）、具有通訊、記憶、傳輸或收發等功能之相關電子產品或其他有礙試場安寧、考試公平之各類器材入場。
- **試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。**
- **試題採雙面列印，考生應注意試題頁數確實作答。**
- **違規者依本校招生考試試場規則及違規處理辦法處理。**

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※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（混合題）

Part I. Single choice questions (4 points for each question, 80 points in total)

1. Place the following types of electromagnetic radiation in order of decreasing energy.
gamma rays radio waves microwaves
(A)Radio waves > microwaves > gamma rays
(B)Gamma rays > microwaves > radio waves
(C)Radio waves > gamma rays > microwaves
(D)Gamma rays > radio waves > microwaves

2. When the following reaction goes from left side to right side, what is the base?
$HCN\ (aq) + H_2O\ (l) \rightleftharpoons CN^{-1}\ (aq) + H_3O^+\ (aq)$
(A) HCN (B) H_2O (C) CN^- (D) H_3O^+

3. Order the following bonds from highest to the lowest bond energy?
Carbon-carbon silicon-silicon silicon-oxygen
(A) C-C, Si-Si, Si-O (B) Si-O, C-C, Si-Si
(C) Si-O, Si-Si, C-C (D) C-C, Si-O, Si-Si

4. When the following organic compound is oxidized, what is the major organic product?
(A) 2-propanoic acid (B) 2-propanol
(C) 2-propanone (D) 2-propanal
(E) dimethylether

5. What is the electron configuration of Cr^{3+} ?
(A) [Ar] $4s^2 3d^1$ (B) [Ar] $4s^1 3d^2$
(C) [Ar] $3d^3$ (D) [Ar] $4s^2 3d$
(E) None of these

6. Arrange the following compounds in increasing order of solubility in water.
(I) Butane; (II) EtOH; (III) acetone; (IV) EtOEt; (V) AcOH; (VI) MeOH
(A) I< IV < III < II <VI <V (B) I < IV < II < VI < III < V
(C) I < III < IV < II < VI < V (D) I < IV < III < VI <II <V
(E) I < IV < III < V <II <VI

7. The pH of a 0.15 M solution of the salt NaA is 9.00. Thus, the K_a for the acid HA is _____.
(A) 1.5×10^{-5} (B) 1.7×10^{-4}
(C) 1.2×10^{2} (D) 1.1×10^{-10}
(E) 1.3×10^{-2}

8. Which of the following ranking is incorrect?
(A)Ionic radius: $F^- > Na^+ > Mg^{2+}$
(B)Atomic radius: Li > Na >K
(C)The first ionization energy: Li > Na > K
(D)Electronegativity: F > O > N

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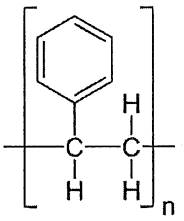
9. For the polystyrene (PS) with the following structure

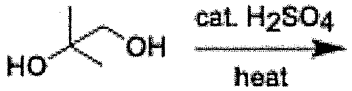


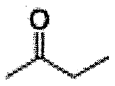
(A)CH_2=CHC_6H_5 is the monomer
(B)This is a condensation polymer
(C)this is a copolymer
(D)this substance is in a liquid state at ambient temperature.

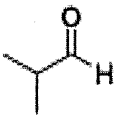
10. The deciding factor that makes HF a weak acid is that
(A)HF has a large bond energy
(B)The enthalpy of hydration of F^- is negative
(C)F_2 has a small bond energy
(D)F^- has the largest ionization energy of all the halide ions
(E)the entropy for hydration of F^- is a large negative value

11. Which one of the following is the strongest intermolecular forces experienced by noble gases
(A)London dispersion forces
(B)Dipole-dipole interactions
(C)Hydrogen bonding
(D)Ionic bonding
(E)Polar covalent bonds

12. The main product of the following reaction is:



(A) 

(B) 

(C) 

(D) 

13. The dissolution process is exothermic if the amount of energy released in bringing about (a) interactions exceed the sum of the amounts of energy absorbed in overcoming (b) and (c) interactions.
(A)Solute-solute solvent-solvent solvent-solute
(B)Solvent-solvent solute-solute solvent-solute
(C)Solvent-solute solute-solute crystal lattice
(D)Solute-solute crystal lattice solvent-solvent
(E)Solvent-solute solute-solute solvent-solvent

14. Which of the following compounds has the lowest viscosity?
(A) H_2O_2 (B) H_2O (C) CH_3OH (D) CH_3CH_2OH (E) CH_3OCH_3

15. How many of the following processes involve an increase in the entropy of the system? Melting of a solid, sublimation, freezing, diffusion, evaporation of liquid?
(A) 1　(B) 2　(C) 3　(D) 4　(E) 5

16. What would be the most possible pressure exerted by 10.0 moles of H_2 gas confined in a volume of 2.0 L at 300 K?
(A) 102 atm　(B) 112 atm　(C) 116 atm　(D) 123 atm　(E) 150 atm

17. Which of the following compounds will undergo solvolysis most readily?
(A) CH_3CH_2-I　(B) $CH_3CHClCH_2CH_3$　(C) C_6H_5C-$Br(CH_3)_2$　(D) $(CH_3)_3C$-Br.

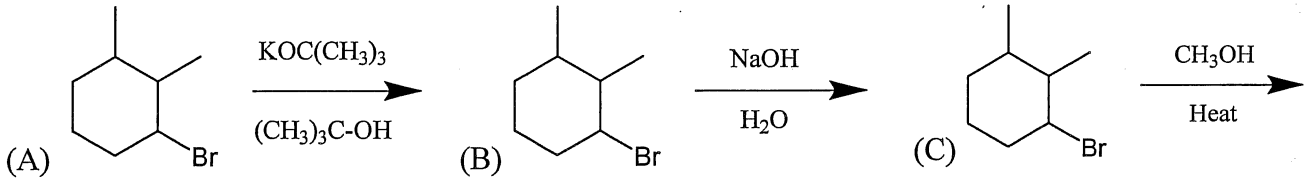
18. Which description of a catalyst is accurate?
(A)Increases the amount of products present at equilibrium
(B)Increases the rate at which equilibrium is reached but decreases the equilibrium constant
(C)Increases the rate at which equilibrium is reached without changing the equilibrium constant
(D)Increases ΔH for the process
(E)Higher the activation energy by changing the reaction pathways

19. Specify the hybridization of the nitrogen atom in each of the following, in order: NO_3^-, N_2, NO_2
(A) sp^3, sp, sp^2　(B) sp^2, sp, sp^2　(C) sp^2, sp, sp^3　(D) sp^3, sp^2, sp^3　(E) sp^3, sp^2, sp^2

20. Which aqueous solution has the highest electrical conductivity?
(A) 0.1 M CH_3COOH　(B) 0.1 M $CH_2ClCOOH$
(C) 0.1 M $CHCl_2COOH$　(D) 0.01 M CH_3COOH
(E) 0.01 M $CHCl_2COOH$

Part II. Long Answers questions (20 points in total)

1. What is the major product of the following reaction? (12 points)



2. A forensic firefighter discovered an unknown chemical reagent at the scene of an incident. He analyzed it using FTIR and NMR. Please assist in analyzing its possible structure and provide reasons for your suggestions. (Hints: there is only one chemical. The boiling point of the compound is below 120 °C.) (8 points)

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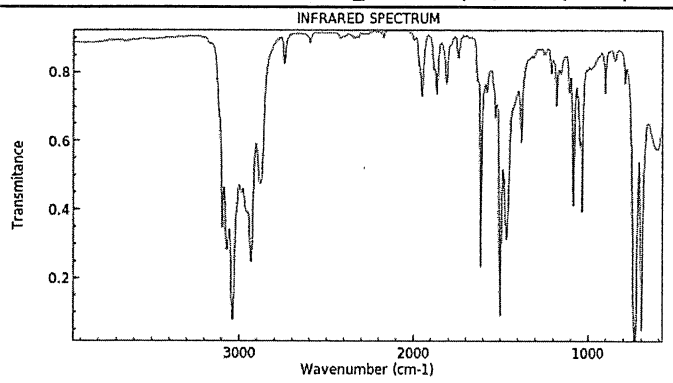
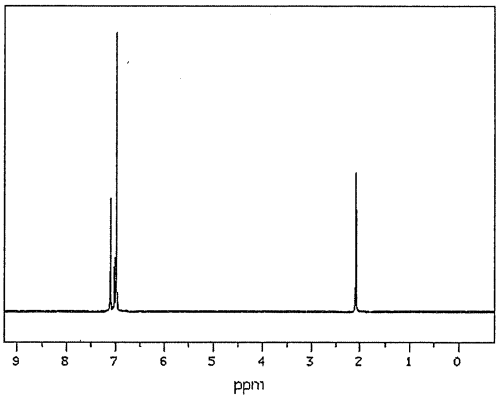


FTIR of unknown chemical reagent



NMR of unknown chemical reagent