大同大學 九十二 學年度研究所碩士在職班入學考試試題

考試科目：基礎化學　　所別：化學工程研究所　　第 1 頁

註：本次考試 不可以參考自己的書籍及筆記； 不可以使用字典； 不可以使用計算器。

第一部份：簡答及計算題（50%）

1. Name or write formulas for the following compounds：（10% ）
   （a）Sulfuric acid
   （b）Aluminum oxide
   （c）Sodium nitrite
   （d）Peroxide
   （e）Calcium carbonate
   （f）CH_3COOH
   （g）NaOH
   （h）CO_2
   （i）$NaHCO_3$
   （j）O_3

2. What mass of $Fe(OH)_3$ would be produced by reacting 75.0 ml of 0.105 M $Fe(NO_3)_3$ with 125 ml of 0.150 M NaOH?（8% ）
   （Na = 23，O = 16，H = 1，N = 14，Fe = 56）

3. Qxygen gas can be produced in small quantities in the laboratory from the thermal decomposition of potassium chlorate ($KClO_3$)
   （a）What is the chemical reaction?（4% ）
   （b）If 2.6 g $KClO_3$ is heated，what volume of gas will be collected over water at 27℃ and 735 torr？（6% ）
   （At 27℃ the vapor pressure of water is 26.7 torr and $KClO_3$ = 122.5g/mole）

4. Briefly explain the following terms：
   （a） Ideal solution（2% ）
   （b） Critical point（2% ）
   （c） Raoult's law and Henry's law（3% ）
   （d） Gibbs phase rule and phase diagram（3% ）

5. A buffer solution contains 0.25 M NH_3 ($Kb = 1.8 \times 10^{-5}$) and 0.40 M NH_4Cl
   （a） Calculate the pH of this solution.（6% ）
   （b） Calculate the pH of this solution that results when 0.1 mol of gaseous HCl is added to 1.0 L of the buffer solution from part (a).（6% ）

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第二部份：選擇題（50%）；請針對下列問題寫出其中一個最適切的答案，每題答對得兩分。

1. What is the ground state electron configuration of oxygen?

a) $1s^2 2s^2 2p^4$　b) $1s^2 2s^2 2p^5$　c) $1s^2 2s^2 2p^6$
d) $1s^2 2s^2 2p^7$　e) $1s^2 2s^2 2p^6 3s^1$

2. What should the H-C-H bond angles be in the methyl cation, CH_3^+?

a) ~90°　b) ~109°　c) ~120°　d) ~180°

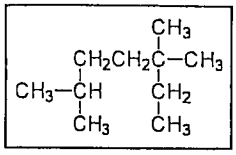
3. Which is a carboxylic acid?

a) $CH_3CH_2\overset{O}{\overset{\|}{C}}OH$　b) $CH_3CH_2\overset{O}{\overset{\|}{C}}H$　c) $CH_3\overset{O}{\overset{\|}{C}}OCH_3$　d) $CH_3\overset{O}{\overset{\|}{C}}CH_3$

4. Those second-row elements which form *pi* (π) bonds, do so by use of:

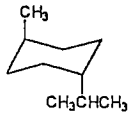
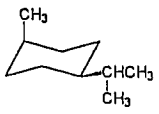
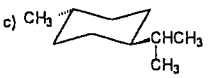
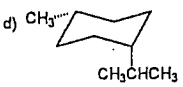
a) *sigma* (σ) orbitals　b) *2s* orbitals　c) *2p* orbitals　d) *2d* orbitals

5. Which is the best name for the following compound?

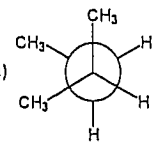
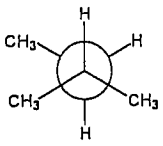
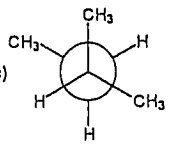
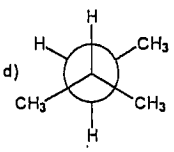


a) 2-ethyl-2,5-dimethylhexane
b) 2-ethyl-2-methyl-4-isopropylbutane
c) 2,5,5-trimethylheptane
d) 5-ethyl-2,5-dimethylhexane
e) isodecane

6. Which of the following 1-methyl-4-isopropylcyclohexanes is most stable?

a) 
b) 
c) 
d) 

7. Which conformer of isopentane is least stable?

a) 
b) 
c) 
d) 

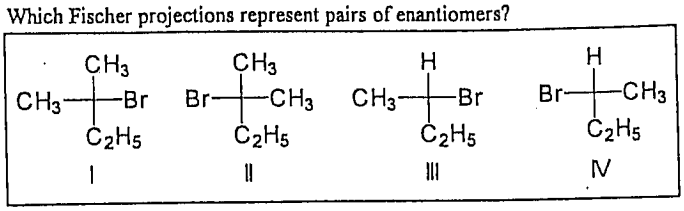
8. Which molecule is the *weakest* acid?

a) CH_3CH_2OH　b) CH_3CH_3　d) H_2O　d) CH_3CO_2H

9. Which statement best describes this reaction?　$NH_3 + BF_3 \rightarrow H_3N\text{-}BF_3$

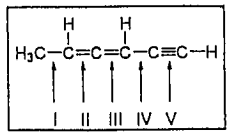
a) an acid-base reaction where NH_3 acts as a Lowry-Brønsted acid
b) an acid-base reaction where NH_3 acts as a Lowry-Brønsted base
c) an acid-base reaction where NH_3 acts as a Lewis acid
d) an acid-base reaction where NH_3 acts as a Lewis base
e) none of the above adequately describe the reaction

10. Which Fischer projections represent pairs of enantiomers?



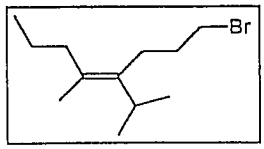
a) I and II　b) II and III　c) II and IV
d) III and IV　e) I and IV　f) none of these

11. The expected bond distances in the following compound are:



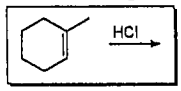
a) II ≈ III > I > IV > V　b) I > IV > II ≈ III > V
c) IV ≈ I > II ≈ III > V　d) IV > I > II ≈ III > V
e) V > II ≈ III > IV > I

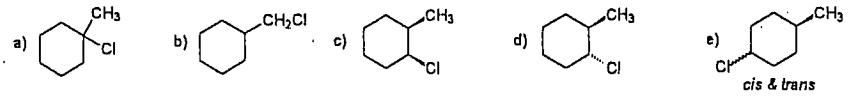
12. What is the IUPAC name for this compound?



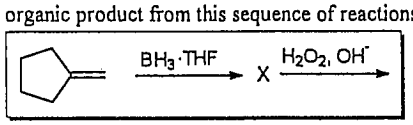
a) (Z)-1-bromo-4-isopropyl-5-methyl-4-octene
b) (E)-1-bromo-4-isopropyl-5-methyl-4-octene
c) (Z)-8-bromo-5-isopropyl-4-methyl-4-octene
d) (E)-8-bromo-5-isopropyl-4-methyl-4-octene

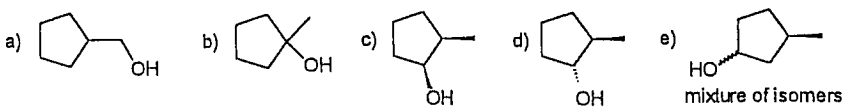
13. What is the major product of the following reaction?



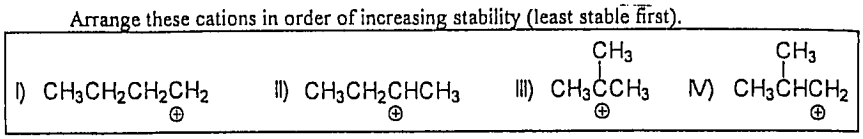


14. What is the major organic product from this sequence of reactions?





15. Arrange these cations in order of increasing stability (least stable first).



a) I > II > III > IV　b) I > II > IV > III　c) I ~ IV > II > III
d) I > II ~ IV > III　e) II > I ~ IV > III

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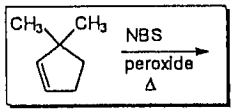
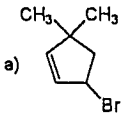
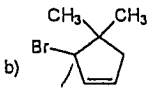
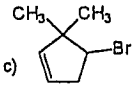
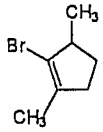
16. What is the major monobromination product from the following?

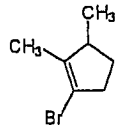


a) 

b) 

c) 

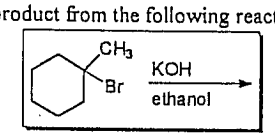
d) 

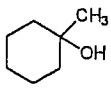
e) 

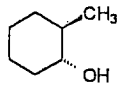
17. Which of the following alkyl halides would react fastest by the S_N2 mechanism?

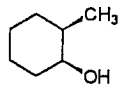
a) $CH_3CH_2CH_2CH_2Cl$　b) $CH_3CHCH_2CH_3$ (Cl)　c) CH_3CHCH_2Cl (CH_3)　d) CH_3CCH_3 (Cl, CH_3)

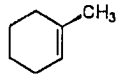
18. What is the major organic product from the following reaction?

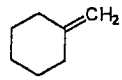


a) 

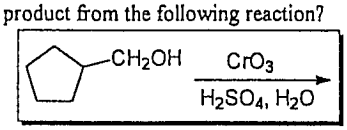
b) 

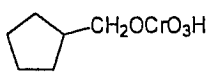
c) 

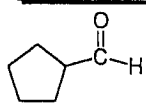
d) 

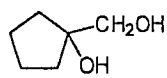
e) 

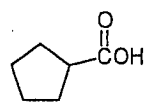
19. What is the major organic product from the following reaction?



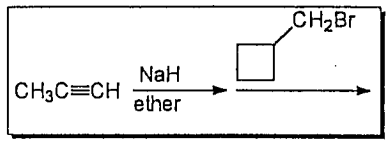
a) 

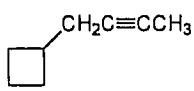
b) 

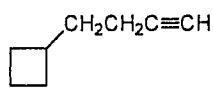
c) 

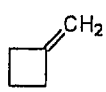
d) 

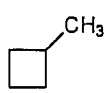
20. What is the major cyclobutane-bearing product from the following sequence of reactions?



a) 

b) 

c) 

d) 

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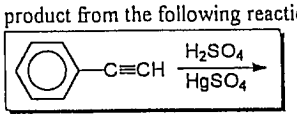
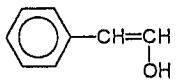
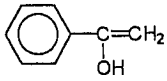
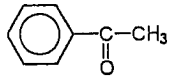
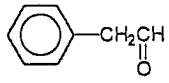
21. What is the major organic product from the following reaction?



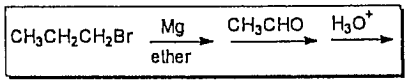
a) 

b) 

c) 

d) 

22. What is the major organic product from this series of reactions?



a) $CH_3CH_2CH_2CH_2OH$ b) $CH_3CH_2CH_2\underset{\displaystyle OH}{\underset{|}{C}}HCH_3$ c) $CH_3CH_2\underset{\displaystyle OH}{\underset{|}{C}}HCH_2CH_3$ d) $CH_3CH_2CH_2OCH_2CH_3$

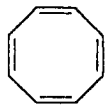
23. Which possesses the most acidic hydrogens?

a) 

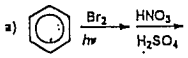
b) 

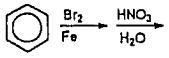
c) 

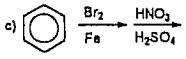
d) 

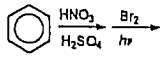
e) 

24. Which method provides the highest yield of 4-nitrobromobenzene?

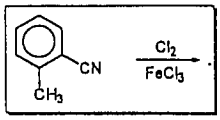
a) 

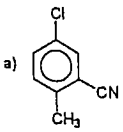
b) 

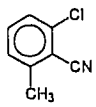
c) 

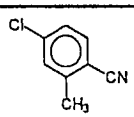
d) 

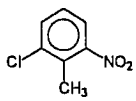
25. Based on your knowledge of the directing and activating/deactivating effects of the various substituents, predict the major product of this reaction.



a) 

b) 

c) 

d) 

e) No reaction occurs