國立高雄大學 101 學年度研究所碩士班招生考試試題

科目：綜合化學(I)　　系所：應用化學系　　是否使用計算機：是
考試時間：100 分鐘　　本科原始成績：100 分

Part I: Inorganic Chemistry ; Total = 50 points

Part A: Select the best choice, and **briefly indicate the reason for each choice**: (21%, 3% each)

1. Largest radius: Sc, Ti, V
2. Greatest volume: S^{2-}, Ar, Ca^{2+}
3. Strongest base to H^{+}: NH_3, NH_2Me, $NHMe_2$
4. Most energy necessary to remove an electron: Fe, Fe^{2+}, Fe^{3+}
5. The molecule or ion having the smallest bond angle: ClO_3^-, BrO_3^-
6. The weakest bond: S_2^+, S_2, S_2^-
7. React more strongly with CO: Fe, Fe^{2+}, Fe^{3+}

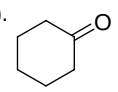
Part B: Answer the following questions, and **briefly indicate the reason(s)**

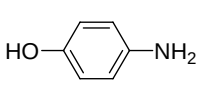
8. On the basis of the 18-electron rule, determine the expected charge: $[(\eta^5\text{-}C_5H_5)Fe(CO)_3]^z$ (3%)
9. Determine the point groups for a. $PtCl_4^{2-}$ b. PF_5 c. $[Co(en)_3]^{3+}$ (9%)
10. Give the term symbol of the ground state for the metal ions in the following complexes: a. $Co(NH_3)_6^{3+}$ b. $Cr(H_2O)_6^{3+}$ (6%)
11. Calculate the number of atoms and the spheres occupy in a face-centered cubic unit cell. (6%)
12. Which of the following complexes is subject to Jahn-Teller distortion? $[V(H_2O)_6]^{3+}$, $[Cr(CN)_6]^{3-}$, $[Cu(H_2O)_6]^{2+}$, $[Co(H_2O)_6]^{2+}$, $[Fe(CN)_6]^{4-}$ (5%)

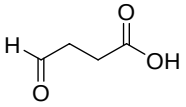
Part II: Organic Chemistry ; Total = 50 points

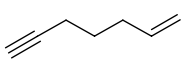
1. Define the following terms. **3 points**
   a). Enantiomer
   b). Meso compound
   c). Racemic mixture

2. Give the IUPAC names of following organic compounds. **4 points**

a). 

b). 

c). 

d). 

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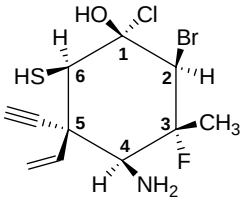
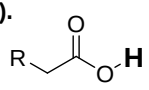
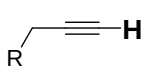
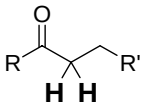
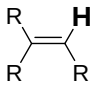
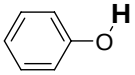
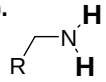
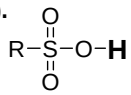
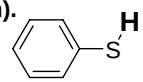
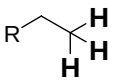
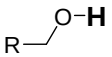
3. Label the R/S configuration of the following asymmetric carbons. **6 points**

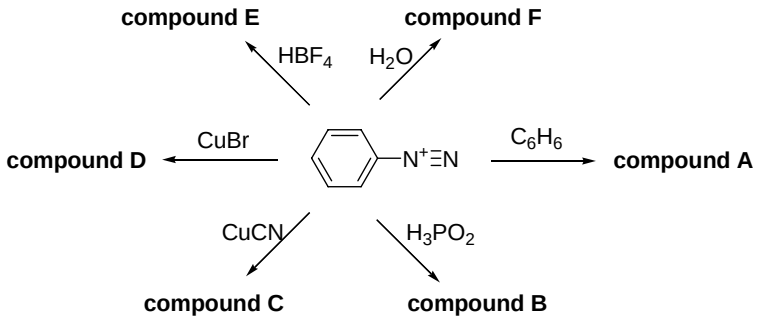


carbon 1: _____　　**carbon 4:** _____
carbon 2: _____　　**carbon 5:** _____
carbon 3: _____　　**carbon 6:** _____

4. For following protons, give the pK_a ranking from low to high. **5 points**

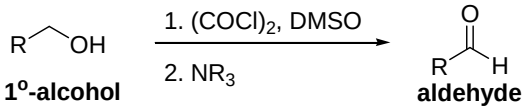
a). 
b). 
c). 
d). 
e). 
f). 
g). 
h). 
i). 
j). 
k). 
l). 

5. For arene-diazonium salt (**Sandmeyer reaction**), write down the structures of **compound A~F** under the giving reaction conditions. **6 points**



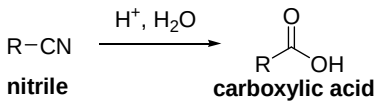
6. Write down step-by-step reaction mechanism for the following reactions:

a). Swern oxidation of alcohols to aldehydes. **5 points**



1°-alcohol　　**aldehyde**

b). Hydrolysis of nitriles to carboxylic acids. **5 points**



nitrile　　**carboxylic acid**

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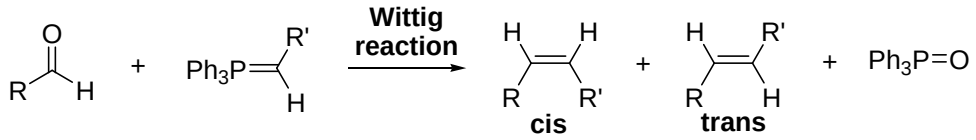
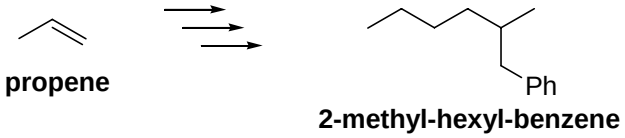
7. Propose suitable transition states to explain how *cis*- and *trans*-products are observed in Wittig reaction. **5 points**



8. Propose suitable routes for the synthesis of following compounds, starting from prop-1-ene. **5 points**



9. Propose your analysis of the following ^{1}H-NMR spectrum and determine the structure of the molecule. **6 points**