國立臺北科技大學

九十四學年度有機高分子研究所入學考試

有機化學甲組試題

填准考證號碼

注意事項：

1. 本試題共 7 題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. Write the structures for the following compounds: (4 points each)
   (a) Pyrrole (b) Thiophene (c) naphthalene (d) Phenylacetaldehyde
   (e) [15]-Crown-5

2. Give the major products for the following reactions: (4 points each)
   (a) $Ph—C\equiv CH + CH_3MgX \rightarrow$ (3a)
   (b) $C_6H_5COOCH_3$ + excess CH_3CH_2MgBr, then $H_3O^+ \rightarrow$ (3b)
   (c) $CH_3CHBrCH_3 + CH_3NH_2 \rightarrow$ (3c)
   (d) $(CH_3)_2C=CHCH_3 + I—Cl \rightarrow$ (3d)
   (e) Toluene + $KMnO_4$, heat, then $H_3O^+ \rightarrow$ (3e)
   (f) Acetophenone + $(C_6H_5)_3P=CH_2 \rightarrow$ (3f)
   (g) $CH_3C\equiv CCH_2CH_3 + H_2$ + Lindlar catalyst $\rightarrow$ (3g)
   (h) $C_6H_5C(O)CH_2CH_3 + H_2NNH_2, HO^-$, heat $\rightarrow$ (3h)

3. Please answer the following questions for the π molecular orbitals of 1,3-butadiene: (4 points each)
   (a) Draw the highest occupied molecular orbital for 1,3-butadiene.
   (b) Draw the lowest unoccupied molecular orbital for 1,3-butadiene.
   (c) Draw the highest energy molecular orbital for 1,3-butadiene.

4. Compound X and Y are isomers with the molecular formula $C_{10}H_{12}O$. The IR spectrum of each compound shows a strong absorption band near 1710 cm^{-1}. The ^1H NMR spectrum of X shows a triplet at δ 1.0 (3H), a quartet at δ 2.5 (2H), a singlet at δ 3.6 (2H), and a multiplet between δ 7.1-7.4 (5H). The ^1H NMR spectrum of Y shows a singlet at δ 2.1 (3H), a triplet at δ 2.7 (2H), a triplet at δ 2.9 (2H), and a multiplet between δ 7.1-7.3 (5H).
   (a) The IR spectrum shows what functional group is present in these two isomers? (4 points)
   (b) Propose structures for X and Y. (10 points)

5. Write the propagation steps for the monobromination of ethane in the presence of light. (6 points)

6. Which of the following conditions would you expect to be more reactive in an S_N1 reaction? Why? (4 points each)
   (a) *tert*-Butyl bromide or *n*-butyl bromide.
   (b) High concentration of the nucleophile or low concentration of the nucleophile.

7. Account for the following: (4 points each)
   (a) The p*K*a of cyclopentadiene is 15, which is extraordinarily acidic for a hydrogen that is bonded to an sp^3 hybridized carbon (p*K*a of ethane is 50).
   (b) In the gas phase the order of increasing basicity of amines is $NH_3 < CH_3NH_2 < (CH_3)_2NH < (CH_3)_3N$.