※注意：請於試卷上「非選擇題作答區」作答，並註明作答之題號。

1. The boiling point of $H_2O$ (100 °C) is much higher than that of HF (-83 °C), even though they have similar molecular weights. Explain. (5%)

2. Compare the basicities of pyrrole, pyridine, and piperidine. (5%)

3. The $\Delta H$ between *anti* and *gauche* conformation of butane is about 0.9 kcal/mol. Estimate the relative amounts of the two conformers at 25 °C. (5%)

4. An ester $C_4H_8O_2$ yields acid **X** and alcohol **Y** upon hydrolysis. Oxidation of **Y** yields **X**. Identify the ester and show the reactions involved. (8%)

5. Two optically active alkenes, **A** and **B**, have the same molecular formula, $C_5H_9Cl$. After addition of one mole of $H_2$ to each, **A** is converted to **C** (achiral), and **B** is converted to **D** (optically active). Give the structures of **A**, **B**, **C**, and **D**. (8%)

6. A compound, $C_{10}H_{14}O$, dissolves in NaOH but not in $NaHCO_3$. It reacts with aqueous $Br_2$ to give $C_{10}H_{12}Br_2O$. The IR spectrum of the compound shows a broad peak at 3250 $cm^{-1}$ and a strong peak at 750 $cm^{-1}$. The $^1$HNMR spectrum shows signals at the following $\delta$ values: (1) $\delta$ = 1.3 ppm, *s*, nine H; (2) $\delta$ = 4.9 ppm, *s* (broad), one H; and (3) $\delta$ = 7.0 ppm, *m*, four H. Deduce the structure of the compound. (9%)

7. In one example, treating acetophenone with a peroxy acid converts it into phenyl acetate. Please give the name of this specific reaction and show the detail of reaction mechanism. (10%)

8. With *p*-cresol and aniline, what compound will be obtained from the diazonium coupling reaction? (5%)

9. Phenol is a highly important industrial chemical. Mainly three methods have been used to synthesize phenol commercially. Please give details of these three industrial syntheses (hint: Dow process, alkali fusion, and cumene process). (10%)

10. Cyclopentadiene is so reactive that on standing at room temperature it slowly undergo a reaction with itself. What are the name and the product of this particular reaction? (5%)

11. Which of the following compounds would you expect to undergo aldol self-condensation? Show the product of each successful reaction: (a) trimethylacetaldehyde; (b) cyclobutanone; (c) pentan-3-one; (d) decanal; (e) 3-phenylprop-2-enal. (10%)

12. Please describe three possible synthetic routes of adding a Grignard reagent to a ketone to synthesize a 2-phenylbutan-2-ol. (10%)

13. What experimental approaches are available for determining whether the polymerization of a particular monomer by ionizing radiation proceeds by a radical or ionic mechanism (state at least two approaches and explain)? (10%)

試題隨卷繳回