

※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. Both diamond and graphite, two different crystalline allotropic forms of carbon, have extremely high melting points ($> 3500^{\circ}\text{C}$). Diamond is very hard while graphite is soft and slippery. Explain in terms of bonding. (5%)
2. The three isomeric pentanes, C_5H_{12} , have boiling points of 9.5, 28, and 36°C . Match each boiling point with the correct structure and give your reasons. (6%)
3. Predict the favored direction of the reaction $\text{H}_3\text{C}:\text{CH}_3 \leftrightarrow 2\text{H}_3\text{C}\cdot$ in terms of enthalpy H and entropy S . (5%)
4. Predict the relative basicities within each of the following groups and give your reasons: (a) Γ^- vs. ^-SeH , (b) CH_3CO_2^- vs. $\text{CH}_3\text{OCO}_2^-$. (8%)
5. Optically active A has the molecular formula C_6H_{12} and catalytic hydrogenation converts it to achiral C_6H_{14} . Give the structure of A. (6%)
6. Deduce the structure of a non-reducible, non-cyclic compound having the following spectral data: no UV absorption, major m/z values from mass spectroscopy are 101 and 86, ^{13}C NMR has two signals, and IR spectroscopy shows absorption at about $3300\text{-}3500\text{ cm}^{-1}$. (10%)
7. Rank the following compounds in the order of increasing oxidation level: propene, isopropanol, acetone, propane. (5%)
8. Cyclohexanone and butanal are respectively placed in a solvent such as D_2O or CH_3OD (catalyzed by acid or base). Please give their deuterated compounds. (5%)
9. Please give the predominant product(s) of mono-nitration (reagents = $\text{HNO}_3/\text{H}_2\text{SO}_4$) of toluene and benzaldehyde, respectively, and explain why. (10%)
10. How does one synthesize 5-hydroxypentan-2-one [$\text{CH}_3\text{C}(\text{O})\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$] using ethyl 4-oxopentanoate [$\text{CH}_3\text{C}(\text{O})\text{CH}_2\text{CH}_2\text{C}(\text{O})\text{OCH}_2\text{CH}_3$] as the starting compound (hint: protecting the keto group)? Please write down each synthetic step as detailedly as possible. (10%)
11. Phenol can be prepared via Dow Process or Cumene Method. Please describe these two synthetic routes as detailedly as possible. (10%)
12. Polyethylene (PE) can be divided to at least two classes: low density polyethylene (LDPE) and high density polyethylene (HDPE). Please describe their physical properties, polymeric structures, and synthetic routes including reaction conditions and catalysts. (20%)

試題隨卷繳回