


1. 所有題目必須在答案卷上作答
2. 計算題必須寫出計算過程

- 1) Write down the English names and predict their structures for (a) HSO_3^- (b) CO_3^{2-} (10%)
- 2) In a many electron atom, the order of energies of orbitals in a given cell is typically $s < p < d < f$. Why? (10%)
- 3) Which of the following species are paramagnetic: (a) N_2 (b) F_2 (c) O_2 (d) O_2^- (e) O_2^+ . (10%)
- 4) Suppose that 1.0 mole of an ideal gas at 292 K and 3.0 atm expands isothermally and reversibly from 8.0 L to 20.0 L and a final pressure of 1.2 atm. Calculate the heat transferred. ($R=8.31 \text{ JK}^{-1} \text{ mol}^{-1}$) (10%)
- 5) Which processes are spontaneous change: (a) $\Delta H_{\text{system}} < 0, \Delta S_{\text{system}} > 0$ (b) $\Delta G_{\text{system}} < 0$ (c) $\Delta G_{\text{system}} = 0$ (d) $\Delta G_{\text{system}} > 0$ (e) $\Delta H_{\text{system}} > 0, \Delta S_{\text{system}} < 0$ (f) $\Delta S_{\text{universe}} > 0$. (10%)
- 6) Calculate the potential of a Daniell cell in which the concentration of Zn^{+2} ions is 0.1 M and that of the Cu^{+2} ions is 0.001 M at 25°C. ($RT/F=0.0257 \text{ V}$, $\text{Zn}^{+2} + 2\text{e}^- \rightarrow \text{Zn}$ $E^\circ = -0.76 \text{ V}$, $\text{Cu}^{+2} + 2\text{e}^- \rightarrow \text{Cu}$ $E^\circ = 0.34 \text{ V}$) (10%)
- 7) Determine the rate constant for the first-order $\text{A} \rightarrow \text{B}$, given that the concentration of A decreases from 0.67 M to 0.53 M in 25 sec. (10%)
- 8) The colors of $\text{Co}(\text{H}_2\text{O})_6^{+3}$ and $[\text{Co}(\text{en})_3]^{+3}$ arise from d-d transition. Predict which of the compounds absorbs shorter wavelength and explain your reasoning. (10%)
- 9) Write down the English names of the three allotropes of Carbon and describe their structures. (10%)
- 10) Draw the structures for (a) 5-methyl-1,3-hexadiene (b) 2,4,6-trinitrophenol. (5%)
- 11) Predict the major products of the reactions of (5%)
 - (a) $\text{CH}_3\text{CH}_2\text{CHO} + \text{Ag}^+ \rightarrow$
 - (b)  + $\text{HNO}_3(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow$