

國立高雄大學 107 學年度研究所碩士班招生考試試題

科目：普通化學

系所：化學工程及材料工程學系

考試時間：100 分鐘

(無組別)

是否使用計算機：是

本科原始成績：100 分

1. In the reaction of N_2 and H_2 to form NH_3 , suppose 25.0 g of nitrogen and 5.00 g of hydrogen are mixed and reacted to form ammonia. If this reaction is run to completion, which is the limiting reactant? How many grams of NH_3 will be formed? If 16.8 g of NH_3 is actually produced, what is the percent yield of ammonia? (atomic mass: N, 14.01; H, 1.008) (8%)
2. Write Lewis structures and predict the molecular structures of I_3^- , BF_3 , and SO_2 . Which of these compounds are polar? (12%)
3. Use the molecular orbital model to write the electron configuration, magnetism and bond order of P_2 . (7%)
4. Draw all resonance structures for OCN^- (carbon is the central atom). Which resonance structure is the most stable one? Explain why. (9%)
5. Write the formula for each compound: (5%)
(a) gallium bromide (b) aluminum oxide (c) potassium hypochlorite (d) sulfur hexafluoride (e) phosphoric acid
6. Draw a plot to show vapor pressure for a solution of two volatile liquids, for which P_{TOTAL} is larger than the value calculated from Raoult's law. Give an example of such kind of volatile liquids. (8%)
7. For a nuclear equation ${}^{222}_{86}Rn \rightarrow {}^{218}_{84}Po + ?$, what is the missing particle? If this reaction follows first-order law and rate constant $k=0.181 \text{ days}^{-1}$. If you begin with 5.28 g pure ${}^{222}_{86}Rn$, how much will be left after 1.96 days? ($e^{0.181} = 1.20$, $(1.20)^{1.96} = 1.43$) (8%)
8. For the chlorine oxyacids, place the oxyacids in the order of increasing acid strength. How does acid strength relate with the number of attached oxygens on the chlorine? Explain why. (8%)
9. Draw the pH (vs. volume of NaOH added) curve for (a) titration of HCl with NaOH and (b) titration of CH_3COOH with NaOH. For the indicator of methyl red (useful pH range is 4.2-6.2), is it suitable in both cases? If not, please explain why. (8%)
10. Identify the most important types of interparticle forces present in the solids of each of the following substances. (8%)
a. CO_2 b. HF c. C_2H_6 d. $CaCl_2$
11. Calculate the $[H^+]$ of a 1.0 L solution that contains 0.40 M CH_3COOH ($K_a=1.8 \times 10^{-5}$) and 0.60 M CH_3COONa . Then, calculate the $[H^+]$ of the solution after the addition of 0.010 mole of solid NaOH? (10%)
12. Describe the cell based on the following half-reactions: (9%)
 $Al^{3+}_{(aq)} + 3e^- \rightarrow Al_{(s)} \quad \epsilon^0 = -1.66 \text{ V}$
 $Mn^{2+}_{(aq)} + 2e^- \rightarrow Mn_{(s)} \quad \epsilon^0 = -1.18 \text{ V}$
Where $T = 25 \text{ }^\circ\text{C}$, $[Mn^{2+}] = 0.50 \text{ M}$, $[Al^{3+}] = 1.00 \text{ M}$
Write the balanced cell reaction and calculate the cell potential at $25 \text{ }^\circ\text{C}$ ($\log 2=0.301$).