

國立高雄大學九十五學年度轉學招生考試試題

科目：普通化學

系所：化學工程及材料工程學系二年級

可

使用計算機

考試時間：90 分鐘

本科原始成績：滿分 100 分

否

- Write the formula for each of the following compounds: (10%)
  - ammonium hydrogen phosphate
  - potassium cyanide
  - aluminum oxide
  - aluminum hydrogen sulfate
  - potassium hydrogen sulfide
- A chemist weighed out 5.14 g of a mixture containing unknown amounts of BaO(s) (153.3 g/mol) and CaO(s) (56.08 g/mol) and placed the sample in a 1.50-L flask containing CO<sub>2</sub>(g) at 30.0°C and 750. torr. After the reaction to form BaCO<sub>3</sub>(s) and CaCO<sub>3</sub>(s) was completed, the pressure of CO<sub>2</sub>(g) remaining was 230. torr. Calculate the mass percentages of CaO(s) and BaO(s) in the mixture. (10%)
- What is greenhouse effect? Explain why the coldest temperatures in winter always occur on clear nights. (10%)
- The 2p orbital has its maximum probability closer to the nucleus than for the 2s orbital. Explain why 2s orbital is lower in energy than the 2p orbitals in a polyelectronic atom? (4%)
- Draw all resonance structures for SCN<sup>-</sup> and OCN<sup>-</sup>. For each species, which resonance structure is the most stable one? Explain why. (10%)
- Using the molecular orbital model, write electron configurations for CO, CO<sup>+</sup>, and CO<sup>2+</sup> and calculate the bond orders. Which ones are paramagnetic? Place the species in order of increasing bond length and bond energy. (10%).
- Write Lewis structures that obey the octet rule for the following species. Assign the formal charge for each central atom. (6%)
  - SO<sub>2</sub>Cl<sub>2</sub>
  - ClO<sub>4</sub><sup>-</sup>
- Predict and explain which substance in each of the following pairs would have the greater intermolecular forces. (10%)
  - CO<sub>2</sub> or OCS
  - SeO<sub>2</sub> or SO<sub>2</sub>
  - CH<sub>3</sub>OH or H<sub>2</sub>CO
  - CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>NH<sub>2</sub> or H<sub>2</sub>NCH<sub>2</sub>CH<sub>2</sub>NH<sub>2</sub>
  - CH<sub>3</sub>CH<sub>3</sub> or H<sub>2</sub>CO
- A buffered solution contains 0.25 M NH<sub>3</sub> (K<sub>b</sub> = 1.8 × 10<sup>-5</sup>) and 0.40 M NH<sub>4</sub>Cl. Calculate the [H<sup>+</sup>] of this solution. Calculate the [H<sup>+</sup>] after 0.10 mol gaseous HCl is added to 1.0 L of the above solution. (10%)
- Two drops of indicator HIn (K<sub>a</sub> = 1.0 × 10<sup>-7</sup>), where HIn is red and In<sup>-</sup> is blue, are placed in 10.0 ml of 0.10 M HCl.
  - What color is the solution initially? (2%)
  - The solution is titrated with 0.05 M NaOH. At what pH will the color change (red to light blue) occur? (4%)
  - What color will the solution be after 15.0 ml of NaOH has been added? (4%)
- Calculate  $\mathcal{E}_{\text{cell}}$  and describe the cell based on the following half-reactions:(10%)
 
$$\text{VO}_2^+ + 2\text{H}^+ + \text{e}^- \rightarrow \text{VO}^{2+} + \text{H}_2\text{O} \quad \mathcal{E}^0 = 1.00 \text{ V}$$

$$\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn} \quad \mathcal{E}^0 = -0.76 \text{ V}$$

Where T = 25°C, [VO<sub>2</sub><sup>+</sup>] = 2.0 M, [H<sup>+</sup>] = 0.50 M, [VO<sup>2+</sup>] = 1.0 × 10<sup>-2</sup> M, [Zn<sup>2+</sup>] = 1.0 × 10<sup>-1</sup> M (log 4 = 0.602)