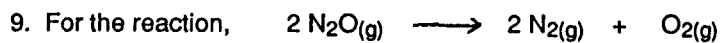


研究所

GENERAL CHEMISTRY

- (a) What is acid rain?
 (b) Describe the effect of acid rain to our life or environment.
 (c) Show, using chemical equation, how acid rain attacks iron or limestone? (8%)
- Predict the geometry and hybrid orbitals used by phosphorus atom in the following species.
 (a) PCl_3 (b) PCl_5 (c) PCl_4^+ (d) PCl_4^- (8%)
- Draw the structural isomers of C_5H_{12} . Name each compound. (4%)
- Chlorofluorocarbons (eg. CF_2Cl_2 . . .) may cause the depletion of the ozone layer. Explain. (4%)
- A compound with molecular formula $\text{C}_6\text{H}_5\text{ONa}$ is a white solid. A 5.805 g of this solid is dissolved in a 250.0 mL of water at 25 °C. The density of water at 25 °C is 0.997 g/mL. The freezing point of this solution is - 0.72 °C. What conclusion can you draw about the form of this compound in aqueous solution. (K_f of H_2O = 1.86, C=12.011, H=1.008, O=15.999, Na=22.990) (4%)
- A certain compound has a normal melting point of 41 °C, normal boiling point of 123 °C, triple point at 39 °C and 85 mmHg, and critical point at 420 °C and 230 atm.
 (a) Sketch the phase diagram. Label the solid, liquid and vapor regions.
 (b) Does the liquid phase has a density greater than, less than or equal to that of solid phase. Explain.
 (c) Describe the phase change(s) that will occur if this compound at 0.5 atm and 39 °C is heated to 1.0 atm and 150 °C. (12%)
- Exactly 0.47 g of monoprotic acid ($\text{p}K_a = 3.35$) is dissolved in water to form a 100 mL of solution and titrated against a 0.100 M of NaOH solution. The volume of base required to reach the equivalence point was 100 mL.
 (a) What kinds of intermolecular forces does this monoprotic acid have?
 (b) Give an indicator for this titration.
 (c) Calculate the molecular weight of this acid.
 (d) What is the pH for the solution at equivalence point? (12%)
- One mole of an ideal gas expands from 1.25 L to 8.00 L against a constant pressure of 5.00 atm under 25 °C. Calculate w , ΔE , and ΔS . (1 atm L = 101.325 J) (12%)



(a) Determine the rate law (or rate equation) according to the following data at 25 °C.

[N ₂ O] (M)	0.100	0.086	0.079	0.075	0.066	0.059	0.049
time (sec)	0	80	120	160	240	320	480

(b) Calculate the activation energy according to the following further data.

temperature (°C)	319	378
rate constant, k	0.522	4.02

(c) Propose a reasonable mechanism for this decomposition reaction. (12%)

10. At very low temperature argon crystallizes in a structure in which Ar atoms are located at the following positions: 0,0,0; 0, 1/2,1/2; 1/2,0,1/2; 1/2,1/2,0. Is the unit cell simple cubic, body centered cubic or faced centered cubic? What is the coordination number of Ar?

(4%)

11. Lithium chloride crystallizes in face centered cubic structure with anion-anion contact. If the unit cell length in this crystal is 0.514 nm.

(a) Define the term "unit cell".

(b) Draw a unit cell picture of this crystal.

(c) Calculate values for the radii of lithium and chloride ions.

(d) How many lithium ions and chloride ions in a unit cell?

(e) Predict the crystal structure of titanium dioxide (TiO₂). ($r_{\text{Ti}^{4+}} = 0.068 \text{ nm}$; $r_{\text{O}^{2-}} = 0.140 \text{ nm}$)

(20%)