

答案一律寫在試卷上，不可寫在試題紙上，否則不予計分。

Please answer the following briefly: (第一題 2 分, 餘每題 4 分)

1. How many mL of H₂O are required to dilute 500 mL of 2.0 M HCl to exactly 0.50 M HCl?
2. What is the molecular mass of a gas that effuses at a rate 2.0 times faster than N₂O?
3. The heat of solution of NH₄NO₃ is +26.2 kJ/mol. Is heat evolved or released when a solution of NH₄NO₃ is diluted by addition of more water?
4. Use the Born-Haber cycle to calculate the lattice energy of NaBr(s). Given the following data:
 $\Delta H(\text{sub}) \text{ Na} = 109 \text{ kJ}$
 $\text{IE} (\text{Na}) = 496 \text{ kJ}$
 $1/2 \text{D} (\text{Br}-\text{Br}) = 96 \text{ kJ}$
 $\text{EA} (\text{Br}) = -324 \text{ kJ}$
 $\Delta H_f^\circ (\text{NaBr}) = -361 \text{ kJ}$
5. Ozone (O₃) is an allotropic form of oxygen. Use VSEPR theory to predict the shape of the ozone molecule.
6. Write the molecular orbital, electron configuration for O₂.
7. Iron crystallizes in a body-centered cubic unit. The edge of this cell is 287 pm. Calculate the density of iron?
8. Nitrogen pentoxide decomposes by a first-order reaction yielding N₂O₄ and oxygen.
$$2\text{N}_2\text{O}_5 \rightarrow 2\text{N}_2\text{O}_4 + \text{O}_2$$

At a given temperature, the half-life of N₂O₅ is 0.90 hours. What is the first-order rate constant for N₂O₅ decomposition?

(背面仍有題目, 請繼續作答)

9. 4.2 mol of oxygen and 4.0 mol of NO are introduced to an evacuated 0.50 L reaction vessel. At the temperature of the system, the equilibrium:
- $$2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$$
- is reached when $[\text{NO}] = 1.6 \text{ M}$. Calculate K_c for the reaction.
10. What is the pH of $1 \times 10^{-9} \text{ M HCl}$?
11. The concentration of Mg^{2+} in seawater is $5.0 \times 10^{-2} \text{ M}$. What is the $[\text{OH}^-]$ necessary to remove 90% of the Mg^{2+} ?
 K_{sp} for $\text{Mg}(\text{OH})_2 = 1.2 \times 10^{-11}$.
12. Write out the steps that show how sulfur in coal is converted to sulfuric acid in acid rain.
13. The heat of vaporization of water is 2.27 kJ/g. What is the ΔS_{vap} per mol at the normal boiling point?