

國立中央大學九十學年度轉學生入學試題

化學系、生科系二年級

科目：普通化學

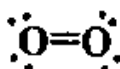
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1. Name three major types of chemical reactions in solutions and give an example for each reaction. (10 points)
2. What is the kinetic theory of gases? How does it explain the ideal gas laws? (10 points)
3. You have the following reagents on hand:

| Solids (pK_a of acid form is given) | solutions |
|--|-------------------|
| Benzoic acid (4.9) | 5.0 M HCl |
| Sodium acetate (4.74) | 1.0 M acetic acid |
| Potassium fluoride (3.14) | 2.6 M NaOH |
| Ammonium chloride (9.26) | 1.0 M HOCl (7.46) |

What combinations of reagents would you use to prepare buffers at the following pH values?

- (a) 3.0 (b) 7.0 (c) 5.0 (d) 9.0 (10 points)
4. Two molecules exist with the formula N_2F_2 .
 - (a) Write the Lewis structures of these two molecules (4 points)
 - (b) What are the N-N-F bond angles in the two molecules. (3 points)
 - (c) What is the polarity of each molecule? (3 points)
 5. A Lewis structure obeying the octet rule can be drawn for O_2 as follows:



Use the molecular orbital energy-level diagram for O_2 to show that the above Lewis structure corresponds to an excited state. (10 points)

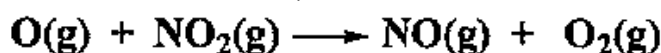
6. You isolate a compound with the formula $PtCl_4 \cdot 2KCl$. From electrical conductance tests of an aqueous solution of the compound, you find that three ions per formula unit are present, and you also notice that addition of $AgNO_3$ does not cause a precipitate. Give the formula for this compound that shows the complex ion present. Explain your findings. Name this compound. (10 points)
7. Name three commercial electrolytic processes and their anode and cathode reactions. (10 points)

參考用

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8. The rate of the reaction



was studied at a certain temperature.

(a) In the first set of experiments, NO_2 was in large excess, at a concentration of 1.0×10^{13} molecules/cm³ with the following data collected:

| Time (s) | [O] (atoms/cm ³) |
|----------------------|------------------------------|
| 0 | 5.0×10^9 |
| 1.0×10^{-2} | 1.9×10^9 |
| 2.0×10^{-2} | 6.8×10^8 |
| 3.0×10^{-2} | 2.5×10^8 |

What is the order of the reaction respect to oxygen atoms? (4 points)

(b) The reaction is known to be first order with respect to NO_2 . Determine the overall rate law and the value of the rate constant. (6 points)

9. Stretch a rubber band while holding it gently to your lips. Then slowly let it relax while still in contact with your lips. (10 points)

(a) Is the stretching an exothermic or endothermic process?

(b) Explain the above result in terms of intermolecular process.

(c) What is the sign of ΔS and ΔG for stretching the rubber band?

(d) Give the molecular explanation for the sign of ΔS for stretching.

10. The oil of deep water fish is rich in *omega*-3 fatty acids. The term *omega*-3 applies to the location of a carbon-carbon double bond. Starting with the terminal methyl group (the *omega* carbon), the double bond is located after the third carbon atom. Draw the structures of the *omega*-3 fatty acids that contain a total of 16 carbon atoms and 18 carbon atoms, respectively. (10 points)