

科目：普通化學 適用：應化所

編號：446

考生注意：

1. 依次序作答，只要標明題號，不必抄題。
2. 答案必須寫在答案卷上，否則不予計分。
3. 限用藍、黑色筆作答；試題須隨卷繳回。

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1. (10pts, 2pts for each) Name or write the formula for each of the following compounds:

- a. Rb_2O
- b. CaS
- c. KMnO_4
- d. chlorine trifluoride
- e. lithium nitride

2. (10pts) Baking soda (NaHCO_3) is often used as an antacid. It neutralizes excess hydrochloric acid secreted by the stomach:

Milk of magnesia, which is an aqueous suspension of magnesium hydroxide, is also used as an antacid:

Which is the more effective antacid per gram, NaHCO_3 or $\text{Mg}(\text{OH})_2$?3. (10pts) Combustion of table sugar produces $\text{CO}_{2(g)}$ and $\text{H}_2\text{O}_{(l)}$. When 1.46 g of table sugar is combusted in a constant volume (bomb) calorimeter, 24.00 kJ of heat is liberated.

- a. (2pts) Assuming that table sugar is pure sucrose, $\text{C}_{12}\text{H}_{22}\text{O}_{11(s)}$, write the balance equation for the combustion reaction.
- b. (4pts) Calculate ΔE in kJ/mol $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ for the combustion reaction of sucrose.
- c. (4pts) Calculate ΔH in kJ/mol $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ for the combustion reaction of sucrose at 25 °C.



4. (10pts, 2pts for each) In each of the following sets, which atom or ion has (is)

a. the smallest radius

 O^+ , O , O^-

b. the largest size

 Ga , Ge , In

c. the least exothermic electron affinity

 F , Cl , Br , I

d. the highest ionization energy

 K^+ , Cl^- , S^{2-}

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e. stable diatomic species predicted by the molecular orbital model H_2^+ , H_2 , H_2^- , H_2^{2-}

5. (5pts) A student was asked to calculate the final temperature of a mixture prepared by adding 20.0 g of ice, initially at -10.0°C , to 20.0 g of water, initially at 25°C . She assumed that all the heat lost in cooling the water would be used to warm the ice and concluded that the final temperature of the mixture would be 13°C . However, the correct answer is 0°C . What did the student neglect in her consideration?

6. (10pts) Sulfuryl chloride (SO_2Cl_2) decomposes to sulfur dioxide and chlorine by reaction in the gas phase. The following pressure data were obtained when a sample containing 5.00×10^{-2} mol sulfuryl chloride was heated to 600°K in a 5.00×10^{-1} L container.

Time (hours):	0.00	1.00	2.00	4.00	8.00	16.00
$P_{\text{SO}_2\text{Cl}_2}$ (atm):	4.93	4.26	3.52	2.53	1.30	0.34

Defining the rate as $-\Delta[\text{SO}_2\text{Cl}_2]/\Delta t$,

- determine the value of the rate constant for the decomposition of sulfuryl chloride at 600°K .
 - what is the half-life of the reaction?
 - what fraction of the sulfuryl chloride remains after 20.0 h?
7. (10pts) At 35°C , $K=1.6 \times 10^{-5}$ for the reaction



If 2.0 mol NO and 1.0 mol Cl_2 are placed into a 1.0-L flask, calculate the equilibrium concentration of all species.

8. (10pts) Place the species in each of the following groups in order of increasing acid strength. Explain the order you chose for each group.

a. (3pts) HIO_3 , HBrO_3

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第 2 頁b. (3pts) H_3PO_4 , H_3PO_3 c. (4pts) NH_4^+ , PH_4^+ (bond energies: N—H, 391 kJ/mol; P—H, 322 kJ/mol)

9. (10pts) Silver(I) chloride dissolves readily in 2 M NH_3 but is quite insoluble in 2 M NH_4NO_3 . Explain.

10. (5pts) Part of a certain DNA sequence is G-G-T-C-T-A-T-A-C. What is the complementary sequence?

11. (10pts, 2pts for each) Give the structure for each of the following.

a. 2-methylcyclopentanol

b. 1-phenyl-2-butene

c. 3-hexane

d. *o*-ethyltoluene

e. 3-methylbenzaldehyde