

國立虎尾科技大學九十七學年度研究所（碩士班）入學試題

所別：光電與材料科技研究所(戊組)

科目：考試科目 2 (普通化學)

注意事項：

- (1) 本試題共有十題，每題配分如題目說明，總分共一百分。
(2) 請依序作答在答案卷上並註明題號。

1. The isotope of an unknown element, X, has a mass number of 79. The most stable ion of the isotope has 36 electrons and forms a binary compound with sodium having a formula of Na_2X . Which of the following statements is(are) true? For the false statements corrects them.

(10%)

- (1) The isotope of X contains 38 protons.
(2) The isotope of X contains 45 neutrons.
(3) The isotope of X contains 35 electrons
(4) The identity of X is Br.

2. Determine the empirical and molecular formulas for a compound that gives the following percentages: 71.65%Cl, 24.27%C and 4.07%H upon analysis (in mass percents). The molar mass is known to be 98.96 g/mol.

(10%)

3. Methanol can be manufactured by CO and H_2 . If 68.5 kg of $\text{CO}(\text{g})$ is reacted with 8.60 kg of $\text{H}_2(\text{g})$. Calculate the CH_3OH actually produced (in kg) if the theoretical yield is 52%.

(10%)

The balanced equation is $2\text{H}_2(\text{g}) + \text{CO}(\text{g}) \rightarrow \text{CH}_3\text{OH}(\text{l})$.

4. What volume of a 0.100 M HCl solution is needed to neutralize 25.0 mL of 0.200 M KOH solution?

(10%)

5. Assign oxidation states to all atoms in the following compounds.

(1) CO_2 , (2) SF_6 , (3) NO^{3-} and (4) CH_4 (10%)

6. Write the electron configuration for the following atoms:
Si, Cl, Al, S, and Ca. (10%)
7. Write Lewis structures that obey the octet rule for the following species.
Assign the formal charge for each central atom.
(a) ClO_4^- (b) SO_2Cl_2 (c) XeO_4 (d) PO_4^{3-} (10%)
8. A certain reaction has an activation energy of 54.0 KJ/mol. As the temperature is increased from 22°C to a higher temperature, the rate constant increases by a factor of 7.00. Calculate the higher temperature. (10%)
9. Commercial brass, an alloy of Zn and Cu, reacts with hydrochloric acid as follows:

$$\text{Zn (s)} + 2 \text{HCl (aq)} \rightarrow \text{ZnCl}_2 \text{ (aq)} + \text{H}_2 \text{ (g)}$$
 (Cu does not react with HCl.) When 0.5065 g of a certain brass alloy is reacted with excess HCl, 0.0985 g ZnCl_2 is eventually isolated.
 (a) What is the composition of the brass by mass?
 (b) How could this result be checked without changing the above procedure? (10%)
10. Given the following data

$$\text{Fe}_2\text{O}_3 \text{ (s)} + 3\text{CO (g)} \star 2\text{Fe (s)} + 3\text{CO}_2 \text{ (g)} \quad \Delta H^\circ = -23 \text{ kJ}$$

$$3\text{Fe}_2\text{O}_3 \text{ (s)} + \text{CO (g)} \star 2\text{Fe}_3\text{O}_4 \text{ (s)} + \text{CO}_2 \text{ (g)} \quad \Delta H^\circ = -39 \text{ kJ}$$

$$\text{Fe}_3\text{O}_4 \text{ (s)} + \text{CO (g)} \star 3\text{FeO (s)} + \text{CO}_2 \text{ (g)} \quad \Delta H^\circ = +18 \text{ kJ}$$
 Calculate ΔH° for the reaction:

$$\text{FeO (s)} + \text{CO (g)} \star \text{Fe (s)} + \text{CO}_2 \text{ (g)} \quad (10\%)$$