2013 年度日本政府（文部科学省）奨学金留学生選考試験

QUALIFYING EXAMINATION FOR APPLICANTS FOR JAPANESE GOVERNMENT (MONBUKAGAKUSHO) SCHOLARSHIPS 2013

学科試験　　問題

EXAMINATION QUESTIONS

（高等専門学校留学生）

COLLEGE OF TECHNOLOGY STUDENTS

化学
CHEMISTRY

注意　☆試験時間は 60 分

PLEASE NOTE: THE TEST PERIOD IS 60 MINUTES

(2013)

CHEMISTRY

Nationality		No.	
Name	(Please print full name, underlining family name)		

Marks	

If necessary, use the following data to answer the questions below.

Atomic Weight: H = 1.0, C = 12.0, O = 16.0, Na = 23.0, S = 32.0, Cl = 35.5, Ag = 108

Faraday's constant: $F = 9.65 \times 10^4$ C/mol

Molar volume of gas at the standard state: 22.4 L/mol

Choose the correct answer from ① to ⑤ in the group below. Write the number in each box at every question. Choose the closest one, when your calculated result does not match exactly any of the values of the alternatives in each group.

1. Answer the following questions.

(A) How many neutrons are there in the following atom?

$$^{37}_{17}\mathrm{Cl}$$

① 3 ② 17 ③ 20 ④ 37 ⑤ 54

(B) Which is the exact isotope?

① O_2 and O_3 ② ^1H and ^2H ③ Fe^{2+} and Fe^{3+}

④ Ne and Na^+ ⑤ Mg and Ca

(C) Which of the ions shown below has the largest ionic radius?

① O^{2-} ② F^{-} ③ Na^{+} ④ Mg^{2+} ⑤ Al^{3+}

(D) Which is the exact combination of the oxidizing agent (**O**) and the reducing agent (**R**) in the redox reaction?

$$2KMnO_4 + 3H_2SO_4 + 5H_2O_2 \rightarrow K_2SO_4 + 2MnSO_4 + 5O_2 + 8H_2O$$

① **O**: $KMnO_4$ **R**: H_2SO_4
② **O**: H_2O_2 **R**: H_2SO_4
③ **O**: H_2O_2 **R**: $KMnO_4$
④ **O**: H_2SO_4 **R**: $KMnO_4$
⑤ **O**: $KMnO_4$ **R**: H_2O_2

(E) Which of the following compounds has two oxygen atoms in the molecular formula?

① glycerin ② acetaldehyde ③ acetic anhydride ④ ethyl acetate

⑤ phenol

(F) Which of the following compounds has its geometric isomers?

① Cl-CH=CH-Cl ② $Cl\text{-}CH_2\text{-}CH_2\text{-}Cl$ ③ $CH_3\text{-}CHCl\text{-}COOH$

④ CH_2=CH-Cl ⑤ $CH_3\text{-}CH_2\text{-}$ Cl

(G) Elemental analysis of the compound which contains only carbon, hydrogen and oxygen gave the following results.

C: 40.0%　　H: 6.67%　　O: 53.3%

Which is the compositional formula of this compound?

① CH_2O　② C_2H_2O　③ CH_2O_2　④ CHO　⑤ C_2H_4O

(H) Which of the following elements has the strongest ionization tendency?

① Ca　② Ag　③ Pb　④ Fe　⑤ Al

(I) Addition of chlorine gas to ethylene afforded the compound A. Then, A was heated to produce the compound B. Which of the following compounds was B?

① 1,2-dichloroethane
② chloroethane
③ vinyl chloride
④ acetylene
⑤ 1,2-dichloroethene

2. Given the thermochemical equation for the combustion of ethanol, answer the following questions.

$$\underline{a}C_2H_5OH(l) + \underline{b}O_2(g) = \underline{c}CO_2(g) + \underline{d}H_2O(l) + 1368\ \text{kJ}$$

(A) What is the coefficient $\underline{b}$?

① 1 ② 2 ③ 3 ④ 4 ⑤ 5

(B) The heats of formation of $CO_2(g)$ and $H_2O(l)$ are 394 kJ/mol and 286 kJ/mol, respectively. Calculate the heat of formation of $C_2H_5OH(l)$.

① 278 kJ ② 386 kJ ③ 494 kJ ④ 672 kJ ⑤ 780 kJ

3. The concentration of a commercially available hydrochloric acid is 12 mol/L. Answer the following questions.

(A) Calculate the molarity of the diluted solution when 10 mL of the commercially available hydrochloric acid was diluted to 1.0 L with distilled water.

① 6 mol/L ② 3 mol/L ③ 1.2 mol/L ④ 0.6 mol/L ⑤ 0.12 mol/L

(B) Calculate the amount of substance of HCl in 100 mL of the above diluted hydrochloric acid.

① 1.2 mol ② 0.24 mol ③ 0.12 mol ④ 0.024 mol ⑤ 0.012 mol

(C) Calculate the morality of a calcium hydroxide solution, when 100 mL of the calcium hydroxide solution was neutralized with 20 mL of the above diluted hydrochloric acid

① 0.006 mol/L ② 0.012 mol/L ③ 0.024 mol/L

④ 0.12 mol/L ⑤ 0.24 mol/L

4. An aqueous solution of $AgNO_3$ was electrolyzed with platinum electrodes for an hour with a 2.0 A current. Answer the following questions.

(A) How many moles of electron flowed in this electrolysis?

① 0.75 mol ② 0.15 mol ③ 0.075 mol

④ 0.037 mol ⑤ 0.0012 mol

(B) How many liters of O_2 were liberated on the platinum electrode? Answer the volume at the standard state.

① 1.68 L ② 0.84 L ③ 0.42 L ④ 0.21 L ⑤ 0.11 L

(C) How many grams of Ag were deposited on the platinum electrode?

① 32.4 g ② 16.2 g ③ 8.1 g ④ 4.05 g ⑤ 2 g

5. When 8.0 g of a metal (M) was oxidized in the oxygen atmosphere, 10.0 g of MO was obtained owing to the following reaction. Answer the following questions.

$$2M + O_2 \rightarrow 2MO$$

(A) How many liters of O_2 were needed in this reaction? Answer the volume at the standard state.

① 28 L ② 14 L ③ 2.8 L ④ 1.4 L ⑤ 0.7 L

(B) Calculate the weight percentage of M in MO.

① 90% ② 80% ③ 70% ④ 60% ⑤ 50%

(C) Calculate the atomic weight of M.

① 32 ② 48 ③ 64 ④ 80 ⑤ 96