2012 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 2012

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

(2012)

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, Cu = 63.6

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

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

Write the number of your answer in the box provided. Choose the one alternative that best answers the question.

1. Answer the following questions.

(A) What is the oxidation number of manganese in $KMnO_4$?

① – II(-2) ② +III(+3) ③ +IV(+4) ④ +VI(+6) ⑤ +VII(+7)

(B) Which is a redox reaction?

① $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$

② $Ca(OH)_2 + 2\,HCl \rightarrow CaCl_2 + 2\,H_2O$

③ $2\,NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$

④ $HCl + NH_3 \rightarrow NH_4Cl$

⑤ $C_2H_5OH + 3\,O_2 \rightarrow 2\,CO_2 + 3\,H_2O$

(C) Which of the following elements has the greatest electronegativity value?

① Al ② C ③ F ④ Na ⑤ O

(D) Which of the following compounds belongs to the alkyne group?

① methane ② ethane ③ propylene ④ propyne ⑤ isoprene

(E) Which of the following gases has the highest density at the standard state?

① Cl_2 ② O_2 ③ N_2 ④ H_2 ⑤ SO_2

(F) Which of the following compounds is optically active?

① NH_2CH_2COOH ② $CH_3CH_2CH(NH_2)COOH$ ③ $(CH_3)_2C(NH_2)COOH$
④ $HOOC(CH_2)_4COOH$ ⑤ $NH_2(CH_2)_5NH_2$

2. A mixture of 6.0 mol of H_2 gas and 4.5 mol of I_2 vapor was heated at a constant temperature in a reaction vessel and allowed to reach equilibrium. At the equilibrium, the amount of HI was 8.0 mol. Answer the following questions.

(A) Calculate the value of the equilibrium constant for $H_2(g) + I_2(g) \rightleftarrows 2\,HI(g)$

① 8 ② 16 ③ 32 ④ 64 ⑤ 128

(B) A mixture of 2.0 mol of H_2 gas and 2.0 mol of I_2 vapor was heated at the same constant temperature in the same reaction vessel and allowed to reach equilibrium. Calculate the amount of HI.

① 0.40 mol ② 1.2 mol ③ 1.6 mol ④ 2.5 mol ⑤ 3.2 mol

3. The solution was prepared by dissolving 4.0g of NaOH in 1000mL of water.

(A) What is the molarity of this solution?

① 0.050 mol/L ② 0.10 mol/L ③ 0.25 mol/L ④ 1.0 mol/L ⑤ 1.5 mol/L

(B) What is the pH value of this solution?

① 1 ② 4 ③ 7 ④ 10 ⑤ 13

(C) How much of a 0.10 mol/L H_2SO_4 solution is required to neutralize 20 mL of this NaOH solution?

① 5.0 mL ② 10 mL ③ 20 mL ④ 25 mL ⑤ 50 mL

4. The thermochemical equation for the combustion of propane is given as follows;

$C_3H_8(g) + 5\ O_2\ (g) \rightarrow 3\ CO_2(g) + 4\ H_2O\ (l)$ $\quad \Delta H = -2220$ kJ

(A) How many kilojoules are liberated when 8.80 g of $C_3H_8(g)$ reacts according to this reaction?

① 111 kJ ② 222 kJ ③ 333 kJ ④ 444 kJ ⑤ 555 kJ

(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 $C_3H_8(g)$.

① 106 kJ/mol ② 502 kJ/mol ③ 610 kJ/mol ④ 896 kJ/mol ⑤ 1040 kJ/mol

5. An aqueous solution of $CuSO_4$ was electrolyzed with platinum electrodes for 2.0 hours with a 1.5 A current.

(A) What is the correct combination of electrode and generated gas?

① O_2 at cathode ② O_2 at anode ③ H_2 at cathode
④ H_2 at anode ⑤ SO_2 at cathode ⑥ SO_2 at anode

(B) How many coulombs were flowed in this electrolysis?

① 3.00 C ② 180 C ③ 360 C ④ 5400 C ⑤ 10800 C

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

① 0.890 g ② 1.78 g ③ 3.56 g ④ 7.12 g ⑤ 14.2 g

6. The combustion of 12.0 mg of a monocarboxylic acid, which contains only carbon, hydrogen and oxygen, gave 17.6 mg of CO_2 and 7.20 mg of H_2O.

(A) Which is the compositional formula of this compound?

① CH_2O ② CHO_2 ③ CH_2O_2 ④ $C_2H_3O_2$ ⑤ $C_3H_6O_2$

(B) Determine the molecular weight of this compound.

① 30 ② 60 ③ 45 ④ 46 ⑤ 74

7. Answer the following questions about a synthetic polymer.

(A) Choose the correct combination of monomers if the polymer has amide bonds.

① ethylene and propylene ② propylene and vinyl chloride
③ hexamethylenediamine and adipic acid ④ vinyl alcohol and ethylene
⑤ terephtalic acide and ethylene glycol

(B) Which of the following polymers is made of repeating units linked by amide bonds?

① PE ② PET ③ Nylon 6,6 ④ PVC ⑤ PVA