

2017 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 2017

学科試験 問題
EXAMINATION QUESTIONS

(高等専門学校留学生)
NATIONAL INSTITUTE OF TECHNOLOGY STUDENTS

化学
CHEMISTRY

注意 ☆試験時間は 60 分

PLEASE NOTE: THE TEST PERIOD IS 60 MINUTES

CHEMISTRY

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

(2017)

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

Atomic Weight: H = 1.0, C = 12.0, N = 14.0, O = 16.0, Na = 23.0, Cl = 35.5

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

Gas constant: $R = 0.082 \text{ (atm}\cdot\text{L) / (K}\cdot\text{mol)} = 8.31\times 10^3 \text{ (Pa}\cdot\text{L) / (K}\cdot\text{mol)}$

Avogadro constant: $N_A = 6.02\times 10^{23} / \text{mol}$

Pressure: 1 atm = $1.01\times 10^5 \text{ Pa} = 760 \text{ mmHg}$

Faraday constant: $F = 9.65\times 10^4 \text{ C / mol}$

Choose the correct answer from the choices ① to ⑤ below. Select the closest one, when your calculated result does not exactly match any of the values of the alternatives in each group.

Q1 Which of the following elements is not a halogen ?

- ① Cl ② Ar ③ Br ④ I ⑤ F

Q2 Which of the following elements has the smallest atomic radius ?

- ① K ② Cl ③ F ④ Li ⑤ Mg

Q3 Which of the following molecules has the linear molecular geometry ?

- ① NH_3 ② SO_2 ③ H_2O ④ CH_4 ⑤ C_2H_2

Q4 Which of the following compounds is a nonelectrolyte ?

- ① CH_3OH ② NaOH ③ MgSO_4

- ④ CH_3COONa ⑤ KCl

Q5 Which of the following molecules is the most difficult to dissolve in water ?

- ① NO ② NH_3 ③ CO_2 ④ H_2S ⑤ HCl

Q6 Calculate the mass percentage % of oxygen in the acetic acid, CH_3COOH , molecule.

- ① 20 % ② 27 % ③ 40 % ④ 53 % ⑤ 73 %

Q7 The density of a mixture of hydrogen, H_2 , gas and nitrogen, N_2 , gas at the standard state is 0.670 g / L. Calculate the volume percentage % of hydrogen gas in the mixed gas.

- ① 30 % ② 40 % ③ 50 % ④ 60 % ⑤ 70 %

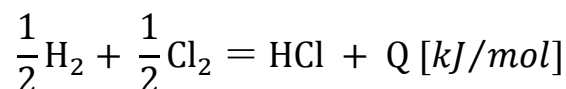
Q8 The density of a solution of 10.0 mol / L sodium hydroxide, NaOH, is 1.33 g / mL. Calculate the mass percentage % of sodium hydroxide in the solution.

- ① 10 % ② 15 % ③ 20 % ④ 25 % ⑤ 30 %

Q9 The solubilities of potassium chloride, KCl, in water are 28 [g / 100 g H₂O] at 273 K, and 51 [g / 100 g H₂O] at 353 K. How many grams of potassium chloride will crystallize out of 250 g of a solution saturated at 353 K if it cools to 273 K ?

- ① 24 g ② 38 g ③ 46 g ④ 67 g ⑤ 83 g

Q10 During the reaction of formation of 3.00 L of hydrogen chloride, HCl, from hydrogen, H₂, and chlorine, Cl₂, at the standard state, 12.4 kJ are evolved. Calculate the heat of formation of hydrogen chloride, Q, according to the following thermochemical equation.



- ① -56 kJ / mol ② -24 kJ / mol ③ +36 kJ / mol
④ +69 kJ / mol ⑤ +93 kJ / mol

Q11 A solution of 100 mL of 8.0×10^{-3} mol / L hydrogen chloride, HCl, and a solution of 50 mL of 1.0×10^{-2} mol / L sodium hydroxide, NaOH, were mixed. Calculate the pH of the mixed solution. Use the following value, if necessary.

$$\log_{10} 2 = 0.30, \quad \log_{10} 5 = 0.70$$

- ① 1.30 ② 1.70 ③ 2.30 ④ 2.70 ⑤ 3.30

Q12 A carbon dioxide, CO_2 , gas occupies a volume of 600 mL at 350 K and 2.43×10^5 Pa. Calculate the mass of the carbon dioxide gas.

- ① 0.05 g ② 2.2 g ③ 5.0 g ④ 22 g ⑤ 50 g

Q13 Calculate the oxidation number of chromium, Cr, in potassium dichromate, $\text{K}_2\text{Cr}_2\text{O}_7$.

- ① -2 ② 0 ③ +4 ④ +5 ⑤ +6

Q14 A certain solution of 10.0 mL of hydrogen peroxide, H_2O_2 , requires 12.0 mL of 0.020 mol/L potassium permanganate, KMnO_4 , to reach the equivalence point for its oxidation. Calculate the molar concentration of hydrogen peroxide in the solution.

- ① 0.050 mol / L ② 0.060 mol / L ③ 0.070 mol / L
④ 0.080 mol / L ⑤ 0.090 mol / L

Q15 When electrolysis of a solution of sodium chloride, NaCl , was carried out for 15 min using a platinum, Pt, electrode, 315 mL of chlorine, Cl_2 , gas was liberated at the standard state. Calculate the current of electrolysis.

- ① 1.0 A ② 2.0 A ③ 3.0 A ④ 4.0 A ⑤ 5.0 A

Q16 Which of the following elements does not have a characteristic flame color ?

- ① Mg ② Ca ③ Ba ④ Na ⑤ K

Q17 Which of the following metal ions does not form a hydroxide precipitate ?

- ① Ba^{2+} ② Mg^{2+} ③ Fe^{2+} ④ Cu^{2+} ⑤ Pb^{2+}

Q18 How many isomers are there for the compound with molecular formula C_4H_8 ?

- ① 3 ② 4 ③ 5 ④ 6 ⑤ 7

Q19 On completely burning 8.8 mg of an organic substance consisting of carbon, hydrogen, and oxygen, 17.6 mg of carbon dioxide, CO_2 , and 7.2 mg of water, H_2O , are obtained. Calculate the number of oxygen in the molecular formula of the organic substance. The molecular weight of the organic substance is 88.

- ① 1 ② 2 ③ 3 ④ 4 ⑤ 5

Q20 Which of the following molecules has a negative reaction in the iodoform test ?

- ① Acetone ② 2-propanol ③ Ethanol
④ Acetaldehyde ⑤ Acetic acid