

2023 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 (MEXT) SCHOLARSHIP 2023

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

CHEMISTRY

(2023)

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

Marks	
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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=64.0

Molar volume of gas at the standard state (STP) : 22.4 L mol^{-1}

Gas constant : $R=0.082 \text{ atm L K}^{-1} \text{ mol}^{-1}=8.31 \times 10^3 \text{ Pa L K}^{-1} \text{ mol}^{-1}$

Avogadro constant : $N_A=6.02 \times 10^{23} \text{ mol}^{-1}$

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

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 the typical element ?

- ① Li ② Mg ③ Ag ④ Si ⑤ Be

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Q2 Which of the following atoms has the smallest number in outermost-shell electrons ?

- ① Xe ② P ③ C ④ N ⑤ Br

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Q3 Which of the following molecules has two lone pair electrons ?

- ① CH_3OH ② C_2H_4 ③ NH_3 ④ CO_2 ⑤ HCl

Q4 Which of the following elements has the highest electronegativity ?

- ① Si ② B ③ C ④ N ⑤ Na

Q5 The density of 15.0 % sulfuric acid, H_2SO_4 , is 1.10 g/mL. Calculate the molar concentration of the sulfuric acid.

- ① 1.50 mol/L ② 1.68 mol/L ③ 2.40 mol/L
④ 3.00 mol/L ⑤ 3.38 mol/L

Q6 Which of the following compounds has the maximum mass percentage of oxygen, O, in the compound ?

- ① CH_3CHO ② $\text{C}_2\text{H}_5\text{OH}$ ③ CH_3OCH_3
④ CH_3COOH ⑤ CH_3OH

Q7 The volume percentage of propane, C_3H_8 , gas is 30 % in a mixture of propane gas and butane, C_4H_{10} , gas at the standard state. Calculate the density of the mixed gas.

- ① 2.24 g/L ② 2.38 g/L ③ 2.40 g/L ④ 2.48 g/L
⑤ 2.84 g/L

Q8 A 2 mL solution is produced by dissolving 0.8 mg of sodium hydroxide, NaOH , in water. What is the pH of this solution ?

- ① 1 ② 2 ③ 11 ④ 12 ⑤ 13

Q9 The solubilities of copper (II) sulfate, CuSO_4 , anhydrous salt in water are 20 [g/100 g H_2O] at 293 K, and 40 [g/100 g H_2O] at 333 K. How many grams of copper (II) sulfate pentahydrate, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, will crystallize out of 361 g of copper (II) sulfate, CuSO_4 , solution saturated at 333 K if it cools to 293 K ?

- ① 40 g ② 52 g ③ 72 g ④ 90 g ⑤ 105 g

Q10 Which of the following molecules has a positive reaction in the iodoform test ?

- ① acetone ② phenol ③ methanol
④ ethane ⑤ acetic acid

Q11 Which of the following metal ions does not form a sulfide precipitate ?

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

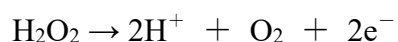
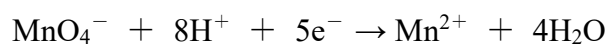
Q12 How many chlorine, Cl, atoms are contained in 55.7 g of sodium hypochlorite, NaClO ?.

- ① 7.5×10^{22} Cl atoms ② 9.8×10^{22} Cl atoms
③ 2.4×10^{22} Cl atoms ④ 4.5×10^{23} Cl atoms
⑤ 5.6×10^{23} Cl atoms

Q13 Calculate the oxidation number of sulfur, S, in sulfuric acid, H_2SO_4 .

- ① -2 ② 0 ③ $+2$ ④ $+4$ ⑤ $+6$

Q14 12.8 mL of 0.20 mol/L potassium permanganate, KMnO_4 , aqueous solution was required to oxidize 20 mL of hydrogen peroxide, H_2O_2 , solution with unknown concentration in sulfuric acid. Calculate the molar concentration of the hydrogen peroxide aqueous solution. At this time, it is assumed that only the following reactions have occurred.



① 0.13 mol/L ② 0.20 mol/L ③ 0.32 mol/L

④ 0.42 mol/L ⑤ 0.63 mol/L

Q15 The heats of formation of carbondioxide $\text{CO}_2(\text{gas})$, water $\text{H}_2\text{O}(\text{liquid})$, ethanol $\text{C}_2\text{H}_5\text{OH}(\text{liquid})$ is 394 kJ/mol, 286 kJ/mol, 277 kJ/mol respectively. Calculate the heat of combustion of ethanol $\text{C}_2\text{H}_5\text{OH}(\text{liquid})$?

① 689 kJ/mol ② 1083 kJ/mol ③ 1369 kJ/mol

④ 1763 kJ/mol ⑤ 2443 kJ/mol

Q16 What is the concentration of sodium hydroxide, NaOH, solution if it takes 12.0 mL to neutralize 10.00 mL of 1.80×10^{-2} mol/L sulfuric acid, H_2SO_4 ?

- ① 1.00×10^{-2} mol/L ② 1.50×10^{-2} mol/L
③ 2.00×10^{-2} mol/L ④ 2.50×10^{-2} mol/L
⑤ 3.00×10^{-2} mol/L

Q17 When 1.15 g of a volatile liquid was completely evaporated at 90 °C, the liquid turned into 377 mL of vapor at 2.0×10^5 Pa. Calculate the molecular weight of this liquid substance.

- ① 28 ② 30 ③ 44 ④ 46 ⑤ 58

Q18 If 7.29 g of glucose (molecular weight = 180) is dissolved in 500 g of water, what will be the freezing point of this solution ? The molar freezing point descent of water is $1.85 \text{ K kg mol}^{-1}$

- ① $-0.405 \text{ }^\circ\text{C}$ ② $-0.150 \text{ }^\circ\text{C}$ ③ $-0.185 \text{ }^\circ\text{C}$
④ $-0.0749 \text{ }^\circ\text{C}$ ⑤ $-0.0146 \text{ }^\circ\text{C}$

Q19 On completely burning 1.48 mg of an organic substance consisting of carbon, C, hydrogen, H, and oxygen, O, 3.26 mg of carbon dioxide, CO_2 , and 1.78 mg of water, H_2O , are obtained. Calculate the number of hydrogen, in the molecular formula of the organic substance. The molecular weight of the organic substance is 60.

- ① 3 ② 4 ③ 6 ④ 8 ⑤ 10

Q20 How many structural isomers are there for the compound with molecular formula C_7H_{16} ? (Stereoisomers are not include in structural isomers)

- ① 6 ② 7 ③ 8 ④ 9 ⑤ 10