

2018 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 2018

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

(2018)

CHEMISTRY

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

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, S = 32.0, Cu = 64.0

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

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

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

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 the noble gas ?

- ① Ne      ② Ar      ③ Br      ④ Kr      ⑤ Xe

Q2 Which of the following elements has the smallest electronegativity ?

- ① K      ② Cl      ③ Zn      ④ Li      ⑤ O

Q3 Which of the following atoms has the most valence electrons ?

- ① N      ② S      ③ Na      ④ Si      ⑤ F

Q4 Which of the following molecules has the most lone pair electrons ?

- ① CH<sub>3</sub>OH      ② C<sub>2</sub>H<sub>4</sub>      ③ NH<sub>3</sub>  
④ CO<sub>2</sub>      ⑤ HCl

Q5 Which of the following oxides is an amphoteric oxide ?

- ① NO<sub>2</sub>      ② CO<sub>2</sub>      ③ Na<sub>2</sub>O      ④ CaO      ⑤ ZnO

Q6 Which of the following compounds has the maximum mass percentage of carbon in the compound ?

- ① CH<sub>3</sub>CHO      ② C<sub>2</sub>H<sub>5</sub>OH      ③ CH<sub>3</sub>OCH<sub>3</sub>  
④ CH<sub>3</sub>OH      ⑤ CH<sub>3</sub>COOH

Q7 The volume percentage of hydrogen,  $H_2$ , gas is 30 % in a mixture of hydrogen gas and methane,  $CH_4$ , gas at the standard state. Answer the following questions.

(A) Calculate the density of the mixed gas.

① 0.28 g / L

② 0.53 g / L

③ 2.8 g / L

④ 5.3 g / L

⑤ 28 g / L

(B) Calculate the heat evolved in a complete combustion of 10.0 L of the mixed gas at the standard state. The heats of combustion of hydrogen and methane are 286 and 891 kJ / mol, respectively.

① 103 kJ

② 209 kJ

③ 317 kJ

④ 421 kJ

⑤ 533 kJ

Q8 The density of 17.0 % sulfuric acid,  $H_2SO_4$ , is 1.12 g / mL. Calculate the molar concentration of the sulfuric acid.

① 0.9 mol / L

② 1.9 mol / L

③ 2.9 mol / L

④ 3.9 mol / L

⑤ 4.9 mol / L

Q9 The solubilities of copper (II) sulfate,  $\text{CuSO}_4$ , in water are 20 [g / 100 g  $\text{H}_2\text{O}$ ] at 293 K, and 54 [g / 100 g  $\text{H}_2\text{O}$ ] at 353 K. How many grams of copper (II) sulfate pentahydrate,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ , will crystallize out of 200 g of a solution saturated at 353 K if it cools to 293 K ?

- ① 32 g      ② 41 g      ③ 55 g      ④ 64 g      ⑤ 77 g

Q10 Calculate the degree of ionization,  $\alpha$ , of  $1.0 \times 10^{-2}$  mol / L acetic acid,  $\text{CH}_3\text{COOH}$ . The ionization constant,  $K_a$ , of acetic acid is  $2.7 \times 10^{-5}$  mol / L. Use the following value, if necessary.

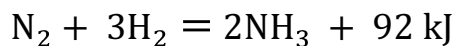
$$\sqrt{3} = 1.73$$

- ① 0.017                      ② 0.026                      ③ 0.035  
④ 0.043                      ⑤ 0.052

Q11 The mass of oxygen,  $\text{O}_2$ , gas occupied a volume of 550 mL is 0.96 g at 330 K. Calculate the pressure of the oxygen gas.

- ①  $0.35 \times 10^5$  Pa              ②  $0.75 \times 10^5$  Pa              ③  $1.5 \times 10^5$  Pa  
④  $2.5 \times 10^5$  Pa              ⑤  $4.0 \times 10^5$  Pa

Q12 In the following reaction, which of the following procedures is correct for the displacement of the equilibrium in the right direction ?



- ① Raising the temperature
- ② Decreasing the pressure
- ③ Reducing the amount of  $\text{NH}_3$
- ④ Reducing the amount of  $\text{N}_2$
- ⑤ Reducing the amount of  $\text{H}_2$

Q13 A certain amount of oxalic acid,  $(\text{COOH})_2$ , reacted with 200 mL of 0.020 mol/L potassium permanganate,  $\text{KMnO}_4$ , to oxidize completely. Calculate the mass of the oxalic acid.

- ① 0.36 g    ② 0.90 g    ③ 1.1 g    ④ 1.4 g    ⑤ 1.8 g

Q14 When electrolysis of a sulfuric acid,  $\text{H}_2\text{SO}_4$ , was carried out at 2.0 A for 25 min using a platinum, Pt, electrode, oxygen,  $\text{O}_2$ , gas was liberated. Calculate the volume of the oxygen gas at the standard state.

- ① 0.14 L                      ② 0.17 L                      ③ 0.34 L
- ④ 0.51 L                      ⑤ 0.68 L

Q15 Which of the following gases is the colored gas ?

- ①  $\text{NO}_2$     ②  $\text{SO}_2$     ③  $\text{CO}_2$     ④  $\text{H}_2\text{S}$     ⑤  $\text{NH}_3$

Q16 Which of the following metal complex ion solutions is the colored solution ?

- ①  $[\text{Cu}(\text{NH}_3)_4]^{2+}$     ②  $[\text{Zn}(\text{NH}_3)_4]^{2+}$     ③  $[\text{Ag}(\text{NH}_3)_2]^+$   
④  $[\text{Zn}(\text{OH})_4]^{2-}$     ⑤  $[\text{Al}(\text{OH})_4]^-$

Q17 How many isomers are there for the compound with molecular formula  $\text{C}_2\text{H}_4\text{O}$  ?

- ① 1    ② 2    ③ 3    ④ 4    ⑤ 5

Q18 Which of the following molecules has a positive reaction in the Fehling's solution test ?

- ① Acetone    ② Dimethyl ether    ③ Ethanol  
④ Acetaldehyde    ⑤ Acetic acid

Q19 Which of the following molecules does not react with ethylene  $\text{CH}_2=\text{CH}_2$  ?

- ①  $\text{Cl}_2$     ②  $\text{Br}_2$     ③  $\text{H}_2$     ④  $\text{N}_2$     ⑤  $\text{HCl}$