2019 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 2019

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

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, Cl = 35.5, Cu = 64.0

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

Gas constant: $R = 0.0082$ atm·L / (K·mol) $= 8.31 \times 10^3$ Pa·L / (K·mol)

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

Pressure: 1 atm = 1.01×10^5 Pa = 760 mmHg

Faraday constant: $F = 9.65 \times 10^4$ 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 the typical element ?

① Zn   ② Mn   ③ Ca   ④ Si   ⑤ Ar

Q2   Which of the following atoms has a different number of neutrons from electrons ?

① ^{4}He   ② ^{14}N   ③ ^{16}O   ④ ^{32}S   ⑤ ^{39}K

Q3　Which of the following atoms has the smallest number of valence electrons?

　　① Cl　　② Be　　③ Al　　④ Ne　　⑤ Na

Q4　Which of the following molecules has the same number of shared electron pairs as unshared electron pairs in one molecule ?

　　① CO_2　　② N_2　　③ O_2　　④ C_2H_4　　⑤ NH_3

Q5　Which of the following salts show acidic when it dissolves in water ?

　　① Na_2CO_3　　② $CaCl_2$　　③ NH_4Cl

　　④ CH_3COONa　　⑤ K_2SO_4

Q6　A 250 mL solution is produced by dissolving 0.10 g of sodium hydroxide in sufficient water.　What is the pH of this solution ?

　　①　1　　②　2　　③　11　　④　12　　⑤　13

Q7 When 10 mL of 1.0 mol / L sulfuric acid reacts with 1.0 g of NaOH, how much reactant will be left after the reaction is completed ?

 ① 0.74 g H_2SO_4 ② none of either compound

 ③ 0.20 g NaOH ④ 0.40 g NaOH ⑤ 0.60 g NaOH

Q8 Calculate the density [g / L] of hydrogen, H_2, gas at standard state.

 ① 0.045 g / L ② 0.089 g / L ③ 0.18 g / L

 ④ 0.45 g / L ⑤ 0.89 g / L

Q9 The solubilities of potassium nitrate, KNO_3, in water are 40 [g / 100 g H_2O] at 27°C, and 169 [g / 100 g H_2O] at 80°C. How many grams of potassium nitrate will crystallize out, when 100 g of the saturated potassium nitrate solution at 80°C is cooled to 27°C ?

 ① 12 g ② 24 g ③ 48 g ④ 60 g ⑤ 69 g

Q10 How much heat is released by the following reaction when 0.25 mol of sodium reacts completely with chlorine ?

$$2Na(s) + Cl_2(g) \rightarrow 2NaCl(s) + 822 \, kJ$$
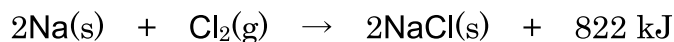
① 103 kJ   ② 206 kJ   ③ 411 kJ

④ 822 kJ   ⑤ 1644 kJ

Q11 In the following reaction, which has the increased oxidation number of the underlined element by the reaction ?

① $2\underline{H}_2O + 2K \rightarrow 2KOH + \underline{H}_2$
② $\underline{Cl}_2 + 2KBr \rightarrow 2K\underline{Cl} + Br_2$
③ $\underline{S}O_2 + 2H_2S \rightarrow 3\underline{S} + 2H_2O$
④ $H_2\underline{O}_2 + SO_2 \rightarrow H_2S\underline{O}_4$
⑤ $\underline{S}O_2 + Br_2 + 2H_2O \rightarrow H_2\underline{S}O_4 + 2HBr$

Q12 9.5 mL of 0.20 mol / L potassium permanganate, $KMnO_4$, aqueous solution was required to oxidize 20 mL of tin (II) chloride, $SnCl_2$, solution with unknown concentration in sulfuric acid. Calculate the molar concentration of the tin (II) chloride aqueous solution. However, at this time, it is assumed that only the following reactions have occurred.

$$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$$
$$Sn^{2+} \rightarrow Sn^{4+} + 2e^-$$
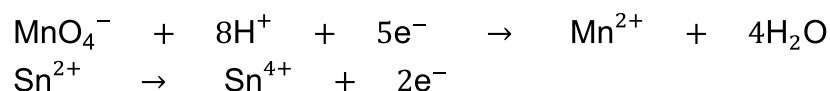
① 0.038 mol / L   ② 0.095 mol / L   ③ 0.19 mol / L

④ 0.24 mol / L   ⑤ 0.48 mol / L

Q13 A copper(II) chloride, $CuCl_2$, aqueous solution was electrolyzed at a current of 1.93 A for 8 minutes and 20 seconds using a carbon, C, electrode. Calculate the mass of the substance produced at the cathode.

① 0.160 g   ② 0.320 g   ③ 0.640 g

④ 1.28 g   ⑤ 3.20 g

Q14 When 1.15 g of a volatile liquid was completely evaporated at 127°C, the liquid turned into 831 mL of vapor at 1.0×10^5 Pa. Calculate the molecular weight of this liquid substance.

① 15   ② 20   ③ 32   ④ 46   ⑤ 83

Q15 When a closed flask of constant capacity holds 2.0 mol each of hydrogen and iodide at a temperature of 30°C, 3.2 mol of hydrogen iodide is produced at equilibrium. Calculate the equilibrium constant K of this reaction.

① 1.6   ② 2.6   ③ 8.0   ④ 20   ⑤ 64

Q16 If 68.4 g of sucrose (molecular weight = 342) 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 K·kg / mol.
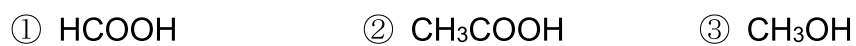
① -7.40×10^{-4} °C ② -3.70×10^{-2} °C ③ -1.85×10^{-1} °C

④ -3.70×10^{-1} °C ⑤ -7.40×10^{-1} °C

Q17 How many isomers are there for the compound with molecular formula C_3H_8O ?

① 1 ② 2 ③ 3 ④ 4 ⑤ 5

Q18 Which of the following compounds show a silver mirror reaction ?

① HCOOH ② CH_3COOH ③ CH_3OH

④ CH_3COCH_3 ⑤ $CH_2{=}CH_2$

Q19 Which of the following compounds is produced when a mixture of ethanol and concentrated sulfuric acid are heated to about 170°C ?

① $CH_2=CH_2$ ② CH_3CHO ③ $HCOOH$

④ CH_3OCH_3 ⑤ $C_2H_5OC_2H_5$

Q20 An unknown compound has the following percentage composition by weight : C = 54.5 %, H = 9.1 % and O = 36.4 %. Its molecular weight is 88. Which is the molecular formula of this compound ?

① CH_2O ② C_2H_4O ③ $C_3H_4O_3$

④ $C_4H_8O_2$ ⑤ $C_5H_{12}O$