

2020 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 2020

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

(2020)

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 = 32.1, Cl = 35.5, 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: $F = 9.65 \times 10^4 \text{ C} / \text{mol}$

$\sqrt{2} = 1.41$, $\sqrt{3} = 1.73$

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 has the most electrons ?

- ① Al ② Ca ③ P ④ S ⑤ Br

Q2 Which of the following atoms has an odd number of neutrons ?

- ① ^{16}O ② ^{14}N ③ ^{12}C ④ ^{32}S ⑤ ^{39}K

Q3 Which of the following atoms has the smallest ionization energy?

- ① Li ② O ③ Ne ④ N ⑤ F

Q4 Which of the following molecules is the most polar?

- ① CO₂ ② N₂ ③ O₂ ④ CH₄ ⑤ NH₃

Q5 Which of the following atoms with the highest electronegativity ?

- ① Na ② F ③ O ④ Ne ⑤ I

Q6 Which of the following compounds is ionically bonded ?

- ① CO₂ ② CH₃Cl ③ NH₃ ④ NaCl ⑤ H₂O

Q7 Which of the following atoms shows yellow color by flame reaction?

- ① Li ② Na ③ K ④ Rb ⑤ Cs

Q8 28.0 L of hydrogen and 11.2 L of oxygen were mixed in the standard state and completely burned. How much gas will remain after reaction completion?

- ① 16.8 L of hydrogen ② none of either gas
③ 5.6 L of hydrogen ④ 2.8 L of hydrogen ⑤ 2.8 L of oxygen

Q9 What is the pH of 0.0005 mol/L sulfuric acid aqueous solution?

- ① 1 ② 2 ③ 3 ④ 4 ⑤ 5

Q10 What is the amount of sodium nitrate precipitated when 112 g of a saturated aqueous solution of sodium nitrate at 60 ° C is cooled to 20 ° C? However, the solubility of sodium nitrate at 60 ° C and 20 ° C is 124 and 88 respectively.

- ① 18 g ② 24 g ③ 36 g ④ 44 g ⑤ 48 g

Q11 How many chloride ions are contained in 27.0 g of copper (II) chloride (CuCl₂)?

- ① 1.2×10^{22} ② 6.0×10^{22} ③ 1.2×10^{23}
④ 2.4×10^{23} ⑤ 6.0×10^{23}

Q12 The body-centered cubic has metal atoms at each of the eight corners and one atom in the center of the cube. What percentage of body-centered cubic filling rate?

- ① 58 % ② 68 % ③ 74 % ④ 84 % ⑤ 92 %

Q13 A copper(II) sulfate (CuSO_4) aqueous solution was electrolyzed at a current of 5.0 A for 32 minutes and 10 seconds using a platinum (Pt) electrode. How much is the compound produced at the cathode?

- ① 0.1 g of H_2 ② 0.2 g of H_2 ③ 1.6 g of Cu
④ 3.2 g of Cu ⑤ 6.4 g of Cu

Q14 9.0 g of copper (II) chloride dihydrate ($\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$) was dissolved in water to prepare a 300 mL aqueous solution. What is the molar concentration of copper (II) chloride solution?

- ① 0.02 mol/L ② 0.18 mol/L ③ 0.22 mol/L
④ 0.5 mol/L ⑤ 3.8 mol/L

Q15 When a mixed gas consisting of 0.6 mol of an alkane and 0.2 mol of propene was completely burned, 3.0 mol of oxygen was required. Choose the molecular formula of this alkane.

- ① CH_4 ② C_2H_4 ③ C_2H_6 ④ C_3H_8 ⑤ C_4H_{12}

Q16 The heats of combustion of carbon (graphite), hydrogen, propane is 395 kJ/mol, 286 kJ/mol, 2220 kJ/mol respectively. Calculate the heat of formation of propane?

- ① -218 kJ ② 109 kJ ③ 177 kJ
④ 189 kJ ⑤ 444 kJ

Q17 The freezing point of an aqueous solution of 0.480 g of urea, $\text{CO}(\text{NH}_2)_2$, dissolved in 20.0 g of water was measured to be -0.74°C . From this result, calculate the molar freezing point depression of water.

- ① 0.19 ② 0.30 ③ 0.40 ④ 1.85 ⑤ 14.8

Q18 How many isomers with molecular formula C_5H_{12} ?

- ① 1 ② 2 ③ 3 ④ 4 ⑤ 5

Q19 Which of the following organic compounds has hydroxyl groups?

- ① glucose ② butane ③ acetylene
④ benzene ⑤ dimethyl ether

Q20 Phenol is manufactured industrially by the cumene method. Choose the compound to be generated with phenol at the final process.

