

2015 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 2015

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

(2015)

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, He = 4.0, C = 12.0, N = 14.0, O = 16.0,

Na = 23.0, Cl = 35.5

Avogadro constant: $6.0 \times 10^{23} \text{ mol}^{-1}$

Molar volume of gas at the standard state: $22.4 \text{ L} \cdot \text{mol}^{-1}$

Choose your correct answer from the choices 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 does not place in the rare gas family on the periodic table?

- ① He ② Xe ③ Ar ④ N ⑤ Ne

Q2 Which of the following molecules has the smallest number in total electrons?

- ① N₂ ② NH₃ ③ CO ④ O₂ ⑤ HCl

Q3 Which of the following atoms has the smallest number in neutrons?

- ① ^{14}N ② ^{15}N ③ ^{12}C ④ ^{13}C ⑤ ^{14}C

Q4 Calculate molar concentration of 62.0wt% nitric acid, HNO_3 (density $1.38 \text{ g}\cdot\text{mL}^{-1}$).

- ① $7.13 \text{ mol}\cdot\text{L}^{-1}$ ② $9.84 \text{ mol}\cdot\text{L}^{-1}$ ③ $11.5 \text{ mol}\cdot\text{L}^{-1}$
④ $13.6 \text{ mol}\cdot\text{L}^{-1}$ ⑤ $14.0 \text{ mol}\cdot\text{L}^{-1}$

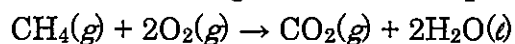
Q5 Calculate the number of oxygen atoms for 1.71 g sucrose, $\text{C}_{12}\text{H}_{22}\text{O}_{11}$.

- ① 3.00×10^{21} ② 3.30×10^{22} ③ 3.60×10^{22}
④ 6.60×10^{22} ⑤ 1.35×10^{23}

Q6 Which of the following gases has the smallest volume (under the standard state) for 1.0 g gas?

- ① O_2 ② N_2 ③ CO ④ He ⑤ Cl_2

Q7 When 1 L methane, CH₄, and 6 L oxygen, O₂, (under the standard state) were reacted as following the chemical equation:



After this reaction, how many liters of gases were left under the standard state? Assume that the water, H₂O, resulted is a liquid.

- ① 2 L ② 3 L ③ 4 L ④ 5 L ⑤ 6 L

Q8 0.70 g of a metal "M" (atomic weight of "M" : 56.0) was oxidized, which led to a formation of 1.00 g of its oxide. Select the composition of this compound listed below.

- ① MO ② MO₂ ③ M₂O ④ M₂O₃ ⑤ M₃O₄

Q9 The heat of combustion of methane CH₄(g) is +891 kJ·mol⁻¹(ΔH=-891kJ·mol⁻¹, exothermic reaction). Calculate the heat of reaction when 1.00 L methane (under the standard state) was combusted.

- ① -55.7 kJ ② -39.8 kJ ③ +39.8 kJ ④ +43.4 kJ
⑤ +55.7 kJ

Q10 Which of the following experimental procedures is not correct for an acid-base titration of an acetic acid, CH_3COOH , solution with the titrant being sodium hydroxide, NaOH , solutions?

- ① The dry measuring pipette was used in order to obtain acetic acid.
- ② A wet conical beaker with water was used.
- ③ Phenolphthalein was used as indicator.
- ④ A wet volumetric flask with water was used in order to dilute acetic acid.
- ⑤ NaOH solution was put into a wet buret with water.

Q11 3.15 g of $(\text{COOH})_2 \cdot 2\text{H}_2\text{O}$ was diluted with water into 500 mL. 8.00 mL of this oxalic acid solution was necessary to neutralize a 10.0 mL of NaOH solution of unknown concentration. What is the concentration of the NaOH solution?

- ① $0.0200 \text{ mol}\cdot\text{L}^{-1}$ ② $0.0400 \text{ mol}\cdot\text{L}^{-1}$ ③ $0.0560 \text{ mol}\cdot\text{L}^{-1}$
- ④ $0.0800 \text{ mol}\cdot\text{L}^{-1}$ ⑤ $0.0280 \text{ mol}\cdot\text{L}^{-1}$

Q12 Which of the following compounds has the largest oxidation number of nitrogen atom?

- ① N_2O ② NO ③ N_2O_3 ④ NO_2 ⑤ HNO_3

Q13 When a metal immerses in a solution listed below, should a reaction occur in which combination?

- ① CuSO_4 solution and Ag ② MgCl_2 solution and Cu
③ NaCl solution and Mg ④ HCl solution and Cu
⑤ FeSO_4 solution and Zn

Q14 When each salt solution below was electrolyzed with Pt electrodes, which option below showed the same cathodic reaction as sodium chloride, NaCl, solution?

- ① CuSO_4 ② H_2SO_4 ③ NaOH
④ AgNO_3 ⑤ CuCl_2

Q15 Which of the following batteries is a storage battery?

- ① $(-)\text{Zn} | \text{KOH}_{\text{aq}} | \text{Ag}_2\text{O}(+)$
② $(-)\text{Zn} | \text{KOH}_{\text{aq}} | \text{MnO}_2(+)$
③ $(-)\text{Zn} | \text{H}_2\text{SO}_{4\text{aq}} | \text{Cu}(+)$
④ $(-)\text{Cd} | \text{KOH}_{\text{aq}} | \text{NiO}(\text{OH})(+)$
⑤ $(-)\text{Zn} | \text{ZnCl}_2(\text{NH}_4\text{Cl})_{\text{aq}} | \text{MnO}_2 | \text{C}(+)$

Q16 Which option is correct for mass changes of electrodes when Daniell cell, $(-)\text{Zn} | \text{ZnSO}_4\text{aq} | \text{CuSO}_4\text{aq} | \text{Cu}(+)$, discharges?

- ① Both electrodes increased.
- ② Cathode increased and anode decreased.
- ③ Cathode decreased and anode increased.
- ④ Both electrodes decreased.
- ⑤ Both electrodes neither increased nor decreased.

Q17 62 mg of organic compound containing C, H, and O burned completely in dry air, which led to a formation of 88 mg of carbon dioxide, $\text{CO}_2(g)$, and 54 mg of water, $\text{H}_2\text{O}(l)$. Determine its empirical formula of this compound.

- ① CHO
- ② CH_2O
- ③ CH_4O_2
- ④ CH_3O
- ⑤ $\text{C}_2\text{H}_3\text{O}_2$

Q18 In which option below does each of the couple have the same number of isomers?

- ① C_3H_6 and C_3H_8
- ② C_3H_6 and C_4H_8
- ③ C_3H_6 and C_4H_{10}
- ④ C_4H_8 and C_5H_{12}
- ⑤ C_4H_{10} and C_5H_{12}

Q19 When iron(III) chloride, FeCl_3 , solution was added to the solutions listed below, which one did not show color reaction?

- | | |
|------------------------|---------------------|
| ① acetylsalicylic acid | ② salicylic acid |
| ③ phenol | ④ methyl salicylate |
| ⑤ σ cresol | |

Q20 Which of the following polymers is formed by condensation polymerization.

- | | |
|--------------------------------|------------------------|
| ① poly(ethylene terephthalate) | ② poly(vinyl chloride) |
| ③ polyethylene | ④ poly(vinyl acetate) |
| ⑤ polypropylene | |