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 項目
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
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: $6.0 \times 10^{23}$ mol$^{-1}$
Molar volume of gas at the standard state: 22.4 L·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?


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

1. $N_2$  2. $NH_3$  3. CO  4. $O_2$  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 g·mL$^{-1}$).

1. 7.13 mol·L$^{-1}$  
2. 9.84 mol·L$^{-1}$  
3. 11.5 mol·L$^{-1}$  
4. 13.6 mol·L$^{-1}$  
5. 14.0 mol·L$^{-1}$

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

1. $3.00\times10^{21}$  
2. $3.30\times10^{22}$  
3. $3.60\times10^{22}$  
4. $6.60\times10^{22}$  
5. $1.35\times10^{23}$

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:

\[ \text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\ell) \]

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(\text{g}) is +891 kJ·mol⁻¹ (\(\Delta H = +891 \text{kJ·mol}^{-1}\), 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, $\text{CH}_3\text{COOH}$, solution with the titrant being sodium hydroxide, $\text{NaOH}$, 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. $\text{NaOH}$ solution was put into a wet buret with water.

Q11 3.15 g of $(\text{COOH})_2\cdot2\text{H}_2\text{O}$ was diluted with water into 500 mL. 8.00 mL of this oxalic acid solution was necessary to neutralize a 10.0 mL of $\text{NaOH}$ solution of unknown concentration. What is the concentration of the $\text{NaOH}$ solution?

1. 0.0200 mol·L⁻¹  
2. 0.0400 mol·L⁻¹  
3. 0.0560 mol·L⁻¹  
4. 0.0800 mol·L⁻¹  
5. 0.0280 mol·L⁻¹

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

1. $\text{N}_2\text{O}$  
2. $\text{NO}$  
3. $\text{N}_2\text{O}_3$  
4. $\text{NO}_2$  
5. $\text{HNO}_3$
Q13  When a metal immerses in a solution listed below, should a reaction occur in which combination?

1  CuSO₄ solution and Ag  2  MgCl₂ solution and Cu  
3  NaCl solution and Mg  4  HCl solution and Cu  
5  FeSO₄ 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  CuSO₄  2  H₂SO₄  3  NaOH  
4  AgNO₃  5  CuCl₂

Q15  Which of the following batteries is a storage battery?

1  (−)Zn | KOH(aq) | Ag₂O(+)  
2  (−)Zn | KOH(aq) | MnO₂(+)  
3  (−)Zn | H₂SO₄(aq) | Cu(+)  
4  (−)Cd | KOH(aq) | NiO(OH)(+)  
5  (−)Zn | ZnCl₂(NH₄Cl)aq | MnO₂ | C(+)
Q16  Which option is correct for mass changes of electrodes when Daniell cell, 
(−)Zn|ZnSO₄aq|CuSO₄aq|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, CO₂(g), and 54 mg 
of water, H₂O(δ). Determine its empirical formula of this compound.

1. CHO  2. CH₂O  3. CH₄O₂  4. CH₃O  5. C₂H₅O₂

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

1. C₃H₆ and C₅H₆
2. C₄H₈ and C₅H₈
3. C₃H₆ and C₄H₁₀
4. C₄H₈ and C₅H₁₂
5. C₄H₁₀ and C₅H₁₂


Q19  When iron(III) chloride, FeCl₃, 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