

2025 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 THE JAPANESE
GOVERNMENT (MEXT) SCHOLARSHIP 2025

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 (2025)

Nationality		No.		(Marks)	
Name	(Please print your full name, underlining the 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, Na = 23.0, S = 32.0, Cl = 35.5, Cu = 63.5

Standard temperature and pressure (abbreviated STP) : 0°C and 1 atm

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

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

Pressure : 1 atm = $1.01 \times 10^5 \text{ Pa}$

Zero of the Celsius scale : 0°C = 273 K

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

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

Ion product of water : $K_w = [\text{H}^+][\text{OH}^-] = 1.0 \times 10^{-14} (\text{mol/L})^2$

Choose the correct answer from ① ~ ⑤ and then fill in the answer sheet. 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 metallic element ?

- ① Ga ② Se ③ Sc ④ Cr ⑤ Be

Q2 Which of the following ions has the highest ionization energy ?

- ① Li ② F ③ Ne ④ Na ⑤ Mg

Q3 Which of the following molecules is the nonpolar molecule ?

- ① HCl ② H₂O ③ NH₃ ④ CO₂ ⑤ H₂S

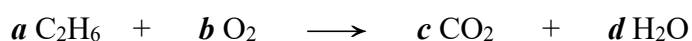
Q4 Which of the following molecules *does not* have a lone pair of electrons ?

- ① CO₂ ② HCl ③ H₂O ④ C₂H₄ ⑤ NH₃

Q5 Which of the following compounds has the largest number of molecules per 1.0 gram ?

- ① CH₄ ② O₂ ③ N₂ ④ H₂O ⑤ NH₃

Q6 Which of the following values is the correct for coefficient ***b*** in the following reaction formula ?



- ① 3 ② 4 ③ 5 ④ 7 ⑤ 10

Q7 Which is the molecular weight of a gas with a density of 1.250 g/L under the standard state ?

- ① 14 ② 16 ③ 28 ④ 32 ⑤ 44

Q8 If a 1.0 mL of a Ca(OH)_2 solution at pH 12.0 was diluted with 99 mL water, which is the molar concentration of Ca(OH)_2 in this diluted solution ?

- ① $1 \times 10^{-4} \text{ mol/L}$ ② $5 \times 10^{-5} \text{ mol/L}$ ③ $2 \times 10^{-12} \text{ mol/L}$
④ $1 \times 10^{-14} \text{ mol/L}$ ⑤ $5 \times 10^{-15} \text{ mol/L}$

Q9 If the volume of a gas is 20 L at 27°C and $1.0 \times 10^5 \text{ Pa}$, how many liters is this gas at 60°C and $3.0 \times 10^5 \text{ Pa}$?

- ① 1.5 L ② 3.0 L ③ 6.0 L ④ 6.7 L ⑤ 7.4 L

Q10 If the mass of a gaseous mixture of oxygen O_2 and nitrogen N_2 in 22.4 L under standard state is 28.4 g, which is the partial pressure of oxygen in the gaseous mixture ?

- ① $1.0 \times 10^4 \text{ Pa}$ ② $2.0 \times 10^4 \text{ Pa}$ ③ $4.0 \times 10^4 \text{ Pa}$
④ $9.0 \times 10^4 \text{ Pa}$ ⑤ $1.0 \times 10^5 \text{ Pa}$

Q11 2.37 g of copper was deposited on the cathode after the solution of an aqueous copper(II) sulfate (CuSO_4) was electrolyzed at 2.4 A with platinum electrode. How many minutes was required for the electrolysis ?

- ① 13 min. ② 25 min. ③ 50 min. ④ 60 min. ⑤ 100 min.

Q12 The osmotic pressure of a solution of 1.8 g of a non-electrolyte substance and water to make 100 mL is 2.5×10^5 Pa at 27°C . Which is the molecular weight of this substance ?

- ① 60 ② 90 ③ 150 ④ 180 ⑤ 240

Q13 The boiling point of an aqueous solution of 0.585 g of sodium chloride (NaCl) dissolved with 100 g of water was measured to be 0.104°C higher than that of pure water. Which is the molar elevation of boiling point of water ?

- ① $0.26 \text{ K} \cdot \text{kg/mol}$ ② $0.52 \text{ K} \cdot \text{kg/mol}$ ③ $0.78 \text{ K} \cdot \text{kg/mol}$
④ $1.04 \text{ K} \cdot \text{kg/mol}$ ⑤ $2.08 \text{ K} \cdot \text{kg/mol}$

Q14 A mixed gas of 60% ethane, 10% carbon monoxide, and 30% carbon dioxide (in volume) was prepared. Which is the amount of the heat of complete combustion of 1000 L gas mixture under standard state ? (The heats of combustion of ethane and carbon monoxide are 1561 kJ/mol and 283 kJ/mol, respectively.)

- ① $4.0 \times 10^3 \text{ kJ}$ ② $1.5 \times 10^4 \text{ kJ}$ ③ $2.2 \times 10^4 \text{ kJ}$ ④ $3.3 \times 10^4 \text{ kJ}$ ⑤ $4.3 \times 10^4 \text{ kJ}$

Q15 Which of the following substances underlined acts as an oxidizing agent ?

- ① $2 \text{KMnO}_4 + 5 \underline{\text{H}_2\text{O}_2} + 3 \text{H}_2\text{SO}_4 \longrightarrow 2 \text{MnSO}_4 + 5 \text{O}_2 + \text{K}_2\text{SO}_4 + 8 \text{H}_2\text{O}$
② $\underline{\text{MnO}_2} + 4 \text{HCl} \longrightarrow \text{MnCl}_2 + 2 \text{H}_2\text{O} + \text{Cl}_2$
③ $\underline{\text{SO}_3} + \text{H}_2\text{O} \longrightarrow \text{H}_2\text{SO}_4$
④ $2 \underline{\text{Al}} + 6 \text{HCl} \longrightarrow 2 \text{AlCl}_3 + 3 \text{H}_2$
⑤ $\text{Fe}_2\text{O}_3 + 3 \underline{\text{CO}} \longrightarrow 2 \text{Fe} + 3 \text{CO}_2$

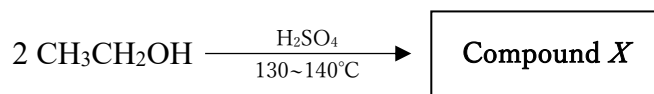
Q16 Which of the following compounds has an unsaturated bond ?

- ① cyclopropane ② acetaldehyde ③ vinyl chloride
④ ethyl acetate ⑤ glycerine

Q17 Which of the following sentences is correct for the characteristics of organic compounds ?

- ① Many of them are combustible and produce carbon dioxide when completely burned.
② Because they have fewer constituent elements, they have fewer types of compounds.
③ Many of them are electrolytes.
④ Many of them are soluble in water, and insoluble in organic solvents such as ether.
⑤ Because they have extremely high melting and boiling points, they are stable to heat.

Q18 Which is “Compound X” produced by the following reaction ?



- ① $\text{CH}_3-\underset{\text{OH}}{\text{CH}}-\text{CH}_2-\text{CH}_3$ ② $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{C}-\text{CH}_3 \\ | \\ \text{OH} \end{array}$ ③ $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{OH}$
④ $\text{CH}_3-\text{CH}_2-\text{O}-\text{CH}_2-\text{CH}_3$ ⑤ $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{O}-\text{CH}_3$

Q19 How many liters of oxygen under the standard state is required for the complete combustion of 37 g of butanol ?

- ① 3.0 L ② 22 L ③ 34 L ④ 67 L ⑤ 72 L

Q20 Among the polymers (a)~(e), two are formed by condensation polymerization. Which of the following combinations is correct ?

- (a) poly(ethylene terephthalate)
- (b) polyethylene
- (c) nylon 6,6
- (d) poly(vinyl chloride)
- (e) styrene butadiene rubber

- ① a, b ② a, c ③ b, c ④ b, d ⑤ b, e