

2017 Enrolment The 3rd  
Japan University Examination  
**Chemistry**

Examination Date: July 2016

( 60 min )

Do not open the examination booklet until the starting signal for the exam is given.

Please read the following instructions carefully.

Please fill in the examinee no. and name below.

**Instructions**

1. The booklet contains 11 pages.
2. The answer sheet is one piece of one sided paper.
3. In the case that you notice there are parts in the booklet where the print is not clear or there are missing pages or misplaced pages, or the answer sheet is soiled, raise your hand to report to the invigilator.
4. There are 4 questions to be answered.
5. Fill the examinee no. and name in the answer sheet.
6. Use black pencil to write answers in the designated section in the answer sheet.
7. Memos and calculations can be written on the examination booklet.
8. When the signal to end the exam is given, check again to see that the examinee no. and name is filled in and submit the answer sheet and the examination booklet according to the invigilator's instructions.

Examinee's No.	Name



# Chemistry

Atomic weight : H=1.0, C=12, O=16.

Per unit volume : 1 L=1 dm<sup>3</sup>=1000 mL=1000 cm<sup>3</sup>

Density : 1 g/cm<sup>3</sup>=1 g cm<sup>-3</sup>

Molar concentration : 1 mol/L=1 mol L<sup>-1</sup>=1 M=1 mol dm<sup>-3</sup>

Amount heat per 1 mol : 1 kJ/mol=1 kJ mol<sup>-1</sup>.

Molar volume of gas in the standard condition (0°C, 1.013×10<sup>5</sup> Pa) : 22.4 L/mol (=22.4 L mol<sup>-1</sup>)

(Remark): The molar volume of gas is the volume occupied by the gas per 1 mol.

## Question 1

For the following (1) ~ (8), please choose one right answer from ①~④, and fill in the number in the answer sheet .

(1) What is the Chemical symbol for iron element?

- ① I                      ② In                      ③ Fe                      ④ Fm

(2) What is the right pair for the congeners?

- ① H and He              ② C and P              ③ Si and S              ④ B and Al

(3) What is the right pair for the alkaline earth metal elements?

- ① Li and Na              ② K and Ca              ③ Na and Al              ④ Ca and Ba

(4) In the following (i)~(iv), what is the right combination for the molecules which with a triple bond?

(i)  $\text{CO}_2$             (ii)  $\text{N}_2$             (iii)  $\text{C}_2\text{H}_2$             (iv)  $\text{C}_2\text{H}_4$

① (i) and (ii)    ② (ii) and (iii)    ③ (iii) and (iv)    ④ (ii) and (iv)

(5) What is the right molecule with the most bonds in the structural formula?

①  $\text{HCl}$             ②  $\text{N}_2$             ③  $\text{H}_2\text{O}$             ④  $\text{CH}_4$

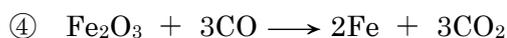
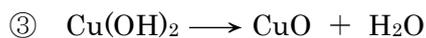
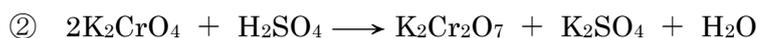
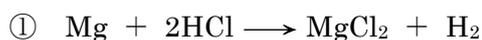
(6) In oxide  $\text{M}_2\text{O}_3$  of metal M, M is contained by 66.7% from mass weight. Then, which one is right as the most suitable numerical value for the atomic weight?

① 27            ② 32            ③ 48            ④ 56

(7) For the following oxides, which one can dissolve and react with hydrochloric acid ( $\text{HCl}$ ) and sodium hydroxide ( $\text{NaOH}$ ) separately?

①  $\text{Ag}_2\text{O}$             ②  $\text{ZnO}$             ③  $\text{SiO}_2$             ④  $\text{Fe}_2\text{O}_3$

(8) For the following reaction, which one is right that the number of oxidation for the metal atom is increased after the reaction?



## Question 2

- (1) In the following description of Ozone ( $O_3$ ), please fill in the right words in , and fill in the right number in  respectively. Note: The number is written down by two significant figures.

Ozone is the  of oxygen ( $O_2$ ), and is generated by discharge in oxygen or ultraviolet irradiation to oxygen.

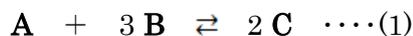


When 1000 mL oxygen was subjected to discharge under standard conditions, the volume changed to 985 mL under standard conditions. In this case, % of oxygen changed to ozone by the discharge.

- (2) In the following description of the neutralization titration, please fill in the name of the indicator in , and fill in the right number in  respectively. Note: The number is written down by two significant figures.

The concentration of 10.0 mL ammonia water ( $NH_3$ ) was unknown, added 2~3 drops of the indicator  solution to the ammonia water ( $NH_3$ ), then it was titrated by 0.10 mol/L hydrochloric acid (HCl). When dropping amount of hydrochloric acid was 20.0 mL, the color of the solution changed from yellow to red, which was the end point by confirmed. Therefore, it was sure that the concentration of the ammonia water was  mol/L.

- (3) The substance C is generated by the reaction from the substance A and the substance B, and the reaction is reversible as the following equation (1).



Put 10 mol substance A and 30 mol substance B in a variable volume container, and make them to react with specified pressure and temperature.

From the above, please answer the following questions (a · b). Note: The substance A~C is always a gaseous state under normal condition.

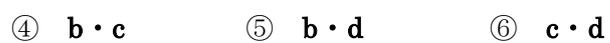
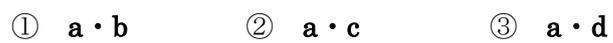
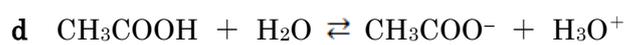
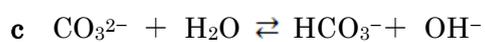
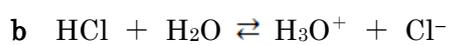
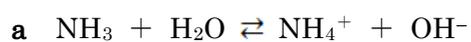
**a** When the reaction reached the equilibrium condition under a certain pressure and temperature, the volume of the container changed to 0.70 times before reaction. Then, how many moles are needed for the amount of substance of C in the equilibrium state? Note: The number is written down by two significant figures.

**b** The positive reaction of (1) is an exothermic reaction. If the equilibrium of (1) is moved to the right, and the production amount of C is increased in the equilibrium state, then how to change the temperature and pressure? Please choose the best answer from the following ①~④.

- ① High temperature and high pressure.
- ② High temperature and low pressure.
- ③ Low temperature and high pressure.
- ④ Low temperature and low pressure.

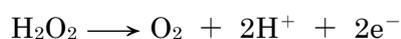
### Question 3

(1) The acid is a substance which gives hydrogen ion to other substances. In the following reaction (a~d), please choose one right combination that the water works as acid from ①~⑥ below.



(2) For the following description, please answer the questions (a, b) below.

When add the hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) into the sulfuric acid solution of potassium permanganate( $\text{KMnO}_4$ ), then the permanganate ion  $\text{MnO}_4^-$  is  to manganese (II)ion  $\text{Mn}^{2+}$  in the solution. At the moment, the oxidation number of manganese atoms changes from  to +2, and the permanganate ion and hydrogen peroxide have changes as follows respectively.

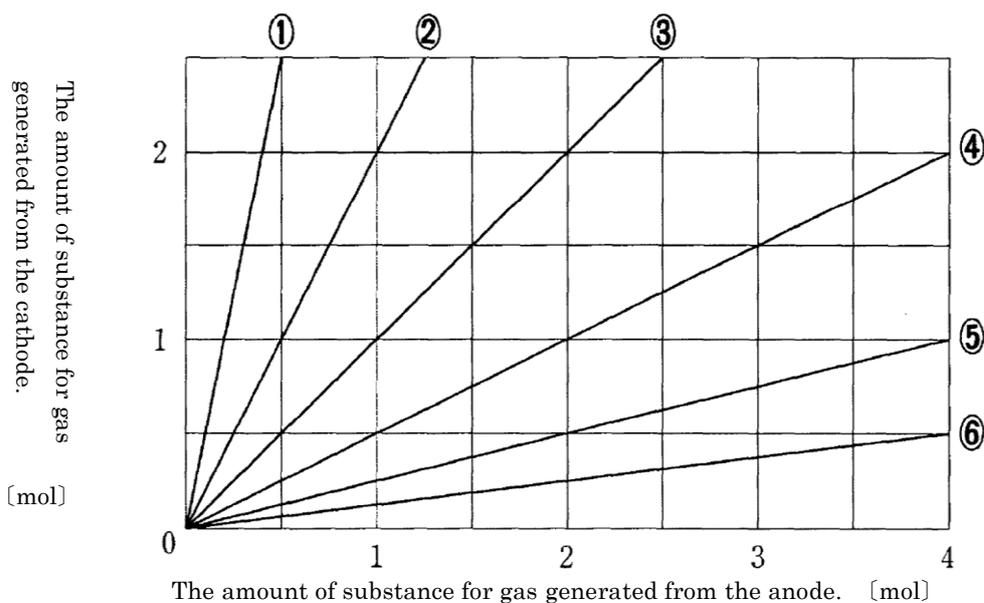


a Please choose a right pair which the words for the blank  and the number for the blank  from ①~⑥ below.

	A	B
①	oxidized	+7
②	oxidized	+4
③	oxidized	0
④	reduced	+7
⑤	reduced	+4
⑥	reduced	0

b If 1 mol potassium permanganate to react with the hydrogen peroxide without excess or deficiency, then how many moles are needed for the amount of substance of hydrogen peroxide? Note: The number is written down by two significant figures. .

- (3) Use platinum as the anode and cathode to electrolyze the sodium sulfate solution ( $\text{Na}_2\text{SO}_4$ ). Then the relationship between the amount of substance of gas which generated from the anode and the cathode is showed by the following straight lines, please choose the right one from ①~⑥ in fig.



Fig

- (4) For the following description of the simple substance and compounds of halogen (F, Cl, Br, I), please choose the wrong one from ①-⑤ below.
- ① All the simple substances of halogen are the diatomic molecule, and among them fluorine has the most strong oxidizing power.
  - ② Upon heating of concentrated hydrochloric acid with the manganese oxide (IV), then chlorine is generated.
  - ③ Chlorine is soluble in water, and a portion of chlorine reacts with the water to produce the hydrogen chloride and hypochlorite.
  - ④ Iodine is the black purple solid and easily to sublimate, but it is hard to dissolve in water..
  - ⑤ Among the silver halide, silver chloride dissolves well in water.

(5) For the following description (a, b), please choose the metal element which applies for both from ①~⑤ below.

**a** The simple substance reacts with water under normal temperature condition, and is soluble while producing gas.

**b** Sulfate dissolves well in water.

① Mg            ② Zn            ③ Ca

④ Na            ⑤ Cu

#### Question 4

(1) For the following description of the hydrocarbon, please choose the wrong one from ①-⑤ below.

- ① When add water to the calcium carbide, acetylene is produced.
- ② When the acetylene passes the red-hot iron pipe, and the benzene is produced.
- ③ When the benzene reacts with propene, then cumene is produced.
- ④ When add water to the acetylene, and then formaldehyde is produced.
- ⑤ If the toluene is oxalated, benzoic acid is produced.

(2) For the following compounds a ~ d, please choose a right pair which all have the stereoisomers from ① ~ ⑥ below.



① **a, b**

② **a, d**

③ **b, c**

④ **b, d**

⑤ **c, d**

⑥ **b, c, d**

(3) The following descriptions for the carboxylic acid, please choose the right one from ① ~ ⑤ below.

- ① Phthalic acid is difficult to dissolve in water, but highly soluble in hydrochloric acid.
- ② When take away one molecule of water from 2 molecules of the acetic acid and make 2 molecules of the acetic acid to combine, glacial acetic acid is produced.
- ③ When heating the fumaric acid, the water is taken away from the molecule and fumaric anhydride is produced.
- ④ The adipic acid is used as a raw material for nylon 66.
- ⑤ Formic acid is obtained by the oxidation of acetaldehyde.

(4) In the following reaction of ① ~ ⑤, please choose one that without the addition reaction.

- ① The propene reacts with the chlorine and the 1,2 - dichloropropane is produced.
- ② The benzene reacts with the chlorine and the 1,2,3,4,5,6 -hexachlorocyclohexane is produced.
- ③ The benzene reacts with the chlorine and the chlorobenzene is produced.
- ④ The propyne reacts with the hydrogen and the propene is produced.
- ⑤ The cyclohexene reacts with the hydrogen and the cyclohexane is produced.

(5) The compound A has one ester bond in the molecule. If 3.7g A is saponified completely, then it need  $5.0 \times 10^{-2}$ mol sodium hydroxide, and obtain the alcohol for 1.6g. Please choose the right one for A from ①~⑤ below.

