Inorganic Chemistry

(1) Gases

-2006 I(5)

What is the gas formed when Iron (II) sulfide FeS is heated with dilute sulfuric acid?

1) Water vapour

2) Hydrogen sulfide

3) Sulfur dioxide

4) Sulfur trioxide

-2008 I(2)

(2) Select two suitable chemical reagents to form sulfur dioxide in a laboratory.

1) sodium chloride　2) sodium hydroxide　3) sodium sulfite

4) iron sulfide　5) formic acid　6) sulfuric acid

-2010 Q11

Q11 From ①–⑥ below choose the one that contains two methods to generate hydrogen.

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(**a**) Metallic sodium (Na) is added to water.

(**b**) Hydrochloric acid (HCl *aq*) is added to copper (Cu).

(**c**) Water is electrolyzed.

(**d**) Hydrochloric acid is added to manganese(IV) oxide (MnO_2) and the mixture is heated.

① **a, b**　② **a, c**　③ **a, d**　④ **b, c**　⑤ **b, d**　⑥ **c, d**

-2017 I(6)

(6) Which of reactions described in 1) to 4) is not accompanied by generation of gas?

1) Excess aqueous ammonia is added to silver chloride.
2) Concentrated sulfuric acid is added to sodium chloride and the mixture is heated.
3) Hydrochloric acid is added to iron(II) sulfide.
4) Aqueous solution of hydrogen peroxide is added to manganese dioxide.

-2017 I(6)

(6) Which of reactions described in 1) to 4) is not accompanied by the generation of gas?

1) Boiling water is added to magnesium.
2) Hydrofluoric acid is added to silicon dioxide.
3) Hydrochloric acid is added to calcium carbonate.
4) Aqueous solution of sodium hydroxide is added to aluminum

-2018 VII(1)

(1) When 0.056g of protein was heated with concentrated sulfuric acid, the protein was completely decomposed. Which of 1) to 5) is the nitrogen compound that is formed?

1) ammonium sulfate 2) aniline 3) pyridine 4) ammonium chloride
5) carbon dioxide

-2020 I(6)

(6) Which of the following reactions is accompanied by the generation of oxygen?

1) Blowing fluorine into water.
2) Addition of sulfuric acid to zinc.
3) Addition of water to potassium.
4) Addition of hydrochloric acid to copper(II) oxide.

(2) Ions

-2006 I(4)

There is a solution contains Ag^{+} and Cu^{2+} ions. As to precipitate only one of the two ions, which reagent among 1) to 5) is the most suitable one?

1) Ammonia water

2) Hydrogen sulfide

3) Aqueous solution of sodium hydroxide

4) Hydrochloric acid

5) Nitric acid

-2007 I(1)

(1) Which of the following compounds 1) to 4) is insoluble in aqueous ammonia?

1) AgCl
2) $Al(OH)_3$
3) $Cu(OH)_2$
4) $Zn(OH)_2$

-2007 I(6)

(6) Bubbling hydrogen sulfide through an acidic solution produces black precipitates. Which of the following cations 1) to 5) is contained in the solution?

1) Al^{3+}
2) Ba^{2+}
3) Cd^{2+}
4) Pb^{2+}
5) Zn^{2+}

-2009 I(3)

(3) There is an aqueous solution containing Cu^{2+} and Pb^{2+} ions. The most suitable reagent to precipitate one of the two ions from the solution is

1) nitric acid
2) sodium carbonate
3) sulfuric acid
4) hydrogen sulfide

-2009 I(8)

(8) The addition of aqueous solutions of (a) ammonia, (b) ammonium sulfide, and (c) potassium hexacyanoferrate(II) to an aqueous solution containing Fe^{3+} each produce precipitate. What is the color of the precipitate?

1) white 2) black 3) green 4) light blue 5) dark blue
6) dark reddish-brown 7) purple 8) yellow

-2012 III

III Procedures (i) to (iii) describe experiments to separate individual metal ions from a neutral aqueous solution which contains Ag^{+}, Cu^{2+} and Zn^{2+}. Write the appropriate colors for (a) and (b), and appropriate chemical formula for (1) and (2).

(i) Upon addition of hydrochloric acid to the solution, (a) precipitates formed. The chemical formula of the precipitates is (1).
(ii) To the supernatant obtained from experiment (i), (2) was bubbled in to form (b) precipitates.
(iii) To the supernatant obtained from experiment (ii), base was added and (2) was bubbled in to form white precipitates.

-2015 IV

IV Give the names of appropriate element for (a) ~ (d) in the passages below.

(1) (a) and (b) are elements that belong to period 5 and 6 in the periodic table, respectively. Both simple substances are solid under room temperature. To an aqueous solution containing cations of (a) and (b), dilute hydrochloric acid was dropped to produce white precipitate. Upon rinsing with boiling water, the precipitate was partially dissolved.
(2) Both (c) and (d) are elements that produce stable trivalent cations in an aqueous solution. To an aqueous solution containing (c) and (d) as trivalent cations, aqueous ammonia was dropped to produce a gel-like precipitate. Upon the addition of concentrated aqueous sodium hydroxide, the precipitate was partially dissolved and the majority of (c) was transferred to the supernatant.

-2017 IV(1)

(1) Aqueous solutions of sodium hydroxide and hydrogen peroxide were successively added into an aqueous solution containing Cr^{3+} and Fe^{3+}, so that the resultant solution was basic. Heating of the solution led to the precipitation of (a). After the precipitation was removed, the supernatant solution became weak acid by adding acetic acid. Further addition of lead acetate into the solution led to the precipitation of (b).

-2019 II(c)(d)

Dissolution of metallic silver Ag(0) into dilute and concentrated nitric acid solutions generates (a) and (b) gases, respectively. Addition of aqueous ammonia into an aqueous solution of silver nitrate generates (c) as a black precipitate, and further addition of excess aqueous ammonia causes (c) to disappear. In the resultant aqueous solution, (d) is present as a cation.

(3) Elements and Their Derivatives

-2007 I(3)

(3) Which of the following metals 1) to 6) reacts with water to evolve hydrogen gas at room temperature?

1) Ag　　2) Ca　　3) Cu

4) Fe　　5) Pb　　6) Zn

-2010 Q13

Q13 From ①–⑥ below choose the best combination of elements that are true for the following statements (**a**)-(**c**), respectively. **13**

(**a**) Its oxide is a basic oxide.

(**b**) Its hydrogen compound is soluble in water and exhibits a strong acidity.

(**c**) The composition of its hydrogen compound is XH_4 (where X stands for an element) .

	a	b	c
①	Al	Cl	C
②	Al	S	N
③	Ca	Cl	P
④	Ca	I	C
⑤	Na	I	N
⑥	Na	S	P

-2010 Q15

Q15 From ①–④ below choose the statement that is **only true for aluminum (Al) or only true for zinc (Zn)**. **15**

① The metal dissolves in hydrochloric acid (HCl *aq*).

② The metal dissolves in aqueous sodium hydroxide (NaOH *aq*).

③ A precipitate is formed when aqueous ammonia (NH_3 *aq*) is added to the aqueous solution of each ion. This precipitate dissolves if excess aqueous ammonia is added.

④ A precipitate is formed when aqueous sodium hydroxide is added to the aqueous solution of each ion. This precipitate dissolves if excess aqueous sodium hydroxide is added.

-2012 I(4)

(4) Which of the metals 1) to 4) is insoluble in hydrochloric acid?

1) copper 2) magnesium 3) tin 4) zinc

-2013 I(2)

(2) In the solid state which of the substances 1) to 4) has the highest density?

1) gold 2) diamond 3) iron 4) magnesium

-2013 III

III Give the appropriate name of compounds that contain calcium for (a) to (d) by the chemical formulas.

(i) The reaction of metallic calcium with water produces (a). (b) is obtained by the reaction of (a) with carbon dioxide

(ii) Oxidation of metallic calcium produces (c). The reaction of (c) with water produces (a).

(iii) Both (a) and (b) produces (d) by their reactions with hydrogen chloride. Metallic calcium is obtained by the electrolysis of (d).

-2013 VII(2)

Write the name of organic compound obtained from the reaction

(2) reaction of calcium carbide with water

-2014 I(4)

(4) Which of the substances 1) to 4) has the highest melting point?

1) Ag 2) Al 3) Fe 4) Sn

-2015 I(5)

(5) Which of the descriptions 1) to 4) is not correct for the properties of sodium?

1) The unit cell of crystalline sodium has a cubic shape.
2) Sodium metal is chemically stable in an ambient atmosphere.
3) The reaction with alcohol produces H_2.
4) Using a flame test, sodium shows as a bright yellow color.

-2016 I(5)

(5) Which of the descriptions 1) to 4) is correct for the properties of carbon and silicon?

1) In both simple substances atoms are connected by metallic bonds.
2) Both chlorides are in a gaseous state under ambient conditions.
3) Both oxides contain double bonds under ambient conditions.
4) Both hydrides have tetrahedral molecular structure.

-2017 I(2)

(2) Which of the substances 1) to 4) is an amphoteric oxide?

1) MgO 2) Al_2O_3 3) SiO_2 4) SO_3

-2017 I(5)

(5) Which of the descriptions 1) to 4) is not correct for the properties of fluorine and chlorine?

1) The atomic radii of chlorine is larger than that of fluorine.
2) Both elements form the diatomic molecules.
3) A simple substance of fluorine is a stronger oxidizing agent than that of chlorine.
4) Neither fluorine nor chlorine form oxides.

-2018 I(5)

(5) Which of the descriptions 1) to 4) is not correct for the properties of silver and gold?

1) Both have high electrical conductivity.
2) Both have high thermal conductivity.
3) Both dissolve in nitric acid.
4) Silver is more easily oxidized than gold.

-2019 I(5)

(5) Which of the descriptions 1) to 4) is correct for copper and zinc?

1) Both form divalent cation.
2) Both dissolve in hydrochloric acid.
3) Both sulfides dissolve in concentrated hydrochloric acid.
4) Copper is more easily oxidized than zinc.

-2020 I(5)

(5) Which of the following descriptions is correct for phosphorus and sulfur?

1) Both are group 16 elements.
2) Both have allotropes.
3) Both oxides exist as solid at ambient temperature and pressure.
4) Both oxides produce basic solutions when dissolved into water.