

Name: _____ Department: _____ Student ID No.: _____

Note:

- ✧ **Time: 12:20~13:10**
- ✧ **Write down the answers on the test sheet.**
- ✧ **There are 20 questions in the test, 4 points for each and the total score is 80.**
- ✧ **The questions marked with * has only one answer.**
- ✧ **Atomic mass (amu): O = 16.0, Cu = 63.6, S = 32.1, R = 0.082 L atm/mol K**

Experiment 1 Molar volume of nitrogen gas

1. According to the experiment, which statement is correct?
 $\text{NO}_2^-_{(\text{aq})} + \text{H}_2\text{NSO}_3\text{H}_{(\text{s})} \rightarrow \text{HSO}_4^-_{(\text{aq})} + \text{H}_2\text{O}_{(\text{l})} + \text{N}_{2(\text{g})}$
 (A) Sulfamic acid ($\text{H}_2\text{NSO}_3\text{H}$) is the oxidant.
 (B) Sodium nitrite (NaNO_2) is a hygroscopic and white to slight yellowish crystal.
 (C) Nitrogen dioxide (NO_2) is the by-product of the reaction.
 (D) The theoretical molar volume of nitrogen gas is 22.4 L at standard temperature and pressure.
2. Which of the following measurement has four significant figures?
 (A) 298.0 K (B) 760.2 mmHg (C) 314.5 mL (D) 0.022 g

Experiment 3 Determination of the chemical formula of a compound

3. According to the experiment, which statement is correct?
 (A) Copper oxide shows red color.
 (B) Calcium chloride is the reducing agent in the experiment.
 (C) We use zinc metal react with hydrochloric acid to produce hydrogen gas.
 (D) The reaction of zinc and $\text{HCl}_{(\text{aq})}$ is exothermic.

Experiment 6 The enthalpies of reactions

4. According to the experiment, which enthalpy change of reaction is correct?
 (A) $\text{CH}_3\text{COOH}_{(\text{aq})} + \text{NaOH}_{(\text{aq})} \rightarrow \text{CH}_3\text{COONa}_{(\text{aq})} + \text{H}_2\text{O}_{(\text{l})}$ $\Delta H > 0$
 (B) $\text{NH}_4\text{NO}_{3(\text{s})} + \text{H}_2\text{O}_{(\text{l})} \rightarrow \text{NH}_4^+_{(\text{aq})} + \text{NO}_3^-_{(\text{aq})}$ $\Delta H_{\text{soln}} > 0$
 (C) $\text{Mg}_{(\text{s})} + 2\text{HCl}_{(\text{aq})} \rightarrow \text{MgCl}_{2(\text{aq})} + \text{H}_{2(\text{g})}$ $\Delta H > 0$
 (D) $\text{MgO}_{(\text{s})} + 2\text{HCl}_{(\text{aq})} \rightarrow \text{MgCl}_{2(\text{aq})} + \text{H}_2\text{O}_{(\text{l})}$ $\Delta H > 0$
- *5. Calculate the molar enthalpy of combustion of ethanol according to the following data:
 $\text{C}_2\text{H}_5\text{OH}_{(\text{l})} + 3\text{O}_{2(\text{g})} \rightarrow 2\text{CO}_{2(\text{g})} + 3\text{H}_2\text{O}_{(\text{l})}$
 $\Delta H_f^0(\text{H}_2\text{O}_{(\text{g})}) = -242 \text{ kJ/mol}$; $\Delta H_f^0(\text{H}_2\text{O}_{(\text{l})}) = -290 \text{ kJ/mol}$;
 $\Delta H_f^0(\text{CO}_{2(\text{g})}) = -390 \text{ kJ/mol}$; $\Delta H_f^0(\text{C}_2\text{H}_5\text{OH}_{(\text{l})}) = -280.0 \text{ kJ/mol}$
 (A) -1226 kJ/mol (B) -400 kJ/mol (C) -352 kJ/mol (D) -1370 kJ/mol

Experiment 8 Acid-base indicators and pH determination

6. Which of the following 0.10 M solution is basic ($\text{pH} > 7$)?
 (A) CH_3COONa (B) NH_4Cl (C) NaHCO_3 (D) Na_3PO_4
- *7. The K_a value of an acid-base indicator is 1×10^{-5} , then the indicator changes color in the range
 (A) pH 3~5 (B) pH 4~6 (C) pH 5~8 (D) pH 4~10

Experiment 9 Solubility Rules

8. Which of the following pair of solutions will form precipitate while mix together?
(A) 0.3 M KNO_3 and 0.3 M Na_2CO_3 (B) 0.3 M NaCl and 0.3 M $\text{Fe}(\text{NO}_3)_3$
(C) 0.3 M $\text{Pb}(\text{NO}_3)_2$ and 0.3 M Na_3PO_4 (D) 0.3 M Na_2SO_4 and 0.3 M $\text{Co}(\text{NO}_3)_3$
9. Choose the reagent that can be used to separate the Hg_2^{2+} and Al^{3+} cations?
(A) $\text{NaCl}_{(aq)}$ (B) $\text{Na}_2\text{CO}_{3(aq)}$ (C) $\text{Na}_3\text{PO}_{4(aq)}$ (D) $\text{NaNO}_{3(aq)}$

Experiment 10 Qualitative Analysis of Cation Group 1

10. Which of the following description of color is correct?
(A) $\text{PbCrO}_{4(s)}$, yellow (B) $\text{Hg}_2\text{Cl}_{2(s)}$, black (C) $\text{Ag}(\text{NH}_3)_2^+_{(aq)}$, deep blue (D) $\text{PbCl}_{2(s)}$, white

Experiment 12 Quantitative analysis of vitamin C

- *11. In the experiment, a vitamin C tablet was dissolved in water and diluted to 100.0 mL. A student took 50.0 mL of solution to titrate. The titration volume of 0.0250 M $\text{KIO}_{3(aq)}$ was 15.80 mL. Calculate the ascorbic acid content per tablet. (The molar mass of vitamin C is 176 g/mol)



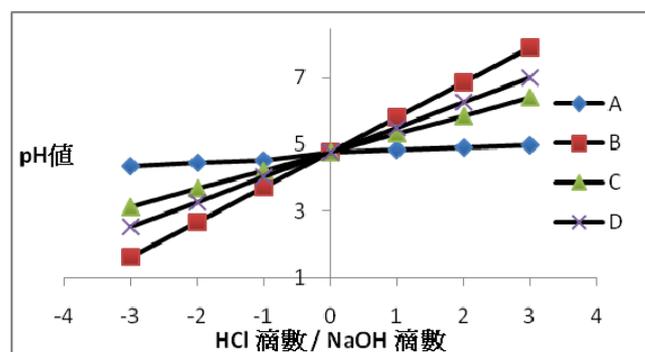
- (A) 69.5 mg (B) 209 mg (C) 834 mg (D) 417 mg
12. According to the experiment, which of the following statement is correct?
(A) Vitamin C is also called ascorbic acid.
(B) Iodide ion (I^-) react with starch indicator to form blue complex.
(C) Vitamin C is an ionic compound and soluble in water.
(D) Vitamin C is used as a reducing agent.

Experiment 13 Determination of solubility product constant of silver acetate

13. Which of the following would affect the K_{sp} value of silver acetate (CH_3COOAg)?
(A) Temperature (B) pH value of solution (C) Common ions (D) Pressure
14. According to the experiment, which of the following description of color is correct?
(A) $\text{CH}_3\text{COOAg}_{(s)}$, white (B) $\text{AgSCN}_{(s)}$, white (C) $[\text{FeSCN}]^{2+}_{(aq)}$, white (D) $\text{Fe}^{3+}_{(aq)}$, red

Experiment 16 The buffer solutions

- *15. According to the experiment, the plots were obtained as shown. Which of the ordering of buffer capacity is correct?
(A) $A > B > C > D$ (B) $A > C > D > B$
(C) $A > B > D > C$ (D) $B > D > C > A$

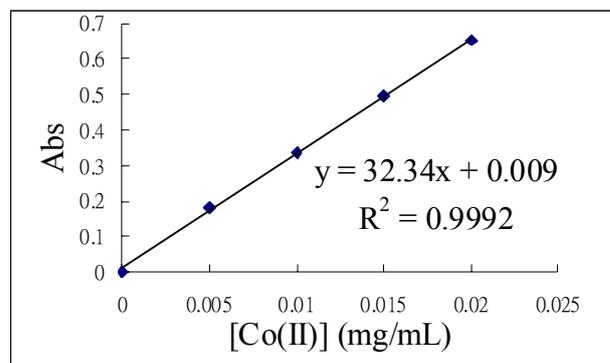


Experiment 17 Quantitative analysis of cobalt(II) ions

16. According to the experiment, which of the following statement is true?
(A) The color of $\text{Co}^{2+}_{(aq)}$ ion is pink.
(B) Acetone is an organic solvent with low dielectric constant.
(C) We use 10-mL graduated cylinder to prepare $[\text{Co}(\text{SCN})_4]^{2-}$ sample solution.
(D) The complex ion, $[\text{Co}(\text{SCN})_4]^{2-}$, absorbs blue color of light and appears blue.

*17. The standard calibration curve of absorbance vs. Co(II) concentration (mg/mL) was obtained as figure. We took 0.50 mL of unknown Co(II) solution, added reagents, and diluted to 10.0 mL according to the experiment. It showed an absorbance of 0.564. What's the concentration of Co(II) ion in the unknown solution?

- (A) 0.017 mg/mL (B) 0.17 mg/mL
(C) 0.34 mg/mL (D) 0.56 mg/mL



Experiment 19. Determination of rate law

*18. According to the experiment, the rate law for the reaction $S_2O_8^{2-} + 2I^- \rightarrow 2SO_4^{2-} + I_2$ is determined as: rate = $k[S_2O_8^{2-}]^{1.1}[I^-]^{0.94}$. Base on the following data, give the correct ordering of initial rate of each trial.

Trial No.	0.20 M NaI (mL)	0.20 M NaCl (mL)	0.0050 M $Na_2S_2O_3$ (mL)	2% starch (mL)	0.10 M K_2SO_4 (mL)	0.10 M $K_2S_2O_8$ (mL)
1	2.0	2.0	1.0	1.0	2.0	2.0
2	2.0	2.0	1.0	1.0	0	4.0
3	4.0	0	1.0	1.0	2.0	2.0

- (A) $2 > 3 > 1$ (B) $3 > 1 > 2$ (C) $1 > 3 > 2$ (D) $2 > 1 > 3$

*19. According to the experiment, which of the following is the limiting reagent of the reaction?

- (A) NaI (B) $Na_2S_2O_3$ (C) K_2SO_4 (D) $K_2S_2O_8$

Experiment 20. The preparation of alum

20. According to the experiment, which statement is true?

- (A) Aluminum foils dissolved in KOH solution is an acid-base reaction.
(B) The Al foils move up and down periodically in the solution is due to the evolution of $H_{2(g)}$.
(C) The crystal of $KAl(SO_4)_2 \cdot 12H_2O$ appears colorless.
(D) The crystal of $KCr(SO_4)_2 \cdot 12H_2O$ appears green.

ANSWER

1	BCD	2	ABC	3	CD	4	B	*5	D
6	ACD	*7	B	8	C	9	A	10	AD
*11	D	12	AD	13	A	14	AB	*15	B
16	AB	*17	C	*18	A	*19	B	20	BC

Have a wonderful winter vacation!