分析化學選擇題共 10 小題, 每一小題 5 分, 答錯一小題扣 10 分.

1. This problem deals with the amino acid cysteine, which we will abbreviate H_2C. The acid dissociation constants of cysteine are pKa_1 = 1.71; pKa_2 = 8.38; pKa_3 = 10.77.

   (A) A 0.0300 M solution was prepared by dissolving dipotassium cysteine, K_2C, in water. Then 40.0 mL of this solution was titrated with 0.0600 M $HClO_4$. Calculate the pH at the first equivalence point.

   ( ) (1) (a) 0.86   (b) 5.04   (c) 5.38   (d) 9.56

   (B) Calculate the quotient $[C^{2-}]/[HC^-]$ in a solution of 0.0500 M cysteinium bromide (the salt $H_3C^+Br^-$).

   ( ) (2) (a) 7.4×10^{-10} (b) 4.71×10^{-5} (c) 1.00   (d) 740

2. A solution was prepared by dissolving 0.1947 g of HgO(FW 216.59) in 20 mL of water containing 4 g of KBr. Titration with HCl required 17.98 mL to reach a phenolphthalein end point. Calculate the molarity of the HCl.

   ( ) (3) (a) 0.0873M   (b) 0.1000M   (c) 0.1083M   (d) 0.1947M

3. Calculate pCu^{2+} at each of the following points in the titration of 50.00 mL of 0.00100M Cu^{2+} with 0.00100 M EDTA at pH 11.00 in a solution whose NH_3 concentration is somehow fixed at 0.100 M . At this pH, $alpha_{Y4-}$ = 0.85, The stepwise formation constants for the reaction of Cu^{2+} with NH_3 are $10^{3.99}$, $10^{3.34}$, $10^{2.73}$, $10^{1.97}$. The Formation constant for Cu^{2+}-EDTA complex is $10^{18.80}$.

   (A) Before titration, pCu^{2+} is:

   ( ) (4) (a) 7.33   (b) 10.06   (c) 11.08   (d) 12.03

   (B) At the equivalence point, pCu^{2+} is:

   ( ) (5) (a) 1.06   (b) 4.46   (c) 8.08   (d) 15.06

   (C) At 55.00 mL titration, pCu^{2+} is:

   ( ) (6) (a) 4.76   (b) 17.73   (c) 17.8   (d) 18.8

4. A solution of I_3^- was standardized by titrating freshly dissolved arsenious oxide (As_4O_6, FW 395.683). The titration of 25.00 mL of a solution prepared by dissolving 0.3663 g of As_4O_6 in a volume of 100.0 mL required 31.77 mL of I_3^- .

   (A) Calculate the molarity of the I_3^- solution.
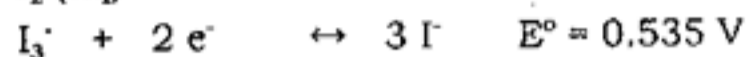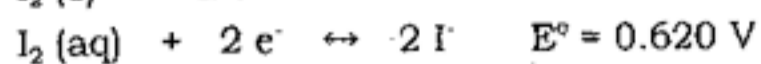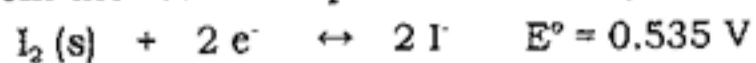
   ( ) (7) (a) 0.02914   (b) 0.0568   (c) 0.177   (d) 0.3663M

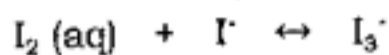   (B) When shall the starch indicator be added ?

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( ) (8) (a) At the beginning of the titration. (b) Near the end point in the titration.

(c) It doesn't matter.

5. From the reduction potentials below, where the FW of I_2 is 253.8,

$$I_2 (s) + 2 e^- \leftrightarrow 2 I^- \qquad E^\circ = 0.535 \text{ V}$$
$$I_2 (aq) + 2 e^- \leftrightarrow 2 I^- \qquad E^\circ = 0.620 \text{ V}$$
$$I_3^- + 2 e^- \leftrightarrow 3 I^- \qquad E^\circ = 0.535 \text{ V}$$

(A) Calculate the equilibrium constant for the reaction

$$I_2 (aq) + I^- \leftrightarrow I_3^-$$

( ) (9) (a) 7×10^2 (b) 0.085   (c) 2.87   (d) 74

(B) Calculate the solubility (g/L) of I_2 (s) in water .

( ) (10) (a) 0.0014   (b) 0.34   (c) 63   (d) 740

1. Choose the correct one or ones. (30%)

( )1. Which of the noble gases would you choose as the lowest-temperature liquid refrigerant ? (1) He, (2) Ne, (3) Ar, (4) Kr.

( )2. Which of the following complexes obeys the rule of 18 (EAN rule)?
(1) $Ni(NH_3)_6^{2+}$, (2) $Ni(CN)_4^{2-}$, (3) $Ni(CO)_4$, (4) $CoCl_4^{2-}$.

( )3.   Consider the acidity of the following species, which ones are correct ?
(1) $[Fe(OH_2)_6]^{3+} > [Fe(OH_2)_6]^{2+}$, (2) $[Ga(OH_2)_6]^{3+} > [Al(OH_2)_6]^{3+}$, (3) $HClO_3 > HClO_4$, (4) $HMnO_4 > H_2CrO_4$.

( )4. Which of the following compounds present an explosion hazard ?
(1) NH_4ClO_4, (2) $Mg(ClO_4)_2$, (3) $NaClO_4$, (4) $[Fe(H_2O)_6](ClO_4)_2$.

( )5. Which of the following mixtures would be expected to have maximum boiling points? (1) methyl acetate – chloroform, (2) C_6H_{12} - C_2H_5OH, (3) acetone – chloroform, (4) water –C_2H_5OH.

( )6. Which of each of the following statements are correct? (1) $CaCl_2$ is more ionic than $MgCl_2$, (2) LiCl is more soluble in water than KCl, (3) $CaCl_2$ is more covalent than $CdCl_2$, (4) Al_2O_3 is harder than Ga_2O_3.

2. Write balanced chemical equations for three major industrial preparations of H_2. Propose a more convenient reaction for use in the laboratory. (10%)

3. Indicate the difference between each of the following: (a) The Lewis acidity of γ-alumina that has been heated to 900°C versus γ-alumina that has been heated to 100°C, (b) The Brønsted acidity of silica gel versus γ-alumina. (10%)