請依序作答於答案紙上

1. Please answer the followings: (28%)

   a). Alka-Seltzer tablets, a medicine, contain a solid citric acid and solid sodium bicarbonate besides aspirin. What will you observe when they are dropped into water? Explain.

   b). Please define colligative properties and give an example to illustrate this property.

   c). What factors must we take into account to predict the spontaneity of a process?

   d). Explain how carbon tetrafluoride can have polar bonds but still be a nonpolar molecule.

   e). Compare the values of electron affinity that would expected for a metal and a nonmetal. Explain the difference.

   f). Why is there a smaller difference in the proton affinities of PH_3 and PF_3 compared to those of NH_3 and NF_3?

   g). For Fe and Mg, please identify respectively a significant role in biological processes.

2. Calculate the concentrations of H_3O^+, HCOOH, $HCOO^-$, and OH^- in a solution prepared from 0.015 mole of HCl, 0.050 mole of HCOOH, and enough water to make 1.00 liter of solution. The ionization constant, *K*a, of HCOOH is 1.77×10^{-4}. (6%)

3. A solution contains 0.100 M acetic acid and 0.100 M sodium acetate. Please answer the following questions. (12%)

   a). What is the pH of the solution if the value of *K*a for acetic acid is 1.75×10^{-5} ?
   b). What is the change in pH if 0.020 mole of HCl is added to 1.00 liter of this solution ?
   c). What is the change in pH if 0.020 mole of NaOH is added to 1.00 liter of this solution ? Assume there is no volume change.

4. Many radioactive nuclides are used to determine the mechanism of chemical reactions or as medical diagnoses. Please answer the following two questions: (6%)

   a). For the reaction below, how do you prove that the hydroxide bonded to the product Cr^{3+} originated from that bound to Co^{3+} or from water ?

   $$Co(NH_3)_5OH^{2+}_{(aq)} + Cr^{2+}_{(aq)} + 5H_2O \rightarrow Cr(H_2O)_5OH^{2+}_{(aq)} + Co^{2+}_{(aq)} + 5NH_{3(aq)}$$

   b). Is ^{56}Co, a positron-emitter with a 77-day half life, a good or a poor choice for medical imagine? State your reason.

(背面仍有題目,請繼續作答)

5. Suggest a simple test to distinquish
   a). $CH_3CH_2CH_2$-O-CH_3 from $CH_3CH_2CH_2CH_2OH$ (3%)
   b). $CH_3CH_2CH_2CH_3$ from CH_2=$CHCH_2CH_3$ (3%)

6. For phenol(C_6H_5OH) and ethanol (CH_3CH_2OH), which one is more acidic. Please account for your answer. (4%)

7. What is a general structure of an α-amino acid? Write an equation to describe how two amino acids combine to form two different dipeptides? Please circle the peptide bonds in the dipeptides? (5 %)

8. The structures and chemical properties of the amino acids are crucial to understanding how proteins carry out their biological functions. Name the amino acid that contains R group (also known as side chain) with following characteristics ? (10 %)

   a). The R group contains a neutral hydroxyl group that can form hydrogen bonds.

   b). Provides the least amount of steric hindrance.

   c). Forms disulfide cross-links between polypeptide chains.

   d). The R groups with positively charged at physiological pH.

   e). The R groups with negatively charged at pH 7.

9. Ames test is a simple test for mutagenic compounds. Please describe this test in detail. (5%)

10. What is the theory concerning the action of AZT (azidothymidine) in the treatment of AIDS ? (5 %)

11. What are the equations for the reactions of oleic acid, $CH_3(CH_2)_7CH$=$CH(CH_2)_7COOH$, with each substance ? (8%)
    a). Br_2
    b). KOH
    c). H_2 (in the presence of catalyst)
    d). CH_3CH_2OH (heated with an acid catalyst)

12. The threonine molecule has two chiral centers, labeled by asterisks. How many stereoisomers of threonine are there ? Please draw their structures (5%)

$$CH_3C^*H(OH)C^*H(NH_3^+)COO^-$$