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一、選擇題：(50%；每題 2 分)

1. According to the law of definite proportions,
   A) if the same two elements form two different compounds, they do so in the same ratio.
   B) it is not possible for the same two elements to form more than one compound.
   C) the ratio of the masses of the elements in a compound is always the same.
   D) the total mass after a chemical change is the same as before the change.

2. Which of the following statements is *incorrect*?
   A) Molecular solids have high melting points.
   B) The binding forces in a molecular solid include London dispersion forces.
   C) Ionic solids have high melting points.
   D) Ionic solids are insulators.
   E) All of these statements are correct.

3. The limiting reagent in a reaction
   A). has the lowest coefficient in a balanced equation.
   B). has the lowest ratio of moles available/coefficient in the balanced equation.
   C). has the lowest ratio of coefficient/ moles available in the balanced equation.
   D). is the reactant for having the fewest number of moles.

4. When $NH_3(aq)$ is added to $Cu^{2+}(aq)$, a precipitate initially forms. What is its formula?
   A) $Cu(NH_3)$ B) $Cu(NO_3)_2$ C) $Cu(OH)_2$
   D) $Cu(NH_3)_2^{+2}$ E) CuO

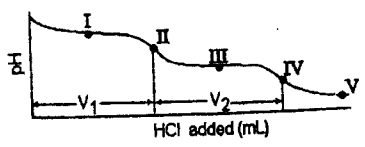
5. Under which of the following conditions does a gas behave most ideally?
   A) STP B) $P = 1.0$ atm, $T = 100.0°C$ C) $P = 0.50$ atm, $T = 100.0°C$
   D) $P = 0.50$ atm, $T = 0.0°C$ E) $P = 2.0$ atm, $T = -100.0°C$

6. The value of the equilibrium constant K depends on:
   I. the initial concentrations of the reactants. II. the initial concentrations of the products
   III. the final concentrations of the reactants. IV. the final concentrations of the products.
   A) I and II only B) II and III only C) III and IV only
   D) three of these E) none of these

7. The strong acid HA is added to water. Which of the following is the strongest base in the system?
   A) HA B) H_2O C) H_3O^+ D) A^- E) H_2A^-

8. The salt BX, when dissolved in water, produces an acidic solution. Which of the following could be true?
   A) HX is a weak acid. B) HX is a strong acid.
   C) The cation B^+ is a weak acid. D) All of these could be true.
   E) Both HX and the cation B^+ are weak acids.

9. The titration curve for disodium ascorbate, Na_2As, with standard HCl is shown below:



What major species is(are) present at point III?
   A) As^{2-} and HAs^- B) HAs^- only C) HAs^- and H_2As
   D) H_2As only E) H_2As and H^+

(背面仍有題目,請繼續作答)

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10. Which of the following will *not* produce a buffered solution?
A) 100 mL of 0.1 *M* Na_2CO_3 and 50 mL of 0.1 *M* HCl
B) 100 mL of 0.1 *M* $NaHCO_3$ and 25 mL of 0.2 *M* HCl
C) 100 mL of 0.1 *M* Na_2CO_3 and 75 mL of 0.2 *M* HCl
D) 50 mL of 0.2 *M* Na_2CO_3 and 5 mL of 1.0 *M* HCl
E) 100 mL of 0.1 *M* Na_2CO_3 and 50 mL of 0.1 *M* NaOH

11. Which of the following statements is (are) true?
A) Enthalpy is a state function.
B) In exothermic reactions, the reactants are lower in potential energy than the products.
C) A chemist takes the point of view of the surroundings when determining the sign for work or heat.
D) The heat of reaction and change in enthalpy can always be used interchangeably.
E) At least two of these statements are true.

12. A gas expands isothermally and irreversibly.

S_{surr} is
A) less than zero. B) equal to zero. C) greater than zero.
D) More information is needed.

13. Choose the correct statement(s) given the following information:
$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$ $E° = 0.77$ V
$Fe(CN)_6^{3-} + e^- \rightarrow Fe(CN)_6^{4-}$ $E° = 0.36$ V

I. $Fe^{2+}(aq)$ is more likely to be oxidized than Fe^{2+} complexed to CN^-.
II. $Fe^{3+}(aq)$ is more likely to be reduced than Fe^{3+} complexed to CN^-.
III. Complexation of Fe ions with CN^- has no effect on their tendencies to become oxidized or reduced.

A) I only B) II only C) I and II D) III only
E) None of these is true.

14. Which of the following statements is true?
A) We can determine the exact location of an electron if we know its energy.
B) An electron in a 2s orbital can have the same n, l, and m_l quantum numbers as an electron in a 3s orbital.
C) Ni has 2 unpaired electrons in its 3d orbitals.
D) In the building up of atoms, electrons occupy the 4f orbitals before the 6s orbitals.
E) Only three quantum numbers are needed to uniquely describe an electron.

15. According to the VSEPR model, the electron pairs around NH_3 and those around CH_4 are arranged
A) differently, because in each case there are a different number of atoms around the central atom.
B) differently, because in each case there are a different number of electron pairs around the central atom.
C) the same, because both nitrogen and carbon are in the second period.
D) the same, because in each case there are the same number of electron pairs around the central atom.
E) differently or the same, depending on the conditions leading to maximum repulsion.

16. Which of the following species has the largest dissociation energy?
A) O_2 B) O_2^- C) O_2^{2-} D) O_2^+ E) O_2^{2+}

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17. The reaction A → B + C is known to be zero order in A with a rate constant of 5.0×10^{-2} mol/L • s at 25° C. An experiment was run at 25°C where $[A]_0 = 1.0 \times 10^{-3}$ *M*. What is the integrated rate law?

A) $[A] = kt$ B) $[A] - [A]_0 = kt$ C) $[A]_0 - [A] = kt$

D) $\ln \dfrac{[A]}{[A]_0} = kt$ E) $\dfrac{[A]}{[A]_0} = kt$

18. Which statement regarding water is true?
A) Energy must be given off in order to break down the crystal lattice of ice to a liquid.
B) Hydrogen bonds are stronger than covalent bonds.
C) Liquid water is less dense than solid water.
D) Only covalent bonds are broken when ice melts.
E) All of these statements are false.

19. Which of the following statements is(are) true?
A) The rate of dissolution of a solid in a liquid always increases with increasing temperature.
B) The solubility of a solid in a liquid always increases with increasing temperature.
C) According to Henry's law, the amount of gas dissolved in a solution is directly proportional to the pressure of the gas above the liquid.
D) Two of these statements are true. E) All of these statements are true.

20. The deciding factor that makes HF a weak acid is that
A) the enthalpy of hydration of F^- is negative.
B) HF has a large bond energy. C) F_2 has a small bond energy.
D) the entropy for hydration of F^- is a large negative value.
E) F^- has the largest ionization energy of all the halide ions.

21. Which of the following statements is true about coordination complexes?
A) The metal is a Lewis base and the ligands are Lewis acids.
B) Only complexes with coordination number 6 are found in nature.
C) When the ligands approach a transition metal ion in an octahedral field, the d_{xz}, d_{yz}, and d_{xy} atomic orbitals are affected the least by the ligands.
D) None of these is true. E) All of these are true.

22. The most likely decay mode (or modes) of the unstable nuclide $^{11}_{6}C$ would be
A) positron production. B) α-particle production.
C) electron capture. D) β emission
E) either positron production or electron capture or both.

23. Which of the following names is a correct one?
A) 3,4-dichloropentane B) 1-chloro-2,4-methyl-3-ethylcyclohexane
C) 1,1-dimethyl-2,2-diethylpentane D) *cis*-1,3-dimethylbutane
E) 2-bromo-1-chloro-4,4-diethyloctane

24. Which of the following becomes more soluble in water upon the addition of NaOH?
A) an amide B) a carboxylic acid C) an amine
D) an aromatic hydrocarbon E) an alkane

25. Which of the following is optically active (that is, chiral)?
A) trimethylamine B) dichloromethane C) 3-bromopentane
D) 3-chlorohexane E) ethanol

系所組別： 地球科學系甲、乙組

考試科目： 普通化學

考試日期：0224，節次：2

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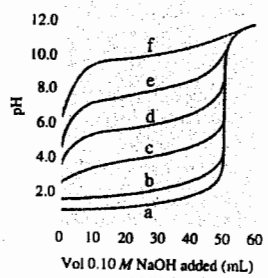
二、非選擇題：(50%)

1. The isotope of an unknown element, X, has a mass number of 79. The most stable ion of the isotope has 36 electrons and forms a binary compound with sodium having a formula of Na2X. Which of the following statements is(are) true? Correct the false statements.
   a. The binary compound formed between X and Flourine will be a covalent compound. (3%)
   b. The isotope of X contains 38 protons. (2%) c. The isotope of X contains 41 neutrons. (2%)

2. Rank the following 0.1 *M* solutions in order of increasing pH (6%)
   a. HI, HF, NaF, NaI b. NH_4Br, HBr, KBr, NH_3
   c. $C_6H_5NH_3NO_3$, $NaNO_3$, NaOH, HOC_6H_5, KOC_6H_5, $C_6H_5NH_2$, HNO_3

3. The following plot shows the pH curves for the titrations of various acids with 0.1 *M* NaOH (all of the acids were 50.0 mL samples of 0.1 *M* concentration).



   a. Which pH curve corresponds to the weakest acid? (2%)
   b. Which pH curve corresponds to the strongest acid? Which point on the pH curve would you examine to see if this acid is a strong acid or a weak acid (assuming you did not know the initial concentration of the acid)? (4%)
   c. Which pH curve corresponds to an acid with Ka≈1 x 10^{-6}? (3%)

4. At what temperatures is the following process spontaneous at 1 atm? (5%)

   $Br_2(l) \rightarrow Br_2(g)$

   Where $\Delta H^o = 31.0$ kJ/mol and $\Delta S^o = 93.0$ JK^{-1} mol^{-1}

   What is the normal boiling point of liquid Br_2? Account for your answer.

5. For concentration cell, please answer the following questions. (10%)
   a. What are the concentration cells? b. What is the ξ^o in a concentration cell?
   c. What is the driving force for a concentration cell to produce a voltage?
   d. Is the higher or the lower ion concentration solution present at the anode?
   e. When the anode ion concentration is decreased and/or the cathode ion concentration is increased, both give rise to larger cell potentials. Why?

6. Does the complex ion [Co(NH3)Br(en)2] exhibit geometrical isomerism? Does it exhibit optical isomerism? Account for your answer. en:ethylene diamine. (6%)

7. a. Describe how to determine the thermodynamic stability of a nucleus, for example $_8O^{16}$. (4%)
   b. For the following plot, what information we can obtain. (3%)