臺灣綜合大學系統105學年度學士班轉學生聯合招生考試試題

科目名稱	普通化學A	類組代碼	E00
		科目碼	E0017

※本項考試依簡章規定各考科均「不可以」使用計算機　　本試題共計5頁

一、選擇題(單選題，每題2分，不扣分，答案請寫在答案卷上)

1. How many of the following postulates of Dalton's atomic theory are still scientifically accepted?

I. All atoms of the same element are identical.
II. Compounds are combinations of different atoms.
III. A chemical reaction changes the way atoms are grouped together.
IV. Atoms are indestructible.

A) 0　B) 1　C) 2　D) 3　E) 4

2. By knowing the number of protons a neutral atom has, you should be able to determine
A) the number of neutrons in the neutral atom　B) the name of the atom
C) the number of electrons in the neutral atom　D) two of the above
E) none of the above

3. Three 1.00-L flasks at 25°C and 725 torr contain the gases CH_4 (flask A), CO_2 (flask B), and C_2H_6 (flask C). In which single flask do the molecules have the greatest mass, the greatest average velocity, *and* the highest kinetic energy?
A) flask A　B) flask B　C) flask C　D) all　E) none

4. The value of the equilibrium constant K is dependent on:

I. the temperature of the system.　II. the nature of the reactants and products.
III. the concentration of the reactants.　IV. the concentration of the products

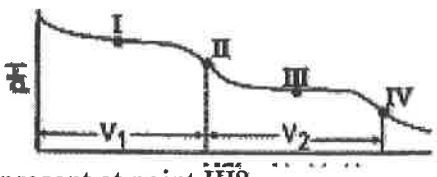
A) I and II only　B) II and III only　C) III and IV only
D) three of these　E) none of these

5. The acids $HC_2H_3O_2$ and HF are both weak, but HF is a stronger acid than $HC_2H_3O_2$. HCl is a strong acid. Order the following according to base strength.
A) $C_2H_3O_2^- > F^- > Cl^- > H_2O$　B) $C_2H_3O_2^- > F^- > H_2O > Cl^-$
C) $Cl^- > F^- > C_2H_3O_2^- > H_2O$　D) $F^- > C_2H_3O_2^- > H_2O > Cl^-$
E) none of these

6. Consider the following information about the diprotic acid ascorbic acid (H_2As stands for ascorbic acid; molar mass = 176.1).

	K_{a1}	pK_a
$H_2As \rightleftharpoons H^+ + HAs^-$	7.9×10^{-5}	4.10
$HAs \rightleftharpoons H^+ + As^{2-}$	1.6×10^{-12}	11.79

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^+

背面有題，請繼續作答。

臺灣綜合大學系統105學年度學士班轉學生聯合招生考試試題

科目名稱	普通化學A	類組代碼	E00
		科目碼	E0017

※本項考試依簡章規定各考科均「不可以」使用計算機　　本試題共計5頁

7. Which of the following mixtures would produce a buffered solution when 1.0 L of each of the two solutions are mixed?
A) 0.1 *M* KOH and 0.1 *M* CH_3NH_3Cl
B) 0.1 *M* KOH and 0.2 *M* CH_3NH_2
C) 0.2 *M* KOH and 0.1 *M* CH_3NH_3Cl
D) 0.1 *M* KOH and 0.2 *M* CH_3NH_3Cl
E) none of these

8. Which of the following statements is correct?
A) The internal energy of a system increases when more work is done by the system than heat is flowing into the system.
B) The internal energy of a system decreases when work is done on the system and heat is flowing into the system.
C) The system does work on the surroundings when an ideal gas expands against a constant external pressure.
D) All the statements are true.
E) All the statements are false

9. For which of the following reaction(s) is the enthalpy change for the reaction *not* equal to $\Delta H°_f$ of the product?

I. $2H(g) \rightarrow H_2(g)$　II. $H_2(g) + O_2(g) \rightarrow H_2O_2(l)$　III. $H_2O(l) + O(g) \rightarrow H_2O_2(l)$

A) I only　B) II only　C) III only　D) I and III　E) II and II

10. Consider the freezing of liquid water at –10°C. For this process what are the signs for ΔH, ΔS, and ΔG, respectively?
A) + – 0　B) – + 0　C) – + –　D) + – –　E) – – –

11. ΔS is _____ for exothermic reactions and _____ for endothermic reactions.
A) favorable, unfavorable　B) unfavorable, favorable　C) favorable, favorable
D) unfavorable, unfavorable　E) cannot tell

12. The reaction below occurs in basic solution. In the balanced equation, what is the sum of the coefficients?

$$Zn + NO_3^- \rightarrow Zn(OH)_4^{2-} + NH_3$$

A) 12　B) 15　C) 19　D) 23　E) 27

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 above

臺灣綜合大學系統105學年度學士班轉學生聯合招生考試試題

科目名稱	普通化學A	類組代碼	E00
		科目碼	E0017

※本項考試依簡章規定各考科均「不可以」使用計算機　　本試題共計5頁

14. What is the probability of finding a particle in a one-dimensional box in energy level $n = 4$ between $x = L/4$ and $x = L/2$? (L is the length of the box.)
A) 12.5%　B) 25%　C) 33%　D) 37.5%　E) 50%

15. Which of the following shows these molecules in order from most polar to least polar?
A) $CH_4 > CF_2Cl_2 > CF_2H_2 > CCl_4 > CCl_2H_2$　B) $CH_4 > CF_2H_2 > CF_2Cl_2 > CCl_4 > CCl_2H_2$
C) $CF_2Cl_2 > CF_2H_2 > CCl_2H_2 > CH_4 = CCl_4$　D) $CF_2H_2 > CCl_2H_2 > CF_2Cl_2 > CH_4 = CCl_4$
E) $CF_2Cl_2 > CF_2H_2 > CCl_4 > CCl_2H_2 > CH_4$

16. Which of the following molecules and ions has a lone pair of electrons on the central atom?
A) CH_3^+　B) XeO_4　C) $BeCl_2$　D) CH_3^-　E) PCl_5

17. Which statement about the thiocyanate ion, SCN^-, is true?
A) Its Lewis structure contains an unpaired electron.
B) Its shape is bent like that of H_2O.
C) Only one correct resonance structure can be drawn.
D) There are more than two σ bonds in the ion.
E) none of these

18. 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) $[A]/[A]_0 = kt$　D) $\ln([A]/[A])_0 = kt$
E) $[A]_0 - [A] = kt$

19. Which of the following statements is(are) *false*?
I. The hexagonal closest-packed structure is ABAB....
II. A body-centered cubic unit cell has four atoms per unit cell.
III. For unit cells having the same edge length, a simple cubic structure would have a smaller density than a body-centered cube.
IV. Atoms in a solid consisting of only one element would have six nearest neighbors if the crystal structure was a simple cubic array.
A) I only　B) II only　C) II and III　D) I and IV　E) II, III, IV

20. Which of the following concentration measures will change in value as the temperature of a solution changes?
A) mass percent　B) mole fraction　C) molality　D) molarity　E) all of these

21. Hydrogen and lithium react very differently, although they are both members of Group 1. What is the primary reason for this difference?
A) The metallic character increases going down a group.
B) The ionization energy increases going down a group.
C) Electron affinity increases going down a group.
D) Electronegativity increases going down a group.
E) There is a very large difference in the atomic radii of H and Li.

背面有題，請繼續作答。

臺灣綜合大學系統105學年度學士班轉學生聯合招生考試試題

科目名稱	普通化學A	類組代碼	E00
		科目碼	E0017

※本項考試依簡章規定各考科均「不可以」使用計算機　　本試題共計5頁

22. Which of the following complexes can exhibit optical isomerism?
(en = $H_2N–CH_2–CH_2–NH_2$ and is bidentate)
A) *cis*–$Co(NH_3)_4Cl_2$　B) *trans*–$Co(en)_2Br_2$　C) *cis*–$Co(en)_2Cl_2$
D) $Co(NH_3)_3Cl_3$　E) none of these

23. Which reaction will produce an isotope of the parent nuclide?
A) $^{210}_{84}Po \rightarrow He + ?$　B) $^{88}_{35}Br \rightarrow n + ?$　C) $^{227}_{89}Ac \rightarrow \beta + ?$
D) $^{13}_{7}N \rightarrow \beta + ?$　E) $^{73}_{33}As + e \rightarrow ?$

24. Which of the following is optically active (that is, chiral)?
A) dimethylamine　B) difluoromethane　C) 2-chloropropane
D) 2-chlorobutane　E) 1-bromohexane

25. Which statement is true for ethane (C_2H_6)?
A) The C—C bond is stronger than the C—H bond.
B) The C—C bond is sterically hindered.
C) It is a cyclic alkane.
D) It is an unsaturated organic compound.
E) It cannot be converted into the radical form.

二、問答題（50分，答案請寫在答案卷上）

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 Na_2X. Which of the following statements is(are) true? For the false statements, correct them.

a. The binary compound formed between X and fluorine will be an ionic compound. (4%)
b. The isotope of X contains 38 protons. (2%)
c. The isotope of X contains 41 neutrons. (2%)

2. Consider the following half reactions:

$Pt^{2+} + 2e^- \rightarrow Pt$　$E° = 1.188$ V
$PtCl_4^{2-} + 2e^- \rightarrow Pt + 4Cl_4^-$　$E° = 0.755$ V
$NO_3^- + 4H^+ + 3e^- \rightarrow NO + 2H_2O$　$E° = 0.96$ V

Explain why platinum metal will dissolve in aqua regia (a mixture of hydrochloric and nitric acids) but not in either concentrated nitric or concentrated hydrochloric acid individually. (8%)

3. a). At what temperature is the following process spontaneous at 1 atm? (4%)

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

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

b). What is the normal boiling point of liquid Br_2? (4%)

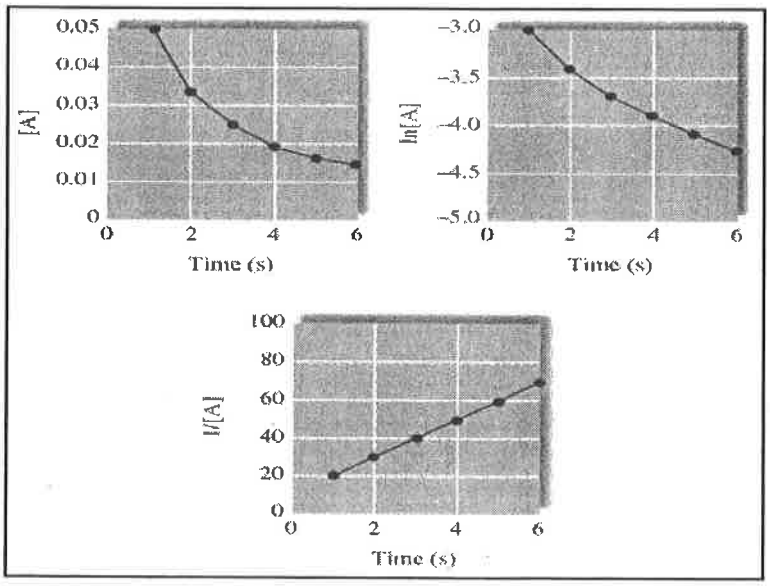
4. Predict the number of unpaired electrons in the complex ion of $[Cr(CN)_6]^{4-}$. Account for your answer. (Atomic number of Cr is 24) (8%)

臺灣綜合大學系統 105 學年度學士班轉學生聯合招生考試試題

科目名稱	普通化學 A	類組代碼	E00
		科目碼	E0017

※本項考試依簡章規定各考科均「不可以」使用計算機　　本試題共計 5 頁

5. Experimental data for the reaction of A →2B + C have been plotted in the following three different ways. Please answer the following three questions:
   a. What is the order of the reaction with respect to A, and what is the initial concentration of A? Account for your answer. (5%)
   b. What is the concentration of A after 9 seconds? (5%)



6. Consider the following graph of the binding energy per nucleon as a function of mass number. Please answer :
   a). What does this graph tell us about the relative half-lives of the nuclides? Explain your answer. (4%)
   b). Which nuclide shown is the most thermodynamically stable? Which nuclide is the least thermodynamically stable. Explain your answer. (4%)