國立暨南國際大學九十六學年度轉學生入學考試試題

第 1 節

科目：普通化學　適用：應化系二

編號： 341

考生注意：
1.依次序作答，只要標明題號，不必抄題。
2.答案必須寫在答案卷上，否則不予計分。
3.限用藍、黑色筆作答；試題須隨卷繳回。

本試題 共 5 頁 第 1 頁

一、是非題：(8% total, 2% each)

1. The H_2^- ion is more stable than H_2 since it has an additional electron to produce a net lowering of energy.
2. As atomic mass increases, the proton/neutron ratio of stable nuclides decreases.
3. Paramagnetism is associated with paired electrons.
4. The net number of spheres in the face-centered cubic unit cell is 4.

二、單選題：(66% total, 2% each)

1. The freezing point of helium is −270°C. The freezing point of xenon is −112°C. Both of these are in the noble gas family. Which of the following statements is supported by these data?
   [A] The London dispersion forces between the helium molecules are less than the London dispersion forces between the xenon molecules.
   [B] Helium and xenon form highly polar molecules.
   [C] The London dispersion forces between the helium molecules are greater than the London dispersion between the xenon molecules.
   [D] As the molecular weight of the noble gas increases, the freezing point decreases.
   [E] none of these
2. For the process $X^-(g) \rightarrow X^-(aq)$, select the ion with the most negative value of ΔS.
   [A] Br^-　[B] I^-　[C] F^-　[D] Cl^-　[E] All the same
3. The pH of a 0.100 M solution of an aqueous weak acid (HA) is 3.20. The K_a for the weak acid is:
   [A] 4.0×10^{-6}　[B] 3.2　[C] 6.3×10^{-4}　[D] 7.2×10^{-5}　[E] none of these
4. Which of the following complexes shows geometric isomerism?
   [A] $[Co(NH_3)_6]Cl_3$　[B] $[Co(NH_3)_5Cl]Cl_2$　[C] $K[Co(NH_3)_2Cl_4]$
   [D] $[Co(NH_3)_5Cl]SO_4$　[E] none of these
5. Aqueous solutions of barium chloride and silver nitrate are mixed to form solid silver chloride and aqueous barium nitrate. The net ionic equation contains which of the following terms?
   [A] $Ag^+(aq)$　[B] $2NO_3^-(aq)$　[C] $NO_3^-(aq)$　[D] $Ba^{2+}(aq)$
6. Consider two organic molecules, ethanol and benzene. One dissolves in water and the other does not. Why?
   [A] One is an electrolyte, the other is not.　[B] They have different molar masses.
   [C] Ethanol contains a polar O−H bond, and benzene does not.
   [D] One is ionic, the other is not.　[E] Two of these.

7. Which of the following compounds is the most soluble (in moles/liter)?

	$BaSO_4$	CoS	$PbSO_4$	AgBr
K_{sp}	1.5×10^{-9}	5.0×10^{-22}	1.3×10^{-8}	5.0×10^{-13}

[A] $BaSO_4$ [B] $PbSO_4$ [C] $BaCO_3$ [D] CoS [E] AgBr

8. Hydrocarbons containing a carbon–carbon triple bond are called

[A] aldehydes [B] alkenes [C] alkanes [D] alkynes [E] cyclic alkanes

9. When the following reaction is balanced in acidic solution, what is the coefficient of I_2?

$$IO_3^- + I^- \rightarrow I_2$$

[A] 3 [B] 1 [C] 4 [D] 2 [E] none of these

10. Zinc metal is added to hydrochloric acid to generate hydrogen gas and is collected over a liquid whose vapor pressure is the same as pure water at 20.0°C (18 torr). The volume of the mixture is 1.7 L and its total pressure is 0.810 atm. Determine the partial pressure of the hydrogen gas in this mixture.

[A] 616 torr [B] 598 torr [C] 580 torr [D] 562 torr [E] 634 torr

11. Using the following data, calculate the standard heat of formation of the compound ICl in kJ/mol:

[A] −14.6 kJ/mol
[B] 16.8 kJ/mol
[C] −211 kJ/mol
[D] 439 kJ/mol
[E] 245 kJ/mol

	$\Delta H°$ (kJ / mol)
$Cl_2(g) \rightarrow 2Cl(g)$	242.3
$I_2(g) \rightarrow 2I(g)$	151.0
$ICl(g) \rightarrow I(g) + Cl(g)$	211.3
$I_2(s) \rightarrow I_2(g)$	62.8

12. Which of the following frequencies corresponds to light with the longest wavelength?

[A] $3.00 \times 10^{13}\ s^{-1}$ [B] $9.12 \times 10^{12}\ s^{-1}$ [C] $4.12 \times 10^{5}\ s^{-1}$
[D] $3.20 \times 10^{9}\ s^{-1}$ [E] $8.50 \times 10^{20}\ s^{-1}$

13. As indicated by Lewis structures, which of the following would probably not exist as a stable molecule?

[A] CH_2O [B] C_2H_2 [C] C_3H_4 [D] CH_3O [E] CH_3OH

14. Which of the following is a d^7 ion?

[A] Cu(II) [B] Mn(II) [C] Co(II)
[D] Mn(IV) [E] At least two of these (a-d) are d^7 ions.

15. Which of the following compounds has the same percent composition by mass as styrene, C_8H_8?

[A] benzene, C_6H_6 [B] acetylene, C_2H_2 [C] α-ethyl naphthalene, $C_{12}H_{12}$
[D] cyclobutadiene, C_4H_4 [E] all of these

16. Name the following: $CH_3-(CH_2)_7-CH_3$

[A] octane [B] decane [C] hexane [D] nonane [E] heptane

17. Which of the following species has a trigonal bipyramid structure?

[A] IF_5 [B] I_3^- [C] NH_3 [D] PCl_5 [E] none of these

18. Calculate the work for the expansion of CO_2 from 1.0 to 2.5 liters against a pressure of 1.0 atm at constant temperature.

[A] −2.5 liter · atm [B] 0 [C] 2.5 liter · atm

[D] 1.5 liter · atm [E] −1.5 liter · atm

19. Draw the Lewis structures of the molecules below and use them to answer the question: which of these molecules show resonance?

I. BH_3 II. NO_2 III. SF_6 IV. O_3 V. PCl_5

[A] II, V [B] I, II [C] III, IV [D] II, IV [E] III, V

20. Sulfuric acid may be produced by the right process: How many moles of H_2SO_4 will be produced form 5.00 moles of FeS_2?

$$4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$$
$$2SO_2 + O_2 \rightarrow 2SO_3$$
$$SO_3 + H_2O \rightarrow H_2SO_4$$

[A] 20.00 [B] 12.22 [C] 10.00 [D] 5.00 [E] 6.11

21. How many oxides of carbon are there?

[A] 4 [B] 3 [C] 1 [D] 2 [E] 5

22. Steel is considered to be a(n) _____

[A] substitutional alloy [B] molecular solid [C] ionic solid

[D] interstitial alloy [E] two of these

23. Determine the standard potential, $E°$, of a cell that employs the reaction $Fe + Cu^{2+} \rightarrow Fe^{2+} + Cu$.

[A] 0.20 V

[B] −0.10 V

[C] 0.10 V

[D] −0.78 V

[E] 0.78 V

Reaction	$E°$ (volts)
$Na^+ + e^- \rightarrow Na$	−2.71
$Al^{3+} + 3e^- \rightarrow Al$	−1.66
$Fe^{2+} + 2e^- \rightarrow Fe$	−0.44
$Cu^{2+} + 2e^- \rightarrow Cu$	+0.34
$Ag^+ + e^- \rightarrow Ag$	+0.80
$Cl_2 + 2e^- \rightarrow 2Cl^-$	+1.36
$F_2 + 2e^- \rightarrow 2F^-$	+2.87

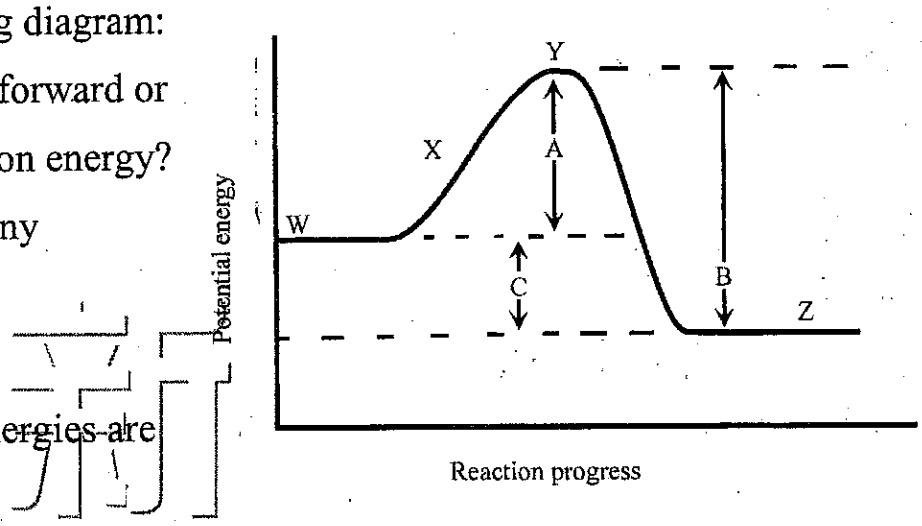
24. The term "proof" is defined as twice the percent by volume of pure ethanol in solution. Thus, a solution that is 95% (by volume) ethanol is 190 proof. What is the molarity of ethanol in a 92 proof ethanol/water solution?

density of ethanol = 0.80 g / cm^3
density of water = 1.0 g / cm^3
mol. wt. of ethanol = 46

[A] 0.46 M [B] 0.80 M [C] 8.0 M

[D] 0.92 M [E] 17 M

25. The questions below refer to the following diagram:



If the reaction were reversible, would the forward or the reverse reaction have a higher activation energy?

[A] The diagram shows no indication of any activation energy.

[B] The reverse activation energy

[C] The forward and reverse activation energies are equal.

[D] The forward activation energy [E] none of these

26. For the reaction $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$, the following data were collected: The initial rate of production of NO_2 for this reaction is approximately

t (minutes)	$[N_2O_5]$ (mol / L)
0	1.24×10^{-2}
10.	0.92×10^{-2}
20.	0.68×10^{-2}
30.	0.50×10^{-2}
40.	0.37×10^{-2}
50.	0.28×10^{-2}
70.	0.15×10^{-2}

[A] 1.6×10^{-4} mol/L · min [B] 1.24×10^{-2} mol/L · min

[C] 6.4×10^{-4} mol/L · min [D] 3.2×10^{-4} mol/L · min

[E] none of these

27. A scientist obtains the number 0.045006700 on a calculator. If this number actually has four (4) significant figures, how should it be written?

[A] 0.4567 [B] 0.04501 [C] 0.4501 [D] 0.04500 [E] 0.045

28. Consider the chemical system $CO + Cl_2 \rightleftharpoons COCl_2$; $K = 4.6 \times 10^9$ L/mol. How do the equilibrium concentrations of the reactants compare to the equilibrium concentration of the product?

[A] They are much smaller. [B] They have to be exactly equal.

[C] You can't tell from the information given. [D] They are about the same.

[E] They are much bigger.

29. Consider the following equilibrium: $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$ with $K = 1.6 \times 10^{-5}$. 1.00 mole of pure NOCl and 1.00 mole of pure Cl_2 are replaced in a 1.00-L container. Calculate the equilibrium concentration of NO(g).

[A] 0.50 M [B] 4.0×10^{-3} M [C] 6.2×10^{-4} M

[D] 1.0 M [E] 1.6×10^{-5} M

30. If you know K_b for ammonia, NH_3, you can calculate the equilibrium constant, K_a, for the following reaction: $NH_4^+ \rightleftharpoons NH_3 + H^+$ by the equation:

[A] $K_a = K_w/K_b$ [B] $K_a = K_wK_b$ [C] $K_a = K_b/K_w$ [D] $K_a = 1/K_b$

31. Which type of battery has been designed for use in space vehicles?

[A] mercury cells [B] fuel cells [C] silver cells [D] lead storage [E] alkaline dry cell

32. How many moles of HCl must be added to 100 mL of a 0.100 M solution of methylamine (pK_b = 3.36) to give a buffer having a pH of 10.0?

[A] 20.0 [B] 41.5 [C] 12.7 [D] 8.1 [E] 18.7

33. The second law of thermodynamics states that

[A] the energy of the universe is increasing. [B] the entropy of the universe is constant.

[C] the energy of the universe is constant. [D] the entropy of the universe is increasing.

[E] the entropy of a perfect crystal is zero at 0 K.

三、簡答題：(26%)

1. Write the formula for (4% total, 2% each)

(1) dinitrogen trioxide (2) nitric acid

2. Write a balanced equation for each of the following reactions: (6% total, 3% each)

(1) Gallium metal with $I_2(s)$. (2) Sodium metal with excess $O_2(g)$.

3. A(n) _____ molecular orbital is lower in energy than the atomic orbital of which it is composed. (2%)

4. Write the electron configuration for K^+. (3%)

5. A chemist is given a white solid that is suspected of being pure cocaine (molar mass = 303.35 g/mol). When 1.22 g of the solid is dissolved in 15.60 g of benzene the freezing point is lowered by 1.32°C. The molar mass is calculated from these data to be 303 g. Assuming the following uncertainties, can the chemist be sure the substance is not codeine (molar mass 299.36)? K_f for benzene is 5.12°C/m. Support your answer with calculations. (3%)

Uncertainties
Mass of solid = ±0.01 g
Mass of benzene = ±0.01 g
ΔT (freezing point lowering) = ±0.04°C
K_f = ±0.01

6. If equal masses of hydrogen gas and helium gas are placed in the same container, determine the ratio of partial pressure of hydrogen: partial pressure of helium. (2%)

7. Complete the following table. (6% total, 1% each)

Symbol	# protons	# neutrons	# electrons	Net Charge
$^{206}_{82}Pb$				
	31	38		3^+