

# 國立嘉義大學九十三年度轉學生招生考試試題

## 科目：普通化學

(請將答案寫在答案卷上)

### 單選題：(每題 2.5 分)

- Which of the following equilibria, will shift to the left in response to a decrease in volume?  
(A)  $\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \leftrightarrow 2 \text{HCl}(\text{g})$   
(B)  $2 \text{SO}_3(\text{g}) \leftrightarrow 2 \text{SO}_2(\text{g}) + \text{O}_2(\text{g})$   
(C)  $\text{N}_2(\text{g}) + 3 \text{H}_2(\text{g}) \leftrightarrow 2 \text{NH}_3(\text{g})$   
(D)  $4 \text{Fe}(\text{s}) + 3 \text{O}_2(\text{g}) \leftrightarrow 2 \text{Fe}_2\text{O}_3(\text{s})$
- Consider the following reaction at equilibrium:  
 $2\text{CO}_2(\text{g}) \leftrightarrow 2\text{CO}(\text{g}) + \text{O}_2(\text{g}) \Delta H^\circ = -514 \text{ kJ}$   
How can the yield of  $\text{CO}(\text{g})$  be maximized?  
(A) at high temperature and high pressure  
(B) at high temperature and low pressure  
(C) at low temperature and low pressure  
(D) at low temperature and high pressure
- Which intermolecular force predominates in the condensation of water?  
(A) H-bonding (B) Van der Waals (C) London (D) Dipole-Ion
- Which one of the following is always positive when a spontaneous process occurs?  
(A)  $\Delta S_{\text{surroundings}}$  (B)  $\Delta S_{\text{universe}}$  (C)  $\Delta H_{\text{universe}}$  (D)  $\Delta H_{\text{surroundings}}$
- Which is true for the following reaction under standard conditions?  
 $\text{C}_2\text{H}_6(\text{g}) \rightarrow \text{C}_2\text{H}_4(\text{g}) + \text{H}_2(\text{g}) \quad \Delta H^\circ \text{ is } 137 \text{ kJ and } \Delta S^\circ \text{ is } 120 \text{ J/K.}$   
(A) spontaneous at all temperatures  
(B) spontaneous only at high temperature  
(C) spontaneous only at low temperature  
(D) not spontaneous at all temperatures
- Which one of the following processes is endothermic?  
(A)  $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g})$  (B)  $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$   
(C)  $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$  (D)  $\text{H}_2\text{O}(\text{s}) \rightarrow \text{H}_2\text{O}(\text{l})$
- Which of the following would be expected to have the highest vapor pressure at room temperature?  
(A) Ethanol bp = 78 (B) methanol bp = 65  
(C) water bp = 100 (D) acetone bp = 56
- The solubility of  $\text{CO}_2$  gas in water  
(A) increases with increasing temperature. (B) decreases with decreasing temperature.  
(C) decreases with increasing temperature. (D) is not dependent on temperature.
- Which of the following compounds should be soluble in  $\text{CCl}_4$ ?  
(A)  $\text{NaCl}$  (B)  $\text{H}_2\text{O}$  (C)  $\text{NaOH}$  (D)  $\text{C}_8\text{H}_{18}$
- Which of the following liquids would make a good solvent for iodine,  $\text{I}_2$ ?  
(A)  $\text{HCl}$  (B)  $\text{H}_2\text{O}$  (C)  $\text{CS}_2$  (D)  $\text{CH}_3\text{OH}$
- The common constituent in all acid solutions is:  
(A)  $\text{H}_2$  (B)  $\text{H}^+$  (C)  $\text{OH}^-$  (D)  $\text{H}_2\text{SO}_4$
- Which of the following compounds is a weak electrolyte?  
(A)  $\text{HCl}$  (B)  $\text{CH}_3\text{COOH}$  (acetic acid) (C)  $\text{C}_6\text{H}_{12}\text{O}_6$  (glucose) (D)  $\text{O}_2$
- Which gas has molecules with the greatest average molecular speed at  $25^\circ\text{C}$ ?  
(A)  $\text{CH}_4$  (B)  $\text{Kr}$  (C)  $\text{N}_2$  (D)  $\text{CO}_2$
- How many significant figures are in the number  $1.20 \times 10^3$ ?  
(A) 2 (B) 3 (C) 4 (D) 5
- What is the chemical formula of the salt produced by neutralization of sodium hydroxide with sulfuric acid?  
(A)  $\text{NaSO}_3$  (B)  $\text{Na}_2(\text{SO}_4)_3$  (C)  $\text{Na}_2\text{SO}_4$  (D)  $\text{Na}(\text{SO}_4)_2$
- Which of the following is named incorrectly?  
(A)  $\text{FeSO}_4$ ; iron(II) sulfate (B)  $\text{Sn}_3(\text{PO}_4)_4$ ; tin(IV) phosphate  
(C)  $\text{Fe}(\text{OH})_2$ ; iron(III) hydroxide (D) all are correct.
- What is the oxidation number of phosphorus in the compound  $\text{H}_3\text{PO}_4$ ?  
(A) 3 (B) 4 (C) 5 (D) 6
- How many neutrons are there in one atom of  $^{48}_{22}\text{Ti}$ ?  
(A) 22 (B) 26 (C) 48 (D) 70
- As the principal energy level increases in an atom's orbitals, the average distance of an electron energy level from the nucleus \_\_\_\_\_.  
(A) increases (B) decreases (C) stays the same (D) varies
- Which one of the ions will have the largest radius?  
(A)  $\text{Cl}^-$  (B)  $\text{S}^{2-}$  (C)  $\text{P}^{3-}$  (D)  $\text{K}^+$
- According to VSEPR theory which one of the following molecules is bent?  
(A)  $\text{CO}_2$  (B)  $\text{C}_2\text{H}_2$  (C)  $\text{SO}_2$  (D)  $\text{BeCl}_2$
- Which one of the following bonds is least polar (lowest percent ionic character)?  
(A) C-Cl (B) C-C (C) C-H (D) N-C
- What is the formal charge on the bromine atom in  $\text{BrO}_3^-$ , drawn with three single bonds?  
(A) -2 (B) -1 (C) +1 (D) +2

24. Indicate the type of hybrid orbitals used by the central atom in  $\text{CCl}_4$   
 (A)  $sp^2$  (B)  $sp^3$  (C)  $sp^3d$  (D)  $sp^3d^2$
25. An atom of iron has \_\_\_\_ unpaired electrons and is \_\_\_\_\_. (The atomic number of Fe is 26.)  
 (A) 0, diamagnetic (B) 6, diamagnetic (C) 4, paramagnetic (D) 5, paramagnetic
26. The decomposition of nitromethane in basic solution was studied at constant temperature. The rate law is first order in [nitromethane]. For a standard solution of 0.0100 M nitromethane, the concentration of nitromethane after 5.00 s was found to be  $2.24 \times 10^{-4}$  M. When a unknown sample of nitromethane was analyzed, the concentration remaining after 5.00 s was found to be  $1.35 \times 10^{-4}$  M. What is the initial concentration of nitromethane in the sample?  
 (A) 0.00854 M (B) 0.00603 M (C) 0.00991 M (D) 0.000329 M
27. For a reaction in which A and B react to form C, the following initial rate data were obtained:
- | [A]   | [B]   | Initial Rate of Formation of C |
|-------|-------|--------------------------------|
| (M)   | (M)   | (M s <sup>-1</sup> )           |
| 0.100 | 0.200 | 0.500                          |
| 0.400 | 0.200 | 2.00                           |
| 0.400 | 0.100 | 0.500                          |
- What is the overall order of the reaction?  
 (A) 1 (B) 2 (C) 3 (D) 4
28. What statement about equilibrium is true?  
 (A) When two opposing processes proceed at identical rates, the system is at equilibrium.  
 (B) The equilibrium constant is independent of temperature.  
 (C) An endothermic reaction shifts toward reactants when heat is applied.  
 (D) Catalysts shifts the position of an equilibrium.
29. For the following reaction,  $\text{C}_6\text{H}_{12}\text{O}_6(\text{s}) + 6\text{O}_2(\text{g}) \rightarrow 6\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{l})$ ,  $\Delta H^\circ = -2816$  kJ, which statement is incorrect?  
 (A) Increasing  $P(\text{O}_2)$ , the reaction shifts toward products.  
 (B) Decreasing  $P(\text{CO}_2)$ , the reaction shifts toward products.  
 (C) Decreasing the total pressure, the reaction shifts toward products.  
 (D) Decreasing temperature, the reaction shifts toward products.
30. For the reaction  $2\text{NOCl}(\text{g}) \rightarrow 2\text{NO}(\text{g}) + \text{Cl}_2(\text{g})$  at 25 °C, the equilibrium pressures were  $P(\text{NOCl}) = 0.887$  atm,  $P(\text{NO}) = 0.0250$  atm, and  $P(\text{Cl}_2) = 0.124$  atm. Find  $K_p$ .  
 (A)  $8.74 \times 10^{-5}$  atm (B)  $9.85 \times 10^{-5}$  atm (C)  $2.53 \times 10^{-4}$  atm (D)  $3.49 \times 10^{-3}$  atm.
31. For the relative order of acid strength, which one is correct?  
 (A)  $\text{HF} > \text{HCl} > \text{HBr}$  (B)  $\text{NH}_3 > \text{H}_2\text{O} > \text{HF}$  (C)  $\text{H}_3\text{PO}_4 > \text{H}_3\text{PO}_3 > \text{H}_3\text{PO}_2$   
 (D) none of these
32. For  $\text{HOCl}$ ,  $K_a = 3.5 \times 10^{-8}$ . Calculate the pH of 0.100 M  $\text{HOCl}$   
 (A) 1.00 (B) 3.73 (C) 7.46 (D) 4.23
33.  $K_a$  for  $\text{HOCl}$  is  $3.5 \times 10^{-8}$ . Calculate the equilibrium constant of the reaction  
 $\text{HOCl} + \text{NaOH} \rightarrow \text{NaOCl} + \text{H}_2\text{O}$ .  
 (A)  $3.5 \times 10^6$  (B)  $2.9 \times 10^7$  (C)  $1.00 \times 10^{14}$  (D)  $2.9 \times 10^{-7}$
34. How many mM of  $\text{HCl}$  must be added to 100 mL of a 0.100 M solution of ammonia ( $pK_b = 4.76$ ) to give a buffer having a pH of 9.50?  
 (A) 2.5 (B) 7.5 (C) 6.4 (D) 3.6
35. Calculate the molar concentration of  $\text{HNO}_3$  (63.0g/mol) in a solution that has a density of 1.42 g/mL and is 70.0% of  $\text{HNO}_3$  (w/w).  
 (A) 17.8 M (B) 15.8 M (C) 14.5 M (D) 12.2 M
36. Solubility Products ( $K_{sp}$ ) in pure water for  $\text{BaCO}_3$ :  $5.0 \times 10^{-9}$ ,  $\text{CaF}_2$ :  $3.9 \times 10^{-11}$ ,  $\text{CuI}$ :  $1.0 \times 10^{-12}$ , and  $\text{Mn}(\text{OH})_2$ :  $2.0 \times 10^{-13}$ . Which of the following compounds is the most soluble in pure water?  
 (A)  $\text{BaCO}_3$  (B)  $\text{CaF}_2$  (C)  $\text{CuI}$  (D)  $\text{Mn}(\text{OH})_2$
37. For the following species:  $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{CH}_3\text{OH}$ , and  $\text{H}_2\text{C} = \text{O}$ , the oxidation state of carbon are  
 (A) 4, 4, 2, 2 (B) 4, -4, -2, 2 (C) 4, -4, -2, 0 (D) 4, 4, 2, 0, respectively.
38. Which of the following is the best oxidizing agent  
 $\text{Cl}_2 + 2e^- \rightarrow 2\text{Cl}^-$   $E^\circ = 1.36\text{V}$   
 $\text{H}_2\text{O}_2 + 2\text{H}^+ + 2e^- \rightarrow 2\text{H}_2\text{O}$   $E^\circ = 1.78\text{V}$   
 $\text{I}_2 + 2e^- \rightarrow 2\text{I}^-$   $E^\circ = 0.536\text{V}$   
 $\text{Cu}^{2+} + 2e^- \rightarrow \text{Cu}$   $E^\circ = 0.337\text{V}$   
 (A)  $\text{H}_2\text{O}_2$  (B)  $\text{Cl}_2$  (C)  $\text{Cu}$  (D)  $\text{I}_2$
39. Calculate the potential of the half cell that Ni is immersed in  $2.00 \times 10^{-3}$  M  $\text{Ni}^{2+}$  at 25 °C,  $\text{Ni}^{2+} + 2e^- \rightarrow \text{Ni}$   $E^\circ = -0.250\text{V}$   
 (A) -0.330 V (B) -0.170 V (C) -0.410 V (D) -0.090 V
40. How many minutes are required to cause reduction of 3.00g  $\text{Cu}^{2+}$  to  $\text{Cu}$  if a constant current of 5.0 amperes is passed through a cell? ( $\text{Cu}$ : 63.5g/mol, 1 faraday = 96500 C)  
 (A) 18.2 (B) 7.1 (C) 15.2 (D) 30.4