國立聯合大學 105 學年度

暑假轉學生招生考試試題紙

科目：普通化學　第 1 頁共 3 頁

選擇題 1~20 題每題 3 分, 21~30 題每題 4 分, 總分共 100 分

1. 10.0 mL of a 0.100 mol L^{-1} solution of a metal ion M^{2+} is mixed with 10.0 mL of a 0.100 mol l^{-1} solution of a substance L. The following equilibrium is established:

$$M^{2+}(aq) + 2L(aq) \rightleftharpoons ML_2^{2+}(aq)$$

At equilibrium the concentration of L is found to be 0.0100 mol L^{-1}. What is the equilibrium concentration of ML_2^{2+}, in mol L^{-1}?

A. 10^{-2}　B. 10^{-3}　C. 4×10^{-2}　D. 2×10^{-2}　E. 5×10^{-3}

2. At 25°C, the equilibrium constant K_c for the reaction is 64.　$2A(aq) \rightleftharpoons B(aq) + C(aq)$

If 3.0 mol of A is added to enough water to prepare 1.00 L of solution, what will the equilibrium concentration of A be?

A. 2.22M　B. 2.82M　C. 1.41M　D. 1.0M　E. 0.18 M

3. Aluminum reacts with oxygen to produce aluminum oxide which can be used as an adsorbent, desiccant or catalyst for organic reactions.　$4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$

A mixture of 82.49 g of aluminum ($\mathcal{M}$ = 26.98 g/mol) and 117.65 g of oxygen ($\mathcal{M}$= 32.00 g/mol) is allowed to react. Identify the limiting reactant and determine the mass of the excess reactant present in the vessel when the reaction is complete.

A. Oxygen is the limiting reactant; 19.81 g of aluminum remain.　B. Oxygen is the limiting reactant; 35.16 g of aluminum remain.

C. Aluminum is the limiting reactant; 16.70 g of oxygen remain.　D. Aluminum is the limiting reactant; 35.16 g of oxygen remain.

E. Aluminum is the limiting reactant; 44.24 g of oxygen remain.

4. What is the molecular shape of SCl_3F as predicted by the VSEPR theory?

A. square pyramidal　B. square planar　C. see-saw　D. octahedral　E. tetrahedral

5. What is the molecular shape of ClF_4^- as predicted by the VSEPR theory?

A. square pyramidal　B. square planar　C. see-saw　D. octahedral　E. tetrahedral

6.For what signs of ΔH and ΔS will a process not be spontaneous at any temperatures?

A. $\Delta H>0, \Delta S<0$　B. $\Delta H>0, \Delta S>0$　C. $\Delta H<0, \Delta S<0$　D. $\Delta H<0, \Delta S>0$　E. $\Delta H=0, \Delta S=0$

7. A voltaic cell consists of a Cd/Cd^{2+} electrode ($E°$ = -0.40 V) and a Fe/Fe^{2+} electrode ($E°$= -0.44 V).

If E_{cell} = 0 and the temperature is 25°C, what is the ratio $[Fe^{2+}]/[Cd^{2+}]$?

A. 10　B. 20　C. 50　D. 100　E. 1000

8. A galvanic cell is constructed using the two hypothetical half-reactions

$$A + e^- \rightarrow B \qquad E° = 1.50\,V$$

and

$$C + 2e^- \rightarrow D \qquad E° = -0.50\,V$$

Calculate the standard potential of this cell, $E°_{cell}$.

A. 0.5V　B. 1.0 V　C. 2.0V　D. 2.5V　E. 3.5 V

9. Calculate the solubility of silver chromate, Ag_2CrO_4, in 0.005 M Na_2CrO_4. $K_{sp} = 2.6\times 10^{-12}$

A. 7.07×10^{-6}　B. 7.07×10^{-5}　C. 1.0×10^{-6}　D. 5.2×10^{-10}　E. 1.1×10^{-5}

10. A buffer is prepared by adding 300.0 mL of 2.0 M NaOH to 500.0 mL of 2.0 M CH_3COOH. What is the $[H^+]$of this buffer? $K_a = 1.8\times 10^{-5}$

A. 3.6×10^{-5}　B. 2.4×10^{-5}　C. 1.2×10^{-5}　D. 2.7×10^{-5}　E. 1.8×10^{-5}

11. Nitrogen and hydrogen combine to form ammonia in the Haber process. Calculate (in kJ) the standard enthalpy change $\Delta H°$ for the reaction written below, using the bond energies given.

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

Bond:	N≡N	H-H	N-H
Bond energy (kJ/mol):	945	432	391

A. 986 B. 537 C. -1495 D. -105 E. 105 kJ

12. The rate law for the reaction $3A \rightarrow 2B$ is rate = k[A] with a rate constant of 0.0447 hr^{-1}. What is the half-life of the reaction? (ln2=0.693)

A. 0.0224 hr B. 0.0645 hr C. 11.2 hr D. 15.5hr E. 22.4 hr

13. The normal freezing point of ammonia is −78°C. Predict the signs of ΔH, ΔS, and ΔG for ammonia when it freezes at −80°C and 1 atm: $NH_3(l) \rightarrow NH_3(s)$

	ΔH	ΔS	ΔG
A)	−	−	0
B)	−	+	−
C)	+	−	+
D)	+	+	0
E)	−	−	−

14. Given that $E°$ for $X + e^- \rightarrow Y$ is greater than $E°$ for $A + 2e^- \rightarrow B$, it is correct to say that, under standard conditions

A. X will oxidize B. Y will oxidize A. C. Y will oxidize A. D. B will oxidize X. E. B will oxidize Y

15. For a reaction in a voltaic cell both $\Delta H°$ and $\Delta S°$ are positive. Which of the following statements is true?

A. $\mathscr{E}°_{cell}$ will increase with an increase in temperature B. $\mathscr{E}°_{cell}$ will decrease with an increase in temperature

C. $\mathscr{E}°_{cell}$ will not change when the temperature increases D. $\Delta G° > 0$ for all temperatures.

E. None of the above statements is true.

16. The vapor pressure of water at 25.0°C is 23.8 torr. Determine the mass of glucose (molar mass = 180 g/mol) needed to add to 500.0 g of water to change the vapor pressure to 23.3 torr.

A.10.7 g B.107 g C. 6.35g D. 63.5g . E.150g

17. Consider the non-aqueous cell reaction: $2Na(l) + FeCl_2(s) \rightleftharpoons 2NaCl(s) + Fe(s)$ for which $E°_{cell} = 2.35$ V at 200°C. $\Delta G°$ at this temperature is

A.-453 kJ B. 453 kJ C. -906 kJ D. 906 kJ . E. -543 kJ

18. Consider the following reaction: $2A + B \rightarrow 3C + D$ 3.0 mol *A* and 2.0 mol *B* react to form 4.0 mol *C*. What is the percent yield of this reaction?

A.33% B. 54% C. 66.6% D. 89%. E. 95%

19. A 230.0-mL sample of a 0.275 *M* solution is left on a hot plate overnight; the following morning the solution is 1.50 *M*. What volume of solvent has evaporated from the 0.275 *M* solution?

A. 42.2 ml B. 63.3ml C. 96.7 ml D. 187.8 ml E. 272.3ml

20. If all of the chloride in a 4.776-g sample of an unknown metal chloride is precipitated as AgCl with 70.90 mL of 0.2010 *M* $AgNO_3$, what is the percentage of chloride in the sample?(Ag:108,Cl:35.5)

A.11 % B. 18% C. 25% D. 29%. E. 33%

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21. An unknown diprotic acid requires 26.66 mL of 0.117 *M* NaOH to completely neutralize a 0.845-g sample. Calculate the approximate molar mass of the acid.
A. 270.9　B. 541.8　C. 812.7　D. 135.5　E. 202.35　g/mole

22. A solution is prepared from 76.4 g of a nonvolatile, nondissociating solute and 85.0 g of water. The vapor pressure of the solution at 60°C is 132 torr. The vapor pressure of water at 60°C is 150. torr. What is the molar mass of the solute?
A. 86.9　B. 238　C. 180　D. 234　E. 119　g/mole

23. Consider the following equilibrium: $2H_2(g) + X_2(g) \rightleftharpoons 2H_2X(g)$ + energy　Addition of argon to the above equilibrium
A. will cause $[H_2]$ to decrease　B. will cause $[X_2]$ to increase　C. will cause $[H_2X]$ to decrease
D. will cause $[H_2X]$ to increase　E. will have no effect

24. Consider the reaction: $4NH_3 + 7O_2 \rightarrow 4NO_2 + 6H_2O$　At a certain instant the initial rate of disappearance of the oxygen gas is X. What is the value of the appearance of water at the same instant?
A. 1.17X　B. 0.86X　C. 0.67X　D. 0.5X　E. 0.33X

25. Arsenic acid, H_3AsO_4, is used industrially to manufacture insecticides. Arsenic acid is a polyprotic acid with $K_1 = 2.5 \times 10^{-4}$, $K_2 = 5.6 \times 10^{-8}$, and $K_3 = 3 \times 10^{-13}$. What is the concentration of the $HAsO_4^{2-}$ in a solution whose initial arsenic acid concentration was 0.35 *M*?
A. 9.4×10^{-3} *M*　B. 2.5×10^{-4} *M*　C. 8.8×10^{-5} *M*　D. 5.6×10^{-8}M　E. 1.6×10^{-9} M.

26. A 3.0-L sample of helium was placed in container fitted with a porous membrane. Half of the helium (He:4.0 g/mole) effused through the membrane in 24 hours. A 3.0-L sample of oxygen (O: 16.0 g/mole) was placed in an identical container. How many hours will it take for half of the oxygen to effuse through the membrane?
A. 68h　B. 60h　C. 32h　D. 16h　E. 8. 5h

27. At a given temperature, you have a mixture of benzene (vapor pressure of pure benzene = 745 torr) and toluene (vapor pressure of pure toluene = 290. torr). The mole fraction of benzene in the solution is 0.590. Assuming ideal behavior, calculate the mole fraction of toluene in the vapor above the solution.
A. 0.213　B. 0.787　C. 0.595　D. 0.316　E.0.642

28. A concentration cell is constructed using two Ni electrodes with Ni^{2+} concentrations of 1.0 *M* and 1.00　10^{-4} *M* in the two half-cells. The reduction potential of Ni^{2+} is –0.23 V. Calculate the potential of the cell at 25°C.
A. 0.348V　B.0.112V　C.0.118V　D.-0.112V　E. -0.348V

29. A 1.57-g sample of a metal chloride, MCl_2, is dissolved in water and treated with excess aqueous silver nitrate. The silver chloride that formed weighed 3.47 g. Calculate the molar mass of M. (Ag:108 g/mole, Cl:35.5 g/mole)
A. 24.3 g/mol　B. 40.0 g/mol　C. 58.9 g/mol　D. 65 g/mol　E. 72.4 g/mol

30. Consider the equation $A(aq) + 2B(aq) \rightleftharpoons 3C(aq) + 2D(aq)$. In one experiment, 45.0 mL of 0.050 *M* A is mixed with 25.0 mL 0.100 *M* B. At equilibrium the concentration of C is 0.0410 *M*. Calculate *K*.
A. 0. 02　B. 0. 036　C. 0. 14　D. 0. 34　E. 3.6×10^{-3}