

## 九十八學年度四年制二、三年級轉學生招生考試

## 四技二年級 化學工程與生物科技系

## 第三節 專業科目 (二) 普通化學 試題

第一頁 共三頁

## 注意事項：

1. 本試題共 40 題，配分共 100 分。(每題 2.5%)
2. 挑選選項時，請依最接近之數值作答。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Based on the activity series, which one of the reactions below will occur?
  - (a)  $\text{Mg(s)} + \text{Ca(OH)}_2(\text{aq}) \rightarrow \text{Mg(OH)}_2(\text{aq}) + \text{Ca(s)}$
  - (b)  $\text{SnI}_2(\text{aq}) + \text{Cu(s)} \rightarrow \text{Sn(s)} + \text{CuI}_2(\text{aq})$
  - (c)  $\text{Hg(l)} + 2\text{Cr(NO}_3)_3(\text{aq}) \rightarrow 3\text{Hg(NO}_3)_2(\text{aq}) + 2\text{Cr(s)}$
  - (d)  $2\text{AgNO}_3(\text{aq}) + \text{Pb(s)} \rightarrow 2\text{Ag(s)} + \text{Pb(NO}_3)_2(\text{aq})$
2. A 50.0 mL sample of 0.150 M acetic acid is titrated with a 0.300 M NaOH solution. What is pH after 25.0 mL of base is added? The  $K_a$  of acetic acid is  $1.74 \times 10^{-5}$ .
  - (a) 13.24
  - (b) 12.17
  - (c) 8.88
  - (d) 7.79
3. From the value of pKa for benzoic acid is 4.20 at 25°C. What is the percentage of benzoic acid molecules that are ionized in a 0.0050 M solution?
  - (a) 12.1
  - (b) 10.6
  - (c) 5.91
  - (d) 3.62
4. Select the substance that is thought to be partially responsible for the depleting the concentration of ozone in the stratosphere.
  - (a)  $\text{CF}_2\text{Cl}_2$
  - (b)  $\text{CO}_2$
  - (c) Kr
  - (d)  $\text{N}_2$
5. The equilibrium constant for a reaction is 0.16 at 300K. What is the value of  $\Delta G^\circ$  (kJ/mol) at this temperature?
  - (a) +9.14
  - (b) +4.57
  - (c) -9.14
  - (d) -12.33
6. Which reaction produces an increase in the entropy of the system?
  - (a)  $\text{Br}_2(\text{l}) \rightarrow \text{Br}_2(\text{g})$
  - (b)  $\text{Ca}^{2+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{CaCO}_3(\text{s})$
  - (c)  $\text{NH}_3(\text{g}) + \text{HCl}(\text{g}) \rightarrow \text{NH}_4\text{Cl}(\text{s})$
  - (d)  $2\text{NO}_2(\text{g}) \rightarrow \text{N}_2\text{O}_4(\text{g})$

7. Which one of the following compound is peroxide?
  - (a)  $\text{CsO}_2$
  - (b)  $\text{OF}_2$
  - (c)  $\text{Li}_2\text{O}$
  - (d)  $\text{Na}_2\text{O}_2$
8. The stand emf for the cell using the overall cell reaction below is +0.48V:
 
$$\text{Zn(s)} + \text{Ni}^{2+}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{Ni(s)}$$
 In the cell  $[\text{Ni}^{2+}] = 2.50 \text{ M}$  and  $[\text{Zn}^{2+}] = 0.75 \text{ M}$ . What value of emf will be generated by the cell?
  - (a) 0.562
  - (b) 0.495
  - (c) 0.465
  - (d) 0.365
9. According to the kinetic-molecular theory, in which of the following gases will the root-mean-square speed of the molecules be the highest at 298K? (atomic mass: C = 12, Cl = 35.5, H = 1, O = 16, S = 32, N = 14)
  - (a)  $\text{SO}_3$
  - (b)  $\text{H}_2\text{S}$
  - (c)  $\text{CH}_4$
  - (d)  $\text{NO}_2$
10. Which one is the predominant intermolecular force in  $\text{CsI}$ ?
  - (a) London-dispersions forces
  - (b) ionic bonding
  - (c) hydrogen bonding
  - (d) dipole-dipole forces
11. Which monomer is polymerized to make natural rubber?
  - (a) ethylene
  - (b) butadiene
  - (c) styrene
  - (d) isoprene
12. A Solution containing 20.0 g of an unknown liquid and 90.0 g water has a freezing point of  $-6.66^\circ\text{C}$ . Given  $K_f = -1.86^\circ\text{C}/\text{m}$  for water, which one is the molar mass of the unknown liquid?
  - (a) 494.2
  - (b) 263.6
  - (c) 62.1
  - (d) 42.4
13. How many enthalpy change (in kJ) is involved in converting 1.00 mol of ice at  $-40.0^\circ\text{C}$  to water at  $70^\circ\text{C}$ ? The specific heat of ice, water, and steam are 2.09 J/g-K, 4.18 J/g-K, and 1.84 J/g-K, respectively. For  $\text{H}_2\text{O}$ ,  $\Delta H_{\text{fus}} = 6.01 \text{ kJ/mol}$ , and  $\Delta H_{\text{vap}} = 40.67 \text{ kJ/mol}$ .
  - (a) 6.23
  - (b) 12.78
  - (c) 20.64
  - (d) 29.36
14. In which region of the electromagnetic spectrum will occur for the transition from  $n = 8$  to  $n = 2$  in the Bohr hydrogen atom?
  - (a) ultraviolet
  - (b) microwave
  - (c) radio
  - (d) X-ray

注意：背面尚有試題

15. Which is the correct ground-state electron configuration for  ${}_{42}\text{Mo}$ ?  
 (a)  $[\text{Kr}]5s^14d^6$   
 (b)  $[\text{Kr}]5s^14d^5$   
 (c)  $[\text{Kr}]5s^24d^5$   
 (d)  $[\text{Kr}]5s^24d^9$
16. Which one of the following represents an acceptable set of quantum numbers for an electron in an atom? (It is arranged as  $n, l, m_l$ , and  $m_s$ .)  
 (a) 1, 2, -1, -1/2  
 (b) 1, 0, 0, -1/2  
 (c) 4, 4, 4, 1/2  
 (d) 5, 3, -5, -1/2
17. The rate constant for a particular second-order reaction is  $0.24 \text{ M}^{-1}\text{s}^{-1}$ . If the initial concentration of reactant is  $0.45 \text{ mol/L}$ , it will take how many second for decreasing to  $0.15 \text{ mol/L}$ ?  
 (a) 26.7  
 (b) 18.5  
 (c) 7.9  
 (d) 3.7
18. The half-life of a first-order reaction is 8.6 min. If the initial concentration of reactant is  $2.4 \text{ M}$ , it will take how many min for it to decrease to  $0.015 \text{ M}$ ?  
 (a) 17.74  
 (b) 24.56  
 (c) 62.97  
 (d) 93.21
19. For a first-order reaction, in which correct plot that will exhibit in a linear relationship?  
 (a)  $\ln[A]_t$  versus  $t$   
 (b)  $\ln[A]_t$  versus  $1/t$   
 (c)  $1/[A]_t$  versus  $t$   
 (d)  $[A]_t$  versus  $t$
20.  $K_b$  for  $\text{NH}_3$  is  $1.8 \times 10^{-5}$ . What is the pH of a  $0.75 \text{ M}$  aqueous solution of  $\text{NH}_4\text{Cl}$  at  $25^\circ\text{C}$ ?  
 (a) 2.21  
 (b) 4.69  
 (c) 9.52  
 (d) 10.13
21. For which salt should the aqueous solubility be most sensitive to pH?  
 (a)  $\text{Zn}(\text{NO}_3)_2$   
 (b)  $\text{KNO}_3$   
 (c)  $\text{CaF}_2$   
 (d)  $\text{LiI}_2$
22. Which combination will produce a precipitate?  
 (a)  $\text{KOH}(\text{aq})$  and  $\text{NaNO}_3(\text{aq})$   
 (b)  $\text{NaOH}(\text{aq})$  and  $\text{Ba}(\text{NO}_3)_2(\text{aq})$   
 (c)  $\text{NaI}(\text{aq})$  and  $\text{KCl}(\text{aq})$   
 (d)  $\text{LiOH}(\text{aq})$  and  $\text{Mg}(\text{NO}_3)_2(\text{aq})$
23. Which one is the correct name for  $\text{Mg}(\text{ClO})_2$ ?  
 (a) magnesium chlorate  
 (b) magnesium hypochlorite  
 (c) magnesium perchlorate  
 (d) magnesium chlorite
24. Magnesium burns in air with a dazzling brilliance to produce magnesium oxide:  
 $2\text{Mg}(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2\text{MgO}(\text{s})$   
 When  $6.46 \text{ g}$  of magnesium burns, what is the theoretical yield of magnesium oxide? ( $\text{Mg} = 24.305$ ,  $\text{O} = 15.9994$ )  
 (a) 4.13  
 (b) 6.46  
 (c) 10.71  
 (d) 14.32
25. Which one of the following species is paramagnetic?  
 (a)  $\text{Sr}$   
 (b)  $\text{Cu}^+$   
 (c)  $\text{Cd}$   
 (d)  $\text{Cr}^{3+}$
26. Combustion of a  $20.10 \text{ mg}$ -sample of a compound containing only carbon, and hydrogen produced  $69.00 \text{ mg}$  of  $\text{CO}_2$  and  $11.30 \text{ mg}$   $\text{H}_2\text{O}$ . What is the empirical formula of the compound? (atomic mass:  $\text{C} = 12.011$ ,  $\text{H} = 1.0079$ ,  $\text{O} = 15.9994$ )  
 (a)  $\text{C}_2\text{H}_6$   
 (b)  $\text{C}_5\text{H}_4$   
 (c)  $\text{C}_5\text{H}_6$   
 (d)  $\text{C}_6\text{H}_4$
27. The value of  $\Delta H^\circ$  for the reaction is  $+128.1 \text{ kJ}$ :  
 $\text{CH}_3\text{OH}(\text{l}) \rightarrow \text{CO}(\text{g}) + \text{H}_2(\text{g})$  (Note: it is in unbalanced)  
 How many kJ of heat are consumed when  $15.20 \text{ g}$  of  $\text{H}_2(\text{g})$  is formed as shown in the equation? (atomic mass:  $\text{H} = 1.00794$ )  
 (a) 482.95  
 (b) 965.89  
 (c) 1500.14  
 (d) 1947.12
28. What is the value of  $\Delta E$  in joules for a system that loses  $65 \text{ J}$  of heat and has  $250 \text{ J}$  of work performed on it by the surroundings?  
 (a) -315  
 (b) -185  
 (c) +185  
 (d) +315
29. Which one of following is a semimetal?  
 (a)  $\text{S}$   
 (b)  $\text{Se}$   
 (c)  $\text{Si}$   
 (d)  $\text{Sn}$
30. The standard half-reaction are listed as follow:  $\text{Fe}^{3+}(\text{aq}) + \text{e}^- \rightarrow \text{Fe}^{2+}(\text{aq})$   $E^\circ(\text{V}) = +0.771$   
 $\text{Sn}^{4+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Sn}^{2+}(\text{aq})$   $E^\circ(\text{V}) = +0.154$ . Which one is the standard cell potential ( $E^\circ_{\text{cell}}$ ) for the voltaic cell based on the reaction below?  
 (a) +0.617  
 (b) +1.21  
 (c) +1.39  
 (d) -0.43

31. What is the coefficient of the  $\text{Mn}^{2+}$  ion when the following equation is balanced in acidic solution?  $\text{MnO}_4^-(\text{aq}) + \text{Br}^-(\text{aq}) \rightarrow \text{Mn}^{2+}(\text{aq}) + \text{Br}_2(\text{aq})$
- (a) 1 (b) 2  
(c) 3 (d) 5
32. Which one of the molecular geometry is T-shaped?
- (a)  $\text{CHCl}_3$  (b)  $\text{BCl}_3$   
(c)  $\text{PH}_3$  (d)  $\text{ICl}_3$
33. Given the data of  $\Delta H_f^\circ$  (kJ/mol) as below, what is the  $\Delta H_{\text{rxn}}^\circ$  for the following reaction?  
 $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$   
 $\Delta H_f^\circ(\text{CaCO}_3(\text{s})) = -1207.0$ ,  $\Delta H_f^\circ(\text{CaO}(\text{s})) = -635.5$ , and  $\Delta H_f^\circ(\text{CO}_2(\text{g})) = -393.7$
- (a) -2236.2 (b) +177.8  
(c) -177.8 (d) +236.2
34. Of the following ions, which has the largest radius?
- (a)  $\text{Cl}^-$  (b)  $\text{K}^+$   
(c)  $\text{S}^{2-}$  (d)  $\text{Se}^{2-}$
35. For the reaction:  $\text{C}_2\text{H}_6(\text{g}) \rightarrow \text{C}_2\text{H}_4(\text{g}) + \text{H}_2(\text{g})$ ,  $\Delta H^\circ$  is +137 kJ/mol and  $\Delta S^\circ$  is +120 J/mol · K. Assuming that  $\Delta H^\circ$  and  $\Delta S^\circ$  are independent of temperature. If it is converted spontaneously, the temperature should be set at greater than which temperature ( $^\circ\text{C}$ )?
- (a) 1142 (b) 869  
(c) 785 (d) 273
36. Which one of hybridizations is used by the Br atom in the  $\text{BrF}_3$  molecule?
- (a)  $\text{sp}^3$  (b)  $\text{sp}^2$   
(c)  $\text{sp}^3\text{d}$  (d)  $\text{sp}^3\text{d}^2$
37. Based on molecular theory, which one is the correct bond order of the N-N in the  $\text{N}_2^{2+}$  ion?
- (a) 3 (b) 2  
(c) 1 (d) 3/2
38. In the gas phase,  $\text{NaCl}$  has a dipole moment of 9.001 D and Na-Cl distance of 236.1 pm.  $1\text{D} = 3.3356 \times 10^{-30} \text{C} \cdot \text{m}$ , and the charge of a single electron is  $1.6022 \times 10^{-19} \text{C}$ . Based on above data, what is the percent ionic character in  $\text{NaCl}(\text{g})$ ?
- (a) 99.05 (b) 94.21  
(c) 79.39 (d) 68.54
39. A 0.0500 M aqueous solution of  $\text{FeCl}_3$  has an osmotic pressure of 4.15 atm at  $25^\circ\text{C}$ . What is the van't Hoff factor  $i$  for the solution?
- (a) 1.27 (b) 2.95  
(c) 3.39 (d) 4.13
40. Which of the elements below has largest electronegativity?
- (a) Se (b) Si  
(c) P (d) Ga