

# 亞洲大學

## 112 學年度學士後獸醫學系招生考試試題紙

學系別	考試科目	考試日期	時 間
學士後獸醫學系	化學(含普通化學、有機化學)	112.04.29	10:30-12:00

1. How many distinct p orbitals exist in the second electron shell, where  $n = 2$ ?

A) 2 B) 3 C) 4 D) 5

2. Orbitals which are equal in energy are referred to as \_\_\_\_\_.

A) degenerate B) polar C) nodes D) filled

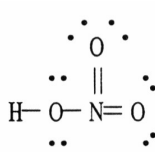
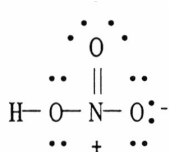
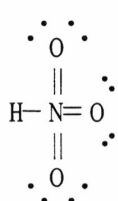
3. The atomic number of boron is 5. The correct electronic configuration of boron is:

A)  $1s^2 2s^3$  B)  $1s^2 2p^3$  C)  $1s^2 2s^2 2p^1$  D)  $2s^2 2p^3$

4. Which of the following molecules contains a polar covalent bond?

A)  $H_2$  B)  $F_2$  C)  $CH_3Cl$  D)  $NaCl$

5. Which of the following are acceptable Lewis structures, including formal charges, for nitric acid,  $HNO_3$ ?



A) A only B) B only C) C only D) both B and C

6. Which atomic orbital combination would result in a molecular sigma bond?

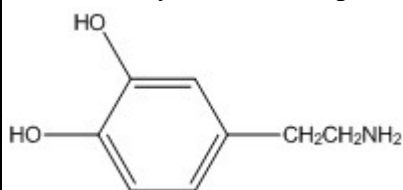
A) B) C) D)

7. How many carbon-carbon  $\sigma$  bonds are present in the molecule shown?



A) 2 B) 3 C) 4 D) 5

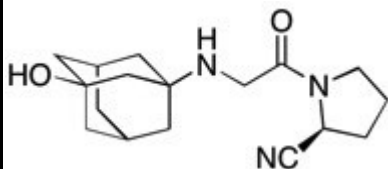
8. How many  $\pi$  bonds are present in the molecule shown?



A) 0 B) 1 C) 3 D) 4

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9. Vildagliptin is a recently released antidiabetic drug (*J. Med. Chem.* **2010**, 7902). How many elements of unsaturation are in Vildagliptin?



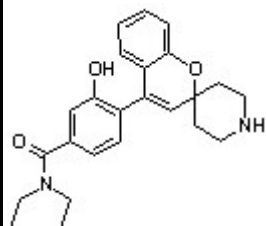
A) 4 B) 5 C) 6 D) 7

10. In the structure below, the hybridization of the oxygen is \_\_\_\_\_ and the C-O-C bond angle is \_\_\_\_\_.



A)  $sp^2$ ;  $120^\circ$  B)  $sp^2$ ;  $<109.5^\circ$  C)  $sp^3$ ;  $120^\circ$  D)  $sp^3$ ;  $<109.5^\circ$

11. The structure below is a potent analgesic agent (pain reliever) (*J. Med. Chem.*, **2009**, 5685). How many secondary carbons are in this structure?



A) 2 B) 4 C) 6 D) 12

12. How many methylene groups are present in 2,4-dimethylhexane?

A) 0 B) 1 C) 2 D) 6

13. Among the butane conformers, which occur at energy minima on a graph of potential energy versus dihedral angle?

A) gauche only B) eclipsed and totally eclipsed C) gauche and anti D) eclipsed only

14. Which of the following species is not formed through a termination reaction in the chlorination of methane?

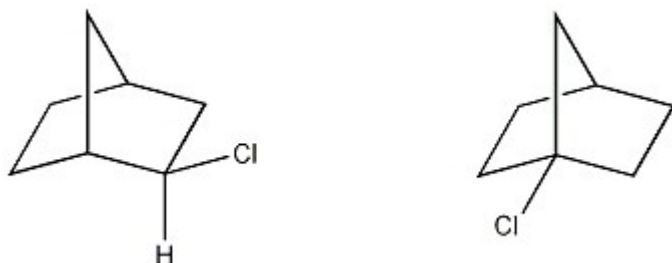
A)  $\text{CH}_3\text{Cl}$  B)  $\text{HCl}$  C)  $\text{H}_2$  D)  $\text{CH}_3\text{CH}_3$

15. If the equilibrium constant ( $K_{\text{eq}}$ ) of a reaction is 0.5 then which of the following that must be true?

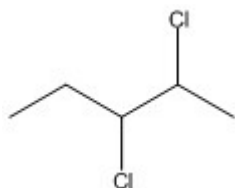
A) The reaction will have an early transition state. B) Reaction equilibrium will favor the products. C) Gibbs free energy ( $G$ ) is positive. D) Gibbs free energy ( $G$ ) is negative.

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16. Which is a measure of the randomness of a system?  
A) entropy B) enthalpy C) free energy D) halogenation
17. Which of the following statements correctly describes the contribution of  $\Delta S^\circ$  to  $\Delta G^\circ$ ?  
A) The entropy term makes a greater contribution to  $\Delta G^\circ$  at low temperatures.  
B) The entropy term makes a greater contribution to  $\Delta G^\circ$  at high temperatures.  
C) The entropy term makes a greater contribution to  $\Delta G^\circ$  in exothermic reactions.  
D) The entropy term makes a greater contribution to  $\Delta G^\circ$  in endothermic reactions.
18. Which of the following is true for the initiation step of a free radical chlorination reaction?  
A)  $\Delta H^\circ > 0$  and  $\Delta S^\circ > 0$  B)  $\Delta H^\circ > 0$  and  $\Delta S^\circ < 0$  C)  $\Delta H^\circ < 0$  and  $\Delta S^\circ > 0$  D)  $\Delta H^\circ < 0$  and  $\Delta S^\circ < 0$
19. What term describes the structural relationship between cis-1,2-dimethylcyclopentane and trans-1,3-dimethylcyclopentane?  
A) not isomers B) constitutional isomers C) enantiomers D) diastereomers
20. What is the structural relationship between the two molecule shown below?



- A) constitutional isomers B) enantiomers C) diastereomers D) conformational isomers
21. How many asymmetric carbon atoms are present in the molecule shown?



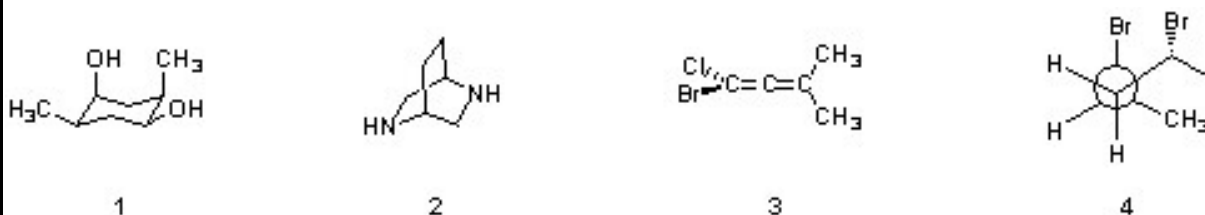
- A) 0 B) 1 C) 2 D) 3

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22. Which of the statements below correctly describes an achiral molecule?

- A) The molecule has a nonsuperimposable mirror image.
- B) The molecule exhibits optical activity when it interacts with plane-polarized light.
- C) The molecule has an enantiomer.
- D) The molecule might be a meso form.

23. Which of the following structures are achiral and meso?



- A) 1 B) 2 C) 3 D) 4

24. Which of the following best describes the carbon-chlorine bond of an alkyl chloride?

- A) nonpolar; no dipole
- B) polar;  $\delta^+$  at carbon and  $\delta^-$  at chlorine
- C) polar;  $\delta^-$  at carbon and  $\delta^+$  at chlorine
- D) ionic

25. Which of the following factors is favorable for nucleophilicity but not basicity?

- A) highly polarizable
- B) low electronegativity
- C) negatively charged
- D) sterically hindered

26. Which of the following compounds will undergo an  $S_N2$  reaction most readily?

- A)  $(CH_3)_3CCH_2I$
- B)  $(CH_3)_3CCl$
- C)  $(CH_3)_2CHI$
- D)  $(CH_3)_2CHCH_2CH_2CH_2I$

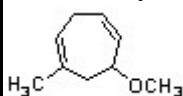
27. Which of the following alkyl halides reacts most rapidly via an  $S_N1$  solvolysis reaction in hot methanol?

- A) 1-iodohexane
- B) 1-fluorohexane
- C) (*R*)-2-bromohexane
- D) 1-iodo-1-methylcyclohexane

28. When a  $S_N1$  reaction of *R*-2-iodobutane takes place in hot methanol, the product \_\_\_\_\_.

- A) is chiral
- B) will rotate plane polarized light
- C) is racemic
- D) will undergo a hydride shift

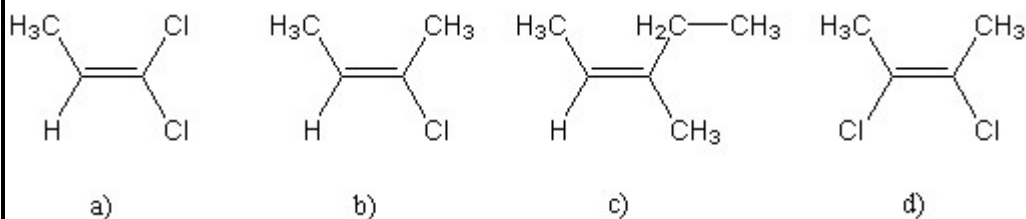
29. Identify the correct name for the following structure.



- A) 3-methoxy-5-methylcyclohepta-1,5-diene
- B) 6-methoxy-1-methylcyclohepta-1,4-diene
- C) 7-methoxy-5-methylcyclohepta-1,4-diene
- D) 4-methoxy-2-methylcyclohepta-1,5-diene

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30. For which of the following alkenes will cis- and trans- isomers not exist?



A) a) only B) b) only C) both a) and c) D) d) only

31. Using Zaitsev's rule, choose the most stable alkene among the following.

A) 1-methylcyclohexene B) 3-methylcyclohexene C) 4-methylcyclohexene  
D) They are all of equal stability according to Zaitsev's rule.

32. Consider the constitutional isomers 2-methylbut-1-ene, 2-methylbut-2-ene, and 3-methylbut-1-ene.

When each of these alkenes is subjected to catalytic hydrogenation ( $H_2$ , Pt), a single product results. Which of the following best describes the structural relationship among these products?

A) The products are cis-trans isomers. B) The products are identical.  
C) The products are constitutional isomers. D) The products are enantiomers.

33. Which of the following alkenes has the smallest molar heat of hydrogenation (ie, releases the least heat upon hydrogenation)?

A) 2,3-dimethyl-2-butene B) 2-methyl-2-butene C) *trans*-2-butene D) *cis*-2-butene

34. HBr can be added to an alkene in the presence of peroxides (ROOR). What function does the peroxide serve in this reaction?

A) nucleophile B) electrophile C) radical chain initiator D) acid catalyst

35. Provide the reagents necessary to complete the following transformation.



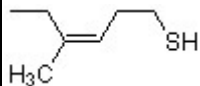
A) 1.  $BH_3 \cdot THF$  2.  $H_2O_2$ ,  $HO^-$  B)  $H_2O$ ,  $H_2SO_4$  C)  $OsO_4$ ,  $H_2O_2$  D)  $CH_3CO_3H$

36. Which of the following is the best reaction sequence to use if one wants to accomplish a Markovnikov addition of water to an alkene with minimal skeletal rearrangement?

A) water + dilute acid B) water + concentrated acid C) oxymercuration-demercuration  
D) hydroboration-oxidation

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37. What is the correct IUPAC name for the following structure?



- A) (Z) 4-methyl-3-hexen-1-thiol B) (Z) 6-mercapto-3-methylhex-3-ene  
C) (E) 6-mercapto-3-methylhex-3-ene D) (E) 4-methylhex-3-en-1-thiol

38. The reaction of  $\text{CH}_3\text{CH}_2\text{MgBr}$  with  $\text{CH}_3\text{COCH}_2\text{CH}_3$  gives \_\_\_\_\_.

- A) an achiral product B) a mixture of diastereomers  
C) the racemate of a chiral product D) a single enantiomer

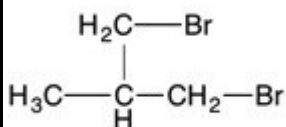
39. Which alcohol reacts most rapidly with the Lucas reagent?

- A) benzyl alcohol B) methanol C) 2-propanol D) isobutanol

40. Which of the following oxidants will convert a primary alcohol to an aldehyde?

- 1) sodium dichromate /sulfuric acid 3) pyridinium chlorochromate  
2) copper oxide 4) dimethylsulfoxide, oxalyl chloride  
A) 3 & 4 B) 2, 3, & 4 C) 3 D) 1, 2, 3, & 4

41. What are the relative integrations for the  $^1\text{H}$  NMR signals for the following compound?



- A) 3:1:2:2 B) 3:3:2 C) 3:1:4 D) 5:3

42. If a molecule contains 4 elements of unsaturation and signals in the  $^1\text{H}$  NMR spectrum between  $\delta$  7.0 and 8.0 ppm, what structural group is likely to be present?

- A) a carbonyl group B) an aromatic ring C) a hydroxyl group D) a cyclohexyl ring

43. Using a 60 MHz spectrometer, the protons in dichloromethane appear at 5.30 ppm. When the same sample is placed in a 100 MHz instrument, where does the signal appear?

- A) 8.33 B) 5.30 C) 3.18 D) cannot be determined from information given

44. Which of the following is another name for cyclobutadiene?

- A) [2]annulene B) [4]annulene C) [6]annulene D) Dewar benzene

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45. In electrophilic aromatic substitution reactions a bromine substituent \_\_\_\_\_.  
 A) is a deactivator and a m-director B) is a deactivator and an o,p-director  
 C) is an activator and a m-director D) is an activator and an o,p-director

46. Which element is oxidized in the reaction below?  

$$\text{Fe}(\text{CO})_5 (\text{l}) + 2\text{HI} (\text{g}) \rightarrow \text{Fe}(\text{CO})_4\text{I}_2 (\text{s}) + \text{CO} (\text{g}) + \text{H}_2 (\text{g})$$
  
 A) C B) O C) H D) Fe

47. Which of the following reactions is a redox reaction?  
 (a)  $\text{K}_2\text{CrO}_4 + \text{BaCl}_2 \rightarrow \text{BaCrO}_4 + 2\text{KCl}$   
 (b)  $\text{Pb}_2^{2+} + 2\text{Br}^- \rightarrow \text{PbBr}$   
 (c)  $\text{Cu} + \text{S} \rightarrow \text{CuS}$   
 A) (a) only B) (b) only C) (c) only D) (a) and (c)

48. The purpose of the salt bridge in an electrochemical cell is to \_\_\_\_\_.  
 A) maintain electrical neutrality in the half-cells via migration of ions  
 B) provide a source of ions to react at the anode and cathode  
 C) provide oxygen to facilitate oxidation at the anode  
 D) provide a means for electrons to travel from the anode to the cathode

49. Consider an electrochemical cell based on the reaction:  

$$2\text{H}^+ (\text{aq}) + \text{Sn} (\text{s}) \rightarrow \text{Sn}^{2+} (\text{aq}) + \text{H}_2 (\text{g})$$
  
 Which of the following actions would not change the measured cell potential?  
 A) lowering the pH in the cathode compartment  
 B) addition of more tin metal to the anode compartment  
 C) increasing the tin (II) ion concentration in the anode compartment  
 D) increasing the pressure of hydrogen gas in the cathode compartment

50. What is the cathode in an alkaline battery?  
 A)  $\text{MnO}_2$  B)  $\text{KOH}$  C) Zn powder D)  $\text{Mn}_2\text{O}_3$

51. The standard cell potential ( $E^\circ_{\text{cell}}$ ) for the reaction below is +0.63 V. At 25 °C, the cell potential for this reaction is \_\_\_\_\_ V when  $[\text{Zn}^{2+}] = 3.0 \text{ M}$  and  $[\text{Pb}^{2+}] = 2.0 \times 10^{-4} \text{ M}$ .  

$$\text{Pb}^{2+} (\text{aq}) + \text{Zn} (\text{s}) \rightarrow \text{Zn}^{2+} (\text{aq}) + \text{Pb} (\text{s})$$
  
 A) 0.51 B) 0.86 C) 0.40 D) 0.75

# 亞洲大學

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52. The first law of thermodynamics can be given as \_\_\_\_\_.  
 A)  $\Delta E = q + w$   
 B)  $\Delta H^{\circ}_{\text{rxn}} = \sum n\Delta H^{\circ}_{\text{f}}(\text{products}) - \sum m\Delta H^{\circ}_{\text{f}}(\text{reactants})$   
 C) for any spontaneous process, the entropy of the universe increases  
 D) the entropy of a pure crystalline substance at absolute zero is zero

53. When a system is at equilibrium, \_\_\_\_\_.  
 A) the reverse process is spontaneous but the forward process is not  
 B) the forward and the reverse processes are both spontaneous  
 C) the forward process is spontaneous but the reverse process is not  
 D) the process is not spontaneous in either direction

54. The second law of thermodynamics states that \_\_\_\_\_.  
 A)  $\Delta E = q + w$   
 B)  $\Delta H^{\circ}_{\text{rxn}} = \sum n\Delta H^{\circ}_{\text{f}}(\text{products}) - \sum m\Delta H^{\circ}_{\text{f}}(\text{reactants})$   
 C) for any spontaneous process, the entropy of the universe increases  
 D) the entropy of a pure crystalline substance is zero at absolute zero

55.  $\Delta S$  is positive for the reaction \_\_\_\_\_.  
 A)  $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g})$  B)  $2\text{NO}_2(\text{g}) \rightarrow \text{N}_2\text{O}_4(\text{g})$   
 C)  $\text{CO}_2(\text{g}) \rightarrow \text{CO}_2(\text{s})$  D)  $\text{BaF}_2(\text{s}) \rightarrow \text{Ba}^{2+}(\text{aq}) + 2\text{F}^{-}(\text{aq})$

56. With thermodynamics, one cannot determine \_\_\_\_\_.  
 A) the speed of a reaction  
 B) the direction of a spontaneous reaction  
 C) the extent of a reaction  
 D) the value of the equilibrium constant

57. Photoionization processes (e.g.,  $\text{N}_2 + h\nu \rightarrow \text{N}_2^{+} + \text{e}^{-}$ ) remove UV of  $< 150 \text{ nm}$ . Which photoreaction is the principal absorber of UV in the 150-200 nm range in the upper atmosphere?  
 A)  $\text{N}_2 + h\nu \rightarrow 2\text{N}$  B)  $\text{O}_2 + h\nu \rightarrow 2^{\circ}$  C)  $\text{O}_3 + h\nu \rightarrow \text{O}_2 + \text{O}$  D)  $\text{N}_2 + \text{O}_2 + h\nu \rightarrow 2\text{NO}$

58. Which one of the following substances found in the atmosphere will absorb radiation in the infrared portion of the spectrum?  
 A)  $\text{N}_2$  B)  $\text{O}_2$  C) Kr D)  $\text{H}_2\text{O}$



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59. What is meant by the salinity of seawater?  
 A) percent by mass of salt in seawater B) mass in grams of dry salts present in 1 kg of seawater  
 C) molality of NaCl in seawater D) osmotic pressure of seawater

60. Which one of the following pairs cannot be mixed together to form a buffer solution?  
 A) C<sub>5</sub>H<sub>5</sub>N, C<sub>5</sub>H<sub>5</sub>NHCl B) HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, NaOH (C<sub>2</sub>H<sub>3</sub>O<sub>2</sub><sup>-</sup> = acetate)  
 C) KOH, HI D) NH<sub>2</sub>CH<sub>3</sub>, HCl

61. The Henderson-Hasselbalch equation is \_\_\_\_\_.  
 A)  $[H^+] = K_a + \frac{[base]}{[acid]}$  B)  $pH = pK_a - \log \frac{[base]}{[acid]}$   
 C)  $pH = pK_a + \log \frac{[base]}{[acid]}$  D)  $pH = pK_a + \log \frac{[acid]}{[base]}$

62. Which compound listed below has the greatest molar solubility in water?  
 A) CdCO<sub>3</sub> B) Cd(OH)<sub>2</sub> C) AgI D) CaF<sub>2</sub>

63. In which one of the following solutions is silver chloride the most soluble?  
 A) 0.200 M HCl B) 0.750 M LiNO<sub>3</sub> C) 0.0150 M NH<sub>3</sub> D) 0.185 M KCl

64. A result of the common-ion effect is \_\_\_\_\_.  
 A) that some ions, such as Na<sup>+</sup> (aq), frequently appear in solutions but do not participate in solubility equilibria  
 B) that common ions, such as Na<sup>+</sup> (aq), don't affect equilibrium constants  
 C) that the selective precipitation of a metal ion, such as Ag<sup>+</sup>, is promoted by the addition of an appropriate counterion (X<sup>-</sup>) that produces a compound (AgX) with a very low solubility  
 D) that ions such as K<sup>+</sup> and Na<sup>+</sup> are common ions, so that their values in equilibrium constant expressions are always 1.00

65. A Brønsted-Lowry base is defined as a substance that \_\_\_\_\_.  
 A) increases [H<sup>+</sup>] when placed in H<sub>2</sub>O B) decreases [H<sup>+</sup>] when placed in H<sub>2</sub>O  
 C) increases [OH<sup>-</sup>] when placed in H<sub>2</sub>O D) acts as a proton acceptor

66. The hydride ion, H<sup>-</sup>, is a stronger base than the hydroxide ion, OH<sup>-</sup>. The product(s) of the reaction of hydride ion with water is/are \_\_\_\_\_.  
 A) H<sub>3</sub>O<sup>+</sup> (aq) B) OH<sup>-</sup> (aq) + H<sub>2</sub> (g) C) OH<sup>-</sup> (aq) + 2H<sup>+</sup> (aq) D) no reaction occurs

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67. Which one of the following has the weakest conjugate base?  
A) HF ( $K_a = 6.8 \times 10^{-4}$ ) B) HClO ( $K_a = 3.0 \times 10^{-8}$ )  
C) HNO<sub>2</sub> ( $K_a = 4.5 \times 10^{-4}$ ) D) HCN ( $K_a = 4.9 \times 10^{-10}$ )

68. Which one of the following will change the value of an equilibrium constant?  
A) changing temperature  
B) adding other substances that do not react with any of the species involved in the equilibrium  
C) varying the initial concentrations of reactants  
D) varying the initial concentrations of products

69. The equilibrium constant for the gas phase reaction  

$$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$$
is  $K_{eq} = 4.34 \times 10^{-3}$  at 300 °C. At equilibrium, \_\_\_\_\_.  
A) products predominate B) reactants predominate  
C) roughly equal amounts of products and reactants are present D) only products are present

70. Consider the following reaction at equilibrium:  

$$2\text{NH}_3(\text{g}) \rightleftharpoons \text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$$
Le Châtelier's principle predicts that the moles of H<sub>2</sub> in the reaction container will increase with \_\_\_\_\_.  
A) some removal of NH<sub>3</sub> from the reaction vessel (V and T constant)  
B) a decrease in the total pressure (T constant)  
C) addition of some N<sub>2</sub> to the reaction vessel (V and T constant)  
D) a decrease in the total volume of the reaction vessel (T constant)

71. Of the following, all are valid units for a reaction rate except \_\_\_\_\_.  
A) mol/L B) M/s C) mol/hr D) g/s

72. When argon is placed in a container of neon, the argon spontaneously disperses throughout the neon because \_\_\_\_\_.  
A) of the large attractive forces between argon and neon atoms  
B) of hydrogen bonding C) a decrease in energy occurs when the two mix  
D) the dispersion of argon atoms produces an increase in disorder

73. When solutions of strong electrolytes in water are formed, the ions are surrounded by water molecules. These interactions are described as a case of \_\_\_\_\_.  
A) hydration B) supersaturation C) crystallization D) dehydration

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學系別	考試科目	考試日期	時 間
學士後獸醫學系	化學(含普通化學、有機化學)	112.04.29	10:30-12:00

74. Pairs of liquids that will mix in all proportions are called \_\_\_\_\_ liquids.  
A) miscible B) unsaturated C) polar D) saturated

75. A solid has a very high melting point, great hardness, and poor electrical conduction. This is a(n) \_\_\_\_\_ solid.  
A) ionic B) molecular C) metallic D) covalent network

76. The unit cell with all sides the same length and all angles equal to  $90^\circ$  that has lattice points only at the corners is called \_\_\_\_\_.  
A) monoclinic B) body-centered cubic C) primitive cubic D) face-centered cubic

77. CsCl crystallizes in a unit cell that contains a  $\text{Cs}^+$  ion at the center of a cube and a  $\text{Cl}^-$  ion at each corner. The unit cell of CsCl is \_\_\_\_\_.  
A) close packed B) body-centered cubic C) face-centered cubic D) amorphous

78. Which molecule has hydrogen bonding as the predominant intermolecular force?  
A)  $\text{CH}_4$  B)  $\text{C}_6\text{H}_6$  C)  $\text{CH}_3\text{OH}$  D)  $\text{CO}_2$

79. The ease with which the charge distribution in a molecule can be distorted by an external electrical field is called the \_\_\_\_\_.  
A) resonance B) polarity C) polarizability D) electron migration

80. Which of the following does not have eight valence electrons?  
A)  $\text{Ca}^+$  B)  $\text{Rb}^+$  C) Xe D)  $\text{Br}^-$