

元智大學 103 學年度研究所 碩士班 招生試題卷

系(所)別： 化學工程與材料
科學學系碩士班

組別： 不分組-選考 B

科目： 普通化學

用紙第

頁共之頁

●可使用的現行『國家考試電子計算器規格標準』規定第二類之計算機

Question 1-20: 4 points each ; Question 21-24: 5 points each

1. The number of neutrons in one atom of $^{204}_{80}\text{Hg}$ is _____?

2. A gaseous compound containing carbon and hydrogen was analyzed and found to consist of 83.65% carbon by mass. What is the empirical formula of the compound?

3. Refer to the following unbalanced equation: $\text{C}_6\text{H}_{14} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
What mass of oxygen (O_2) is required to react completely with 11.7 g of C_6H_{14} ?

4. Consider that calcium metal reacts with oxygen gas in the air to form calcium oxide. Suppose we react 5.66 mol calcium with 4.00 mol oxygen gas. Determine the number of moles of oxygen left over after the reaction is complete.

5. When NH_3 is prepared from 28 g N_2 and excess H_2 , the theoretical yield of NH_3 is 34 g. When this reaction is carried out in a given experiment, only 15 g is produced. What is the percentage yield? (Ignore significant figures for this problem.)

6. A 51.1 g sample of aluminum at 95.0°C is dropped into 35.0 g of water at 40.0°C . What is the final temperature of the mixture? (specific heat capacity of aluminum = $0.89 \text{ J/g}^\circ\text{C}$; specific heat capacity of water = $4.184 \text{ J/g}^\circ\text{C}$)

7. A given set of *f* orbitals consists of _____ orbital(s).

8. Rank the following bonds from least polar to most polar:

Si-Cl P-Cl Mg-Cl S-Cl

9. How many of the following compounds are nonpolar?

CBr_2H_2 BH_3 XeCl_4 SF_4 HCl

10. Which compound has bond angles of 109.5° around the central atom?

CBr_2H_2 BH_3 XeCl_4 SF_4 HCl

11. Which of the following species would be expected to have the lowest ionization energy?

a. Br^- ; b. Kr ; c. Se^{2-} ; d. Sr^{2+} ; e. Rb^-

12. Which of the following has the largest radius?

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用紙第 2 頁共 2 頁

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a. S^{2-} ; b. Cl^- ; c. Ar ; d. K^+ ; e. Ca^{2+}

13. How many liters of $HCl(g)$ measured at STP can be produced from 5.44 g of Cl_2 and excess H_2 according to the following equation? $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$

14. Rank the following compounds from lowest to highest boiling point.

CH_3OH CH_4 H_2O C_2H_6

15. Which of the following is a conjugate acid-base pair?

a. HNO_3^- , H_2NO_3 ; b. HNH_4 , NH_4^{4+} ; c. H_2F , HF^- ; d. HPO_4^{2-} , PO_4^{3-} ; e. H_2CN , CN^-

16. The concentration of Ag^+ in a saturated solution of Ag_2SO_4 at a certain temperature is $2.9 \times 10^{-2} M$. What is the K_{sp} value for Ag_2SO_4 at this temperature?

17. The bonds between hydrogen and oxygen in a water molecule can be characterized as
a. hydrogen bonds; b. London forces; c. intermolecular forces; d. intramolecular forces;
e. dispersion forces.

18. Calculate the molar mass of a sample if a single molecule weighs $8.90 \times 10^{-23} g$.

19. Aluminum oxide solid reacts with gaseous carbon monoxide to produce aluminum metal and carbon dioxide gas. Write the balanced equation for this reaction.

20. The factors that most commonly cause chemical reactions to occur are all the following except
a. formation of a solid; b. formation of a gas; c. formation of water; d. transfer of electrons;
e. a decrease in temperature

21. Write the electron configuration for Se. (34 electrons)

22. Draw the Lewis structure for CO.

23. Write the molecular equation, the complete ionic equation, and the net ionic equation for the following reaction: Aqueous solutions of copper(II) nitrate and sodium hydroxide are mixed to form solid copper(II) hydroxide and aqueous sodium nitrate.

24. Write down the equilibrium expression for the reaction of sulfur dioxide gas with oxygen gas to produce sulfur trioxide gas:

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