系所組別： 材料科學及工程學系

考試科目： 普通化學

考試日期：0223，節次：2

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普通化學共 50 題選擇題，每題答對得 2 分，答錯倒扣 0.5 分；滿分 100 分，倒扣至 0 分為止。

1. How many isomers does C_6H_4 have?
Ⓐ 4 Ⓑ 5 Ⓒ 6 Ⓓ 7

2. What is the reaction product of an acid chloride and an amine
Ⓐ imide Ⓑ ester Ⓒ amino acid Ⓓ amide

3. What is the most common reaction of aldehydes and ketones? Ⓐ nucleophilic addition
Ⓑ nucleophilic substitution Ⓒ electrophilic addition Ⓓ electrophilic substitution

4. The pH of a solution is 3.60. What is the $H_3O^+(aq)$ concentration?
Ⓐ 1.2×10^{-3} M Ⓑ 2.5×10^{-4} M Ⓒ 3.8×10^{-4} M Ⓓ 4.2×10^{-5} M

5. A concentrated HCl solution contains 37.2 % HCl by mass and a density of 1.19 g/mL. Calculate the molarity of HCl in this solution.
Ⓐ 12.1 M Ⓑ 13.6 M Ⓒ 15.0 M Ⓓ 11.4 M

6. Which compound reacting with a carboxylic acid will give an ester?
Ⓐ Amine Ⓑ Alcohol Ⓒ ketone Ⓓ aldehyde

7. Which is the product of the oxidation of $(CH_3)_2CHOH$?
Ⓐ CH_3CHO Ⓑ $(CH_3)_3OH$ Ⓒ CH_3CH_2COOH Ⓓ $(CH_3)_2C=O$

8. Which crystal has the least cohesive energy (energy required to evaporate crystal to gas)
Ⓐ Fe(s) Ⓑ CS_2(s) Ⓒ Li(s) Ⓓ NaCl(s)

9. Which has the biggest solubility product?
Ⓐ $Sr(OH)_2$ Ⓑ $Be(OH)_2$ Ⓒ $Mg(OH)_2$ Ⓓ $Ca(OH)_2$

10. Which has the greatest heat of hydration?
Ⓐ Rb^+ Ⓑ K^+ Ⓒ Li^+ Ⓓ Na^+

11. The Bohr radius for n=1 is a_o, therefore the radius for n=3 is
Ⓐ $3a_o$ Ⓑ $9a_o$ Ⓒ $6a_o$ Ⓓ $12a_o$

(背面仍有題目，請繼續作答)

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12. In the quantum-mechanical model, the general shape of an orbital is determined by quantum number(S)
Ⓐn Ⓑl Ⓒm_l Ⓓm_l and m_s

13. Which of the following is not an intensive property?
Ⓐheat content Ⓑdensity Ⓒtemperature Ⓓphysical state

14. Which of the following best describes the hybrids used by S in the sulfite ion, SO_3^{2-}?
Ⓐsp Ⓑsp^2 Ⓒsp^3 Ⓓdsp^2

15. The sequence of electronegativity of the following elements is:
Ⓐ$F>Cl>Br>I$ Ⓑ$F<Cl<Br<I$ Ⓒ$F>Br>Cl>I$ Ⓓ$F>Cl=Br=I$

16. The right sequence of solubility of hydrogen halide in water is:
Ⓐ $HF<HCl<HBr<HI$ Ⓑ$HF>HCl>HBr>HI$ Ⓒ$HF=HCl=HBr=HI$ Ⓓ$HF=HCl>HBr>HI$

17. What you may not expect to see when a strip of Zn is immersed in a $CuSO_4$ solution?
Ⓐdissolution of Zn Ⓑplating of Cu on the Zn strip Ⓒgas bubbling Ⓓcolor change in solution

18. For the voltaic cell $Zn;Zn^{2+}\|Cu^{2+};Cu$ which of the following statement is correct?
Ⓐ Zn^{2+} is the anode Ⓑ Cu^{2+} is the cathode Ⓒ Cu releases Cu^{2+} Ⓓ Cu is the cathode

19. Regarding the lead storage battery of automobile, which of the following statements is correct?
Ⓐthe battery is both a voltaic and an electrolytic cell Ⓑthe battery is a voltaic cell Ⓒ the battery is an electrolytic cell Ⓓ the battery is neither a voltaic cell nor an electrolytic cell

20. Which of the following carboxylic acid may exhibit the highest solubility in water?
Ⓐ$(COOH)_2$ Ⓑ$C_2H_4(OH)COOH$ Ⓒ$C_2H_4O_2(COOH)_2$ Ⓓ$C_3H_4OH(COOH)_3$

21. CO_2 gas can be detected by bubbling the gas through "lime water", a solution of saturated with calcium hydroxide. What happens in this process? Ⓐ the solution becomes milky with formation of $CaCO_3$ Ⓑ the solution becomes milky with formation of $Ca(OH)_2$ Ⓒ the solution becomes yellow with formation of $CaHCO_2$ Ⓓ the solution becomes grey with precipitation of calcium

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22. Purification is a big issue in chemistry. Which following process can NOT result in the sample purification? Ⓐ Precipitation Ⓑ Recrystallization Ⓒ Distillation Ⓓ Grinding

23. Which description about the free radical is INCORRECT? Ⓐ a free radical is a substance with unpaired electrons Ⓑ two free radicals proceed combination to form a covalent bond Ⓒ all free radicals have extremely short life time Ⓓ free radicals can be generated via a redox reaction

24. Calculate the number of moles in an idea gas sample whose volume is 350 mL at 77 °C and 0.41 atm. Ⓐ 5 mol Ⓑ 0.5 mol Ⓒ 0.05 mol Ⓓ 0.005 mol

25. A mixture of 200 mL aqueous solution with pH = 4 and 200 mL aqueous with pH = 6 will give you a 400 mL aqueous solution with: Ⓐ pH = 6.5 Ⓑ pH = 5.7 Ⓒ pH = 5.0 Ⓓ pH = 4.3

26. Which following element (symbol) is correct? Ⓐ Boron (Bo) Ⓑ Helium (He) Ⓒ Copper (Co) Ⓓ Tin (Tn)

27. The octet rule indicates that Ⓐ a stable electron configuration is not related to the number of covalent bonds that can be established on an atom. Ⓑ eight valence electrons are needed for achieving a stable electron configuration. Ⓒ shared electrons in the covalent bond are not counted as considering a stable electron configuration. Ⓓ only metal atoms can reach a stable electron configuration.

28. For the reaction, $SnO_2(s) + 2C(s) \rightarrow Sn(s) + 2CO(g)$, Ⓐ the SnO_2 is oxidized by carbon. Ⓑ the reaction rate can be increased by adding more oxygen. Ⓒ the carbon atoms are reduced by SnO_2. Ⓓ if one substance is oxidized, another substance must be simultaneously reduced in the same reaction.

29. For carbon materials, Ⓐ diamond and graphite are allotropes of $CH_2{=}CH_2$. Ⓑ C_{60} and graphite are allotropes of carbon. Ⓒ carbon nanotube and C_{60} molecules should not be classified as allotropes of carbon. Ⓓ graphite is electrical conductive but with a low thermal conductivity.

30. For the bond properties, Ⓐ the bonding electron pair in F-F is not equally shared by fluorine atoms. Ⓑ the pair of bonding electrons in nonpolar covalent bond is equally shared by bonding atoms. Ⓒ the pair of bonding electrons in polar covalent bond is equally shared by bonding atoms. Ⓓ the pair of bonding electrons is equally shared in hydrogen bonding.

(背面仍有題目，請繼續作答)

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31. For electronegativity, Ⓐ it represents the ability of a covalently-bonded atom to release shared electrons. Ⓑ the fluorine atom is the least electronegative element. Ⓒ in general it decreases diagonally upward and to the right in the periodic table. Ⓓ in general metals lose electrons easily, and thus are more electronegative than nonmetals.

32. $(dT/dP)_S$ = Ⓐ $-(dS/dV)_P$ Ⓑ $(dS/dV)_P$ Ⓒ $-(dV/dS)_P$ Ⓓ $(dV/dS)_P$, where d: partial derivative, T: temperature, V: volume, P: pressure, and S: entropy.

33. $(dA/dV)_T$ = Ⓐ -S Ⓑ S Ⓒ -P Ⓓ P, where d: partial derivative, A: Helmholtz free energy, T: temperature, V: volume, P: pressure, and S: entropy.

34. $(dG/dT)_P$ = Ⓐ -S Ⓑ S Ⓒ -V Ⓓ V, where d: partial derivative, G: Gibbs free energy, T: temperature, V: volume, P: pressure, and S: entropy.

35. In a system of three components (C=3), tie lines are present in Ⓐ one- Ⓑ two- Ⓒ three- Ⓓ four-phase regions at constant T and P.

36. The gas is in equilibrium with a solution of A and B, where the mole fraction of A is 0.40 at room temperature. At room temperature the vapor pressures of pure A and B are 408 and 141 mmHg, respectively. The mole fraction of A in the gas at room temperature is
Ⓐ 0.45 Ⓑ 0.56 Ⓒ 0.66 Ⓓ 0.78.

37. If the drop is spherical the pressure difference between the interior of the drop and its surroundings is Ⓐ $2\gamma/r$ Ⓑ $2\gamma/3r$ Ⓒ γ/r Ⓓ $\gamma/2r$, where γ the surface energy, r the radius of the drop.

38. Which are the conjugate base and acid of HSO_4^-, respectively? Ⓐ H_2SO_4 and SO_4^{2-} Ⓑ SO_4^{2-} and H_2SO_4 Ⓒ HSO_4 and HSO_3 Ⓓ SO_2 and SO_3.

39. Please identify the order of the following materials in terms of strength of electrolyte: $CaCl_2$, $HC_2H_3O_2$ (acetic acid), and CH_3OH. Ⓐ $CaCl_2$ > CH_3OH> $HC_2H_3O_2$ (acetic acid) Ⓑ $HC_2H_3O_2$ (acetic acid) > $CaCl_2$ > CH_3OH Ⓒ $CaCl_2$ > $HC_2H_3O_2$ (acetic acid) > CH_3OH Ⓓ CH_3OH > $CaCl_2$ > $HC_2H_3O_2$ (acetic acid).

40. The element iron (Fe) crystallizes in a α-iron phase with a body-centered-cubic (BCC) unit cell. How many iron atoms are in the unit cell? Ⓐ 2 Ⓑ 1 Ⓒ 4 Ⓓ 3.

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41. What is the density of oxygen gas at 76 mm Hg and 117 °C (R = 0.0821 L-atm/K-mol)?
Ⓐ 10 g/L Ⓑ 100 g/L Ⓒ 0.01 g/L Ⓓ 0.1 g/L.

42. Please identify polarity of the following compounds: NF_3 and BCl_3. Ⓐ nonpolar and polar Ⓑ polar and nonpolar Ⓒ polar and polar Ⓓ nonpolar and nonpolar.

43. Please identify the element with the highest first ionization energy from the following list: Cl, Br, S, and Se. Ⓐ Br Ⓑ S Ⓒ Cl Ⓓ Se.

44. What is the Na^+ ion concentration in the solution formed by mixing 20. mL of 0.10 M Na_2SO_4 solution with 50. mL of 0.30 M Na_3PO_4 solution? Ⓐ 0.15 M Ⓑ 0.24 M Ⓒ 0.48 M Ⓓ0.70 M

45. How many nearest neighbors surround each particle in a face-centered cubic lattice?
Ⓐ 4 Ⓑ 6 Ⓒ 8 Ⓓ12

46. Methyl-*t*-butyl ether, $C_5H_{12}O$, is added to gasoline to promote cleaner burning. How many moles of oxygen gas, O_2, are required to burn 1.0 mol of this compound completely to form carbon dioxide and water? Ⓐ 4.5 mol Ⓑ6.0 mol Ⓒ 7.5 mol Ⓓ8.0 mol

47. A 1.50 g sample of an ore containing silver was dissolved, and all of the Ag+ was converted to 0.124 g of Ag_2S. What was the percentage of silver in the ore? (atomic weight: 107.9 for Ag, 32 for S)
Ⓐ6.41% Ⓑ7.20% Ⓒ 8.27% Ⓓ10.8%

48. For a particular reaction, $\Delta Ho = -38.3$ kJ and $\Delta So = -113\ J \cdot K^{-1}$. This reaction is Ⓐ spontaneous at all temperatures. Ⓑ nonspontaneous at all temperatures. Ⓒ spontaneous at temperatures below 66 °C. Ⓓ spontaneous at temperatures above 66 °C.

49. Which acid is the strongest? Ⓐ H_3BO_3 Ⓑ H_3PO_4 Ⓒ H_2SO_3 Ⓓ $HClO_3$

50. What is the atomic number of sulfur? Ⓐ 8 Ⓑ 16 Ⓒ 32 Ⓓ 48.