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：0222，節次：2

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

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. The "rule of eight" tells us the information regarding to

　Ⓐatomic weight of isotopes　Ⓑelectronic structure of ions　Ⓒionic bonding energy　Ⓓionic radius

2. According to the Molecular Orbital Theory, which of the following statement is correct?

　Ⓐthe antibonding electrons are in higher energy level than the bonding electrons

　Ⓑthe antibonding electrons are in lower energy level than the bonding electrons

　Ⓒthe antibonding and bonding electrons are of the same energy level

　Ⓓthe Molecular Orbital Theory does not tell the energy difference for electrons.

3. The HNO_3 (in water) can be called:

　Ⓐhydrogen nitrate　Ⓑhydrogen nitroxide　Ⓒhydrogen notro-trioxide　Ⓓnitric acid

4. A student has set up an experimental vessel to investigate the reaction of zinc with nitric acid and acetic acid. Within the same period of reaction time and the same concentration of both acids in separate vessel, which of the following statements may be the correct observation?

　Ⓐacetic acid produce more volume of hydrogen

　Ⓑacetic acid produce the same volume of hydrogen as nitric acid

　Ⓒthe reaction does not produce hydrogen gas

　Ⓓnitric acid produce more volume of hydrogen gas

5. The boiling point of water under 1 atmosphere pressure is $100^{\circ}C$. Which of the following may exhibit boiling point lower than $100^{\circ}C$?

　ⒶAlcohol in water solution　Ⓑsugar in water solution　Ⓒcoffee in water solution　Ⓓmilk in water solution

6. The atomic volume of a vacancy in an FCC crystal with the lattice constant of 0.4 nm is

　Ⓐ0.8　　Ⓑ1.2　　Ⓒ1.6　　Ⓓ2.2 x 10^{-29} m^3.

7. The lattice constant of a diamond crystal with atomic density of 4.0 x 10^{22} atoms/cm^3 is

　Ⓐ0.50　　Ⓑ0.53　　Ⓒ0.58　　Ⓓ0.62 nm.

8. Ge is a diamond lattice with atomic density of 4.42 x 10^{22} atoms/cm^3. The height of a monolayer for Ge is

　Ⓐ0.12　　Ⓑ0.14　　Ⓒ0.16　　Ⓓ0.28 nm.

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

(背面仍有題目，請繼續作答)

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10. Which of the following is a compound? Ⓐsugar solution Ⓑalpha iron ⒸVitamin C Ⓓstainless steel

11. Addition of a strong acid a solution in which Ag^+, AgCl, $Ag(NH3)^+$, ammonia and Cl^- are at equilibrium will cause:

    Ⓐmore AgCl dissolve

    Ⓑsome AgCl precipitate from solution

    Ⓒmore $Ag(NH3)^+$ form

    Ⓓthe concentrations of Ag^+, $Ag(NH3)^+$ and Cl^- increase

12. Calculate the mole fraction of CCl_4 (MM = 154 g/mol) in a solution prepared by dissolving 32 g of CCl_4 in 75 g of C_6H_6 (MM = 78 g/mol).

    Ⓐ0.18　　　　　Ⓑ0.22　　　　　Ⓒ0.30　　　　　Ⓓ0.46

13. Ammonium chloride is used as an electrolyte in dry cells. Which of the following statements about a 0.10 M solution of NH_4Cl is correct?

    ⒶThe solution is basic.

    ⒷThe solution is neutral.

    ⒸThe solution is acidic.

    ⒹThe values for K_a and K_b for the species in solution must be known before a prediction can be made.

14. A pH buffer is best described as a solution containing:

    Ⓐa weak acid.

    Ⓑa strong acid.

    Ⓒa mixture of a weak acid and a strong acid.

    Ⓓa mixture of a weak acid and the salt of a weak acid.

15. Which of the following statements is **TRUE**?

    ⒶAn exothermic process will always be spontaneous.

    ⒷA process in which the entropy of the system increases will always be spontaneous.

    ⒸAn endothermic process can never be spontaneous.

    ⒹAn exothermic process that is accompanied by an increase in the entropy of the system will always be spontaneous.

16. The Nobel Prize in Chemistry this year (2012) was awarded to R. J. Lefkowitz and B. K. Kobilka for:

    Ⓐstudies of G-protein-coupled receptors

    Ⓑthe discovery of quasicrystals

    Ⓒpalladium-catalyzed cross couplings in organic synthesis

    Ⓓstudies of the structure and function of the ribosome.

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17. Fullerene (C60) was identified in 1985.　Their research works were quickly extended to the alternatives of the carbon nanotube and the graphene.　What is the common in fullerene, carbon nanotube, and graphene?

Ⓐsp^2 carbons　　Ⓑtwisted sp^2 carbons　　Ⓒsp^3 carbons　　Ⓓtwisted sp^3 carbons

18. $AgNO_3$ can NOT be used as:

Ⓐantibacterial agent　Ⓑphotographic emulsion　Ⓒchlorine ion indicator　Ⓓreduction agent

19. What description about Lewis acid/base is correct?

Ⓐa Lewis acid: a substance that donates an electron pair

Ⓑa Lewis base: a substance that has a vacant valence orbital and can thus accept an electron pair

Ⓒa Lewis acid/base definition is nothing to do with protons

Ⓓa Lewis acid is not an electrophile

20. Which description about m.p., b.p. and f.p. is correct?

Ⓐf.p. stands for fire point　　　　　Ⓑvolatile solvent has high m.p.

Ⓒvolatile solvent has low f.p.　　　Ⓓlow b.p. solvent is more expensive

21. For the solid state,

Ⓐceramic and glass are examples of amorphous solid.

Ⓑall kinds of amorphous solid can be annealed into crystalline solid.

Ⓒthe amorphous solid is less stable than crystalline solid.

Ⓓamorphous solid is less brittle than crystalline solid.

22. For the heat capacity,

Ⓐit changes with sample weight.

Ⓑit changes with heating rate.

Ⓒit changes with the occurrence of melting.

Ⓓthe heat capacity of the amorphous solid is conventionally higher than that of crystalline solid.

23. Which of the following bonding equally shared the pair of bonding electrons?

ⒶNonpolar covalent bonding.　　　ⒷIonic bonding.

ⒸHydrogen bonding.　　　　　　　ⒹThe bonding between charged atoms.

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24. Considering the electron affinity, it is known that
    Ⓐadding an electron to the oxygen atom is favored as a result of high affinity.
    Ⓑthe oxygen atom become less stable by acquiring an electron.
    Ⓒthe chlorine atom intends to lose an electron.
    Ⓓthe energy bandgap between ground state and excited state is the origin.

25. Considering the ionization energy,
    Ⓐit increases gradually across the period of transition elements.
    Ⓑit decreases gradually across the period of inner transition elements.
    Ⓒa higher value means that an electron is easier to be removed.
    Ⓓit is related to the relaxation of an electron from excited state to ground state.

26. Which form of electromagnetic radiation has the longest wavelength?
    Ⓐgamma rays　　　　Ⓑ microwaves　　　　Ⓒradio waves　　　　Ⓓx-rays

27. For a reaction for which the activation energies of the forward and reverse directions are equal in value,
    Ⓐthe stoichiometry is the mechanism　　　Ⓑ $\Delta H=0$　　　Ⓒ $\Delta S=0$　　　Ⓓthe order is 0

28. When a fluorine atom forms the fluoride ion, it has the same charge as the_____ion.
    Ⓐsulfite　　　　Ⓑnitrite　　　　Ⓒammonium　　　　Ⓓphosphate

29. The carbonate of which alkali metal is used in treatment of manic-depressive illness?
    ⒶNa　　　　ⒷLi　　　　ⒸK　　　　ⒹCs

30. Which one of the following vitamin is water soluble?
    ⒶD　　　　ⒷE　　　　ⒸA　　　　ⒹB

31. A fuel cell use $H_2(g)$ as the fuel and $O_2(g)$ as the oxidant. What is the half cell reaction at cathode?
    Ⓐ$2H_2 + O_2 = 2H_2O$　　Ⓑ$H_2 \rightarrow 2H^+ +2e^-$　　Ⓒ$2H^+ + 2e^- \rightarrow H_2$　　Ⓓ$O_2 +2H_2O + 4e^- \rightarrow 4OH^-$.

32. Is $H_2(g)$ capable of reducing $Ag^+(aq)$?
    Ⓐyes　　　　Ⓑno　　　　Ⓒboth　　　　Ⓓnone of the above.

33. What mass of hydrogen can be produced in HCl solution if 15A of current is passed for 1.0 h?
    Ⓐ36.5 g　　　　Ⓑ18.3 g　　　　Ⓒ0.56 g　　　　Ⓓ0.28g.

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34. Which element has the following electron configuration: $1s^2 2s^2 2p^6 3s^2 3p^4$?
 Ⓐ O 　　　　　Ⓑ P 　　　　　Ⓒ S 　　　　　Ⓓ Se.

35. For a certain reaction process, the activation energy is greater for the forward reaction than for the reverse reaction. The Gibbs free energy change for this forward reaction is
 Ⓐ negative 　　　Ⓑ positive 　　　Ⓒ zero 　　　　Ⓓ none of the above.

36. Which of the following metals has the lowest melting point?
 Ⓐ tungsten 　　　Ⓑ iron 　　　　Ⓒ copper 　　　Ⓓ tin.

37. The addition of nonvolatile solute into water will normally cause the freezing point
 Ⓐ to increase 　　Ⓑ to decrease 　　Ⓒ to remain the same 　　Ⓓ none of the above.

38. Which element has the highest electronegativity?
 Ⓐ F 　　　　　Ⓑ Cl 　　　　　Ⓒ Br 　　　　　Ⓓ I.

39. Which is the most abundant element (mass percent) in human body?
 Ⓐ carbon 　　　Ⓑ hydrogen 　　　Ⓒ oxygen 　　　Ⓓ nitrogen.

40. Identify the reducing agent in the following reaction: $Cu^{2+}(aq) + Zn(s) \rightarrow Cu(s) + Zn^{+}(aq)$
 Ⓐ $Cu^{2+}(aq)$ 　　Ⓑ $Zn(s)$ 　　　Ⓒ $Cu(s)$ 　　　Ⓓ $Zn^{+}(aq)$.

41. When the isoelectronic species, K^+, Ca^{2+}, and Cl^-, are arranged in order of increasing radius, what is the correct order?
 Ⓐ K^+, Ca^{2+}, Cl^- 　　Ⓑ K^+, Cl^-, Ca^{2+} 　　Ⓒ Cl^-, Ca^{2+}, K^+ 　　Ⓓ Ca^{2+}, K^+, Cl^-

42. When ionic hydrides react with water, the products are
 Ⓐ acidic solutions and hydrogen gas 　　　　Ⓑ acidic solutions and oxygen gas
 Ⓒ basic solutions and hydrogen gas. 　　　　Ⓓ basic solutions and oxygen gas.

43. How many moles of Na^+ ions are in 20 mL of 0.40 M Na_3PO_4?
 Ⓐ 0.0080 　　　Ⓑ 0.024 　　　Ⓒ 0.050 　　　Ⓓ 0.20

44. Which solid reacts with dilute hydrochloric acid at 25 °C to produce a gas that is more dense than air?
 Ⓐ Zn 　　　　Ⓑ Pb(NO3)$_2$ 　　　Ⓒ NaBr 　　　　Ⓓ NaHCO$_3$

45. The molar mass of a gas with a density of 5.8 g·L^{-1} at 25 °C and 740 mm Hg is closest to
 Ⓐ 10 g·mol^{-1} 　　Ⓑ 20 g·mol^{-1} 　　　Ⓒ 150 g·mol^{-1} 　　　Ⓓ 190 g·mol^{-1}

(背面仍有題目，請繼續作答)

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46. In what form would you expect glycine (H_2NCH_2COOH) to exist in basic solution?

　Ⓐ$H_2NCH_2COO^-$　　　　ⒷH_2NCH_2COOH　　　　Ⓒ$H_3NCH_2COOH^+$　　　　Ⓓ$H_2NCH_2COOH^+$

47. What are the characteristic bond angles about the carbon-carbon triple bond in an alkyne?

　Ⓐ60°　　　　　　　Ⓑ120°　　　　　　　Ⓒ180°　　　　　　　Ⓓcannot determine.

48. Give the number of d electrons associated with the central metal in $[V(NH_3)_3Cl_3]^-$ complex.

　Ⓐ1　　　　　　　　Ⓑ2　　　　　　　　Ⓒ4　　　　　　　　Ⓓ3.

49. Predict what predominantly properties will be exhibited by the Cu_2O oxide.

　Ⓐneutral　　　　　Ⓑcannot determine　　　Ⓒacidic　　　　　Ⓓbasic.

50. Complete and balance the following equation: Cu_2S (s) + $2O_2$ (g) →

　Ⓐ$2CuO$ (s) + SO_2 (g)　　ⒷCuO (s) + SO_2 (g)　　Ⓒ$2Cu$ (s) + SO_4 (g)　　ⒹCu (s) + SO_4 (g)