編號： 96

國立成功大學 104 學年度碩士班招生考試試題

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：0211，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. Name the following compounds: $KClO_3$ and H_5IO_6.

(a) potassium chlorite and iodine acid

(b) Cobalt chlorate and iodine acid

(c) potassium chlorate and paraperiodic acid

(d) Copper chloratite and paraperiodic acid

2. What is the anhydride of HNO_3?

(a) N_2O_5

(b) NO_2

(c) H_2O

(d) H_2SO_3

3. Calculate the minimum number of kilowatt-hours of electricity required to produce 27 g of aluminum by electrolysis of Al^{3+} if required electromotive force (emf) is 3.6 V. (Hint: Al: 27g/mol, 1 kilowatt-hour: $3.6*10^6$ J, 1 Faraday = 96500 C/mol e^-)

(a) ~ 0.1

(b) ~ 0.3

(c) ~ 0.5

(d) ~ 1.0

4. From standard free energies of formation (ΔG_0), calculate the **logarithm** equilibrium constant (log K) for the reaction $N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g)$ at room temperature (298k). (Hint: assume ΔG_0 = -2.477 kJ/mol, $\Delta G = \Delta G_0 + 2.303RT \log K$, RT = 2477 J/mol)

(a) ~ 0.43

(b) ~ 4.3

(c) ~ 43

(d) ~ 0.043

5. Write the expression for the solubility-product constant for $Ca_3(PO_4)_2$.

(a) $[Ca^{2+}]^2[PO_4^{3-}]^3$

(b) $[Ca^{2+}]^3[PO_4^{3-}]^2/Ca_3(PO_4)_2$

(c) $Ca_3(PO_4)_2/[Ca^{2+}]^3[PO_4^{3-}]^2$

(d) $[Ca^{2+}]^3[PO_4^{3-}]^2$

6. What is the pH of a 0.005 M $Ca(OH)_2$ solution?

(a) 2
(b) 12
(c) 7
(d) 9

7. Which expression gives the value for $\Delta G°$ in $kJ \cdot mol^{-1}$ for this reaction at 25 °C?
(a) –6 x 8.31 x 0.43 x 1000
(b) –6 x 96500 x 0.43 x 1000 / 8.31
(c) –6 x 96500 x 0.43 / 1000
(d) –6 x 8.31 x 0.43 / 1000

8. What is the voltage for this cell when $[Cu^{2+}] = 1.0$ M and $[Cr^{3+}] = 0.010$ M?
(a) 1.2
(b) 0.87
(c) 0.47
(d) 0.39

9. Which element can exhibit more than one oxidation state in compounds? 1. Cr 2. Pb 3. Sr
(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

10. Which Group 2 element has chemical properties least like the other members of the group?
(a) Be
(b) Ca
(c) Sr
(d) Ba

11. All of these species have the same number of valence electrons as NO_3^- ***except***
(a) CO_3^{2-}
(b) HCO_3^-
(c) NF3
(d) SO3

12. Which are nonpolar molecules? 1. NCl_3 2. SO_3 3. PCl_5

(a) 1 only
(b) 2 only
(c) 1 and 3 only
(d) 2 and 3 only

13. One mole of C_3H_8 reacts with oxygen to produce CO_2 and H_2O. How many moles of CO_2 can be produced?
(a) 1 mole
(b) 2 moles
(c) 3 moles
(d) 4 moles

14. When an aqueous solution of silver nitrate is added to an aqueous solution of potassium chloride, a white precipitate forms. What is the white precipitate?
(a) AgCl
(b) KNO_3
(c) $AgNO_3$
(d) KCl

15. The oxidation state of nitrogen in NO_3^- ion is
(a) +2
(b) +3
(c) +4
(d) +5

16. Concerning the reaction: $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$. Which species is oxidized?
(a) carbon
(b) hydrogen
(c) oxygen
(d) all

17. Which element has an oxidation state of -2?
(a) H_2S
(b) SO_2
(c) $CaCl_2$
(d) AlF_3

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18. Predict the shift in equilibrium position if the volume is reduced for the reaction:
$P_4(s) + 6Cl_2(g) \rightleftarrows 4PCl(l)$

(a) right
(b) left
(c) no effect
(d) none of the above

19. The correct order of electron affinities is
(a) F>Cl>Br>I
(b) F>Br>Cl>I
(c) Cl>Br>F>I
(d) Cl>F>Br>I

20. Which atom has the lowest ionization energy?
(a) O
(b) N
(c) F
(d) Ne

21. Which wavelength below is in the visible light region?
(a) 50000nm
(b) 5000nm
(c) 500nm
(d) 50nm

22. Which ion has the least radius?
(a) Na^+
(b) Mg^{2+}
(c) Ca^{2+}
(d) Al^{3+}

23. Which compound does not exist?
(a) XeF_2
(b) XeF_4
(c) XeF_6
(d) XeF_8

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24. Regarding the phase diagram, which of the following descriptions is NOT correct?
(a) The phase diagram indicates the stable energy state of matter.
(b) The phase diagram is able to indicate the stable phase(s) at selected pressure and temperature.
(c) The phase diagram is able to indicate developed crystalline phase during selected cooling process from molten state.
(d) The equilibrium melting temperature of solid state can be found on phase diagram.

25. Regarding the Arrhenius equation, which of the following descriptions is NOT correct?
(a) This equation describes the impact of temperature on the rate of phase transition.
(b) If the activation energy linearly increases with temperature, reaction rate must decrease linearly with temperature.
(c) The activation energy is considered as the dominative factor for reaction rate.
(d) This equation describes the impact of temperature on the rate of chemical reaction.

26. Which of following interaction has the highest bonding energy?
(a) Hydrogen bonding.
(b) van der Waals interaction.
(c) Interaction between charged and non-dipole molecules.
(d) Interaction between two nonpolar molecules.

27. Which of following radiation has the longest wavelength?
(a) X-ray
(b) Ultraviolet light
(c) Infrared light
(d) Microwave.

28. After the initial mixture of CH_4 and H_2O reaching the equilibrium state through the reaction $CH_4\,(g) + H_2O\,(g) \Leftrightarrow CO(g) + 3H_2(g)$,
(a) the entropy decreases.
(b) the entropy remains the same.
(c) the reaction stops.
(d) the number of covalent bonds decrease.

29. One of the general approaches for preventing corrosion of a metal object is to
(a) paint the metal surface to enhance the oxidation of water.
(b) paint the metal surface to avoid the reduction of metal.
(c) form a layer of oxidized iron for inhibiting further oxidation.
(d) increase the oxidation rate of metal with surrounding water.

30. The diameter of a benzene ring is about:
(a) 0.015 nm
(b) 0.15 nm
(c) 0.03 nm
(d) 0.30 nm

31. The first "T" and the second "T" of *TNT*, the most well-known explosive, respectively stand for:
(a) Tri and Toluene
(b) Three and Toluene
(c) Toluene and Tri
(d) Toluene and Three

32. Plasticizers, such as DOP and DEHP, commonly used in the plastics cause significant attention to the public health. Which following description is correct?
(a) DOP is di-octyl phosphate
(b) DOP is di-octyl phthalate
(c) DEHP is di(2-ethylhexyl) phosphoric acid
(d) DEHP is di(2-ethylhexyl) propane

33. "Electron Affinity" of an atom or a molecule is
(a) nothing to do with the electronegativity
(b) under the unit of kJ/cm^3
(c) the amount of energy released when an electron is remove to form a negative ion
(d) the minimum amount of energy required to remove a bound electron from an anion to produce a neutral atom

34. Aromatic compounds mean:
(a) containing a conjugated ring of saturated bonds
(b) containing a conjugated ring of unsaturated bonds
(c) containing a non-conjugated ring of saturated bonds
(d) containing a non-conjugated ring of unsaturated bonds

35. At room temperature, which solvent is completely soluble with water?
(a) Chloroform
(b) Toluene
(c) Diethyl ether
(d) Acetone

36. Which of the following compounds does not contain a carbonyl group?
(a) Primary alcohol
(b) Primary amide
(c) acid chloride
(d) ethyl ester

37. What are the characteristic absorption frequencies of carboxylic acids in the IR spectrum ?
(a) 675~870 cm-1
(b) 3500-3800 cm-1
(c) 2500~3000 cm-1
(d) 2000~2300 cm-1

38. How many secondary carbon atoms does methylcyclopropane have?
(a) none
(b) one
(c) two
(d) three

39. The structure of chloroform is
(a) CH_3Cl
(b) CH_2Cl_2
(c) $CHCl_3$
(d) CCl_4

40. Alcohols can be easily distinguished from phenols because
(a) phenols are soluble in sodium hydroxide, but alcohols are not
(b) alcohols are soluble in sodium hydroxide, but phenols are not
(c) phenols are soluble in sodium bicarbonate, but alcohols are not
(d) alcohols are soluble in sodium bicarbonate but phenols are not

41. What is the reaction product of propane with bromine in the dark at room temperature?
(a) $CH_3CH_2CH_2Br$
(b) $CH_3CH_2B_rCH_2$ Br
(c) $CH_3CH_2B_rCH_3$
(d) No reaction

42. It was found that 35.45 mL of a HCl solution was needed to dissolve 1.110 g of pure $CaCO_3$. The

reaction is: $CaCO_3$ (s) + 2 HCl (aq)→ $CaCl_2 + H_2O + CO_2$. The molar mass of $CaCO_3$ is 100.09 g/mol. What was the molarity of the HCl solution?

(a) 0.5803 M
(b) 0.5954 M
(c) 0.6105 M
(d) 0.6257 M

43. Use the given data at 298 K calculate ΔG^o for the reaction:

$2\ Cl_2(g) + SO_2(g) \div SOCl_2(g) + Cl_2O(g)$

Substance	$Cl_2(g)$	$SO_2(g)$	$SOCl_2(g)$	$Cl_2O(g)$
ΔH^o_f (kJ/mol)	0	-296.8	-212.5	80.3
S_o (J/Kmol)	223.0	248.1	309.77	266.1

(a) 129.3 KJ
(b) 133.6 KJ
(c) 196.0 KJ
(d) 199.8 KJ

44. Which of the followings may serve as emulsifying agent?
(a) table salt
(b) cement
(c) gelatin
(d) silica

45. For an endothermic liquid reaction, the equilibrium concentration of the reaction product is governed by:
(a) pressure
(b) catalyst
(c) stirring
(d) temperature

46. With the given equilibrium constant of acetic acid, you may not be able to estimate:
(a) percentage ionization of the acetic acid at certain concentration
(b) final concentration of the proton
(c) the ionization speed
(d) pH value of the solution

47. The melting point decreasing sequence for the following elements is:

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(a) Li>Na>Mg>Ca
(b) Ca>Mg>Na>Li
(c) Ca>Mg>Li>Na
(d) Na>Mg>Li>Ca

48. Atoms of the same element that have different weights are called
(a) allotrope
(b) isotope
(c) polymorphs
(d) eutectic

49. Which of the followings has the lowest first ionization energy?
(a) carbon
(b) magnesium
(c) sodium
(d) helium

50. Which of the following elements is not in the same family as others?
(a) Ca
(b) Ba
(c) Mg
(d) Al