

國立臺北科技大學 114 學年度碩士班招生考試

系所組別：3602

化學工程與生物科技系生化與生醫工程碩士班

第一節 普通化學 試題 (選考)

第 1 頁 共 6 頁

注意事項：

1. 本試題共 50 題，每題 2 分，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

Choose the BEST answer of the multiple-choice questions

1. Which of the following aqueous solutions contains the greatest number of ions in solution?
 - A) 2.0 L of 2.00 M sodium phosphate
 - B) 2.0 L of 2.00 M calcium chloride
 - C) 3.0 L of 2.00 M potassium chloride
 - D) 2.0 L of 2.50 M sodium chloride
 - E) 1.0 L of 4.00 M potassium carbonate
2. Which of the following processes is endothermic?
 - A) water droplets condensing on a soda can on a hot summer day
 - B) thermite reaction between iron (III) oxide and aluminum (spectacular flames are observed)
 - C) an ice pack getting cold (resulting from ammonium nitrate dissolving in water inside the pack)
 - D) freezing water to make ice cubes
 - E) none of the above are endothermic processes.
3. Which of the following is the correct formula for a saturated hydrocarbon that contains five carbon atoms?
 - A) C_5H_{12}
 - B) C_5H_{10}
 - C) C_5H_{14}
 - D) C_5H_6
 - E) C_5H_7

4. Which of the following processes is a physical change?
 - A) Burning gasoline
 - B) Cooking an egg
 - C) Decomposing meat
 - D) Rusting iron
 - E) Evaporating water
5. Rank the following compounds **from lowest to highest** boiling point.
 - A) $H_2O < CH_3OH < C_2H_6 < CH_4$
 - B) $C_2H_6 < CH_4 < CH_3OH < H_2O$
 - C) $CH_4 < C_2H_6 < CH_3OH < H_2O$
 - D) $CH_4 < C_2H_6 < H_2O < CH_3OH$
 - E) $CH_4 < CH_3OH < C_2H_6 < H_2O$
6. Assume that vinegar is a 0.852 M solution of acetic acid (CH_3COOH) in water. What volume of 0.2136 M NaOH would be needed to completely neutralize 5.68 mL of vinegar?
 - A) 4.84 mL
 - B) 1.21 mL
 - C) 1.42 mL
 - D) 22.7 mL
 - E) 4.00 mL
7. Which of the following is a homogeneous mixture?
 - A) Pure water
 - B) Gasoline
 - C) Sodium chloride
 - D) Soil
 - E) Copper metal
8. Something done to test a hypothesis that produces new observations is called a(n)
 - A) observation
 - B) measurement
 - C) theory
 - D) natural law
 - E) experiment
9. Teflon is an example of a
 - A) copolymer
 - B) homopolymer
 - C) dimer
 - D) two of these
 - E) none of these

注意：背面尚有試題

10. How many isomers of C₆H₁₄ are there?

- A) 1
- B) 2
- C) 3
- D) 5
- E) 6

11. Which of the following is the alternative name for 1,3-dichlorobenzene

- A) *m*-dichlorobenzene
- B) *o*-dichlorobenzene
- C) *p*-dichlorobenzene
- D) benzene dichloride
- E) phenyl dichloride

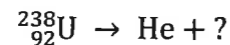
12. Given the reaction $A(g) + B(g) \rightleftharpoons C(g) + D(g)$. You have the gases A, B, C, and D at equilibrium. Upon adding gas A, the value of K

- A) increases because when A is added, more products are made, increasing the product-to-reactant ratio
- B) decreases because A is a reactant, so the product-to-reactant ratio decreases
- C) does not change because A does not figure into the product-to-reactant ratio
- D) does not change as long as the temperature is constant
- E) depends on whether the reaction is endothermic or exothermic

13. Alpha particles are

- A) electrons
- B) protons
- C) neutrons
- D) helium nuclei
- E) X rays

14. Identify the missing particle in the following equation:



- A) ${}^{242}_{94}\text{Pu}$
- B) ${}^{234}_{90}\text{Th}$
- C) ${}^{242}_{90}\text{Th}$
- D) ${}^{234}_{92}\text{U}$
- E) none of these

15. Which of the following statements best describes the movement of electrons in a p orbital?

- A) The electrons move along the outer surface of the p orbital, similar to a “figure 8” type of movement.
- B) The electrons move within the two lobes of the p orbital, but never beyond the outside surface of the orbital.
- C) The electrons are concentrated at the center (node) of the two lobes.
- D) The electrons are moving in only one lobe at any given time.
- E) The electron movement cannot be exactly determined.

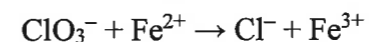
16. Which of the following statements (A-D) is **false**?

- A) The process of splitting a heavy nucleus into two nuclei with smaller mass numbers is called fission.
- B) A beta particle is a particle with the same mass as the electron but opposite charge.
- C) Nitrogen can be changed into oxygen by bombarding it with alpha particles.
- D) Archaeologists use radioactivity to determine the age of some artifacts and rocks.
- E) All of the above statements are true.

17. The oxidation state of phosphorus in Mg₃(PO₄)₂ is

- A) 0
- B) +2
- C) +4
- D) +5
- E) +6

18. In the balanced equation for the following reaction (in acidic solution)



the coefficient of Fe²⁺ is

- A) 1
- B) 6
- C) 2
- D) 8
- E) 3

19. The solubility of Pb(OH)₂ in water at a certain temperature is 6.7×10^{-6} mol/L. The value of *K*_{sp} of Pb(OH)₂ at this temperature is

- A) 1.2×10^{-15}
- B) 1.1×10^{-5}
- C) 6.7×10^{-6}
- D) 1.9×10^{-14}
- E) none of these

20. Which of the following is **true** of a system at equilibrium?
- The concentration(s) of reactant(s) is equal to the concentration(s) of product(s).
 - No new product molecules are formed.
 - The concentration(s) of reactant(s) is constant over time.
 - The concentration(s) of product(s) is not constant over time.
 - The reaction has stopped.
21. What is the pH of a solution prepared by dissolving 93.1 g NaOH in enough water to make 3.4 L of solution?
- 13.84
 - 0.16
 - 14.16
 - 11.80
 - none of these
22. The molarity of Cl^- in 110. mL of a solution containing 3.97 g of CaCl_2 is
- 0.325 M
 - 0.0358 M
 - 0.00393 M
 - 0.650 M
 - 0.437 M
23. A nitric acid solution containing 71.0% HNO_3 (by mass) has a density of 1.42 g/mL. How many moles of HNO_3 are present in 1.98 L of this solution?
- 62.8 mol
 - 31.7 mol
 - 22.3 mol
 - 15.3 mol
 - none of these
24. The freezing point of helium is approximately -270°C . The freezing point of xenon is -112°C . Both of these are in the noble gas family. Which of the following statements is supported by these data?
- Helium and xenon form highly polar molecules.
 - As the molar mass of the noble gas increases, the freezing point decreases.
 - The London forces between the helium molecules are less than the London forces between the xenon molecules.
 - The London forces between the helium molecules are greater than the London forces between the xenon molecules.
 - none of these
25. A certain balloon will pop if it expands to a volume greater than 16.0 L. The balloon is currently filled with air at a volume of 8.0 L. You heat the balloon such that the temperature measured in degrees Celsius doubles. Which of the following best describes what happens?
- The balloon will expand to a volume greater than 16.0 L and pop.
 - The balloon will expand to a volume less than 16.0 L and not pop.
 - The balloon will expand to a volume of 16.0 L and pop.
 - The balloon will expand to a volume of 16.0 L and not pop.
 - The volume of the balloon will remain the same but the pressure will increase.
26. The cesium-137 nuclide has a half-life of 30 years. After 90 years, about 9 g remains. The original mass of the cesium-137 is closest to
- 70 g
 - 50 g
 - 90 g
 - 80 g
 - 60 g
27. Which of the following statements are **true** of real gases?
- A real gas behaves more like an ideal gas at high pressures and low temperatures.
 - The individual gas particles have no volume.
 - The individual gas particles are not attracted to one another.
 - The particles collide with the walls of its container and exert pressure.
 - The kinetic energy of the gas particles is directly proportional to the temperature of the gas in degrees Celsius.
28. The volume of a sample of gas is 531.6 mL at STP. What volume will the sample occupy at 0.0°C and 950.0 torr?
- 664.5 mL
 - 425.3 mL
 - 389.6 mL
 - 537.3 mL
 - none of these
29. Zinc metal is added to hydrochloric acid to generate hydrogen gas and is collected over a liquid whose vapor pressure is the same as that of pure water at 20.0°C (18 torr). The volume of the mixture is 1.7 L, and its total pressure is 0.792 atm. Determine the number of moles of hydrogen gas present in the sample.
- 0.796 mol
 - 0.112 mol
 - 0.217 mol
 - 0.0543 mol
 - 0.0320 mol

30. Which of the following elements is the most electronegative element?

- A) C
- B) Ge
- C) Pb
- D) Si
- E) Sn

31. The Lewis structure for which of the following contains the greatest number of lone pairs of electrons?

- A) CH_4
- B) HF
- C) F_2
- D) H_2O
- E) H_2

32. Which has a planar structure?

- A) SO_3^{2-}
- B) NF_3
- C) H_3O^+
- D) CH_4
- E) CO_3^{2-}

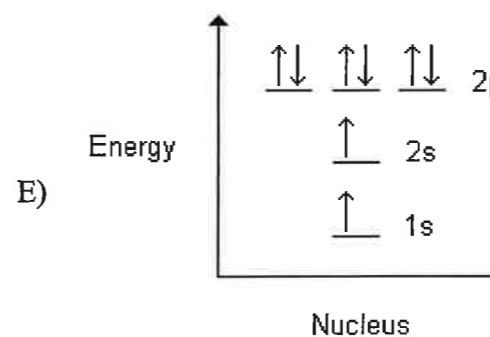
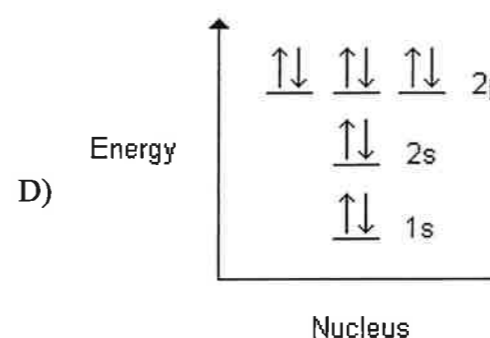
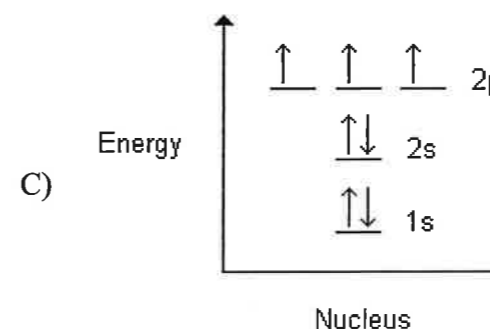
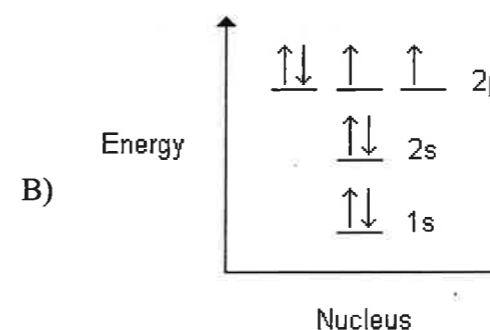
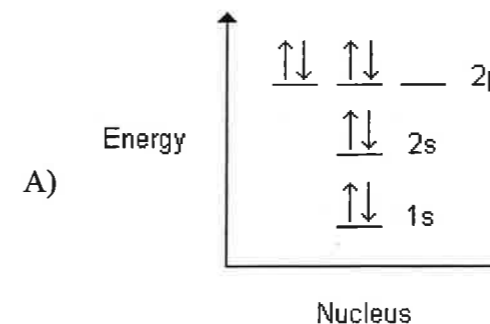
33. We usually use the term _____ for all forms of electromagnetic radiation.

- A) energy
- B) photons
- C) radiation
- D) light
- E) none of these

34. _____ is a phenomenon that may be caused by the burning of fossil fuels, which increases the carbon dioxide content in the earth's atmosphere.

- A) Acid rain
- B) The greenhouse effect
- C) Infrared radiation
- D) The ozone problem
- E) None of these

35. Choose the correct energy-level diagram for the ground state of oxygen.



36. The yet undiscovered element with atomic number 113 would be a member of
- the halogens
 - the transition elements
 - the noble gases
 - the Group 3A elements
 - none of these
37. Which of the following processes is endothermic?
- water droplets condensing on a soda can on a hot summer day
 - an ice pack getting cold (due to ammonium nitrate dissolving in water inside the pack)
 - hermite reaction between iron(III) oxide and aluminum (spectacular flames are observed)
 - freezing water to make ice cubes
 - none of the above are endothermic processes
38. Refer to the following equation: $4\text{NH}_3(\text{g}) + 7\text{O}_2(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{g})$
- How many moles of ammonia will be required to produce 10.9 mol of water?
- 4.36 mol
 - 10.9 mol
 - 7.27 mol
 - 5.45 mol
 - none of these
39. Consider the equation: $\text{A} + 6\text{B} \rightarrow 5\text{C} + 5\text{D}$
- When equal masses of A and B are reacted, which is limiting?
- If the molar mass of A is less than the molar mass of B, then B must be limiting.
 - If the molar mass of A is greater than the molar mass of B, then A must be limiting.
 - If the molar mass of A is greater than the molar mass of B, then B must be limiting.
 - If the molar mass of A is less than the molar mass of B, then A must be limiting.
 - Neither reactant is limiting.
40. A compound is found to have a percent composition (by mass) of 85.63% C and 14.37% H. The molar mass of the compound was found to be 42.0 g/mol. Which of the following is the empirical formula and the molecular formula, respectively?
- C_2H_3 and C_4H_6
 - CH and C_3H_3
 - CH_2 and C_3H_6
 - CH_3 and C_2H_6
 - C_2H_6 and C_3H_9
41. An aqueous solution of potassium carbonate is allowed to react with an aqueous solution of nickel(II) chloride. Identify the solid formed in the reaction.
- NiCO_3
 - KCl
 - NiCl_2
 - K_2CO_3
 - No solid is formed in the reaction.
42. Which of the following ionic compounds is insoluble in water?
- Na_2SO_4
 - CuSO_4
 - $\text{Fe}_2(\text{SO}_4)_3$
 - FeSO_4
 - PbSO_4
43. All of the following are clues that a chemical reaction has taken place **except**
- A color change occurs.
 - A solid forms.
 - The reactant is smaller.
 - Bubbles form.
 - A flame occurs.
44. The compound PI_3 is named
- potassium iodide
 - monophosphorus iodide
 - phosphorus iodide
 - phosphorus triiodide
 - none of these
45. What is the correct name of the compound that has a metal ion containing 24 electrons and the most stable ion for sulfur?
- Iron(II) sulfate
 - Iron(III) sulfide
 - Chromium(II) sulfide
 - Nickel(III) sulfate
 - Iron(II) sulfide
46. Which of the following is named **correctly**?
- $\text{HCl}(\text{aq})$; hypochlorous acid
 - $(\text{NH}_4)_3\text{PO}_3$; ammonium phosphate
 - $\text{H}_2\text{SO}_3(\text{aq})$; sulfuric acid
 - NH_3 ; ammonium ion
 - $\text{HNO}_3(\text{aq})$; nitric acid

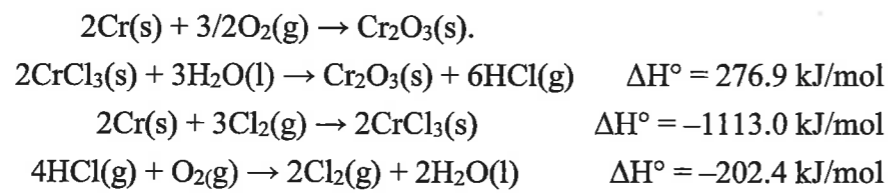
47. What is the **most abundant** element on the earth (including the crust, oceans, and atmosphere)?

- A) silicon
- B) oxygen
- C) hydrogen
- D) carbon
- E) iron

48. An atom with 15 protons and 16 neutrons is an atom of

- A) P
- B) Ga
- C) S
- D) Pd
- E) Rh

49. Using the following thermochemical data, calculate ΔH_f° for the reaction,



- A) 633.7 kJ/mol
- B) -1038.5 kJ/mol
- C) 1592.3 kJ/mol
- D) -1187.5 kJ/mol
- E) -1139.7 kJ/mol

50. A substance that, when dissolved in water, produces a solution that conducts electric current very efficiently is called

- A) a strong electrolyte
- B) a weak electrolyte
- C) a strong ion
- D) an electrical solute
- E) none of these