

國立臺北科技大學 111 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

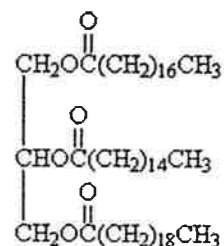
第一節 普通化學 試題 (選考)

第 1 頁 共 5 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。

- (1) What is the abbreviated electron configuration for nickel (atomic number 28)?
 - A) [He]2s²2p³
 - B) [Ar]4s²3d⁸
 - C) [Kr]4s²3d⁸
 - D) [Ar]4s²4p⁴
 - E) [Ar]3d⁸
- (2) A wooden object from a prehistoric site has a carbon-14 activity of 10 counts per minute (cpm) compared to 40 cpm for new wood. If carbon-14 has a half-life of 5730 years, what is the age of the wood?
 - A) 1430 yr
 - B) 5730 yr
 - C) 11,500 yr
 - D) 17,200 yr
 - E) 22,900 yr
- (3) What type of lipid is the following compound?



- A) triacylglycerol
- B) wax
- C) glycerophospholipid
- D) bile salt
- E) steroid

- (4) What is the oxidation state of Hg in Hg₂Cl₂?
 - A) +2
 - B) -1
 - C) -2
 - D) +1
 - E) 0
- (5) In stage three of metabolism, the overall result is to release
 - A) glucose and water.
 - B) lactate and acetyl CoA.
 - C) lactate and glucose.
 - D) glycogen and water.
 - E) carbon dioxide and energy.
- (6) The Greeks proposed that matter consisted of four fundamental substances are
 - A) fire, earth, water, air
 - B) fire, metal, water, air
 - C) earth, metal, water, air
 - D) atoms, fire, water, air
 - E) atoms, metal, fire, air
- (7) During complete oxidation of the fatty acid CH₃(CH₂)₁₈COOH, _____ molecules of acetyl CoA are produced, and the fatty acid goes through the β-oxidation cycle _____ times.
 - A) ten; ten
 - B) nine; ten
 - C) nine; nine
 - D) nine; eight
 - E) ten; nine
- (8) A mixture of KCl and KNO₃ is 44.20% potassium by mass. The percentage of KCl in the mixture is closest to
 - A) 40%
 - B) 50%
 - C) 60%
 - D) 70%
 - E) 80%
- (9) Consider two organic molecules, ethanol and benzene. One dissolves in water and the other does not. Why?
 - A) Ethanol contains a polar O-H bond, and benzene does not.
 - B) One is ionic, the other is not.
 - C) They have different molar masses.
 - D) One is an electrolyte, the other is not.
 - E) Two of these are correct.

注意：背面尚有試題

(10) A compound is composed of element X and hydrogen. Analysis shows the compound to be 80% X by mass, with three times as many hydrogen atoms as X atoms per molecule. Which element is element X?

- A) He
- B) C
- C) F
- D) S
- E) none of these

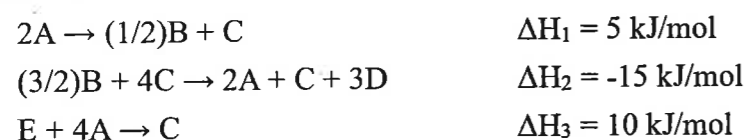
(11) A 1.63 g sample of a metal chloride, MCl_2 , is dissolved in water and treated with excess aqueous silver nitrate. The silver chloride that formed weighed 3.48 g. Calculate the molar mass of M.

- A) 70.9 g/mol
- B) 32 g/mol
- C) 64 g/mol
- D) 67 g/mol
- E) 72.4 g/mol

(12) Which of the following would represent the greatest pressure?

- A) 0.501 atm
- B) 437 mmHg
- C) 11.7 psi
- D) 66062 Pa
- E) 18.8 in Hg

(13) Consider the following processes:



Calculate ΔH for: $C \rightarrow E + 3D$

- A) 0 kJ/mol
- B) 10 kJ/mol
- C) -10 kJ/mol
- D) -20 kJ/mol
- E) 20 kJ/mol

(14) For which of the following transitions does the light emitted have the longest wavelength?

- A) $n = 4$ to $n = 3$
- B) $n = 4$ to $n = 2$
- C) $n = 4$ to $n = 1$
- D) $n = 3$ to $n = 2$
- E) $n = 2$ to $n = 1$

(15) The purity of a sample (84.0% zinc) containing zinc and weighing 0.323 g is determined by measuring the amount of hydrogen formed when the sample reacts with an excess of hydrochloric acid. What amount of hydrogen (measured at STP) was obtained?

- A) L
- B) g
- C) mole
- D) molecules
- E) atoms

(16) What is the hybridization of the carbon atom that is bonded to chlorine?

- A) sp
- B) sp^2
- C) sp^3
- D) dsp^3
- E) d^2sp^3

(17) In the unit cell of sphalerite, Zn^{2+} ions occupy half the tetrahedral holes in a face-centered cubic lattice of S^{2-} ions. The number of formula units of ZnS in the unit cell is:

- A) 6
- B) 4
- C) 3
- D) 2
- E) 1

(18) What is the correct order of the following bonds in terms of decreasing polarity?

- A) N-Cl, P-Cl, As-Cl
- B) P-Cl, N-Cl, As-Cl
- C) As-Cl, N-Cl, P-Cl
- D) P-Cl, As-Cl, N-Cl
- E) As-Cl, P-Cl, N-Cl

(19) Choose the molecule with the strongest bond.

- A) HF
- B) HCl
- C) HBr
- D) HI
- E) All are equal.

(20) Which substance involves no bonding forces except London dispersion forces?

- A) $NaCl_{(l)}$
- B) $HF_{(l)}$
- C) $N_{2(s)}$
- D) $H_2O_{(l)}$
- E) $K_{(s)}$

- (21) Which of the following is the net reaction for one turn of the citric acid cycle?
- A) $\text{Acetyl-CoA} + 3\text{NAD}^+ + \text{FAD} + \text{GDP} + \text{P}_i + 2\text{H}_2\text{O} \rightarrow 2\text{CO}_2 + 3\text{NADH} + 3\text{H}^+ + \text{FADH}_2 + \text{HS-CoA} + \text{GTP}$
 B) $\text{Pyruvate} + 3\text{NAD}^+ + \text{FAD} + \text{GDP} + \text{P}_i + 2\text{H}_2\text{O} \rightarrow 3\text{CO}_2 + 3\text{NADH} + 3\text{H}^+ + \text{FADH}_2 + \text{GTP}$
 C) $\text{Acetyl-CoA} + \text{NAD}^+ + \text{FAD} + \text{GDP} + \text{P}_i \rightarrow 2\text{CO}_2 + \text{NADH} + \text{H}^+ + \text{FADH}_2 + \text{HS-CoA} + \text{GTP}$
 D) $\text{Glucose} + 2\text{NAD}^+ + 2\text{GDP} + 2\text{P}_i + 2\text{H}_2\text{O} \rightarrow 2\text{Pyruvate} + 2\text{NADH} + 2\text{H}^+ + \text{GTP}$
 E) $\text{Glucose} + 2\text{GDP} + 2\text{P}_i \rightarrow 2\text{Lactate} + 2\text{GTP}$
- (22) What is the boiling point change for a solution containing 0.582 moles of naphthalene (a nonvolatile, nonionizing compound) in 250g of liquid benzene? ($K_b = 2.53^\circ\text{C}/\text{m}$ for benzene)
- A) 5.89°C
 B) 1.08°C
 C) 4.35°C
 D) 1.47°C
 E) 0.368°C
- (23) The following statements concerning petroleum are all true **except**:
- A) It is a thick, dark liquid composed mostly of hydrocarbons.
 B) It must be separated into fractions (by boiling) in order to be used efficiently.
 C) Some of the commercial uses of petroleum fractions include gasoline and kerosene.
 D) It was probably formed from the remains of ancient marine organisms.
 E) All of its hydrocarbon chains contain the same number of carbon atoms.
- (24) A 4.53-gram sample of a compound is dissolved in enough water to form 100.0 mL of solution. This solution has an osmotic pressure of 25.0 torr at 25°C . If it is assumed that each molecule of the solute dissociates into two particles (in this solvent), estimate what is the molar mass of this solute?
- A) $8.86 \times 10^1 \text{ g/mol}$
 B) $5.65 \times 10^3 \text{ g/mol}$
 C) $3.37 \times 10^3 \text{ g/mol}$
 D) $6.74 \times 10^4 \text{ g/mol}$
 E) none of these
- (25) Which of the following statements concerning equilibrium is **not true**?
- A) A system that is disturbed from an equilibrium condition responds in a manner to restore equilibrium.
 B) Equilibrium in molecular systems is dynamic, with two opposing processes balancing one another.
 C) The value of the equilibrium constant for a given reaction mixture is the same regardless of the direction from which equilibrium is attained.
 D) A system moves spontaneously toward a state of equilibrium.
 E) The equilibrium constant is independent of temperature.
- (26) Consider the reaction: $2\text{SO}_{2(\text{g})} + \text{O}_{2(\text{g})} \rightleftharpoons 2\text{SO}_{3(\text{g})}$ at constant temperature. Initially a container is filled with pure $\text{SO}_{3(\text{g})}$ at a pressure of 2 atm, after which equilibrium is reached. If y is the partial pressure of O_2 at equilibrium, the value of K_p is:
- A) $\frac{(2-2y)^2}{(y^2)(2y)}$
 B) $\frac{(2-y)^2}{(y^2)(y/2)}$
 C) $\frac{(2-y)^2}{(2y)^2(y)}$
 D) $\frac{(2-2y)^2}{(2y)^2(y)}$
 E) none of these.
- (27) The alpha helix and beta sheet are examples of
- A) protein denaturation.
 B) protein primary structure.
 C) complementary bases.
 D) protein tertiary structure.
 E) protein secondary structure.
- (28) For the reaction $\text{CO}_{(\text{g})} + 2\text{H}_{2(\text{g})} \rightleftharpoons \text{CH}_3\text{OH}_{(\text{g})}$, $\Delta G^\circ_{700\text{K}} = -13.456 \text{ kJ}$. The K_p for this reaction at 700K is
- A) 10.1
 B) 1.00
 C) 1.54
 D) 2.31
 E) none of these
- (29) What is the equilibrium constant for the following reaction? $\text{N}_3^- + \text{H}_3\text{O}^+ \rightleftharpoons \text{HN}_3 + \text{H}_2\text{O}$
 The K_a value for $\text{HN}_3 = 1.9 \times 10^{-5}$.
- A) 5.3×10^{-10}
 B) 1.9×10^{-9}
 C) 1.9×10^{-5}
 D) 5.3×10^4
 E) 1.9×10^9
- (30) A monoprotic weak acid when dissolved in water is 0.66% dissociated and produces a solution with a pH of 3.04. Calculate the K_a of the acid.
- A) 6.6×10^{-3}
 B) 1.4×10^{-1}
 C) 6.1×10^{-6}
 D) Need to know the initial concentration of the acid.
 E) None of these.

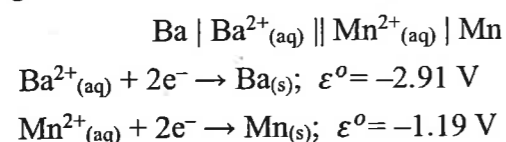
(31) Which of the following is true?

- A) By spontaneous we mean that the reaction or process will always proceed to the right (as written) even if very slowly. Increasing the temperature may speed up the reaction, but it does not affect the spontaneity of the reaction.
- B) By spontaneous we mean that the reaction or process will always proceed to the left (as written) even if very slowly. Increasing the temperature may speed up the reaction, but it does not affect the spontaneity of the reaction.
- C) By spontaneous we mean that the reaction or process will always proceed to the left (as written) even if very slowly. Increasing the temperature may speed up the reaction and it generally affects the spontaneity of the reaction.
- D) By spontaneous we mean that the reaction or process will always proceed to the right (as written) even if very slowly. Increasing the temperature may speed up the reaction, and it generally affects the spontaneity of the reaction.
- E) None of the above is true.

(32) The average mass of a carbon atom is 12.011. Assuming you were able to pick up only one carbon unit, the chances that you would randomly get one with a mass of 12.011 is

- A) 0%
- B) 0.011%
- C) about 12%
- D) 12.011%
- E) greater than 50%

(33) Which of the following statements is true concerning the electrochemical cell depicted below?

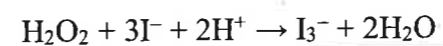


- A) The cell reaction is spontaneous with a standard cell potential of 1.72 V.
- B) The cell reaction is spontaneous with a standard cell potential of 4.1 V.
- C) The cell reaction is nonspontaneous with a standard cell potential of -1.72 V.
- D) The cell reaction is nonspontaneous with a standard cell potential of -4.1 V.
- E) The cell is at equilibrium.
- (34) If 138.0 g of CH_4 and 138.0 g of H_2O are reacted at 975 °C and 12.0 atm, how much hydrogen should be available for industrial use?
- A) 153 L
- B) 220 L
- C) 196 L
- D) 21.8 L
- E) 65.4 L

(35) Which metal ion has a d^5 electron configuration?

- A) Pd^{2+}
- B) Ag^+
- C) Fe^{3+}
- D) V^{2+}
- E) Co^{2+}

Consider the following data concerning the equation for problem (36) and (37):



	$[\text{H}_2\text{O}_2]$	$[\text{I}^-]$	$[\text{H}^+]$	rate
I	0.100 M	$5.00 \times 10^{-4} \text{ M}$	$1.00 \times 10^{-2} \text{ M}$	0.137 M/sec
II	0.100 M	$1.00 \times 10^{-3} \text{ M}$	$1.00 \times 10^{-2} \text{ M}$	0.268 M/sec
III	0.200 M	$1.00 \times 10^{-3} \text{ M}$	$1.00 \times 10^{-2} \text{ M}$	0.542 M/sec
IV	0.400 M	$1.00 \times 10^{-3} \text{ M}$	$2.00 \times 10^{-2} \text{ M}$	1.084 M/sec

(36) The rate law for this reaction is

- A) $\text{rate} = k[\text{H}_2\text{O}_2][\text{I}^-][\text{H}^+]$
- B) $\text{rate} = k[\text{H}_2\text{O}_2]^2[\text{I}^-]^2[\text{H}^+]^2$
- C) $\text{rate} = k[\text{I}^-][\text{H}^+]$
- D) $\text{rate} = k[\text{H}_2\text{O}_2][\text{H}^+]$
- E) $\text{rate} = k[\text{H}_2\text{O}_2][\text{I}^-]$

(37) The average value for the rate constant k (without units) is

- A) 2710
- B) 2.74×10^4
- C) 137
- D) 108
- E) none of these

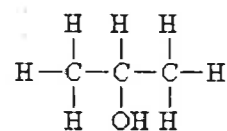
(38) Which of the following statements is true about the octahedral complexes of Ni^{2+} ?

- A) Both strong- and weak-field complexes are diamagnetic.
- B) The strong-field complex is diamagnetic and the weak-field complex is paramagnetic.
- C) The strong-field complex is paramagnetic and the weak-field complex is diamagnetic.
- D) Both strong- and weak-field complexes are paramagnetic.
- E) There are no octahedral complexes of Ni.

(39) In the balanced molecular equation for the neutralization of sodium hydroxide with sulfuric acid, the products are:

- A) $\text{NaSO}_4 + \text{H}_2\text{O}$
- B) $\text{NaSO}_3 + 2\text{H}_2\text{O}$
- C) $2\text{NaSO}_4 + \text{H}_2\text{O}$
- D) $\text{Na}_2\text{S} + 2\text{H}_2\text{O}$
- E) $\text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$

(40) Name the following:



- A) methyl alcohol
 B) ethyl alcohol
 C) propyl alcohol
 D) isopropyl alcohol
 E) butanol
- (41) What nitrogen-containing compound is used as rocket fuel?
 A) nitrous oxide
 B) ammonia
 C) nitric oxide
 D) hydrazine
 E) nitrogen dioxide
- (42) Which statement of fibrous proteins is true?
 A) Provide structural integrity and strength for many types of tissues.
 B) Transport and store oxygen and nutrients.
 C) Act as catalysts.
 D) Are the main components of cellular membrane, myelin sheath, and brain tissue.
 E) Fight invasion of the body by foreign objects.
- (43) Which of the following statements about polymers is/are correct?
 I. Condensation polymers are always formed from a single monomer.
 II. Addition polymerization sometimes requires an initiator, such as an organic peroxide.
 III. Polyesters are formed from amines and carboxylic acid monomers which have two or more amine and carboxylic acid functional groups per monomer.
 A) 1 only
 B) 2 only
 C) 3 only
 D) 2 and 3
 E) 1, 2, and 3
- (44) A double cheeseburger with bacon contains 640 kcal and 39 g of fat. Calculate the number of kilocalories from fat, rounded to the tens place (1 gram of fat = 9 kcal).
 A) 4.3 kcal from fat
 B) 39 kcal from fat
 C) 71 kcal from fat
 D) 350 kcal from fat
 E) 640 kcal from fat

(45) What is the functional group corresponding to a peptide bond?

- A) amine
 B) ether
 C) amide
 D) hemiacetal
 E) carboxylic acid
- (46) Under anaerobic conditions, there is a net production of _____ ATP during glycolysis.
 A) zero
 B) two
 C) four
 D) six
 E) eight
- (47) Fatty acids are not a source of energy for the brain because
 A) they cannot diffuse across the blood-brain barrier.
 B) the citric acid cycle does not operate in the brain.
 C) chylomicrons are too large for absorption by brain cells.
 D) they are metabolized before they get as far as the brain.
 E) there is no lipase in the brain.
- (48) The coenzyme(s) used in fatty acid synthesis is (are)
 A) NADH.
 B) FADH₂.
 C) NADPH.
 D) NADH and NADPH.
 E) FADH₂ and NADH.
- (49) All of the following are insoluble in water except _____.
 A) oleic acid
 B) carnauba wax
 C) acetic acid
 D) cholesterol
 E) glyceryl tripalmitate
- (50) Iron is biologically important in the transport of oxygen by red blood cells from lungs to various organs of the body. In the blood of an adult human, there are approximately 2.63×10^{13} red blood cells with a total of 2.90 g of iron. On the average, how many iron atoms are present in each red blood cell? (molar mass Fe = 55.85 g/mol)
 A) 8.41×10^{-10}
 B) 1.19×10^9
 C) 3.13×10^{22}
 D) 2.63×10^{13}
 E) 6.16×10^{-2}