

# 國立中山大學 104 學年度轉學考招生考試試題

科目名稱：普通化學【海工系二年級】

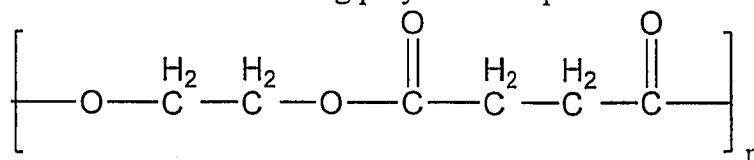
題號：759001

※本科目依簡章規定「不可以」使用計算機

共 3 頁 第 1 頁

一、單選題 (50% total, 2% each)

1. What kinds of monomer units are the following polymers composed of?



I. HOCH<sub>2</sub>CH<sub>2</sub>OH    II. HOOCCH<sub>2</sub>CH<sub>2</sub>COOH    III. HOCH<sub>2</sub>CH<sub>2</sub>COOH    IV. HOCH=CHOH

(a) II    (b) III    (c) IV    (d) I 和 II    (e) II 和 III。

2. The affinity of CO for hemoglobin is about 210 times that of O<sub>2</sub>. Assume that a person is inhaling air that contains 86 ppm of CO. If all the hemoglobin leaving the lungs carries either oxygen or CO, what is the fraction in carboxyl hemoglobin? The O<sub>2</sub> is present in the atmosphere to the extent of 209000 ppm.

(a) 10%    (b) 7.9%    (c) 3%    (d) 0.8%    (e) 8.6%

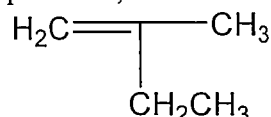
3. Which of the following is a tertiary amine?

(a) (CH<sub>3</sub>)<sub>2</sub>NH    (b) (CH<sub>3</sub>)<sub>3</sub>CNH<sub>2</sub>    (c) CH<sub>3</sub>CONH<sub>2</sub>    (d) CH<sub>3</sub>CON(CH<sub>3</sub>)<sub>2</sub>

4. Which of the following aqueous has the strongest acidity?

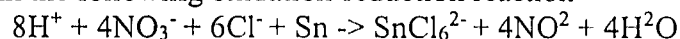
(a) 1M HI    (b) 1M HNO<sub>3</sub>    (c) 1M HClO<sub>4</sub>    (d) 1M HCl    (e) all of the above solution have the same acidity

5. The correct systematic name of the compound is,



(a) 2-ethyl-1-propene    (b) 2-methyl-1-ethyl-ethylene    (c) 2-ethyl-2-propene    (d) 2-methyl-1-butene

6. In the following oxidation-reduction reaction



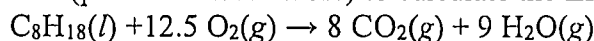
The reducing agent is

(a) Sn    (b) Cl<sup>-</sup>    (c) NO<sub>3</sub><sup>-</sup>    (d) H<sup>+</sup>

7. Syrup is a concentrated solution of sucrose (C<sub>12</sub>H<sub>22</sub>O<sub>11</sub>) used for many culinary applications. What volume of a 5.84 M syrup solution is needed to produce 5.40 × 10<sup>-1</sup> L of a 1.00 M sucrose solution?

(a) 92.5 mL    (b) 46.3 mL    (c) 13.9 mL    (d) 3.15 mL

8. Use the enthalpies of formation (provided in the table) to calculate the ΔH<sup>o</sup><sub>rxn</sub> of the reaction:



Given:

Substance	ΔH <sub>f</sub> <sup>o</sup> (kJ/mol)
C <sub>8</sub> H <sub>18</sub> (l)	250.1
H <sub>2</sub> O (g)	241.8
CO <sub>2</sub> (g)	393.5

(a) 2537 kJ    (b) -7611 kJ    (c) -2537 kJ    (d) -5074 kJ

背面有題

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共 3 頁第 2 頁

9. The spin quantum number,  $m_s$ , was introduced as a result of the discovery of:
- the Heisenberg uncertainty principle.
  - the Aufbau principle.
  - Hund's rule.
  - the Pauli exclusion principle.
10. Which shows the correct order of increasing radius?
- $\text{Cl}^- < \text{Ca}^{2+} < \text{S}^{2-}$
  - $\text{Ca}^{2+} < \text{Cl}^- < \text{S}^{2-}$
  - $\text{S}^{2-} < \text{Cl}^- < \text{Ca}^{2+}$
  - $\text{Ca}^{2+} < \text{S}^{2-} < \text{Cl}^-$
11. Which bond is most polar?
- N-O
  - F-F
  - Si-O
  - Br-C
12. Determine the volume of an object that has a mass of  $4.556 \times 10^2$  g and a density of  $19.3 \text{ g/cm}^3$ .
- $8.79 \times 10^2$  mL
  - $2.36 \times 10^1$  mL
  - $2.36 \times 10^2$  mL
  - $8.79 \times 10^3$  mL
13. Write the molecular equation for the precipitation reaction that occurs (if any) when solutions of calcium nitrate and ammonium sulfate are mixed.
- $\text{Ca}(\text{NO}_3)_2(aq) + (\text{NH}_4)_2\text{SO}_4(aq) \rightarrow 2 \text{NH}_4\text{NO}_3(s) + \text{CaSO}_4(aq)$
  - $2 \text{Ca}(\text{NO}_3)_2(aq) + 2 (\text{NH}_4)_2\text{SO}_4(aq) \rightarrow 4 \text{NH}_4\text{NO}_3(aq) + \text{CaSO}_4(s)$
  - $\text{Ca}(\text{NO}_3)_2(aq) + (\text{NH}_4)_2\text{SO}_4(aq) \rightarrow 2 \text{NH}_4\text{NO}_3(aq) + \text{CaSO}_4(s)$
  - No reaction occurs.
14. Which of the following will have the greatest volume at STP?
- 22g CO
  - 22g O<sub>2</sub>
  - 22g He
  - 22g Cl<sub>2</sub>
15. What is the wavelength of the blue light emitted by a mercury lamp with a frequency of  $6.88 \times 10^{14}$  Hz?
- 436 nm
  - 229 nm
  - 485 nm
  - 206 nm
16. Which of the following is a possible set of quantum numbers  $[n, l, ml, m_s]$  for an electron in a 3p orbital?
- $[3, 3, 3, 1/2]$
  - $[3, 1, -2, -1/2]$
  - $[3, 2, 0, 1]$
  - $[3, 1, 0, -1/2]$
17. Which of the following N-N bonds is the strongest?
- the N-N bond in N<sub>2</sub>(g)
  - the N-N bond in N<sub>2</sub>H<sub>2</sub>(g)
  - the N-N bond in N<sub>2</sub>H<sub>4</sub>(g)
  - The N-N bonds in A-C have about the same strengths
18. How many sigma ( $\sigma$ ) and pi ( $\pi$ ) bonds are in a CH<sub>2</sub>CHCH<sub>3</sub> molecule?
- 9  $\sigma$ , 0  $\pi$
  - 7  $\sigma$ , 2  $\pi$
  - 8  $\sigma$ , 1  $\pi$
  - 8  $\sigma$ , 2  $\pi$
19. 12.0 kJ of heat is supplied to a 150.0-g sample of ethanol initially at 25.0 °C. What is the final temperature of the ethanol? The specific heat capacity of ethanol is 2.42 J/g·°C.
- 21.7 °C
  - 28.3 °C
  - 58.1 °C
  - 35.7 °C
20. Which of the following is a redox reaction?
- $\text{NaOH}(aq) + \text{HCl}(aq) \rightarrow \text{H}_2\text{O}(l) + \text{NaCl}(aq)$
  - $\text{Mg}(s) + 2 \text{H}_2\text{O}(l) \rightarrow \text{Mg}(\text{OH})_2(s) + \text{H}_2(g)$
  - $\text{K}_2\text{CO}_3(aq) + \text{NiCl}_2(aq) \rightarrow 2 \text{KCl}(aq) + \text{NiCO}_3(s)$

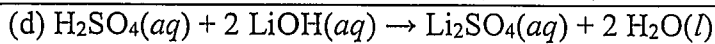
國立中山大學 104 學年度轉學考招生考試試題

科目名稱：普通化學【海工系二年級】

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共 3 頁第 3 頁



21. What is the pH of a 0.25 M NaF, sodium fluoride, solution?  
 $K_a$  for HF, hydrofluoric acid, is  $3.5 \times 10^{-4}$ .  
(a) 8.43 (b) 5.87 (c) 9.71 (d) 9.28
22. Calculate the molar solubility of  $\text{Ca}(\text{OH})_2$  in pure water. The  $K_{sp}$  of  $\text{Ca}(\text{OH})_2$  is  $4.68 \times 10^{-6}$  M.  
(a)  $4.05 \times 10^{-3}$  M (b)  $3.05 \times 10^{-1}$  M (c)  $2.05 \times 10^{-4}$  M (d)  $1.05 \times 10^{-2}$  M
23. Three solutions (listed below) are combined. Assuming the volumes are additive, what is the chloride concentration in the combined solution?  
I. 25.0 mL of 0.100 M  $\text{MgCl}_2$   
II. 40.0 mL of 0.250 M  $\text{LiCl}$   
III. 30.0 mL of 0.400 M  $\text{KBr}$   
(a) 0.158 M (b) 0.284 M (c) 0.223 M (d) 0.258 M
24. Which statement is FALSE with regard to protons, neutrons and electrons?  
(a) Protons and electrons have the same magnitude of charge but opposite in sign.  
(b) Electrons were the first subatomic particle discovered.  
(c) Protons and neutrons are located in the nucleus.  
(d) Protons and electrons have approximately the same mass.
25. Which of the following statements is TRUE?  
(a) The total number of molecular orbitals formed does not always equal the number of atomic orbitals combined.  
(b) In  $\text{H}_2$  molecules, the two 1s orbitals combine constructively, which results in one bonding orbital and one nonbonding orbital  
(c) Electrons placed in antibonding orbitals stabilize the species.  
(d) When filling degenerate  $\pi$  orbitals, electrons will fill the orbitals singly, and with parallel spin, before pairing.

二、問答題 (50% total)

1. Write the names (in English) of the following compounds : (15% total, 3% each.)  
a.  $\text{K}_2\text{Cr}_2\text{O}_7$     b.  $\text{KMnO}_4$     c.  $\text{Fe}(\text{NO}_3)_3$     d.  $\text{HCOOH}$     e.  $\text{TiO}_2$
2. Describe the origin of ozone ( $\text{O}_3$ ) in atmosphere, why it is desirable in upper atmosphere and not desirable in lower atmosphere. (20%)
3. Define the following terms of electrochemistry : (15% total, 3% each.)  
a. Free Energy Change                      b. Free Radical  
c. Configurational Isomers                d. Chromatography                      e. BOD (biological oxygen demand)

# 國立中山大學 104 學年度轉學考招生考試試題

科目名稱：普通物理【海工系二年級】

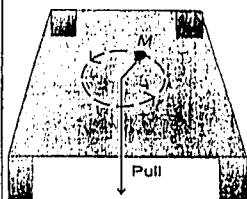
題號：759002

※本科目依簡章規定「不可以」使用計算機

共 2 頁 第 1 頁

單選題，共 20 題，每題 5 分，總分 100 分，不作答 0 分，答錯倒扣 1 分。

1. Let  $\vec{V} = 2.00\hat{i} + 6.00\hat{j} - 3\hat{k}$ . The magnitude of  $\vec{V}$  is: (A) 5.00 (B) 5.57 (C) 7.00 (D) 7.42 (E) 8.54
2. A projectile has an initial velocity  $v_0$  at an angle  $\theta_0$  above the horizontal. It reaches the highest point of its trajectory in a time  $T$  after launch. The highest point is a vertical distance  $h_{max}$  and a horizontal distance  $d$  from the firing point. All of the following statements are true except: (A)  $T = (v_0 \cos \theta_0)/g$  (B)  $d = v_0 T \cos \theta_0$  (C)  $h_{max} = (v_0 \sin \theta_0)^2 / 2g$  (D)  $v = v_0 \cos \theta_0$  (E) the acceleration is  $g$  (in magnitude)
3. Which in the following does not represent the dimension of force? (A)  $ma$  (B)  $kx$  (C)  $qE$  (D)  $qB$  (E)  $mv^2/x$
4. A 1000 kg airplane moves in straight flight at constant speed. The force of air friction is 1800 N. The net force on the plane is: (A) zero (B) 11800 N (C) 1800 N (D) 9800 N (E) none of these
5. A particle moves 5 m in the  $+x$  direction while being acted upon by a constant force  $\vec{F} = (4\hat{i} + 2\hat{j} - 4\hat{k})N$ . The work (in N·m) done on the particle by this force is: (A) 20 (B) 10 (C) -20 (D) 30 (E) need to know other forces
6. An unstable nucleus has mass  $M$  and is initially at rest. It ejects a particle of mass  $m$  with speed  $v$ . The recoil speed of the remaining nucleus is: (A)  $v$  (B)  $mv/M$  (C)  $mv/(m+M)$  (D)  $(m+M)v/m$  (E)  $mv/(M-m)$
7. An object  $M$ , on the end of a string, moves in a circle on a horizontal frictionless table as shown below. As the string is slowly pulled through a small hole in the table: (A) the angular momentum of  $M$  remains constant (B) the angular momentum of  $M$  decrease (C) the kinetic energy of  $M$  decreases (D) the kinetic energy of  $M$  remains constant (E) none of the above



8. A particle moves along the  $z$  axis under the influence of a stationary object. The force exerted on the particle is given by  $F = 9x^2$ , where  $F$  is in newtons and  $x$  is in meters. If  $x = 0$  is taken to be the zero of potential energy, then the potential energy in joules is given by: (A)  $3x^3$  (B)  $-3x^3$  (C)  $18x$  (D)  $-18x$  (E)  $10-3x^3$
9. A wheel rotates with a constant angular acceleration of  $3.50 \text{ rad/s}^2$ . If the angular speed of the wheel is  $2.00 \text{ rad/s}$  at  $t_i=0$ , through what angular displacement does the wheel rotate in  $1.00 \text{ s}$ ? (A)  $630^\circ$  (B)  $200^\circ$  (C)  $40^\circ$  (D)  $100^\circ$  (E)  $315^\circ$
10. A solid sphere and a hollow sphere have the same mass and radius. They are rotating with the same angular speed. Which one has the higher angular momentum (A) the solid sphere (B) the hollow sphere (D) both have the same (E) impossible to determine
11. An object attached to one end of spring makes 20 vibrations in 10 s. Its period is: (A) 10 Hz (B) 2 Hz (C) 0.5 Hz (D) 2 s (E) 0.5 s
12. In a stationary homogeneous liquid: (A) pressure depends on the direction (B) pressure is the same at all points (C) pressure is the same at all points at the same level (D) pressure is independent of any atmospheric pressure on the upper surface of the liquid (E) none of above
13. The displacement of a string is given by  $y(x, t) = y_m \sin(kx + \omega t)$ . The wavelength of the wave is: (A)  $\frac{2\pi k}{\omega}$  (B)  $\frac{k}{\omega}$  (C)  $\omega k$  (D)  $\frac{k}{2\pi}$  (E)  $\frac{2\pi}{k}$
14. A  $5.5 \times 10^{-8}\text{-C}$  charge is fixed at the origin. A  $-2.3 \times 10^{-8}\text{-C}$  charge is moved from  $x = 3.5 \text{ cm}$  on the  $x$  axis to  $y = 3.5 \text{ cm}$  on the  $y$  axis. The change in the potential energy of the two-charge system is: (A) 0 (B)  $3.2 \times 10^{-4} \text{ J}$  (C)  $-3.2 \times 10^{-4} \text{ J}$  (D)  $9.3 \times 10^3 \text{ J}$  (E)  $-9.3 \times 10^3 \text{ J}$

國立中山大學 104 學年度轉學考招生考試試題

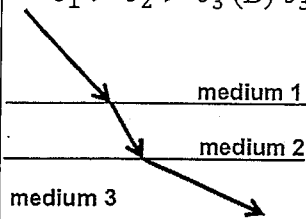
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題號：759002

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共 2 頁第 2 頁

15. If there are  $N$  identical capacitors connected first in series and then in parallel, the combined capacitance in parallel is 25 times larger than for the series connection.  $N=?$  (A) 10 (B) 5 (C) 20 (D) 100 (E) 15
16. A capacitor and a resistor are connected in series to a battery. At the end of 10 ms its charge is half the final value. The capacitor is about: (A)  $8.6 \mu F$  (B)  $12 \mu F$  (C)  $20 \mu F$  (D)  $5.2 \mu F$  (E)  $10 \mu F$
17. If  $\vec{j}$  is the current density and  $d\vec{A}$  is a vector element of area then the integral  $\int \vec{j} \cdot d\vec{A}$  over an area represents: (A) the electric flux through the area (B) the average current density at the position of the area (C) the resistance of the area (D) the conductance of the area (E) the current through the area
18. Which of the following describe the Gauss's law? (A)  $\oint \vec{B} \cdot d\vec{l} = \mu_0 I$  (B)  $\oint \vec{E} \cdot d\vec{l} = -\frac{\partial \Phi_B}{\partial t}$  (C)  $\oint \vec{E} \cdot d\vec{A} = \frac{\Sigma Q_{in}}{\epsilon_0}$  (D)  $\oint \vec{B} \cdot d\vec{A} = 0$  (E)  $\oint \vec{B} \cdot d\vec{l} = 0$
19. A long narrow solenoid has length  $l$  and a total of  $N$  turns, each of which has cross-sectional area  $A$ . Its inductance is: (A)  $\mu_0 N^2 A l$  (B)  $\mu_0 N^2 A / l$  (C)  $\mu_0 N A / l$  (D)  $\mu_0 N^2 l / A$  (E) none of these
20. A ray of light passes through three media as shown. The speed of light in these media obey: (A)  $v_1 > v_2 > v_3$  (B)  $v_3 > v_1 > v_2$  (C)  $v_3 > v_2 > v_1$  (D)  $v_2 > v_1 > v_3$  (E)  $v_1 > v_2 > v_3$ .



# 國立中山大學 104 學年度轉學考招生考試試題

科目名稱：微積分【海工系二年級】

題號：759003

※本科目依簡章規定「不可以」使用計算機(問答申論題)

共 1 頁第 1 頁

請寫題號並詳列計算及推導。

1. (a) Find  $f'(1)$ , where  $f(x) = \int_x^{2x} te^t dt$ . (10%)

(b) Find  $\lim_{x \rightarrow 0^+} x^2 e^{-x}$  if it exists. (10%)

2. (a) Evaluate

$$\int_0^1 \frac{1}{x^2 + 4x + 3} dx. \quad (10\%)$$

(b) Evaluate the integral  $\int_0^\infty te^{-2t} dt$ . (10%)

3. (a) Find all first-order and second-order partial derivatives of  $f(x, y) = e^{x/y}$ . (10%)

(b) Find the directional derivative of  $f(x, y) = x^2 + y^2 - 3$  at the point  $(1, 0)$  in the direction  $\langle 3, -4 \rangle$ . (10%)

(c) Find all relative extreme values of  $f(x, y) = x^2 + y^2 - 2x + 2y + 4$ . (10%)

4. (a) Let  $R = \{(x, y) | 0 \leq x \leq 1, 0 \leq y \leq 2\}$ . Evaluate the double integral  $\int_R x^2 y dA$ . (10%)

(b) Evaluate

$$\int_0^2 \int_0^{\sqrt{4-x^2}} \frac{\sqrt{x^2 + y^2}}{1 + x^2 + y^2} dy dx. \quad (10\%)$$

(c) Evaluate the line integral  $\int_C xy dt$ , where  $C$  is the curve  $x = t^2, y = e^t, 0 \leq t \leq 2$ . (10%)