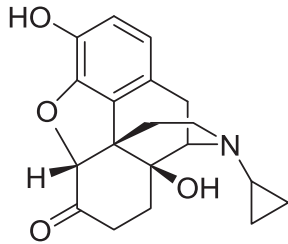


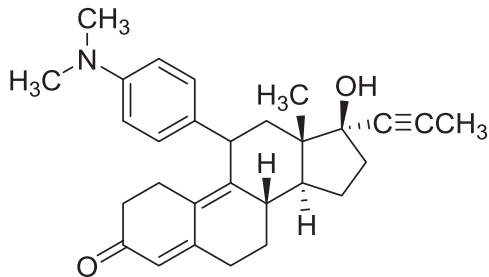


(C)22. What are the hybridization state and geometry of the nitrogen atom in the following chemical structure?



- (A)  $sp$  hybridized and linear geometry (B)  $sp^2$  hybridized and trigonal pyramidal  
 (C)  $sp^3$  hybridized and trigonal pyramidal (D)  $sp^3$  hybridized and trigonal planar  
 (E)  $sp^3$  hybridized and bent

(D)23. How many asymmetric carbons are presented in the compound below?



- (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

(A)24. The chemical compound “ethylenediaminetetraacetic acid, EDTA” is a chelating agent to coordinate several metallic ions, such as ferric, copper, and calcium ions. In the living organism, which amino acid is usually used as a chelating agent?

- (A) Cysteine (B) Glycine (C) Leucine  
 (D) Tryptophan (E) Proline

送分 25. Which one of the following molecules has a dipole moment but without polarity?

- (A)  $O_3$  (B)  $PH_3$  (C)  $NH_3$  (D)  $PCl_5$  (E)  $H_2O_2$

(C)26. Consider the following processes:



Calculate  $\Delta H$  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

(C)27. CdS can be described as cubic closest packed anions with the cations in tetrahedral holes. What fraction of the tetrahedral holes is occupied by the cations?

- (A) 0.125 (B) 0.25 (C) 0.50 (D) 0.75 (E) 1.0

(E) 28. For the reaction  $3A(g) + 2B(g) \rightarrow 2C(g) + 2D(g)$ , the following data was collected at constant temperature. Determine the correct rate law for this reaction.

Trial	Initial [A] (mol/L)	Initial [B] (mol/L)	Initial Rate (mol/(L·min))
1	0.200	0.100	$6.00 \times 10^{-2}$
2	0.100	0.100	$1.50 \times 10^{-2}$
3	0.200	0.200	$1.20 \times 10^{-1}$
4	0.300	0.200	$2.70 \times 10^{-1}$

- (A) Rate =  $k[A][B]$                       (B) Rate =  $k[A][B]^2$                       (C) Rate =  $k[A]^3[B]^2$   
 (D) Rate =  $k[A]^{1.5}[B]$                       (E) Rate =  $k[A]^2[B]$

(C) 29. What is the number of the half-lives required for a radioactive element to decay to about 6% of its original activity? (please choose the nearest number)

- (A) 2                      (B) 3                      (C) 4                      (D) 5                      (E) 6

(C) 30. Identify the element of Period 2 which has the following successive ionization energies, in kJ/mol.

IE <sub>1</sub> , 1314	IE <sub>2</sub> , 3389	IE <sub>3</sub> , 5298	IE <sub>4</sub> , 7471
IE <sub>5</sub> , 10992	IE <sub>6</sub> , 13329	IE <sub>7</sub> , 71345	IE <sub>8</sub> , 84087
(A) Li	(B) B	(C) O	
(D) Ne	(E) None of these		

**【單選題】** 每題 2 分，共計 120 分，答錯 1 題倒扣 0.5 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。31~60 題為物理，61~90 題為化學。

(E) 61. Select the answer with the correct number of decimal places for the following sum:

$$13.914 \text{ cm} + 243.1 \text{ cm} + 12.00460 \text{ cm} =$$

- (A) 269.01860 cm                      (B) 269.0186 cm                      (C) 269.019 cm  
 (D) 269.02 cm                      (E) 269.0 cm

(B) 62. Detection of radiation by a Geiger-Müller counter depends on \_\_\_\_\_.

- (A) the emission of a photon from an excited atom  
 (B) the ability of an ionized gas to carry an electrical current  
 (C) the emission of a photon of light by the radioactive particle  
 (D) the ability of a photomultiplier tube to amplify the electrical signal from a phosphor  
 (E) the detection of the sound made by decay particles

(B) 63. Please calculate the  $\Delta S$  if  $\Delta H_{\text{vap}}$  is 66.8 kJ/mol, and the boiling point is 83.4°C at 1 atm, when the substance is vaporized at 1 atm.

- (A) -187 J/K mol                      (B) 187 J/K mol                      (C) 801 J/K mol  
 (D) -801 J/K mol                      (E) 0

(C) 64. Which of the following values is based on the Third Law of Thermodynamics?

- (A)  $\Delta H^\circ_f = 0$  for Al(s) at 298 K  
 (B)  $\Delta G^\circ_f = 0$  for H<sub>2</sub>(g) at 298 K  
 (C)  $S^\circ = 51.446$  J/(mol·K) for Na(s) at 298 K  
 (D)  $q_{\text{sys}} < 0$  for H<sub>2</sub>O(l) → H<sub>2</sub>O(s) at 0°C  
 (E) None of these

(A) 65. What are the values of bond order belonging to O<sub>2</sub><sup>-</sup> and O<sub>2</sub><sup>+</sup>, respectively?

- (A) 1.5, 2.5      (B) 2.5, 1.5      (C) 2, 3      (D) 3, 2      (E) 2, 2

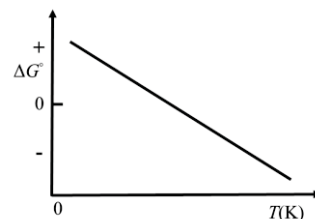
(B) 66. The lattice energy of NaI(s) is -686 kJ/mol, and its heat of solution is -7.6 kJ/mol. Calculate the hydration of energy of NaI(s) in kJ/mol.

- (A) -678      (B) -694      (C) +678      (D) +694      (E) +15.2

(A) 67. According to molecular orbital, which of the following molecules is diamagnetic?

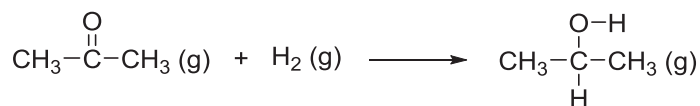
- (A) HF      (B) O<sub>2</sub>      (C) NO      (D) N<sub>2</sub><sup>+</sup>      (E) N<sub>2</sub><sup>-</sup>

(D) 68. Consider the figure, which shows  $\Delta G^\circ$  for a chemical process plotted against absolute temperature. Which of the following is an incorrect conclusion, based on the information in the diagram?



- (A)  $\Delta H^\circ > 0$   
 (B)  $\Delta S^\circ > 0$   
 (C) The reaction is spontaneous at high temperatures.  
 (D)  $\Delta S^\circ$  increases with temperature while  $\Delta H^\circ$  remains constant.  
 (E) There exists a certain temperature at which  $\Delta H^\circ = T\Delta S^\circ$ .

(C) 69. Acetone can be easily converted to isopropyl alcohol by addition of hydrogen to the carbon-oxygen double bond. Calculate the enthalpy of reaction using the bond energies given.



Bond:	C=O	H-H	C-H	O-H	C-C	C-O
Bond energy (kJ/mol):	745	436	414	464	347	351
(A) -484 kJ	(B) -366 kJ	(C) -48 kJ	(D) +48 kJ	(E) +366 kJ		

(D) 70. How many of the following molecules exhibit resonance: NO<sub>2</sub><sup>-</sup>, O<sub>3</sub>, OCl<sub>2</sub>, NF<sub>3</sub>, N<sub>2</sub>O, CCl<sub>4</sub>, CNO<sup>-</sup>, O<sub>2</sub>F<sub>2</sub>?

- (A) 1      (B) 2      (C) 3      (D) 4      (E) 5

(B) 71. One mole of X(g) and one mole of Y(g) are mixed in a closed reactor in the presence of catalysts, and Z(g) is generated. The reaction is  $aX + bY \rightarrow cZ$ , where  $a$ ,  $b$ , and  $c$  are the coefficients in the balanced equation. At a certain time, the mixture contains 1.8 moles of gases while the ratio of their partial pressures is  $P_X:P_Y:P_Z = 7:9:2$ . What are the values of  $a$ ,  $b$ , and  $c$ ?

- (A)  $a = 1, b = 2, c = 3$       (B)  $a = 3, b = 1, c = 2$       (C)  $a = 7, b = 9, c = 2$   
 (D)  $a = 3, b = 1, c = 8$       (E)  $a = 2, b = 9, c = 7$

(E) 72. Consider an adiabatic and reversible expansion process from state I to state II. Which of the following statements is true?

- (A)  $P_1V_1 = P_2V_2$   
 (B)  $T_1V_1^\gamma = T_2V_2^\gamma, \gamma = C_p/C_v$   
 (C) The final temperature will be higher than the initial temperature.  
 (D) The final volume of the gas is much greater than the expansion were carried out isothermally.  
 (E) The work delivered to the surrounding is much smaller than the expansion were carried out isothermally.

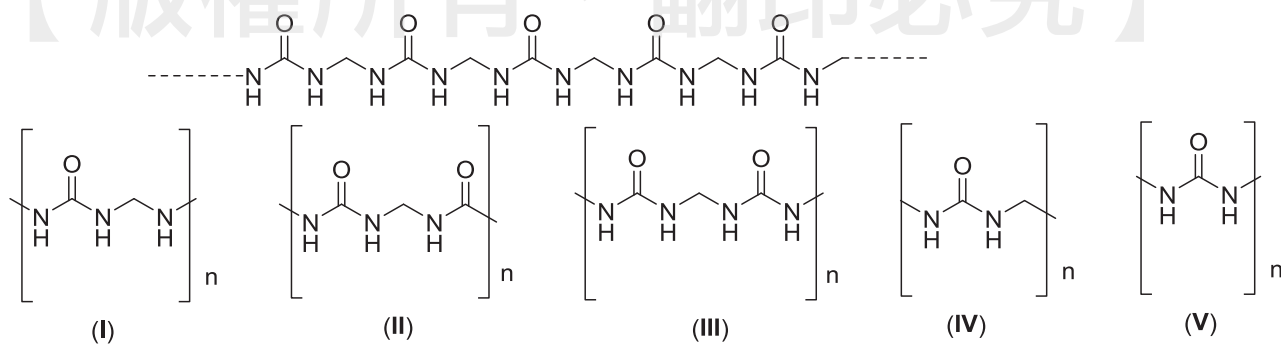
(E) 73. When a 1.00 mL of the  $3.55 \times 10^{-4}$  M solution of organic acid is diluted with 9.00 mL of ether, forming solution A and then 2.00 mL of the solution A is diluted with 8.00 mL of ether, forming solution B. What is the concentration of solution B?

- (A)  $3.55 \times 10^{-6}$  M      (B)  $9.86 \times 10^{-6}$  M      (C)  $7.10 \times 10^{-5}$  M  
 (D)  $7.89 \times 10^{-5}$  M      (E)  $7.10 \times 10^{-6}$  M

(E) 74. What is the volume of  $O_2(g)$  generated when 22.4 g of  $KClO_3$  is decomposed at  $153^\circ C$  under 0.820 atm? ( $KClO_3$ : 122.55 g/mol)

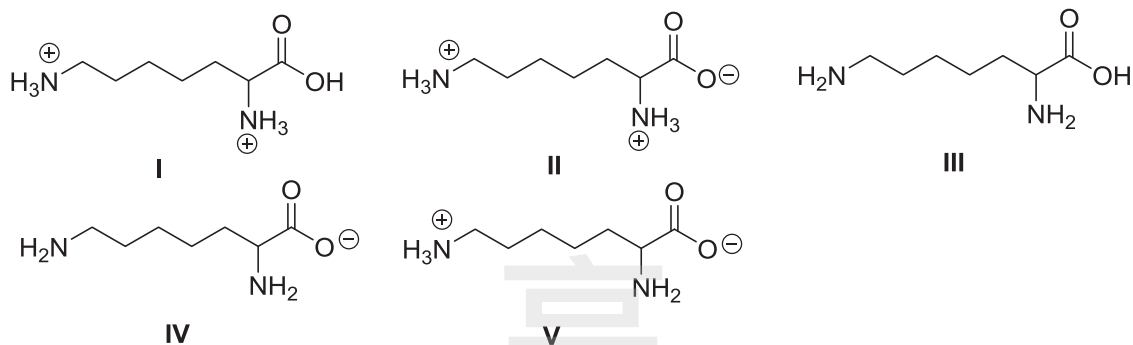
- (A) 0.09 L      (B) 3.00 L      (C) 4.20 L      (D) 7.79 L      (E) 11.7 L

(D) 75. What is the appropriate representation of the repeating unit of the following polymer?



- (A) I      (B) II      (C) III      (D) IV      (E) V

(D) 76. Which of the following structures is the major form of the lysine at the pH = 14?



- (A) I                      (B) II                      (C) III                      (D) IV                      (E) V

(E) 77. Which of the followings is a correct set of quantum numbers for an electron in a  $3d$  orbital?

- (A)  $n = 3, l = 0, m_l = -1$                       (B)  $n = 3, l = 1, m_l = 3$                       (C)  $n = 3, l = 2, m_l = 3$   
 (D)  $n = 3, l = 3, m_l = 2$                       (E)  $n = 3, l = 2, m_l = -2$

(D) 78. Which of the following complexes will absorb visible radiation of the shortest wavelength?

- (A)  $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$                       (B)  $[\text{Co}(\text{I})_6]^{3-}$                       (C)  $[\text{Co}(\text{OH})_6]^{3-}$   
 (D)  $[\text{Co}(\text{en})_3]^{3+}$                       (E)  $[\text{Co}(\text{NH}_3)_6]^{3+}$

(C) 79. Please choose the most stable cation?



- (A) I                      (B) II                      (C) III                      (D) IV                      (E) V

(E) 80. Which of the following statements about “The Bohr Model” and “Particle in a Box” is TRUE?

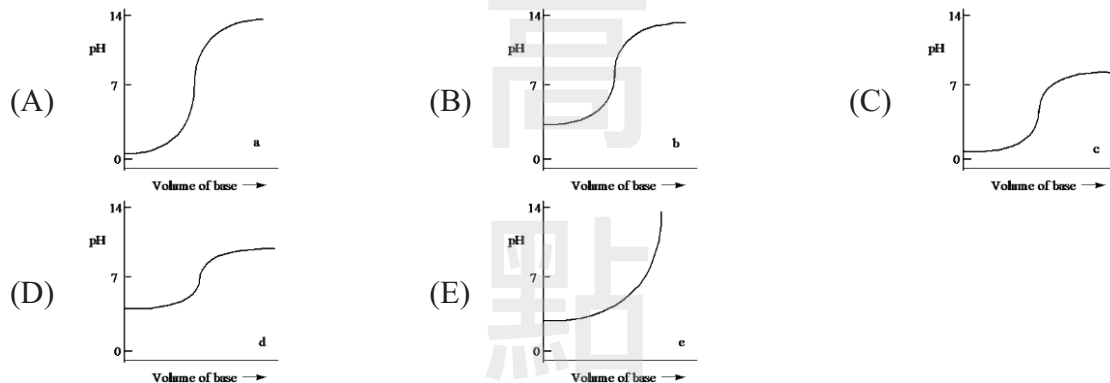
- (A) For an electron trapped in a one-dimensional box, as the length of the box increases, the spacing between energy levels will increase.  
 (B) The total probability of finding a particle in a one-dimensional box (length is  $L$ ) in energy level  $n = 4$  between  $x = L/4$  and  $x = L/2$  is 50%.  
 (C) If the wavelength of light necessary to promote an electron from the ground state to the first excited state is  $\lambda$  in a one-dimensional box, then the wavelength of light necessary to promote an electron from the first excited state to the third excited state will be  $3\lambda$ .  
 (D) A function of the type  $A \cos(Lx)$  can be an appropriate solution for the particle in a one-dimensional box.  
 (E) Assume that a hydrogen atom’s electron has been excited to the  $n = 5$  level. When this excited atom loses energy, 10 different wavelengths of light can be emitted.

- (A) 81. Which of the following statements concerning a face-centered cubic unit cell and the corresponding lattice, made up of identical atoms, is incorrect?
- (A) The coordination number of the atoms in the lattice is 8.  
 (B) The packing in this lattice is more efficient than for a body-centered cubic system.  
 (C) If the atoms have radius  $r$ , then the length of the cube edge is  $\sqrt{8} \times r$ .  
 (D) There are four atoms per unit cell in this type of packing.  
 (E) The packing efficiency in this lattice and hexagonal close packing are the same.
- (A) 82. Which of the followings will give a solution with a pH > 7, but is not an Arrhenius base in the strict sense?
- (A)  $\text{CH}_3\text{NH}_2$     (B)  $\text{NaOH}$     (C)  $\text{CO}_2$     (D)  $\text{Ca(OH)}_2$     (E)  $\text{CH}_4$
- (D) 83. Pentane,  $\text{C}_5\text{H}_{12}$ , boils at  $35^\circ\text{C}$ . Which of the followings is true about kinetic energy,  $E_k$ , and potential energy,  $E_p$ , when liquid pentane at  $35^\circ\text{C}$  is compared with pentane vapor at  $35^\circ\text{C}$ ?
- (A)  $E_k(g) < E_k(l); E_p(g) \approx E_p(l)$     (B)  $E_k(g) > E_k(l); E_p(g) \approx E_p(l)$   
 (C)  $E_p(g) < E_p(l); E_k(g) \approx E_k(l)$     (D)  $E_p(g) > E_p(l); E_k(g) \approx E_k(l)$   
 (E)  $E_p(g) \approx E_p(l); E_k(g) \approx E_k(l)$
- (C) 84. Five molecules are shown as below. Which one has the highest ionic strength?
- (A)  $\text{B(OH)}_3$     (B)  $\text{HNO}_3$     (C)  $\text{Na}_2\text{HPO}_4$     (D)  $\text{CaCO}_3$     (E)  $\text{BaSO}_4$
- (B) 85. Hydroxylamine nitrate contains 29.17 mass % N, 4.20 mass % H, and 66.63 mass % O. Determine its empirical formula.
- (A)  $\text{HNO}$     (B)  $\text{H}_2\text{NO}_2$     (C)  $\text{HN}_6\text{O}_{16}$     (D)  $\text{HN}_{16}\text{O}_7$     (E)  $\text{H}_2\text{NO}_3$
- (B) 86. Given the following two standard reduction potentials,
- $$\text{Fe}^{3+} + 3 \text{e}^- \rightarrow \text{Fe} \quad E^\circ = -0.036 \text{ V}$$
- $$\text{Fe}^{2+} + 2 \text{e}^- \rightarrow \text{Fe} \quad E^\circ = -0.44 \text{ V}$$
- determine for the standard reduction potential of the half-reaction
- $$\text{Fe}^{3+} + \text{e}^- \rightarrow \text{Fe}^{2+}$$
- (A) 0.40 V    (B) 0.77 V    (C) -0.40 V    (D) -0.11 V    (E) 0.11 V
- (B) 87. The rate law for a reaction is found to be  $\text{Rate} = k[\text{A}]^2[\text{B}]$ . Which of the following mechanisms gives this rate law?
- I.  $\text{A} + \text{B} \rightleftharpoons \text{E}$  (fast)    II.  $\text{A} + \text{B} \rightleftharpoons \text{E}$  (fast)    III.  $\text{A} + \text{A} \rightarrow \text{E}$  (slow)  
 $\text{E} + \text{B} \rightarrow \text{C} + \text{D}$  (slow)     $\text{E} + \text{A} \rightarrow \text{C} + \text{D}$  (slow)     $\text{E} + \text{B} \rightarrow \text{C} + \text{D}$  (fast)
- (A) I    (B) II    (C) III    (D) I & II    (E) II & III

(A) 88. When the redox reaction in basic solution:  $\text{NO}_2^-(aq) + \text{Al}(s) \rightarrow \text{NH}_3(aq) + \text{AlO}_2^-(aq)$  is balanced using the smallest whole-number coefficients, the coefficient of  $\text{H}_2\text{O}$  is  $x$  and the sum of all coefficients is  $y$ . What is the sum of  $x$  and  $y$ ,  $(x + y)$ ?

- (A) 9                      (B) 10                      (C) 11                      (D) 12                      (E) 13

(B) 89. Which of the followings is the best representation of the titration curve which will be obtained in the titration of a weak acid ( $0.10 \text{ mol L}^{-1}$ ) with a strong base of the same concentration?



(A) 90. The students used salicylic acid and acetic anhydride to synthesize aspirin in the experiment of “The Preparation of Aspirin”. The chemical reaction is shown as below:

Which compound will react with  $\text{FeCl}_3$  to become a purple complex?

- (A) Salicylic acid                      (B) Acetic anhydride                      (C) Aspirin  
(D) Acetic acid                      (E) 18 M sulfuric acid

【版權所有，翻印必究】



## 化 學

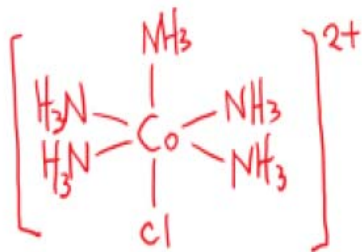
梁傑(梁家榮)老師提供

解析

16. For the process  $\text{Co}(\text{NH}_3)_5\text{Cl}^{2+} + \text{Cl}^- \rightarrow \text{Co}(\text{NH}_3)_4\text{Cl}_2^+ + \text{NH}_3$ , what would be the ratio of *cis* to *trans* isomers in the product?

B

- (A) 1:1      (B) 4:1      (C) 2:1      (D) 1:4      (E) 1:2



起始物結構上有 4 個  $\text{NH}_3$  與  $\text{Cl}$  為 *cis* 關係

起始物結構上只有 1 個  $\text{NH}_3$  與  $\text{Cl}$  為 *trans* 關係

因此當第二個  $\text{Cl}$  取代其中一個  $\text{NH}_3$  時，順式與反式的比例為：4 : 1

普化正課講義, ch6, page 6-132

- 注意：發生取代反應後的立體異構物比例計算

For the process  $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+} + \text{Cl}^- \rightarrow [\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+ + \text{NH}_3$  what would be the ration of *cis* to *trans* isomer in the product?

- (A) 1 : 1      (B) 1 : 2      (C) 1 : 4      (D) 4 : 1      (E) 2 : 1      ANS:D

17. Which of the solvents shown below could best dissolve  $\text{KBr}$ ?

- (A)  $\text{C}_6\text{H}_{14}$  (hexane)      (B)  $\text{CH}_3\text{CH}_2\text{OH}$  (ethanol)  
 (C)  $\text{C}_6\text{H}_6$  (benzene)      (D)  $\text{CCl}_4$  (carbon tetrachloride)  
 (E)  $\text{C}_6\text{H}_{12}$  (cyclohexane)

B

Like dissolve like

$\text{KBr}$ 最能夠溶解於極性最高的  $\text{CH}_3\text{CH}_2\text{OH}$  當中

普化正課講義, ch9, page 9-66

私醫90(18)考過類似考題

- 注意(1)：極性溶質喜歡溶於極性溶劑

18. 下列哪種溶劑對於  $\text{KI}$  (potassium iodide)的溶解度最好？

- (A) 苯(benzene) (B) 戊烷(pentane) (C) 環己烷(cyclohexane) (D) 乙醇(ethanol)      私醫 90(18)D

18. Which of the following options best describes the relationship between the following two compounds?



- (A) Constitutional isomers  
 (B) Stereoisomers  
 (C) Identical  
 (D) Not isomers, different compounds entirely.  
 (E) Conformers

19. Please calculate the specific heat capacity of a metal if 15.0 g of it requires 169.6 J to change the temperature from 25.00°C to 32.00°C?

- D (A) 0.619 J/g°C (B) 11.3 J/g°C  
 (C) 24.2 J/g°C (D) 1.62 J/g°C  
 (E) 275 J/g°C

$$\Delta H = m \times S \times \Delta T \Rightarrow 169.6 = 15 \times S \times (32 - 25)$$

$$\Rightarrow S = 1.62 \text{ J/g}^\circ\text{C}$$

普化正課講義, ch10, page 10-21

(b) 物質的熱容量(heat capacity, C)的定義為：

物質的熱容量(heat capacity, C)定義為： $C = \frac{\text{heat absorbed}}{\text{increase in temperature}}$

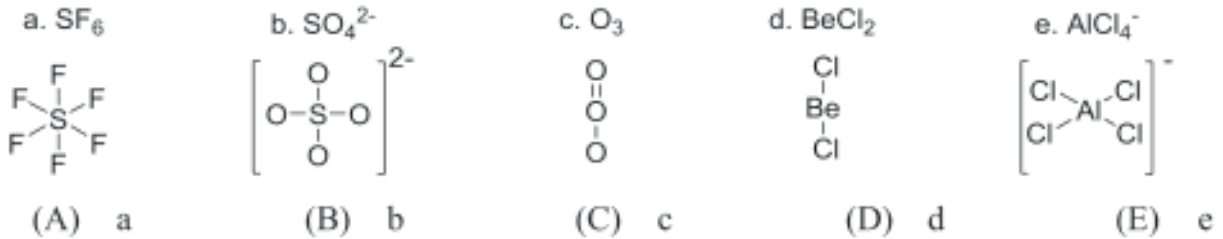
specific heat capacity	molar heat capacity
the energy required to raise the temperature of 1 g of a substance by 1°C	the energy required to raise the temperature of 1 mol of a substance by 1°C
單位： $\frac{\text{J}}{\text{K} \cdot \text{g}}$ or $\frac{\text{J}}{^\circ\text{C} \cdot \text{g}}$	單位： $\frac{\text{J}}{\text{K} \cdot \text{mol}}$ or $\frac{\text{J}}{^\circ\text{C} \cdot \text{mol}}$

物質吸收或釋放的熱與其溫度變化的關係： $\Delta H = q_p = m \times S \times \Delta T$  (題目提供比熱)

$\Delta H = q_p = n \times \bar{C} \times \Delta T$  (題目提供莫耳熱容量)

20. Which of the following structures contains the central atom which has a formal charge of +2?

B



a: 0    b: +2    c: +1    d: 0    e: -1

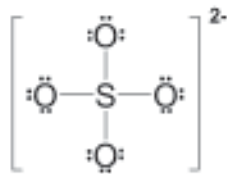
普化先修, ch0, page 0-45

很多的分子和多電子離子常有不同路易士結構(Lewis structure)形式

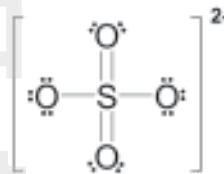
此時化學家會利用型式電符或八隅律的幫助來判定何種結構式為最接近真實情況的表示方式

Case 03: 硫酸根(SO<sub>4</sub><sup>2-</sup>)的結構

可能一:



可能二:



①有些化學家認為原子在分子或離子中，會趨向擁有最少形式電符者

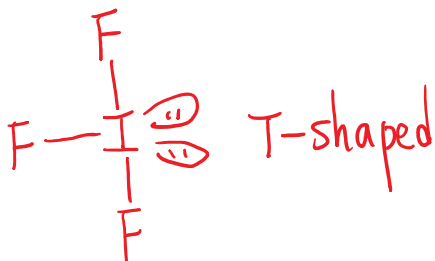
此學派認為EN較大原子的電子會傾向分配給帶正價電符之EN較小之原子，以利其平衡使其各原子皆具有最小的形式電符

②另一派化學家認為應該優先滿足八隅律才比較穩定

21. What is the molecular shape of IF<sub>3</sub> using the VSEPR theory?

- (A) Trigonal bipyramidal    (B) See-saw    (C) T-shaped  
(D) Linear    (E) Square pyramidal

C



普化分章, page 6-34



重點

中心原子有5組電子雲 (其中包含2組lone pair) : T-Shape

(註: 有機chap 0 + 普化chap 06)

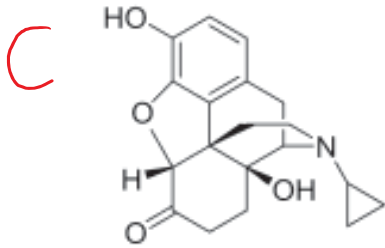
◎ 依據VSEPR理論，下列何分子之形狀為T形？

- (A) NH<sub>3</sub>    (B) ClF<sub>3</sub>    (C) SO<sub>2</sub>    (D) AlCl<sub>3</sub>

中國 90 (3)

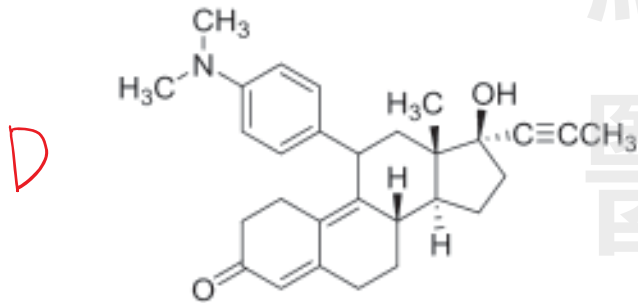
答案: (B)

22. What are the hybridization state and geometry of the nitrogen atom in the following chemical structure?

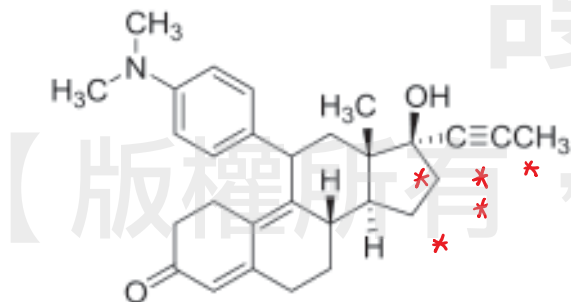


- (A)  $sp$  hybridized and linear geometry (B)  $sp^2$  hybridized and trigonal pyramidal  
 (C)  $sp^3$  hybridized and trigonal pyramidal (D)  $sp^3$  hybridized and trigonal planar  
 (E)  $sp^3$  hybridized and bent

23. How many asymmetric carbons are presented in the compound below?



- (A) 2 (B) 3 (C) 4 (D) 5 (E) 6



普化正課, ch16, page 16-44

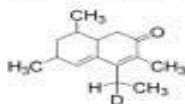
題型(3): 結構上掌性中心的數量

15. 2-異丙基-5-甲基-環己醇有幾個不對稱中心?

- (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

中國內科 99(15)B

33. 下列化合物有幾個對掌中心(chiral centers)?



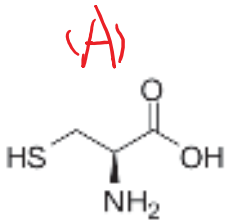
- (A) 4 (B) 5 (C) 6 (D) 7

秘醫 107(33)A

24. The chemical compound "ethylenediaminetetraacetic acid, EDTA" is a chelating agent to coordinate several metallic ions, such as ferric, copper, and calcium ions. In the living organism, which amino acid is usually used as a chelating agent?

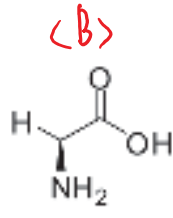
A

- (A) Cysteine (B) Glycine (C) Leucine  
(D) Tryptophan (E) Proline

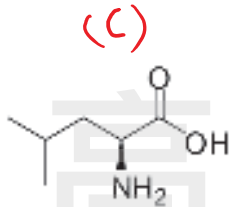


cysteine

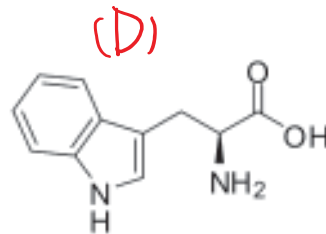
結構上的SH  
可與金屬陽離子作用



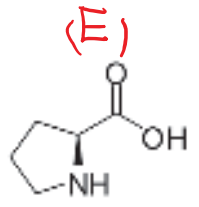
glycine



leucine



tryptophan



proline

25. Which one of the following molecules has a dipole moment but without polarity?

D

- (A) O<sub>3</sub> (B) PH<sub>3</sub> (C) NH<sub>3</sub> (D) PCl<sub>5</sub> (E) H<sub>2</sub>O<sub>2</sub>

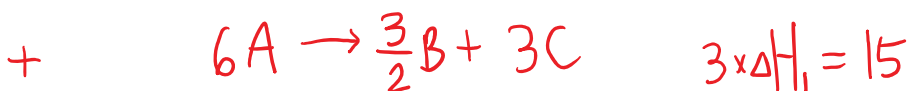
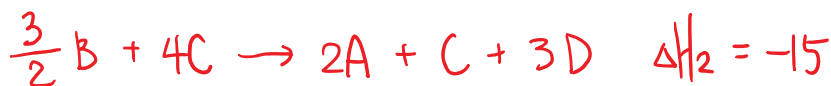
題目應該寫 has a "bond" dipole moment but without polarity 才對

26. Consider the following processes:



Calculate  $\Delta H$  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



27. CdS can be described as cubic closest packed anions with the cations in tetrahedral holes. What fraction of the tetrahedral holes is occupied by the cations?
- C (A) 0.125 (B) 0.25 (C) 0.50 (D) 0.75 (E) 1.0

anion 以 ccp 方式排列，則單位晶格中含有 4 個  $S^{2-}$

由於 CdS 陽離子和陰離子數量比為 1:1，因此 CdS 單位晶格中也含有 4 個  $Cd^{2+}$  而 ccp 晶格含有 8 個 Td hole，因此只有 50% 的 Td hole 填入陽離子

28. For the reaction  $3A(g) + 2B(g) \rightarrow 2C(g) + 2D(g)$ , the following data was collected at constant temperature. Determine the correct rate law for this reaction.

Trial	Initial [A] (mol/L)	Initial [B] (mol/L)	Initial Rate (mol/(L·min))
1	0.200	0.100	$6.00 \times 10^{-2}$
2	0.100	0.100	$1.50 \times 10^{-2}$
3	0.200	0.200	$1.20 \times 10^{-1}$
4	0.300	0.200	$2.70 \times 10^{-1}$

E (A) Rate =  $k[A][B]$  (B) Rate =  $k[A][B]^2$  (C) Rate =  $k[A]^3[B]^2$   
 (D) Rate =  $k[A]^{1.5}[B]$  (E) Rate =  $k[A]^2[B]$

依照題目所給數據可看出: Rate =  $k[A]^2[B]$

【版權所有，翻印必究】

29. What is the number of the half-lives required for a radioactive element to decay to about 6% of its original activity? (please choose the nearest number)
- C (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

$$\ln\left(\frac{100}{6}\right) = k \times t = \frac{0.693}{t_{1/2}} \times t \Rightarrow t = \frac{\ln\left(\frac{100}{6}\right)}{0.693} \times t_{1/2} = 4 \times t_{1/2}$$



62. Detection of radiation by a Geiger-Müller counter depends on \_\_\_\_\_.

- B
- (A) the emission of a photon from an excited atom
  - (B) the ability of an ionized gas to carry an electrical current
  - (C) the emission of a photon of light by the radioactive particle
  - (D) the ability of a photomultiplier tube to amplify the electrical signal from a phosphor
  - (E) the detection of the sound made by decay particles

蓋革計數器利用輻射粒子使儀器內填充之氣體產生游離現象所伴隨的氣體放電，產生電流信號，可用來測量輻射粒子的數量

普化分章, page 15-26



◎ 下列何種儀器可以測量輻射粒子？

- (A) 電流計 (B) 蓋革計數器(Geiger counter) (C) 酸鹼檢測儀 (D) 電壓計

私醫 104 (3)

答案：(B)

63. Please calculate the  $\Delta S$  if  $\Delta H_{\text{vap}}$  is 66.8 kJ/mol, and the boiling point is 83.4°C at 1 atm, when the substance is vaporized at 1 atm.

- B
- (A) -187 J/K mol
  - (B) 187 J/K mol
  - (C) 801 J/K mol
  - (D) -801 J/K mol
  - (E) 0

$$\Delta S_{\text{vap}} = \frac{\Delta H_{\text{vap}}}{T_b} = \frac{66.8 \times 10^3}{(273 + 83.4)} = 187.4 \text{ J/K}\cdot\text{mol}$$

64. Which of the following values is based on the Third Law of Thermodynamics?

- C
- (A)  $\Delta H_f^\circ = 0$  for Al(s) at 298 K
  - (B)  $\Delta G_f^\circ = 0$  for H<sub>2</sub>(g) at 298 K
  - (C)  $S^\circ = 51.446 \text{ J}/(\text{mol}\cdot\text{K})$  for Na(s) at 298 K
  - (D)  $q_{\text{sys}} < 0$  for H<sub>2</sub>O(l) → H<sub>2</sub>O(s) at 0°C
  - (E) None of these

由於 0 K 的完美單晶之 entropy 為零，才能得到 Na 在 298 K 時的絕對熵



普化總複習, page 10-5, TCUS107A(22)考過一樣的題目

22. Which of the following values is based on the Third Law of Thermodynamics?

- A.  $\Delta H_f^\circ = 0$  for Al(s) at 298 K
- B.  $\Delta G_f^\circ = 0$  for H<sub>2</sub>(g) at 298 K
- C.  $S^\circ = 51.446$  J/(mol·K) for Na(s) at 298 K
- D.  $q_{sys} < 0$  for H<sub>2</sub>O(l) → H<sub>2</sub>O(s) at 0°C
- E. None of these choices is correct.

TCUS107A(22)

65. What are the values of bond order belonging to O<sub>2</sub><sup>-</sup> and O<sub>2</sub><sup>+</sup>, respectively?

- (A) 1.5, 2.5      (B) 2.5, 1.5      (C) 2, 3      (D) 3, 2      (E) 2, 2

A

	O <sub>2</sub> <sup>+</sup>	O <sub>2</sub>	O <sub>2</sub> <sup>-</sup>
价电子总数	11	12	13
键级	2.5	2	1.5

普化正課, ch6, page 6-96

3. 某一雙原子分子的電子組態為  $(\sigma_{1s})(\sigma_{1s}^*)(\sigma_{2s})(\sigma_{2s}^*)(\pi_{2p})^2$ , 該雙原子間的鍵級為何?

- (A) 1.5      (B) 1.0      (C) 0.5      (D) 2.0

慈濟 107(3)D

13. 當氧氣分子失去一個電子形成 O<sub>2</sub><sup>+</sup>時, 其化學鍵的鍵級(bond order)為多少?

- (A) 1      (B) 1.5      (C) 2      (D) 2.5      (E) 3

中醫 109(13)D

2. 氧氣分子經氧化還原後的鍵級(bond order)等於 2.5, 其價數可能為

- (A) -2      (B) -1      (C) +1      (D) +2

義守 109(2)C

66. The lattice energy of NaI(s) is -686 kJ/mol, and its heat of solution is -7.6 kJ/mol. Calculate the hydration of energy of NaI(s) in kJ/mol.

B

- (A) -678      (B) -694      (C) +678      (D) +694      (E) +15.2

$$\Delta H_{\text{soln}} = \Delta H_{\text{LE}} + \Delta H_{\text{hyd}}$$

$$-7.6 = (+686) + \Delta H_{\text{hyd}} \Rightarrow \Delta H_{\text{hyd}} = -693.6 \text{ kJ/mol}$$

## 普化正課, ch9, page 9-83

練習：溶解焓的計算(1)

The lattice energy of NaI is  $-686$  kJ/mol, and the enthalpy of hydration is  $-694$  kJ/mol. Calculate the enthalpy of solution per mole of solid NaI. Describe the process to which this enthalpy change applies.

Ans:  $-8$  kJ/mol

67. According to molecular orbital, which of the following molecules is diamagnetic?

- A (A) HF (B) O<sub>2</sub> (C) NO (D) N<sub>2</sub><sup>+</sup> (E) N<sub>2</sub><sup>-</sup>

O<sub>2</sub> 是常考的順磁分子NO、N<sub>2</sub><sup>+</sup>、N<sub>2</sub><sup>-</sup> 擁有奇數價電子，必定是順磁分子

答案選(A)

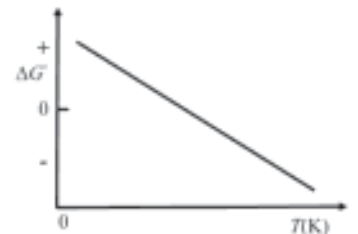
普化正課, ch6, page 6-100 · 中國107(8)考過類似考題

8. 下列分子中，幾個具有順磁性 (paramagnetism)? →代碼:【ta2xc】

- (a) N<sub>2</sub> (b) O<sub>2</sub> (c) CO (d) F<sub>2</sub> (e) C<sub>2</sub><sup>2+</sup> (f) O<sub>2</sub><sup>2+</sup> (g) NO<sup>+</sup> (h) B<sub>2</sub><sup>2+</sup> (i) HF (j) NO<sup>-</sup>  
 (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

中國 107(8)A

68. Consider the figure, which shows  $\Delta G^\circ$  for a chemical process plotted against absolute temperature. Which of the following is an incorrect conclusion, based on the information in the diagram?



- D (A)  $\Delta H^\circ > 0$   
 (B)  $\Delta S^\circ > 0$   
 (C) The reaction is spontaneous at high temperatures.  
 (D)  $\Delta S^\circ$  increases with temperature while  $\Delta H^\circ$  remains constant.  
 (E) There exists a certain temperature at which  $\Delta H^\circ = T\Delta S^\circ$ .

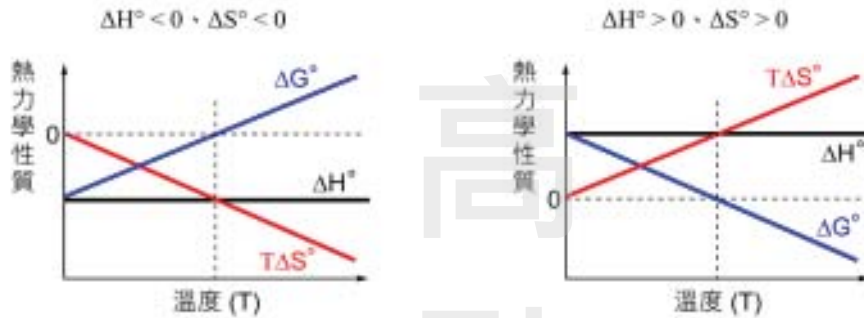
由圖可看出當  $T=0$  時， $\Delta G^\circ = \Delta H^\circ > 0$ ，(A)正確當溫度升高， $\Delta G^\circ$  變小，表示  $\Delta S^\circ > 0$ ，且高溫有利於自發，(B)、(C)正確某特定溫度下， $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ = 0$ ，此時  $\Delta H^\circ = T\Delta S^\circ$ ，(E)正確由此圖看不出  $\Delta S^\circ$  會隨溫度變化，(D)錯誤

普化正課, ch11, page 11-45

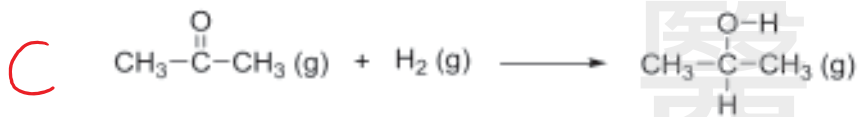
11.7A 溫度影響自由能的討論

反應物和產物的 H 和 S 都是溫度的函數，因此當溫度改變時，H 和 S 也會跟著改變，但 H 和 S 受溫度改變而改變的數值通常不大，因此我們都假設  $\Delta H^\circ$  和  $\Delta S^\circ$  不受溫度影響。

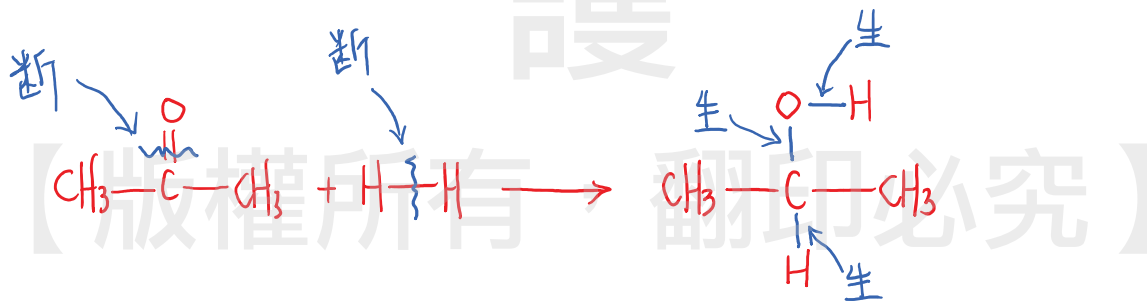
但是  $\Delta G^\circ$  就不同了， $\Delta G^\circ$  受溫度的影響極大，當溫度改變時， $\Delta G^\circ$  也會有很大改變：



69. Acetone can be easily converted to isopropyl alcohol by addition of hydrogen to the carbon-oxygen double bond. Calculate the enthalpy of reaction using the bond energies given.



Bond:	C=O	H-H	C-H	O-H	C-C	C-O
Bond energy (kJ/mol):	745	436	414	464	347	351
(A) -484 kJ	(B) -366 kJ	(C) -48 kkJ	(D) +48 kkJ	(E) +366 kkJ		



$$\Delta H = (+745) + (+436) + (-414) + (-351) + (-464) = -48$$

普化分章, ch10, page 10-36, 私醫104(23)考過一樣的考題

11. 丙酮經由加氫反應形成異丙醇，其反應式如下：

CC(=O)C + H2(g) -> CC(O)C

以下列鍵能計算該反應的反應熱(enthalpy)。

鍵結:	C=O	H-H	C-H	O-H	C-O
鍵能(kJ/mol):	745	436	414	464	351
(A) -366 kJ	(B) -48 kJ	(C) +48 kJ	(D) +366 kJ		

私醫 104 (23) 答案: (B)

70. How many of the following molecules exhibit resonance:  $\text{NO}_2^-$ ,  $\text{O}_3$ ,  $\text{OCl}_2$ ,  $\text{NF}_3$ ,  $\text{N}_2\text{O}$ ,  $\text{CCl}_4$ ,  $\text{CNO}^-$ ,  $\text{O}_2\text{F}_2$ ?

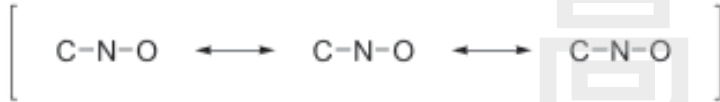
- D (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

可畫共振的分子:  $\text{NO}_2^-$ ,  $\text{O}_3$ ,  $\text{N}_2\text{O}$ ,  $\text{CNO}^-$

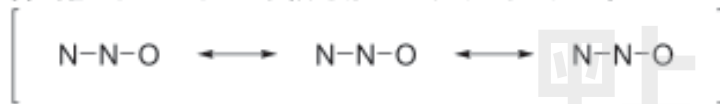
普化正課, ch6, page 6-41

練習:

(a) 請畫出最佳的  $\text{CNO}^-$  結構 (負電優先出現在高陰電性原子上)



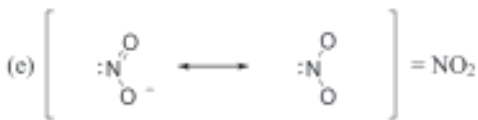
(c) 請畫出最佳的  $\text{N}_2\text{O}$  結構 (負電優先出現在高陰電性原子上)



普化正課, ch6, page 6-39



臭氧共有 \_\_\_\_\_ 個共振式  
OO 鍵的鍵級(bond order)為 \_\_\_\_\_



亞硝酸根共有 \_\_\_\_\_ 個共振式  
NO 鍵的鍵級(bond order)為 \_\_\_\_\_

71. One mole of  $\text{X}(\text{g})$  and one mole of  $\text{Y}(\text{g})$  are mixed in a closed reactor in the presence of catalysts, and  $\text{Z}(\text{g})$  is generated. The reaction is  $a\text{X} + b\text{Y} \rightarrow c\text{Z}$ , where  $a$ ,  $b$ , and  $c$  are the coefficients in the balanced equation. At a certain time, the mixture contains 1.8 moles of gases while the ratio of their partial pressures is  $P_X:P_Y:P_Z = 7:9:2$ . What are the values of  $a$ ,  $b$ , and  $c$ ?

- B (A)  $a=1, b=2, c=3$  (B)  $a=3, b=1, c=2$  (C)  $a=7, b=9, c=2$   
(D)  $a=3, b=1, c=8$  (E)  $a=2, b=9, c=7$

$$\left. \begin{array}{l} P_X = P_Y = P_Z = 7:9:2 \\ n_X + n_Y + n_Z = 1.8 \text{ mol} \end{array} \right\} n_X = 0.7, n_Y = 0.9, n_Z = 0.2$$

$$\left. \begin{array}{l} aX + bY \rightarrow cZ \\ \text{I: } 1 \quad 1 \quad 0 \\ \text{C: } -3 \cdot 0.1 \quad -1 \cdot 0.1 \quad +2 \cdot 0.1 \\ \hline \text{E: } 0.7 \quad 0.9 \quad 0.2 \end{array} \right\} a=3, b=1, c=2$$

72. Consider an adiabatic and reversible expansion process from state I to state II. Which of the following statements is true?

- E
- (A)  $P_1V_1 = P_2V_2$
  - (B)  $T_1V_1^\gamma = T_2V_2^\gamma$ ,  $\gamma = C_p/C_v$
  - (C) The final temperature will be higher than the initial temperature.
  - (D) The final volume of the gas is much greater than the expansion were carried out isothermally.
  - (E) The work delivered to the surrounding is much smaller than the expansion were carried out isothermally.

絕熱可逆過程的壓力與體積之關係為:  $P_1V_1^\gamma = P_2V_2^\gamma$ , (A)錯誤

絕熱可逆過程的溫度與體積之關係為:  $T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$ , (B)錯誤

絕熱可逆膨脹, 系統要消耗自己的內能來對外界做功

因此末狀態的溫度較低, 體積相對較小, (C)、(D)錯誤

由於絕熱可逆膨脹過程達到的末狀態體積相對較小, 因此對環境做的功也相對較小, (E)正確

73. When a 1.00 mL of the  $3.55 \times 10^{-4}$  M solution of organic acid is diluted with 9.00 mL of ether, forming solution A and then 2.00 mL of the solution A is diluted with 8.00 mL of ether, forming solution B. What is the concentration of solution B?

- E
- (A)  $3.55 \times 10^{-6}$  M
  - (B)  $9.86 \times 10^{-6}$  M
  - (C)  $7.10 \times 10^{-5}$  M
  - (D)  $7.89 \times 10^{-5}$  M
  - (E)  $7.10 \times 10^{-6}$  M

$$C_M = \frac{\left(3.55 \times 10^{-4} \frac{\text{mol}}{\text{L}} \times \frac{1}{1000} \text{L}\right) \times \frac{2 \text{ mL}}{(9+1) \text{ mL}}}{\left[\frac{(8+2)}{1000} \text{L}\right]} = 7.1 \times 10^{-6} \text{ M}$$

普化正課, ch4, page 4-32

練習: 溶液稀釋和混合的綜合性考題

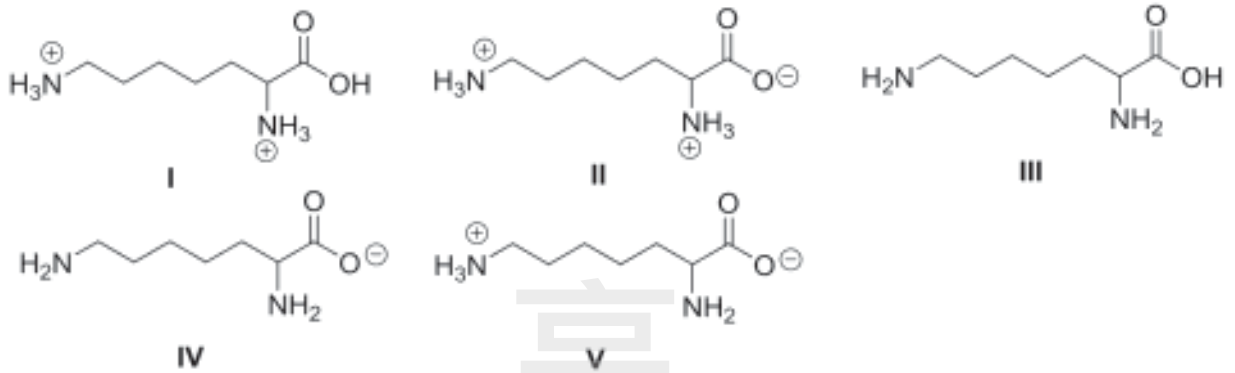
將濃度 2 M 溶液一瓶, 倒去半瓶再用水加滿, 拌勻後再倒去 3/4 瓶, 然後再以 3 M 溶液加滿, 則最後濃度為 \_\_\_。

- (A) 1 M
- (B)  $\frac{5}{2}$  M
- (C)  $\frac{2}{3}$  M
- (D)  $\frac{1}{2}$  M

Ans: B



76. Which of the following structures is the major form of the lysine at the pH = 14?

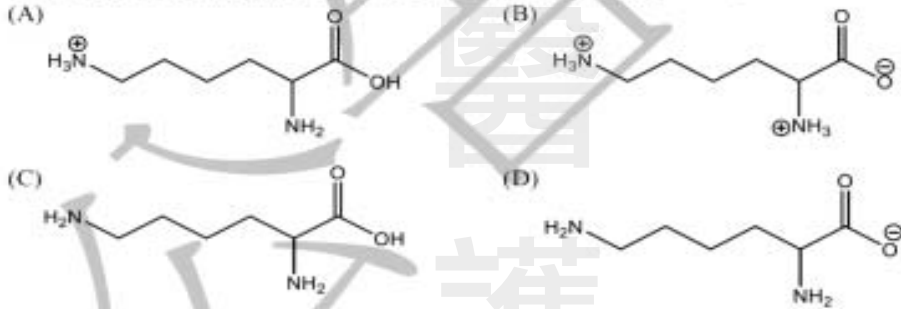


- (A) I (B) II (C) III (D) IV (E) V

當 pH = 14 時，此時的 pH 都遠大於 lysine 的 pKa  
 因此 lysine 能展現酸性的部分都會以解離的狀態存在，答案選(D)

普化正課, ch12, page 12-58 · 慈濟109(49)考過一樣的題目

49. 下列何者是離胺酸(lysine)在 pH=14 之環境中的主要結構?



慈濟 109(49)D

77. Which of the followings is a correct set of quantum numbers for an electron in a 3d orbital?

- E (A)  $n = 3, l = 0, m_l = -1$  (B)  $n = 3, l = 1, m_l = 3$  (C)  $n = 3, l = 2, m_l = 3$   
 (D)  $n = 3, l = 3, m_l = 2$  (E)  $n = 3, l = 2, m_l = -2$

3d orbital:  $n=3, l=2, m_l = -2, -1, 0, +1, +2 \Rightarrow$  答案選(E)

普化正課, ch5, page 5-70

Case 03:  $m_s \neq \pm \frac{1}{2}$

下列是原子中 4d 電子的四個量子數( $n, l, m_l, m_s$ )，請問何者正確？

- (A) (4,2,-1,1/2) (B) (4,1,2,1/2) (C) (4,2,1,0) (D) (4,1,2,0)

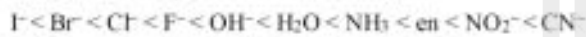
Ans:A

78. Which of the following complexes will absorb visible radiation of the shortest wavelength?

- D (A)  $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$  (B)  $[\text{Co}(\text{I})_6]^{3-}$  (C)  $[\text{Co}(\text{OH})_6]^{3-}$   
 (D)  $[\text{Co}(\text{en})_3]^{3+}$  (E)  $[\text{Co}(\text{NH}_3)_6]^{3+}$

ethylenediamine(en) 是所有選項中最強場的配位基，complex 吸收最短波長的可見光  
 普化正課, ch6, page 6-138, 中國108(19)考過一樣的題目

19. 光譜化學序列 (spectrochemical series) 如下：



下列哪一個錯合物吸收的可見光的波長最短？

- (A)  $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$  (B)  $[\text{CoI}_6]^{3-}$  (C)  $[\text{Co}(\text{OH})_6]^{3-}$   
 (D)  $[\text{Co}(\text{NH}_3)_6]^{3+}$  (E)  $[\text{Co}(\text{en})_3]^{3+}$

中國 108(19)E

79. Please choose the most stable cation?

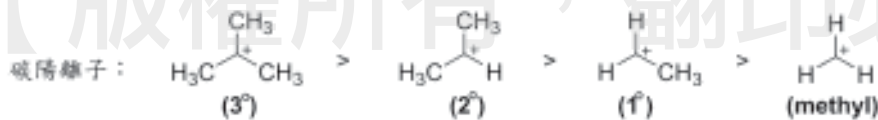


級數愈高的碳陽離子通常愈穩定

化學先修, page 0-41

(2) 超共軛所造成的影響

相對穩定度大小：





80. Which of the following statements about "The Bohr Model" and "Particle in a Box" is TRUE?

- (A) For an electron trapped in a one-dimensional box, as the length of the box increases, the spacing between energy levels will increase.
- (B) The total probability of finding a particle in a one-dimensional box (length is  $L$ ) in energy level  $n = 4$  between  $x = L/4$  and  $x = L/2$  is 50%.
- (C) If the wavelength of light necessary to promote an electron from the ground state to the first excited state is  $\lambda$  in a one-dimensional box, then the wavelength of light necessary to promote an electron from the first excited state to the third excited state will be  $3\lambda$ .
- (D) A function of the type  $A \cos(Lx)$  can be an appropriate solution for the particle in a one-dimensional box.
- (E) Assume that a hydrogen atom's electron has been excited to the  $n = 5$  level. When this excited atom loses energy, 10 different wavelengths of light can be emitted.

(A)錯誤，當盒子的邊長上升，energy level之間的能量差會變小

(B)錯誤， $n = 4$  時， $x=L/4$ 到 $x=L/2$ 之間找到質點的機率為 25%

(C)錯誤

ground state  $\rightarrow$  1<sup>st</sup> excited state

$$\begin{aligned} \Delta E &= E_{n=2} - E_{n=1} \\ &= \frac{2^2 h^2}{8mL^2} - \frac{1^2 h^2}{8mL^2} = \frac{3h^2}{8mL^2} = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{8mL^2 \cdot c}{3h} \end{aligned}$$

1<sup>st</sup> excited state  $\rightarrow$  3<sup>rd</sup> excited state

$$\begin{aligned} \Delta E &= E_{n=4} - E_{n=2} \\ &= \frac{4^2 h^2}{8mL^2} - \frac{2^2 h^2}{8mL^2} = \frac{12h^2}{8mL^2} = \frac{hc}{\lambda'} \Rightarrow \lambda' = \frac{8mL^2 \cdot c}{12h} \end{aligned}$$

$$\lambda' = \frac{1}{4} \lambda$$

(D)錯誤，一維盒中質點的方程式應為： $A \sin\left(\frac{n\pi}{L} x\right)$

(E)正確  $n=5 \rightarrow n=4$ 、 $n=5 \rightarrow n=3$ 、 $n=5 \rightarrow n=2$ 、 $n=5 \rightarrow n=1$

$n=4 \rightarrow n=3$ 、 $n=4 \rightarrow n=2$ 、 $n=4 \rightarrow n=1$

$n=3 \rightarrow n=2$ 、 $n=3 \rightarrow n=1$

$n=2 \rightarrow n=1$

普化正課講義, ch5, page 5-45到page 5-49之間的全部內容

81. Which of the following statements concerning a face-centered cubic unit cell and the corresponding lattice, made up of identical atoms, is incorrect?

- A (A) The coordination number of the atoms in the lattice is 8.  
 (B) The packing in this lattice is more efficient than for a body-centered cubic system.  
 (C) If the atoms have radius  $r$ , then the length of the cube edge is  $\sqrt{8} \times r$ .  
 (D) There are four atoms per unit cell in this type of packing.  
 (E) The packing efficiency in this lattice and hexagonal close packing are the same.

(A)錯誤 · fcc配位數為12

普化正課, ch8, page 8-40

六方最密堆積  
(hexagonal closest packing)

Exploded view      Hexagonal close-packed structure

(a)

(1) 排列方式：ABABAB.....  
 (2) 配位數：12  
 (3) 單位晶格原子數目：6  
 (4) 填充效率：74%

立方最密堆積  
(cubic closest packing)  
→代碼：【95swu】

Exploded view      Cubic close-packed structure

(b)

(1) 排列方式：ABCABCABC.....  
 (2) 配位數：12  
 (3) 單位晶格原子數目：4  
 (4) 填充效率：74%

82. Which of the followings will give a solution with a pH > 7, but is not an Arrhenius base in the strict sense?

- A (A)  $\text{CH}_3\text{NH}_2$  (B)  $\text{NaOH}$  (C)  $\text{CO}_2$  (D)  $\text{Ca}(\text{OH})_2$  (E)  $\text{CH}_4$

$\text{CH}_3\text{NH}_2$ 本身不直接產生 $\text{OH}^-$ ，但卻也會使其水溶液  $\text{pH} > 7$

普化正課, ch4, page 4-67

● 注意：三種酸鹼學說之間的比較

學說	定義		適用範圍
	酸	鹼	
阿瑞尼士	水中生成 $\text{H}^+$	水中生成 $\text{OH}^-$	水溶液 (生成鹽和水)
布恩斯特-羅瑞	提供 $\text{H}^+$	接受 $\text{H}^+$	水溶液或質子轉移反應
路易斯	接受電子對	提供電子對	水溶液、質子轉移反應甚至不含 $\text{H}^+$ 或 $\text{H}_3\text{O}^+$ 之反應 (生成配位共價鍵)

83. Pentane,  $C_5H_{12}$ , boils at  $35^\circ C$ . Which of the followings is true about kinetic energy,  $E_k$ , and potential energy,  $E_p$ , when liquid pentane at  $35^\circ C$  is compared with pentane vapor at  $35^\circ C$ ?

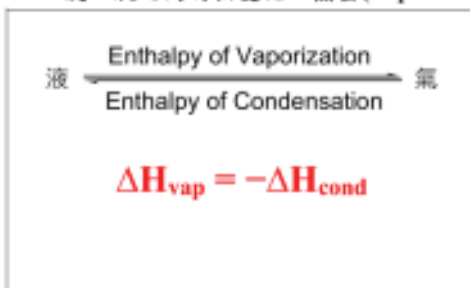
- D (A)  $E_k(g) < E_k(l); E_p(g) \approx E_p(l)$  (B)  $E_k(g) > E_k(l); E_p(g) \approx E_p(l)$   
 (C)  $E_p(g) < E_p(l); E_k(g) \approx E_k(l)$  (D)  $E_p(g) > E_p(l); E_k(g) \approx E_k(l)$   
 (E)  $E_p(g) \approx E_p(l); E_k(g) \approx E_k(l)$

在 pentane 的沸點  $35^\circ C$  時

液體狀態的分子具有足夠的動能掙脫分子間作用力的束縛變成氣體狀態，此時  $E_k(g) \approx E_k(l)$   
 液態分子間距離很近，氣態分子間距離很遠，因此  $E_p(g) > E_p(l)$

普化正課, ch9, page 9-5

9.1C 氣、液之間的相變化：蒸發(Vaporization)和凝結(Condensation)



液體分子蒸發的條件：

- (1) 具有足夠動能可克服液體分子間引力
- (2) 運動方向正確

蒸發或凝結所伴隨的現象：

- (1) 蒸發過程是吸熱(endothermic)過程
- (2) 蒸發速率會隨溫度上升而上升
- (3) 凝結過程是放熱(exothermic)過程

84. Five molecules are shown as below. Which one has the highest ionic strength?

- C (A)  $B(OH)_3$  (B)  $HNO_3$  (C)  $Na_2HPO_4$  (D)  $CaCO_3$  (E)  $BaSO_4$

$$I = \frac{1}{2} \sum C_{M,i} \cdot Z_i^2$$

↑ 粒子濃度    ↑ 粒子電荷

離子濃度較高或離子電荷較大者，有較大的離子強度(ionic strength)

普化總複習, page 9-50, 曾經提醒過 ionic strength 的概念

(34) 離子強度

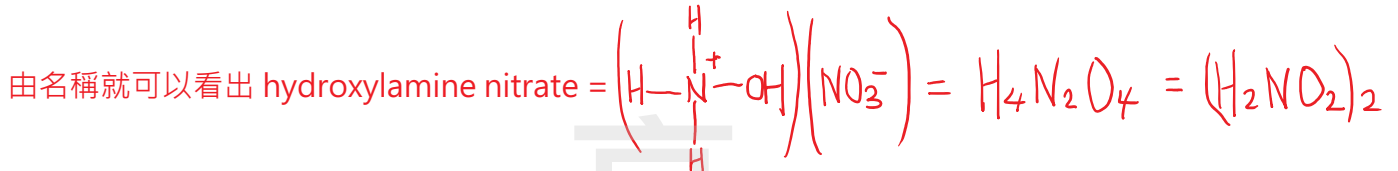
29. Which of the following aqueous solutions should demonstrate the most ideal behavior?

- (A) 0.1 M  $K_2SO_4$  (B) 0.1 M  $CaCl_2$  (C) 3.0 M  $LiF$  (D) 0.1 M  $MgSO_4$   
 (E) 0.1 M  $NaCl$

UST99A5(29)

85. Hydroxylamine nitrate contains 29.17 mass % N, 4.20 mass % H, and 66.63 mass % O. Determine its empirical formula.

- B (A) HNO (B) H<sub>2</sub>NO<sub>2</sub> (C) HN<sub>6</sub>O<sub>16</sub> (D) HN<sub>16</sub>O<sub>7</sub> (E) H<sub>2</sub>NO<sub>3</sub>



普化正課, ch2, page 2-28 · 義守109(17)曾經考過一樣的考題

17. Hydroxylamine nitrate 含有 29.17 質量%N、4.20 質量%H 和 66.63 質量%O。如果它的分子量介於 94 至 98 g/mol 之間，它的分子式是什麼？

- (A) NH<sub>2</sub>O<sub>2</sub> (B) N<sub>2</sub>H<sub>4</sub>O<sub>4</sub> (C) N<sub>6</sub>H<sub>16</sub>O<sub>16</sub> (D) N<sub>16</sub>H<sub>4</sub>O<sub>7</sub>

義守 109(17)B

86. Given the following two standard reduction potentials,



determine for the standard reduction potential of the half-reaction



- B (A) 0.40 V (B) 0.77 V (C) -0.40 V (D) -0.11 V (E) 0.11 V

$$E = \frac{(-0.036) \times 3 + (0.44) \times 2}{1} = +0.77 \text{ V}$$

普化正課, ch13, page 13-45 · 類似義守99(10)

10. 已知  $\text{Cu}^{2+} + e^- \rightarrow \text{Cu}^+ \quad E^\circ = 0.15 \text{ V}$ ;  $\text{Cu}^+ + e^- \rightarrow \text{Cu} \quad E^\circ = 0.52 \text{ V}$ 。  
請計算右式反應  $\text{Cu}^{2+} + 2e^- \rightarrow \text{Cu}$  的標準電位值  $E^\circ = ?$

- (A) 0.67 V (B) 0.34 V (C) -0.37 V (D) -0.67 V

義守 99(10)B

反應方程式	半電池電位	$\Delta G^\circ$
$\text{Cu}^{2+} + e^- \rightarrow \text{Cu}^+$	$E_1 = +0.15$	$\Delta G_1^\circ = -1 \times F \times (+0.15)$
$\text{Cu}^+ + e^- \rightarrow \text{Cu}$	$E_2 = +0.52$	$\Delta G_2^\circ = -1 \times F \times (+0.52)$
$\text{Cu}^{2+} + 2e^- \rightarrow \text{Cu}$	$E_3 = ?$	$\Delta G_3^\circ = -2 \times F \times E_3$

87. The rate law for a reaction is found to be  $\text{Rate} = k[\text{A}]^2[\text{B}]$ . Which of the following mechanisms gives this rate law?

- B**
- I.  $\text{A} + \text{B} \rightleftharpoons \text{E}$  (fast)      II.  $\text{A} + \text{B} \rightleftharpoons \text{E}$  (fast)      III.  $\text{A} + \text{A} \rightarrow \text{E}$  (slow)  
 $\text{E} + \text{B} \rightarrow \text{C} + \text{D}$  (slow)       $\text{E} + \text{A} \rightarrow \text{C} + \text{D}$  (slow)       $\text{E} + \text{B} \rightarrow \text{C} + \text{D}$  (fast)
- (A) I      (B) II      (C) III      (D) I & II      (E) II & III

$$k_1[\text{A}][\text{B}] = k_{-1}[\text{E}] \Rightarrow [\text{E}] = \frac{k_1}{k_{-1}}[\text{A}][\text{B}]$$

$$\text{Rate} = k_2[\text{E}][\text{A}] = k_2 \left( \frac{k_1}{k_{-1}}[\text{A}][\text{B}] \right) [\text{A}] = \frac{k_1 k_2}{k_{-1}} [\text{A}]^2 [\text{B}]$$

普化總複習, ch14, page 14-38 · UST106A7(19)曾經考過一樣的考題

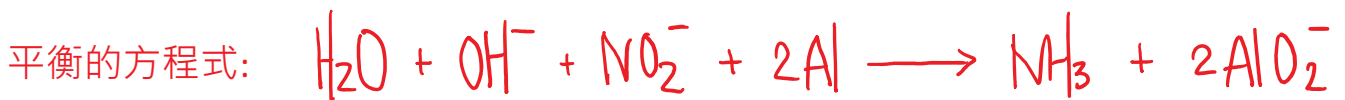
19. The rate law for a reaction is found to be  $\text{Rate} = k[\text{A}]^2[\text{B}]$ . Which of the following mechanisms gives this rate law?

- I.  $\text{A} + \text{B} \rightleftharpoons \text{E}$  (fast)  
 $\text{E} + \text{B} \rightarrow \text{C} + \text{D}$  (slow)
- II.  $\text{A} + \text{B} \rightleftharpoons \text{E}$  (fast)  
 $\text{E} + \text{A} \rightarrow \text{C} + \text{D}$  (slow)
- III.  $\text{A} + \text{A} \rightarrow \text{E}$  (slow)  
 $\text{E} + \text{B} \rightarrow \text{C} + \text{D}$  (fast)
- (A) I only (B) II only (C) III (D) two of these (E) none of these

UST106A7(19)

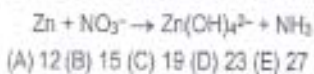
88. When the redox reaction in basic solution:  $\text{NO}_2^-(\text{aq}) + \text{Al}(\text{s}) \rightarrow \text{NH}_3(\text{aq}) + \text{AlO}_2^-(\text{aq})$  is balanced using the smallest whole-number coefficients, the coefficient of  $\text{H}_2\text{O}$  is  $x$  and the sum of all coefficients is  $y$ . What is the sum of  $x$  and  $y$ ,  $(x + y)$ ?

- A** (A) 9 (B) 10 (C) 11 (D) 12 (E) 13

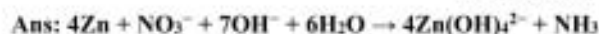


普化正課, ch4, page 4-57 · UST105A1(3)曾經考過類似考題

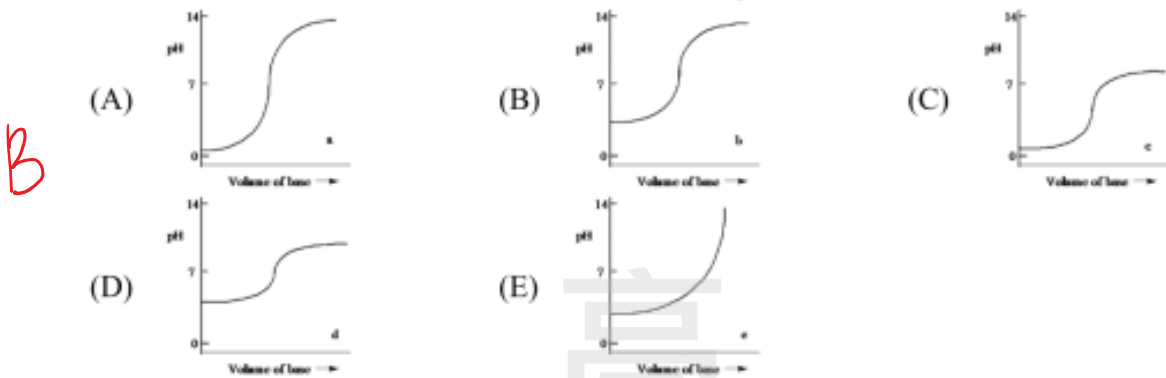
3. The reaction below occurs in basic solution. In the balanced equation, what is the sum of the coefficients?



UST105A1(3)D



89. Which of the followings is the best representation of the titration curve which will be obtained in the titration of a weak acid ( $0.10 \text{ mol L}^{-1}$ ) with a strong base of the same concentration?



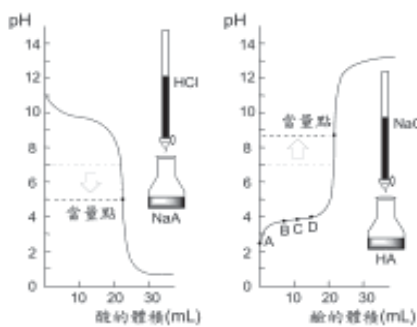
B

強鹼滴定弱酸時，當量點的  $\text{pH} > 7$ ，只有(B)較符合

普化正課, ch12, page 12-79

(1) 弱酸強鹼或弱鹼強酸的滴定曲線：

HCl加入 $\text{NH}_3$ 水溶液 強酸滴定弱鹼      NaOH加入 $\text{HOAc}$ 水溶液 強鹼滴定弱酸



滴定曲線特色

- (a) 達半當量點時， $\text{pH} = \text{pKa}$  且達半當量點前後的 $\text{pH}$ 值變化幅度不大(B, C, D)
- (b) 到達當量點(S)時， $\text{pH}$ 值突然大幅度變化，但變化幅度比強酸強鹼的幅度小
- (c) 當量點(S)的 $\text{pH}$ 值不等於7，且 $\text{pH}$ 值大小依照強鹼中和過程產生的鹽之種類不同而不同  
產生鹼性鹽： $\text{pH} > 7$   
產生酸性鹽： $\text{pH} < 7$
- (d) 達當量點後，如果再繼續加入滴定液，則 $\text{pH}$ 的改變很慢，且最終 $\text{pH}$ 值接近滴定液本身的 $\text{pH}$ 值

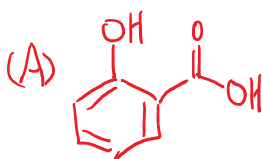
90. The students used salicylic acid and acetic anhydride to synthesize aspirin in the experiment of "The Preparation of Aspirin". The chemical reaction is shown as below:

A

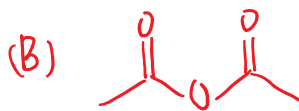
Which compound will react with  $\text{FeCl}_3$  to become a purple complex?

- (A) Salicylic acid      (B) Acetic anhydride      (C) Aspirin
- (D) Acetic acid      (E) 18 M sulfuric acid

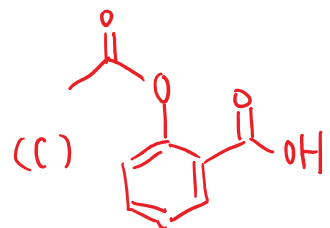
具有 phenolic structure 者，可在  $\text{FeCl}_3$  溶液中展現紫色，稱為 ferric chloride test



salicylic acid



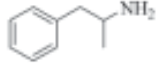
acetic anhydride



aspirin

有機分章, page 15-40, 類似私醫93(50)考的觀念

9. 違禁藥物安非他命(amphetamine)的結構如下, 有關其性質的預測, 何項錯誤?



- (A) 其在稀酸中的溶解度, 大於在純水中  
(B) 其水溶液會使 $\text{FeCl}_3(\text{aq})$ 成紫色  
(C) 其水溶液會使紅色石蕊試紙變藍  
(D) 其為一級胺類

私醫 93 (50)

答案: (B)

►►解析:

有 phenolic structure 者才能使 $\text{FeCl}_3$ 溶液變成紫色

高  
點  
醫  
護

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