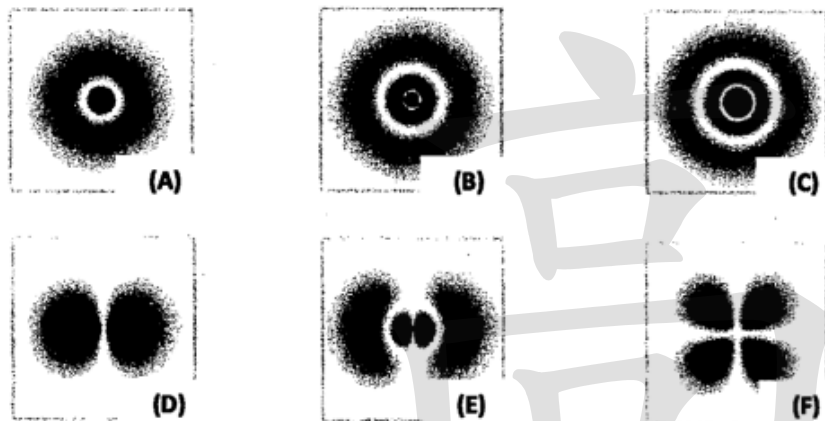


國立臺灣大學109學年度轉學生招生考試試題

1. 109 年台大普化 A

(5) Given the following probability density of selected atomic orbitals of hydrogen atom. Which set of orbitals have the same principal quantum number?

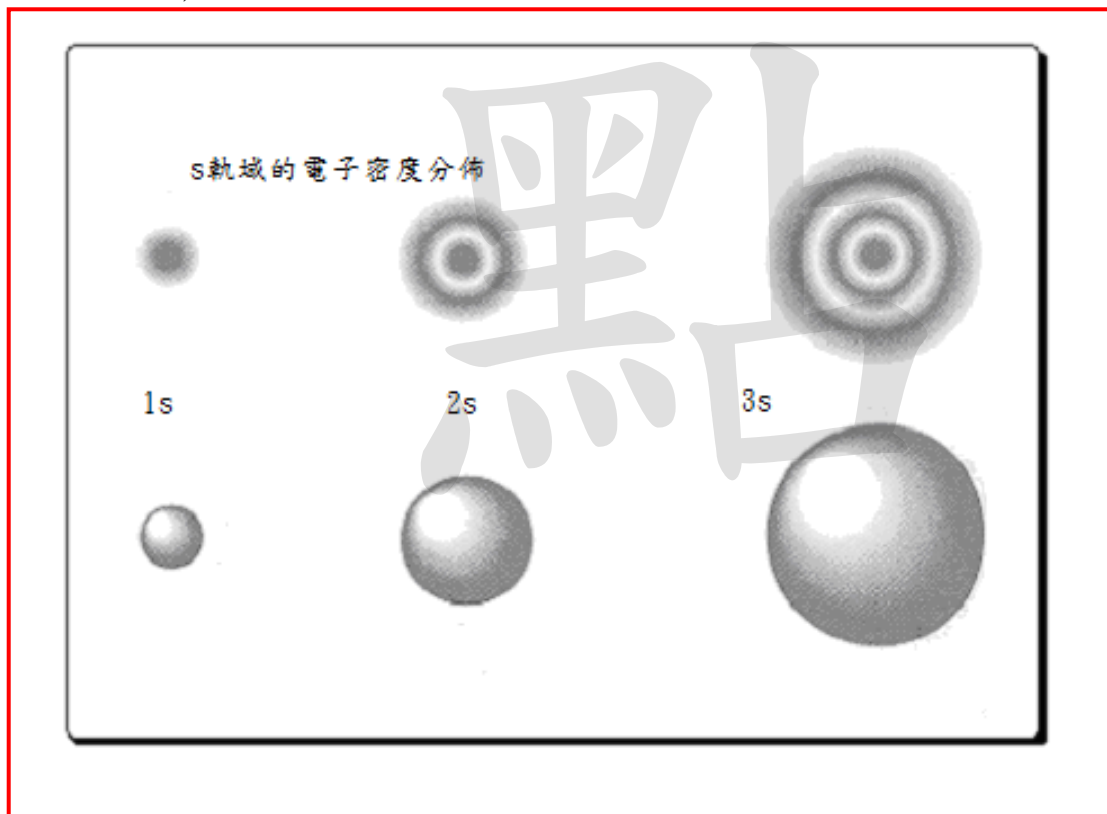


- a. A, B, C
- b. A, D
- c. B, E, F
- d. C, F
- e. D, E

ANS: b, d

(A) = 2s, (B) = 2s, (C) = 3s, (D) = 2p, (E) = 3p, (F) = 3d

A = B = D; C = E = F



(徑函數的代表的意義是原子軌域內的電子分佈情況)

普化講義第二冊, p31

2. 109 台大普化 A

(9) Assume that there are only two isotopes of copper, ^{63}Cu and ^{65}Cu , and the atomic weight of copper is 63.55 g/mol, which of the following statement is/are correct?

- a. ^{63}Cu and ^{65}Cu have the same number of protons and electrons
- b. ^{63}Cu and ^{65}Cu have totally different chemical reactions
- c. The % abundance of ^{63}Cu is 72.5 %
- d. The % abundance of ^{65}Cu is 23.5%
- e. None of the above

ANS: a, c

$$63.55 = 63x + 65(1-x) = 65 - 2x, x = 0.725$$

^{63}Cu 佔 72.5 % ; ^{65}Cu 佔 27.5%

4. Naturally occurring copper exists in two isotopic forms: ^{63}Cu and ^{65}Cu . The atomic mass of copper is 63.55 amu. What is the approximate natural abundance of ^{63}Cu ?

(A) 70 % (B) 63 % (C) 90 % (D) 50 % (E) 30 %

【106 後西】

ANS: (A)

$$63.55 = 65x + 63(1-x) = 2x + 63, x = 0.275 \rightarrow 27.5\% \sim 30\% \text{ } ^{65}\text{Cu}; \underline{70\% \text{ } ^{63}\text{Cu}}$$

普化講義第一回, p.158

3. 109 台大普化 A (陸生)

第 8 題 The K_f for the complex ion $\text{Ag}(\text{NH}_3)_2^+$ is 1.7×10^7 , and K_{sp} for AgI is 1.5×10^{-16} . What is the molar solubility of AgI in a solution that is 2.0 M in NH_3 ?

(A) 1.5×10^{-9} (B) 1.3×10^{-3} (C) 1.0×10^{-4} (D) 5.8×10^{-12} (E) 8.4×10^{-5}

ANS: (E)



2 - 2x x x at equilibrium

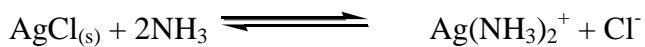
$$2.55 \times 10^{-9} = K = x^2 / (2 - 2x)^2, 5.0497 \times 10^{-5} = x / (2 - 2x)$$

$$10 \times 10^{-5} - (10 \times 10^{-5})x = x, x \sim 9 \times 10^{-5} \text{ M}$$

【精選範例】

在 0.10 M NH_3 中 AgCl 溶解度為若干？

ANS:



$$0.10 - 2x \qquad \qquad x \qquad \qquad x$$

$$K = \frac{[\text{Ag}(\text{NH}_3)_2^+][\text{Cl}^-]}{[\text{NH}_3]^2} = \frac{[\text{Ag}^+][\text{Cl}^-]}{[\text{Ag}^+][\text{NH}_3]^2} \times \frac{[\text{Ag}(\text{NH}_3)_2^+]}{[\text{Ag}^+][\text{NH}_3]^2}$$

$$(1.7 \times 10^{-10})(6.0 \times 10^{-8})^{-1} = 2.8 \times 10^{-3}$$

$$\frac{x^2}{(0.10 - 2x)^2} = 2.8 \times 10^{-3} \rightarrow x/(0.10 - 2x) = 5.29 \times 10^{-2}$$

$$(5.29 \times 10^{-3}) - (1.06 \times 10^{-1})x = x$$

$$x = 4.8 \times 10^{-3} \text{ M}$$

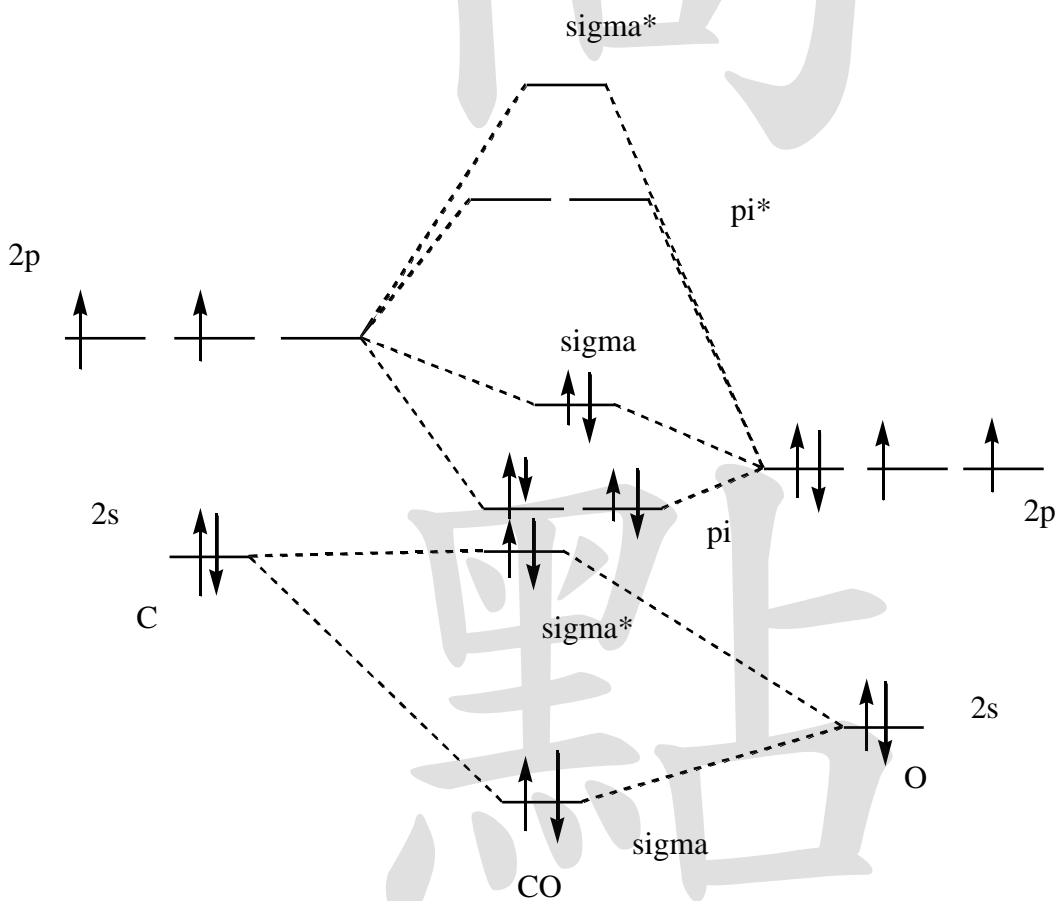
普化講義第五冊, p.90

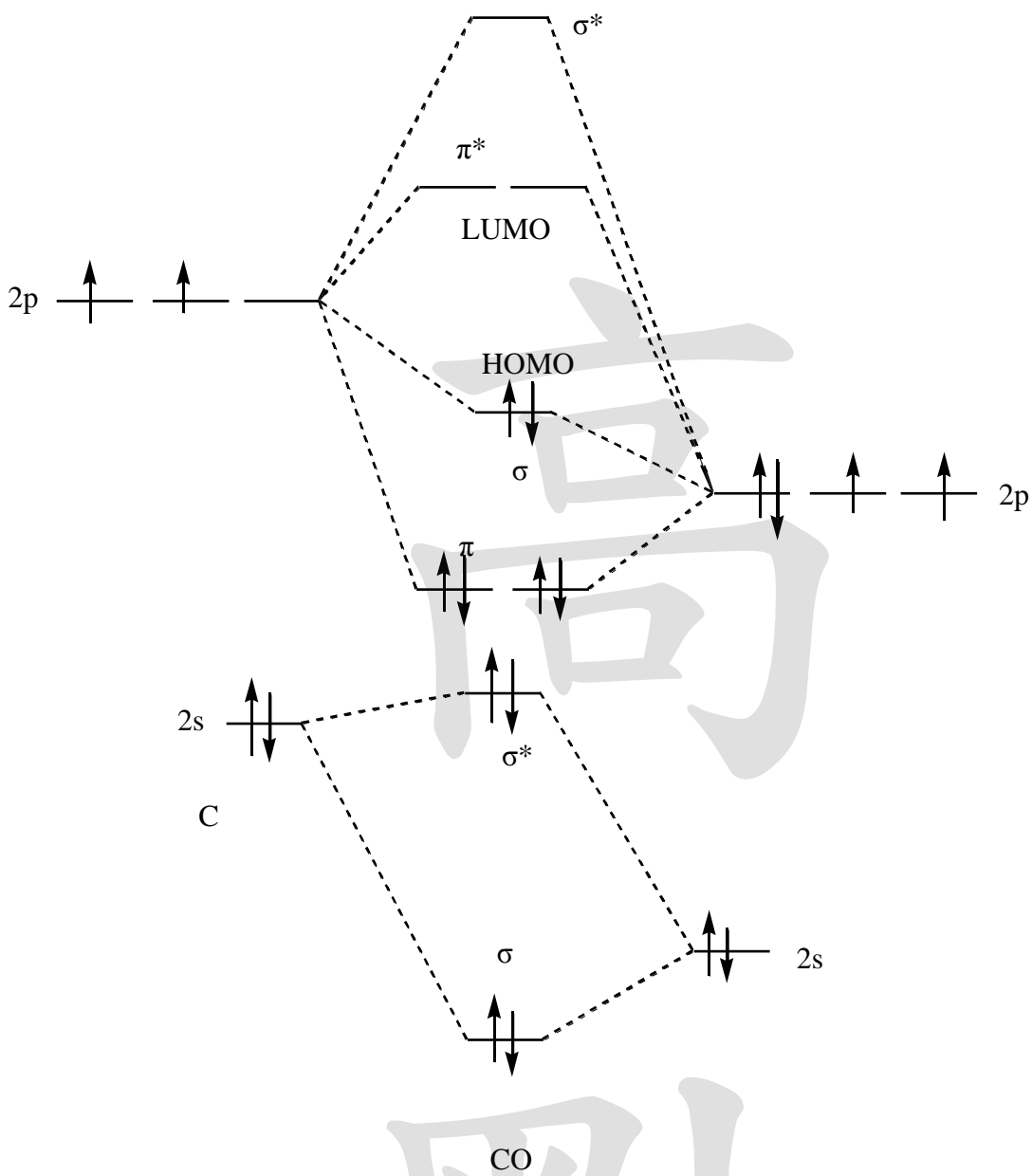
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第 22 題:

Construct the molecular orbital (MO) diagram of carbon monoxide (CO) step-by-step: (A) put atomic orbitals (AO) of C atom on the left side and those of O atom on the right (including only 2s and 2p electrons, and note the relative energy of AOs of C and O atoms), (B) put up the MO of CO molecule in the middle, and connect the MOs with the contributing AOs. (C) Fill up the electrons of AOs and MOs. Note that when combining the p orbitals, the pi molecular orbital has a lower energy than the sigma molecular orbital

ANS:

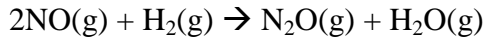




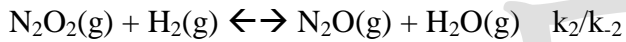
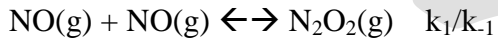
普化講義第二冊, p.133

第 28 題:

The reaction between nitric oxide and hydrogen,



may proceed via the following mechanism:



Give the rate law for the overall reaction if the second step is the rate-determining step

ANS:

$r = k_2[\text{N}_2\text{O}_2][\text{H}_2]$ because of the second step is rds

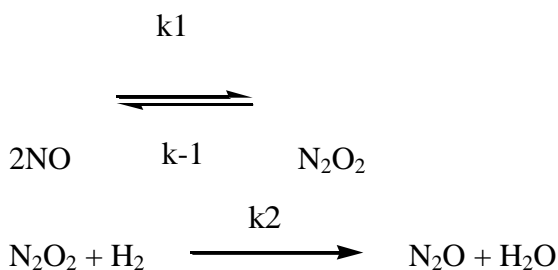
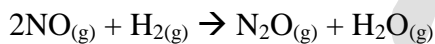
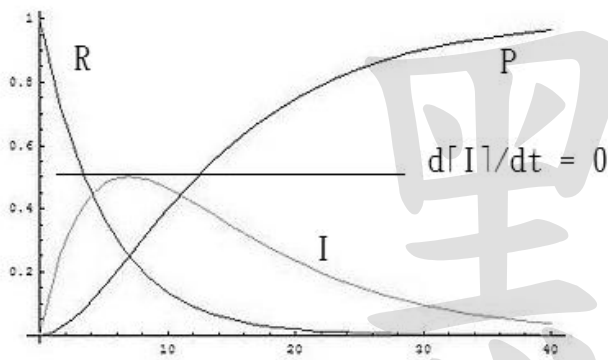
$$K = k_1/k_{-1} = [\text{N}_2\text{O}_2]/[\text{NO}]^2$$

$$r = k_2K[\text{NO}]^2[\text{H}_2]$$

****The Steady-State Approximation 穩態逼近法**

$\text{R} \rightarrow \text{I} \rightarrow \text{P}$, R: 反應物, I: 中間物, P: 產物

利用中間物濃度變化極大值處切線斜率為零(一次微分等於零), 找出中間物與各物種間的函數關係 → 推出速率定律式(rate law)



$d[\text{N}_2\text{O}_2]/dt = 0$ (中間體濃度對時間的變化率為零)

$$k_1[\text{NO}]^2 - k_{-1}[\text{N}_2\text{O}_2] - k_2[\text{N}_2\text{O}_2][\text{H}_2] = 0$$

because rate = $k_2[\text{N}_2\text{O}_2][\text{H}_2]$

$$\text{so } [\text{N}_2\text{O}_2] = \frac{k_1[\text{NO}]^2}{k_{-1} + k_2[\text{H}_2]}$$

$$\text{rate} = \frac{k_2 k_1 [\text{NO}]^2 [\text{H}_2]}{k_{-1} + k_2 [\text{H}_2]}$$

請按 $k_2[\text{H}_2] \gg k_{-1}$ and $k_{-1} \gg k_2[\text{H}_2]$ 等條件改變 rate law 的寫

普化講義第四冊, p.77

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