#3) First let's $\boxed{\text{NOT}}$ assume Brillouin

UISD doubles equations:

$$C^{ij}_{ab}\left(\varepsilon^{ij}_{ab}+E_c\right)=\langle \Phi^{ab}_{ij}|V_c(1+C_1+C_2)|\Phi\rangle$$

(x+) (0) (y+)   (1) (0) (z+) (x+) ← $\boxed{\text{Leading orders}}$

(x+)   (x+ + y+)   (1) (1+z+) (1+x+) ← $\boxed{\text{Distribute}}$

$\vee$ $\vee$ $\vee$ $\vee$

0   x+   1   1

- we know that leading orders must be the same on both sides of the equation.
- since the leading order of the LHS is x, and the leading order of the RHS is 1, $\boxed{X=1}$.

UISD singles equations

$$C^{i}_{a}\left(\varepsilon^{i}_{a}+E_c\right)=\langle \Phi^{a}_{i}|V_c(1+C_1+C_2)|\Phi\rangle$$

(z+) (0) (y+)   (1) (0) (z+) (2+) ← $\boxed{\text{Leading orders}}$

(z+)   (z+ y+)   (1) (1+z+) (2+) ← $\boxed{\text{Distribute}}$

$\vee$ $\vee$ $\vee$

0   z+   1

- again, since the leading order of each side must be equal on each side, $\boxed{Z=1}$

UISD energy expression

$$E_c=\langle \Phi^{a}_{i}|V_c(\cancel{1}+C_1+C_2)|\Phi\rangle$$

(y+)   (1) (0) (1+) (1+) ← $\boxed{\text{Leading orders}}$

(y+)   (2+) (2+) ← $\boxed{\text{Distribute}}$

- by the same argument $\boxed{Y=2}$

3) Now if we assume Brillouin, the same analysis applies for the doubles equations, so C_{ab}^{ij} and therefore C_2 have leading order 1:

$$\underbrace{C_{ab}^{ij}}_{(1+)}(\underbrace{\epsilon_{ab}^{ij}}_{(0)} + \underbrace{E_c}_{(y+)}) = \langle \Phi_{ij}^{ab} | \underbrace{V_c}_{(1)}(\underbrace{1}_{(0)} + \underbrace{C_1}_{(z+)} + \underbrace{C_2}_{(1)}) | \Phi \rangle$$

(1+) (1+ + y+) (1) + (1+z+) + (2)

Singles equations

$$\underbrace{C_a^i}_{(z+)}(\underbrace{\epsilon_a^i}_{(0)} + \underbrace{E_c}_{(y+)}) = \langle \Phi_i^a | \underbrace{V_c}_{(1)}(\cancel{1} + \underbrace{C_1}_{(z+)} + \underbrace{C_2}_{(1+)}) | \Phi \rangle$$

(z+) (z+ + y+) (1+z (z+1)+

$\vee$ $\vee$ $\vee$

0 z 1

L.H.S. has leading order z

R.H.S. Has leading order 2

$$\boxed{z = 2}$$

ENERGY EXPRESSION:

$$\underbrace{E_c}_{(y+)} = \langle \Phi | \underbrace{V_c}_{(1)}(\cancel{C_1} + \underbrace{C_2}_{(1)}) | \Phi \rangle$$

(1+1) $\Longrightarrow$ $\boxed{y = 2}$