

NOTACIÓN DE LEWIS

DISTRIBUCIÓN DE e^- EN LA MOLECULA

Nomenclatura:

$$N_{e^- \text{ TOTAL}} = N_{e^- \text{ ENTOTAL}}$$

$$N_{e^- \text{ VAL}} = N_{e^- \text{ de valencia}}$$

$$N_{e^- \text{ C}} = N_{e^- \text{ compartidos}}$$

$$N_{e^- \text{ NC}} = N_{e^- \text{ no compartidos}}$$

Definiciones:

$$N_{e^- \text{ C}} = N_{e^- \text{ TOTAL}} - N_{e^- \text{ VAL}}$$

$$N_{e^- \text{ NC}} = N_{e^- \text{ VAL}} - N_{e^- \text{ C}}$$

La carga formal de un átomo (CF), es la diferencia entre los e^- que presenta cuando está aislado a cuando está enlazado.

Los e^- que pertenecen a un átomo son todos sus pares de electrones solitarios (no compartidos), y la mitad de los electrones compartidos.

$$\begin{aligned} CF_{\text{ATOMO}} &= \frac{N_{e^- \text{ (AISLADO)}}}{N_{e^- \text{ VAL}}} - \frac{N_{e^- \text{ (ENLAZADO)}}}{N_{e^- \text{ NC}} + \frac{1}{2} N_{e^- \text{ C}}} = \\ &= \frac{N_{e^- \text{ VAL}}}{N_{e^- \text{ VAL}}} - \frac{N_{e^- \text{ (ENLAZADO)}}}{N_{e^- \text{ NC}} + \frac{1}{2} N_{e^- \text{ C}}} \end{aligned}$$

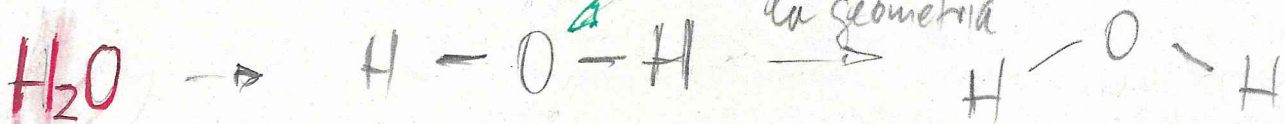
Átomo central:

Suele ser el elemento menos electronegativo, es decir el que necesita más electrones para completar su nivel de valencia.

Ejercicio 15, p 67. EDEBE Bach 2.

Deduce la estructura de Lewis y calcula la carga formal de cada uno de los átomos en las moléculas siguientes:

H_2O , NH_3 , $BeCl_2$, BCl_3 , SCl_2 , CO_2 , SO_2 , SO_3 , CH_4 ,
 $HClO_4$, H_2CO_3 , HNO_2 .

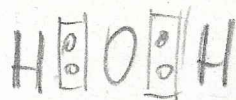


átomo central
no importa la geometría

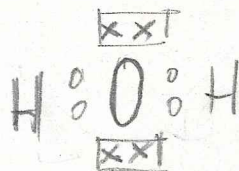
$$N^{\circ e^-}_{TOTAL} = 8e^-(O) + 2 \times (2e^-(H)) = 12e^-$$

$$N^{\circ e^-}_{VAL} = 6e^-(O) + 2 \times (1e^-(H)) = 8e^-$$

$$N^{\circ e^-}_C = N^{\circ e^-}_{TOTAL} - N^{\circ e^-}_{VAL} = 12e^- - 8e^- = 4e^- \rightarrow 2PE = \text{pares e- enlazantes}$$

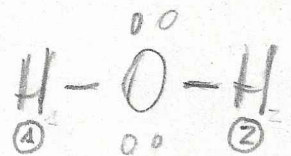


$$N^{\circ e^-}_{NC} = N^{\circ e^-}_{VAL} - N^{\circ e^-}_C = 8e^- - 4e^- = 4e^- \rightarrow 2PE = \text{pares e- no enlazantes}$$



Cálculo de la carga formal

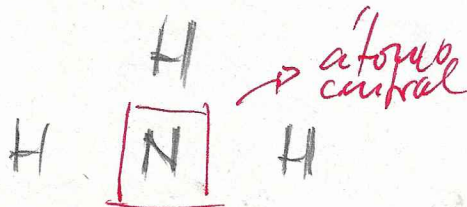
$$CF_{\text{átomo}} = N^{\circ e^-}(\text{AISLADO}) - N^{\circ e^-}(\text{ENLAZADO}) = N^{\circ e^-}_{VAL} - (N^{\circ e^-}_{NC} + \frac{1}{2} N^{\circ e^-}_C)$$



$$CF(H)_1 = 1 - (0 + \frac{1}{2} \cdot 2) = 1 - 1 = \boxed{0}$$

$$CF(H)_2 = 1 - (0 + \frac{1}{2} \cdot 2) = 1 - 1 = \boxed{0}$$

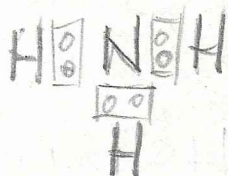
$$CF(O) = 6 - (4 + \frac{1}{2} \cdot 4) = 6 - 6 = \boxed{0}$$



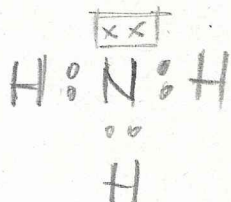
$$N^{\circ}e^{-}_{\text{TOTAL}} = 8e^{-}(\text{N}) + 3 \times (2e^{-})(\text{H}) = 14e^{-}$$

$$N^{\circ}e^{-}_{\text{VAL}} = 5e^{-}(\text{N}) + 3 \times (1e^{-})(\text{H}) = 8e^{-}$$

$$N^{\circ}e^{-}_{\text{C}} = N^{\circ}e^{-}_{\text{TOTAL}} - N^{\circ}e^{-}_{\text{VAL}} = 14e^{-} - 8e^{-} = 6e^{-} \sim 3\text{PE}$$



$$N^{\circ}e^{-}_{\text{NC}} = N^{\circ}e^{-}_{\text{VAL}} - N^{\circ}e^{-}_{\text{C}} = 8e^{-} - 6e^{-} = 2e^{-} \sim 1\text{PNE}$$



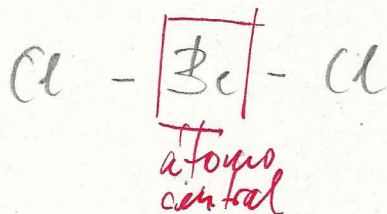
Cálculo de la carga formal

$$\begin{aligned} \text{CF}_{\text{ATOMO}} &= N^{\circ}e^{-}(\text{AISLADO}) - N^{\circ}e^{-}(\text{ENLAZADO}) = \\ &= N^{\circ}e^{-}_{\text{VAL}} - (N^{\circ}e^{-}_{\text{NC}} + \frac{1}{2} N^{\circ}e^{-}_{\text{C}}) \end{aligned}$$

$$\text{CF}(\text{H}) = 1 - (0 + \frac{1}{2} \cdot 2) = 1 - 1 = \underline{\underline{0}} \quad (\text{para los 3H})$$

e⁻ que pertenecen al átomo cuando está enlazado

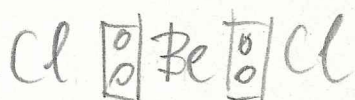
$$\text{CF}(\text{N}) = 5 - (2 + \frac{1}{2} \cdot 6) = 5 - 5 = \underline{\underline{0}}$$



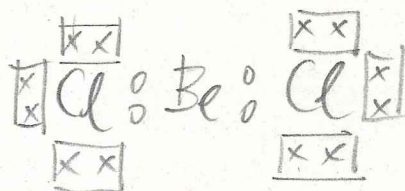
$$N^{\circ}e^{-}_{\text{TOTAL}} = 4e^{-}(\text{Be}) + 2 \times 8e^{-}(\text{Cl}) = 20e^{-}$$

$$N^{\circ}e^{-}_{\text{VAL}} = 2e^{-}(\text{Be}) + 2 \times 7e^{-}(\text{Cl}) = 16e^{-}$$

$$N^{\circ}e^{-}_{\text{C}} = N^{\circ}e^{-}_{\text{TOTAL}} - N^{\circ}e^{-}_{\text{VAL}} = 20e^{-} - 16e^{-} = 4e^{-} \rightarrow 2 \text{PE}$$



$$N^{\circ}e^{-}_{\text{NC}} = N^{\circ}e^{-}_{\text{VAL}} - N^{\circ}e^{-}_{\text{C}} = 16e^{-} - 4e^{-} = 12e^{-} \rightarrow 6 \text{PNE}$$



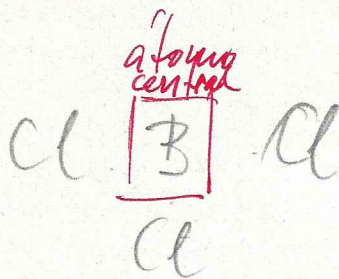
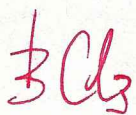
Cálculo de la carga formal

$$\begin{aligned} \text{CF}_{\text{ATOMO}} &= \underbrace{N^{\circ}e^{-}(\text{AISLADO})}_{N^{\circ}e^{-}_{\text{VAL}}} - \underbrace{N^{\circ}e^{-}(\text{ENLAZADO})}_{\left(N^{\circ}e^{-}_{\text{NC}} + \frac{1}{2} N^{\circ}e^{-}_{\text{C}}\right)} = \\ &= N^{\circ}e^{-}_{\text{VAL}} - \left(N^{\circ}e^{-}_{\text{NC}} + \frac{1}{2} N^{\circ}e^{-}_{\text{C}}\right) \end{aligned}$$

e^{-} que pertenecen al átomo unido está unido

$$\text{CF}(\text{Be}) = 2 - \left(0 + \frac{1}{2} 4\right) = 2 - 2 = \underline{\underline{0}}$$

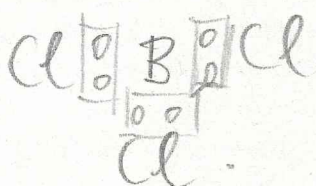
$$\text{CF}(\text{Cl}) = 7 - \left(6 + \frac{1}{2} 2\right) = 7 - 7 = \underline{\underline{0}}$$



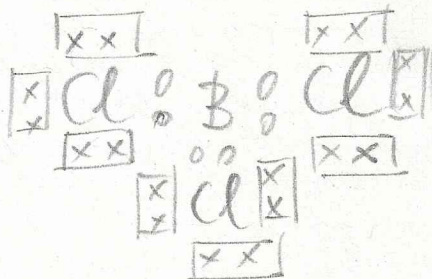
$$N^{\circ}e^{-}_{\text{TOTAL}} = 6e^{-}(\text{B}) + 3 \times 8e^{-}(\text{Cl}) = 30e^{-}$$

$$N^{\circ}e^{-}_{\text{VAL}} = 3e^{-}(\text{B}) + 3 \times 7e^{-}(\text{Cl}) = 24e^{-}$$

$$N^{\circ}e^{-}_{\text{C}} = N^{\circ}e^{-}_{\text{TOTAL}} - N^{\circ}e^{-}_{\text{VAL}} = 30e^{-} - 24e^{-} = 6e^{-} \rightarrow \underline{\underline{3\text{PE}}}$$



$$N^{\circ}e^{-}_{\text{NC}} = N^{\circ}e^{-}_{\text{VAL}} - N^{\circ}e^{-}_{\text{C}} = 24e^{-} - 6e^{-} = 18e^{-} \rightarrow \underline{\underline{9\text{PNE}}}$$



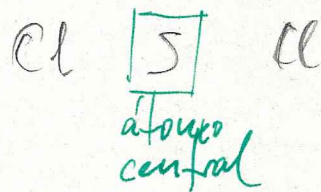
Cálculo de la carga formal

$$\begin{aligned} \text{CF}_{\text{ATOMO}} &= N^{\circ}e^{-}(\text{AISLADO}) - \frac{N^{\circ}e^{-}(\text{COMPARTIDO})}{2} = \\ &= N^{\circ}e^{-}_{\text{VAL}} - \left(N^{\circ}e^{-}_{\text{NC}} + \frac{1}{2} N^{\circ}e^{-}_{\text{C}} \right) \end{aligned}$$

e⁻ que pertenecen al átomo anclado

$$\text{CF}(\text{B}) = 3 - \left(0 + \frac{1}{2} 6 \right) = 3 - 3 = \underline{\underline{0}}$$

$$\text{CF}(\text{Cl}) = 7 - \left(6 + \frac{1}{2} 2 \right) = 7 - 7 = \underline{\underline{0}}$$



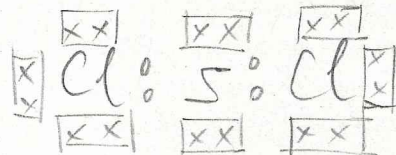
$$N^{\circ}e^{-}_{\text{TOTAL}} = 8e^{-}(S) + 2 \times 8e^{-}(Cl) = 24e^{-}$$

$$N^{\circ}e^{-}_{\text{VAL}} = 6e^{-}(S) + 2 \times 7e^{-}(Cl) = 20e^{-}$$

$$N^{\circ}e^{-}_{\text{C}} = N^{\circ}e^{-}_{\text{TOTAL}} - N^{\circ}e^{-}_{\text{VAL}} = 24e^{-} - 20e^{-} = 4e^{-} \rightarrow 2 \text{ PE}$$



$$N^{\circ}e^{-}_{\text{NC}} = N^{\circ}e^{-}_{\text{VAL}} - N^{\circ}e^{-}_{\text{C}} = 20e^{-} - 4e^{-} = 16e^{-} \rightarrow 8 \text{ PNC}$$



Cálculo carga formal

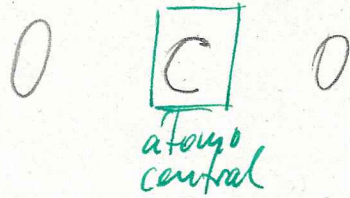
$$CF_{\text{ATOMO}} = N^{\circ}e^{-}(\text{AISLADO}) - N^{\circ}e^{-}(\text{ENLAZADO}) =$$
$$= N^{\circ}e^{-}_{\text{VAL}} - \left(N^{\circ}e^{-}_{\text{NC}} + \frac{1}{2} N^{\circ}e^{-}_{\text{C}} \right)$$

e⁻ que corresponden al átomo enlazado

$$CF(S) = 6 - \left(4 + \frac{1}{2} \cdot 4 \right) = 6 - 6 = 0$$

$$CF(Cl) = 7 - \left(6 + \frac{1}{2} \cdot 2 \right) = 7 - 7 = 0$$

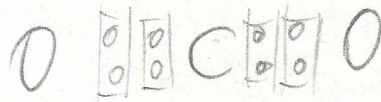
CO_2
(Dióxido de carbono)



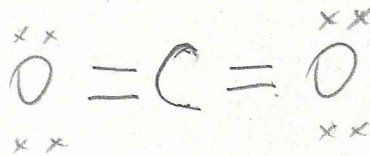
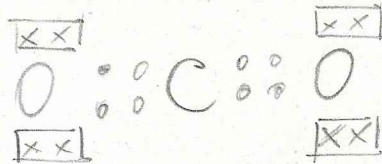
$$N^{\circ}e^{-}\text{-TOTAL} = 8e^{-}(\text{C}) + 2 \times 8e^{-}(\text{O}) = 24e^{-}$$

$$N^{\circ}e^{-}\text{-VAL} = 4e^{-}(\text{C}) + 2 \times 6e^{-}(\text{O}) = 16e^{-}$$

$$N^{\circ}e^{-}\text{-C} = N^{\circ}e^{-}\text{-TOTAL} - N^{\circ}e^{-}\text{-VAL} = 24e^{-} - 16e^{-} = 8e^{-} \rightarrow 4 \text{PE}$$



$$N^{\circ}e^{-}\text{-NC} = N^{\circ}e^{-}\text{-VAL} - N^{\circ}e^{-}\text{-C} = 16e^{-} - 8e^{-} = 8e^{-} \rightarrow 4 \text{PNC}$$



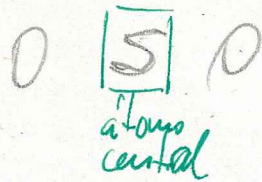
Cálculo carga formal

$$\begin{aligned} \text{CF}_{\text{ATOMO}} &= N^{\circ}e^{-}(\text{AISLADO}) - N^{\circ}e^{-}(\text{ENLAZADO}) = \\ &= N^{\circ}e^{-}\text{-VAL} - \left(N^{\circ}e^{-}\text{-NC} + \frac{1}{2} N^{\circ}e^{-}\text{-C} \right) \end{aligned}$$

$$\text{CF}(\text{C}) = 4 - \left(0 + \frac{1}{2} \cdot 8 \right) = 4 - 4 = \underline{\underline{0}}$$

$$\text{CF}(\text{O}) = 6 - \left(4 + \frac{1}{2} \cdot 4 \right) = 6 - 6 = \underline{\underline{0}}$$

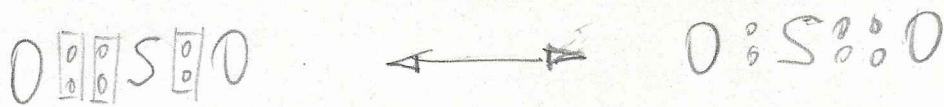
SO₂
(Dióxido de azufre)



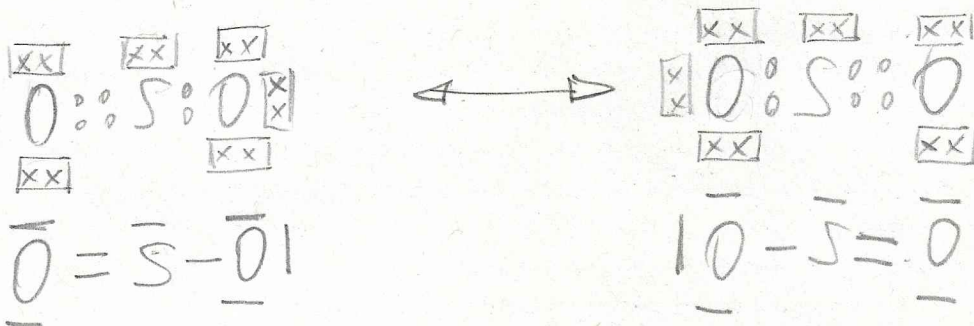
$$N^{\circ}e^-_{\text{TOTAL}} = 8e^- (S) + 2 \times 8e^- (O) = 24e^-$$

$$N^{\circ}e^-_{\text{VAL}} = 6e^- (S) + 2 \times 6e^- (O) = 18e^-$$

$$N^{\circ}e^-_c = N^{\circ}e^-_{\text{TOTAL}} - N^{\circ}e^-_{\text{VAL}} = 24e^- - 18e^- = 6e^- \rightarrow 3 \text{ PE}$$



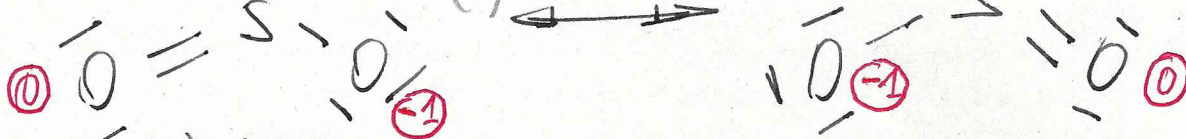
$$N^{\circ}e^-_{\text{NC}} = N^{\circ}e^-_{\text{VAL}} - N^{\circ}e^-_c = 18e^- - 6e^- = 12e^- \rightarrow 6 \text{ PNE}$$



Si consideramos la geometría molecular:

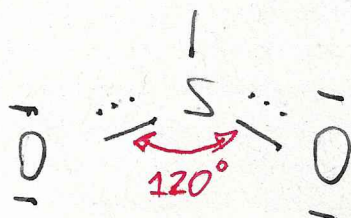
$$C\pm(S) = 6 - (2 + \frac{1}{2} \cdot 6) = 6 - 5 = +1$$

$$C\pm(O) = 6 - (6 + \frac{1}{2} \cdot 2) = 6 - 7 = -1$$

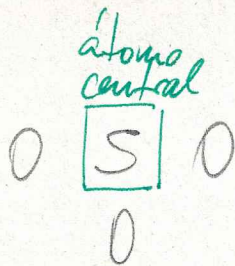


$$C\pm(O) = 6 - (4 + \frac{1}{2} \cdot 4) = 6 - 6 = 0$$

La estructura real es la intermedia entre las dos estructuras resonantes. Los 5 pares de e⁻ alrededor del S, dos dobles y uno no enlazante, cuentan como 3 pares alrededor del S y se distribuyen en una estructura TRIANGULAR PLANA para minimizar las f. repulsivas entre pares de e⁻.



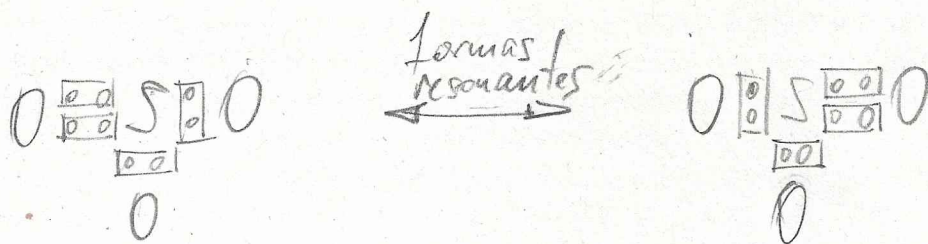
SO_3
(trioxido de azufre)



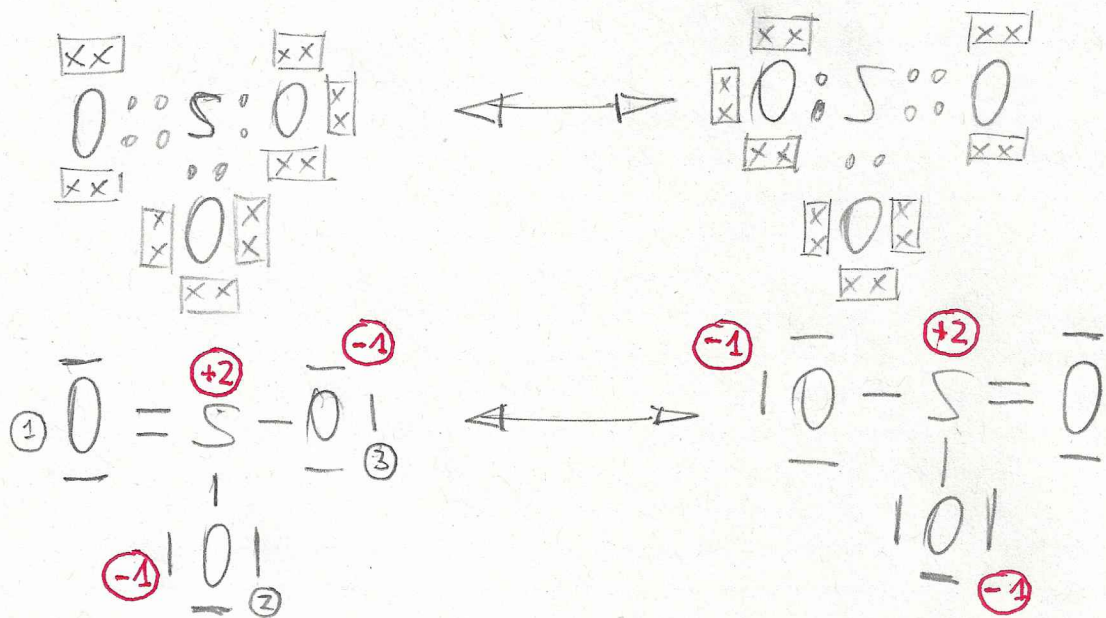
$$N^{\circ}_{e^{-} \text{TOTAL}} = 8e^{-}(S) + 3 \times 8e^{-}(O) = 32e^{-}$$

$$N^{\circ}_{e^{-} \text{VAL}} = 6e^{-}(S) + 3 \times 6e^{-}(O) = 24e^{-}$$

$$N^{\circ}_{e^{-} \text{C}} = N^{\circ}_{e^{-} \text{TOTAL}} - N^{\circ}_{e^{-} \text{VAL}} = 32e^{-} - 24e^{-} = 8e^{-} \rightsquigarrow \underline{\underline{4 \text{ PEC}}}$$



$$N^{\circ}_{e^{-} \text{NC}} = N^{\circ}_{e^{-} \text{VAL}} - N^{\circ}_{e^{-} \text{C}} = 24e^{-} - 8e^{-} = 16e^{-} \rightsquigarrow \underline{\underline{8 \text{ PNC}}}$$



Cálculo carga formal

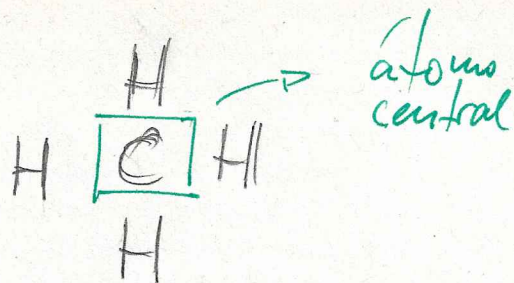
$$CF(O)_1 = 6 - \left(4 + \frac{1}{2} \cdot 4\right) = 6 - 6 = 0$$

$$CF(O)_2 = 6 - \left(6 + \frac{1}{2} \cdot 2\right) = 6 - 7 = \boxed{-1}$$

$$CF(O)_3 = 6 - \left(6 + \frac{1}{2} \cdot 2\right) = 6 - 7 = \boxed{-1}$$

$$CF(S) = 6 - \left(0 + \frac{1}{2} \cdot 8\right) = 6 - 4 = \boxed{+2}$$

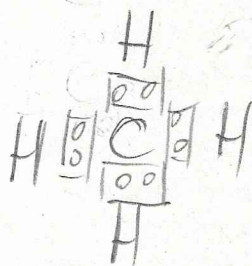
CH₄
(Metano)



$$N^{\circ}e^{-}_{\text{TOTAL}} = 8e^{-}(\text{C}) + 4 \times 2e^{-}(\text{H}) = 16e^{-}$$

$$N^{\circ}e^{-}_{\text{VAL}} = 4e^{-}(\text{C}) + 4 \times 1e^{-}(\text{H}) = 8e^{-}$$

$$N^{\circ}e^{-}_{\text{C}} = N^{\circ}e^{-}_{\text{TOTAL}} - N^{\circ}e^{-}_{\text{VAL}} = 16e^{-} - 8e^{-} = 8e^{-} \rightsquigarrow \boxed{4 \text{ PEC}}$$



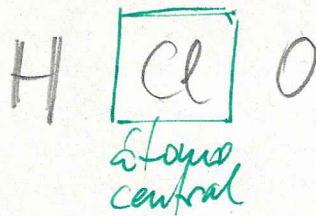
$$N^{\circ}e^{-}_{\text{NC}} = N^{\circ}e^{-}_{\text{VAL}} - N^{\circ}e^{-}_{\text{C}} = 8e^{-} - 8e^{-} = 0 \rightsquigarrow \boxed{0 \text{ PENC}}$$

cálculo carga formal

$$CF(\text{C}) = N^{\circ}e^{-}_{\text{VAL}} - (N^{\circ}e^{-}_{\text{NC}} + \frac{1}{2} N^{\circ}e^{-}_{\text{C}}) = 4 - (0 + \frac{1}{2} 8) = 4 - 4 = 0$$

$$CF(\text{H}) = N^{\circ}e^{-}_{\text{VAL}} - (N^{\circ}e^{-}_{\text{NC}} + \frac{1}{2} N^{\circ}e^{-}_{\text{C}}) = 1 - (0 + \frac{1}{2} 2) = 1 - 1 = 0$$

HClO
(ácido hipocloroso)

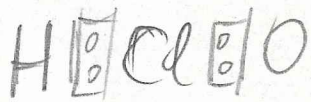


$$N^{\circ}e^{-}_{TOTAL} = 8e^{-}(Cl) + 8e^{-}(O) + 2e^{-}(H) = 18e^{-}$$

$$N^{\circ}e^{-}_{VAL} = 7e^{-}(Cl) + 6e^{-}(O) + 1e^{-}(H) = 14e^{-}$$

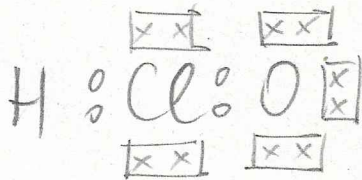
$$N^{\circ}e^{-}_{C} = N^{\circ}e^{-}_{TOTAL} - N^{\circ}e^{-}_{VAL} = 18e^{-} - 14e^{-} = 4e^{-} \rightarrow \boxed{2PEC}$$

2 pares e^{-} compartidos



$$N^{\circ}e^{-}_{NC} = N^{\circ}e^{-}_{VAL} - N^{\circ}e^{-}_{C} = 14e^{-} - 4e^{-} = 10e^{-} \rightarrow \boxed{5PENC}$$

5 pares e^{-} no compartidos

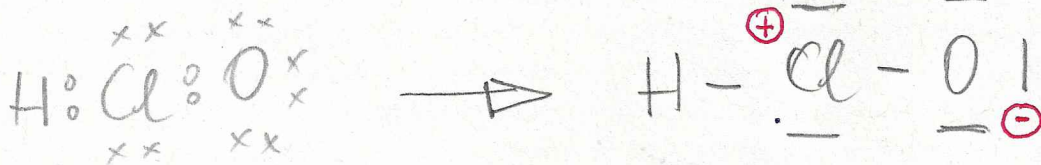


Cálculo carga formal

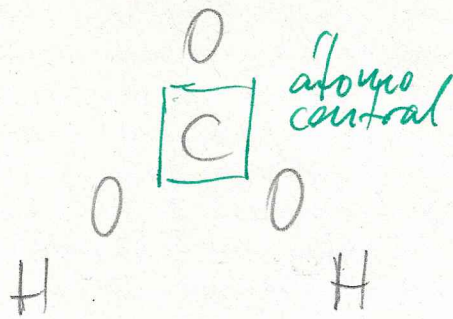
$$CF(H) = 1 - (0 + \frac{1}{2} \cdot 2) = 1 - 1 = \underline{\underline{0}}$$

$$CF(Cl) = 7 - (4 + \frac{1}{2} \cdot 4) = 7 - 6 = \underline{\underline{+1}}$$

$$CF(O) = 6 - (6 + \frac{1}{2} \cdot 2) = 6 - 7 = \underline{\underline{-1}}$$



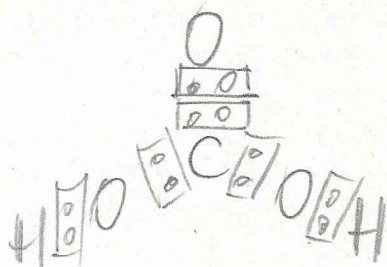
H_2CO_3
(Acido carbónico)



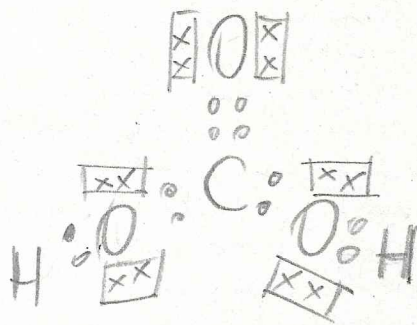
$$N^{\circ}e^{-}_{TOTAL} = 8e^{-}(C) + 3 \times 8e^{-}(O) + 2 \times 2e^{-}(H) = 36e^{-}$$

$$N^{\circ}e^{-}_{VAL} = 4e^{-}(C) + 3 \times 6e^{-}(O) + 2 \times 1e^{-}(H) = 24e^{-}$$

$$N^{\circ}e^{-}_C = N^{\circ}e^{-}_{TOTAL} - N^{\circ}e^{-}_{VAL} = 36e^{-} - 24e^{-} = 12e^{-} \leadsto \boxed{6PEC}$$

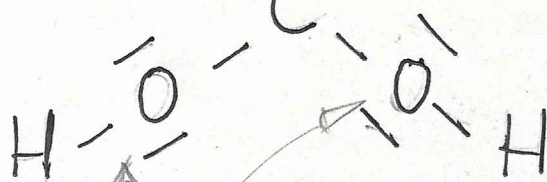


$$N^{\circ}e^{-}_{NC} = N^{\circ}e^{-}_{VAL} - N^{\circ}e^{-}_C = 24e^{-} - 12e^{-} = 12e^{-} \leadsto \boxed{6PENC}$$



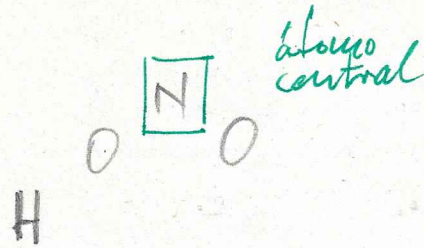
En resumen:

$$C^{\#}(C) = 4 - (0 + \frac{1}{2}8) = \boxed{0} \quad \begin{array}{c} \text{O} \\ || \\ \text{C} \end{array} \quad C^{\#}(O) = 6 - (4 + \frac{1}{2}4) = \boxed{0}$$



$$C^{\#}(O) = 6 - (4 + \frac{1}{2}4) = 6 - 6 = \boxed{0}$$

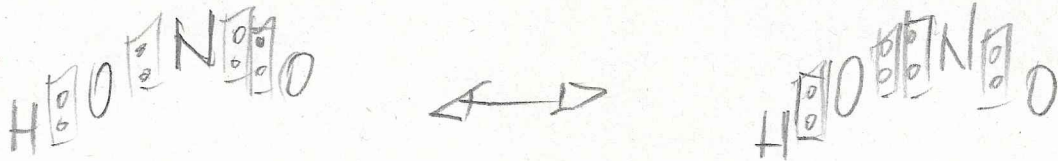
HNO_2
(ácido nítrico)



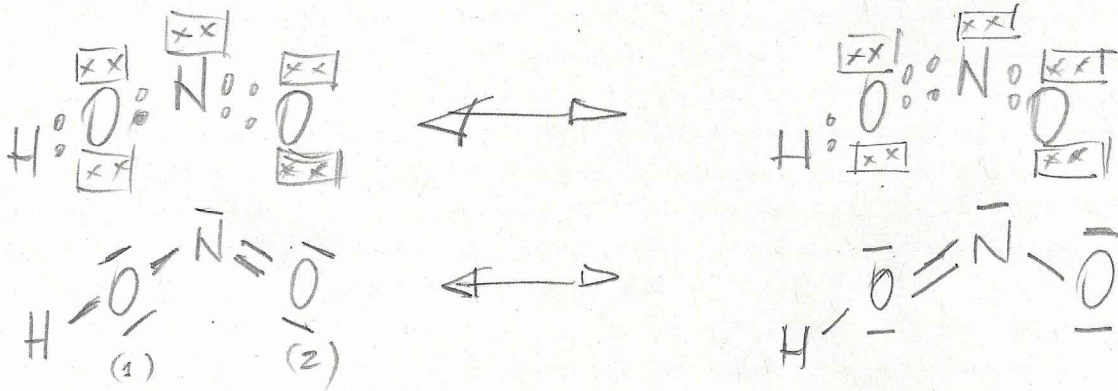
$$N^\circ e^-_{\text{TOTAL}} = 7e^-(\text{N}) + 2 \times 8e^-(\text{O}) + 2e^-(\text{H}) = 26e^-$$

$$N^\circ e^-_{\text{VAL}} = 5e^-(\text{N}) + 2 \times 6e^-(\text{O}) + 1e^-(\text{H}) = 18e^-$$

$$N^\circ e^-_{\text{C}} = N^\circ e^-_{\text{TOTAL}} - N^\circ e^-_{\text{VAL}} = 26e^- - 18e^- = 8e^- \sim \boxed{4 \text{ PEC}}$$



$$N^\circ e^-_{\text{NC}} = N^\circ e^-_{\text{VAL}} - N^\circ e^-_{\text{C}} = 18e^- - 8e^- = 10e^- \sim \boxed{5 \text{ PENC}}$$



Cálculo de la carga formal

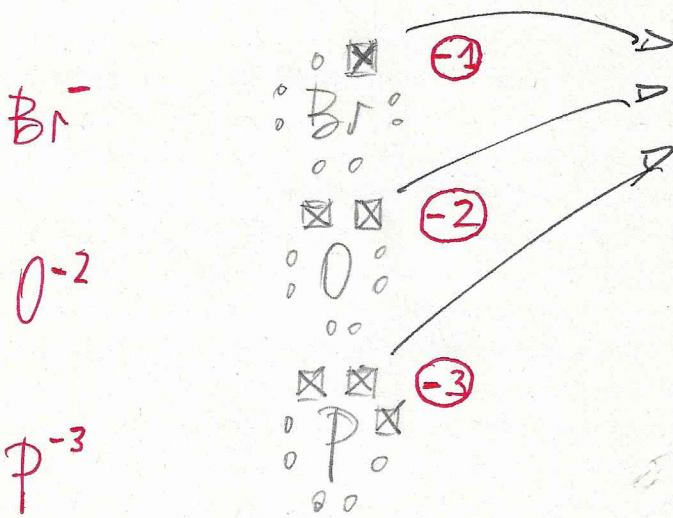
$$C\#(\text{N}) = 5 - \left(2 + \frac{1}{2} \cdot 6\right) = 5 - (2+3) = 5-5 = 0$$

$$C\#(\text{O})_{(1)} = 6 - \left(4 + \frac{1}{2} \cdot 4\right) = 6 - (4+2) = 6-6 = 0$$

$$C\#(\text{O})_{(2)} = 6 - \left(4 + \frac{1}{2} \cdot 4\right) = 6 - (4+2) = 6-6 = 0$$

Ejercicio 16, p67. EDEBE Bach 2.

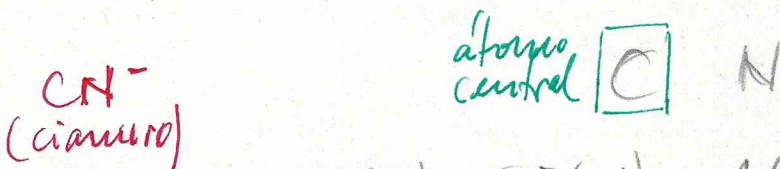
Escribe las estructuras de Lewis de las iones: Br^- , O^{2-} , P^{3-}



Electrones que capta para adquirir la estructura de gas noble.

Ejercicio 17, p67. EDEBE Bach 2

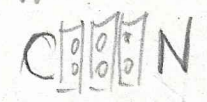
Deduce la estructura de Lewis de los siguientes iones: CN^- , OH^- , ClO_2^- , NO_3^- , SO_4^{2-} , H_3O^+ , NH_4^+



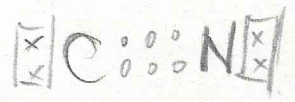
$N^{\circ}e^-_{\text{TOTAL}} = 8e^-(\text{C}) + 8e^-(\text{N}) = 16e^-$ VALENCIA CIANURO

$N^{\circ}e^-_{\text{VAL}} = 4e^-(\text{C}) + 5e^-(\text{N}) + 1e^- = 10e^-$

$N^{\circ}e^-_{\text{C}} = N^{\circ}e^-_{\text{TOTAL}} - N^{\circ}e^-_{\text{VAL}} = 16e^- - 10e^- = 6e^- \rightsquigarrow \boxed{3 \text{ PEC}}$



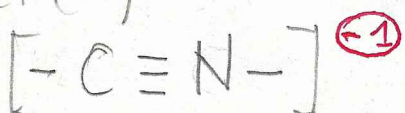
$N^{\circ}e^-_{\text{NC}} = N^{\circ}e^-_{\text{VAL}} - N^{\circ}e^-_{\text{C}} = 10e^- - 6e^- = 4e^- \rightsquigarrow \boxed{2 \text{ ENC}}$



Cálculo carga formal

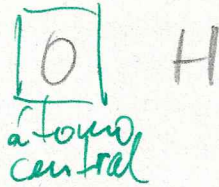
$CF(\text{C}) = 4 - (2 + \frac{1}{2} \cdot 6) = 4 - (2+3) = 4 - 5 = -1$

$CF(\text{N}) = 5 - (2 + \frac{1}{2} \cdot 6) = 5 - (2+3) = 5 - 5 = 0$



En el caso de los iones, la suma de todas las CF será igual a la carga del ion

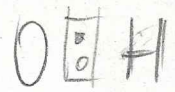
OH^-
(Hidroxido)



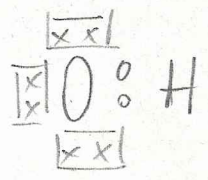
$$N^{\circ}e^-_{\text{TOTAL}} = 8e^- (\text{O}) + 2e^- (\text{H}) = 10e^-$$

$$N^{\circ}e^-_{\text{VAL}} = 6e^- (\text{O}) + 1e^- (\text{H}) + 1e^- = 8e^-$$

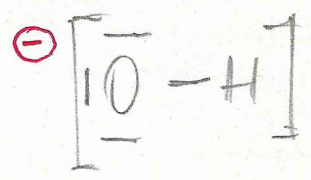
$$N^{\circ}e^-_c = N^{\circ}e^-_{\text{TOTAL}} - N^{\circ}e^-_{\text{VAL}} = 10e^- - 8e^- = 2e^- \rightarrow \boxed{1 \text{ PEC}}$$



$$N^{\circ}e^-_{\text{NG}} = N^{\circ}e^-_{\text{VAL}} - N^{\circ}e^-_c = 8e^- - 2e^- = 6e^- \rightarrow \boxed{3 \text{ PENC}}$$



Es decir:

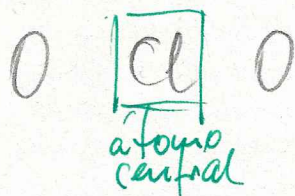


Cálculo carga formal

$$CF(\text{H}) = 1 - (0 + \frac{1}{2} \cdot 2) = 1 - (0 + 1) = \underline{\underline{0}}$$

$$CF(\text{O}) = 6 - (6 + \frac{1}{2} \cdot 2) = 6 - (6 + 1) = \underline{\underline{-1}}$$

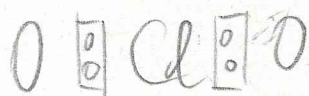
ClO_2^-
(anión cloroso)



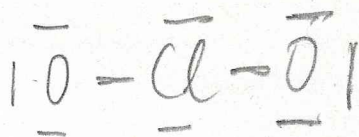
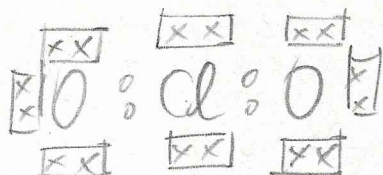
$$N^{\circ}e^-_{\text{TOTAL}} = 8e^- (\text{Cl}) + 2 \times 8e^- (\text{O}) = 24e^-$$

$$N^{\circ}e^-_{\text{VAL}} = 7e^- (\text{Cl}) + 2 \times 6e^- (\text{O}) + 1e^- = 20e^-$$

$$N^{\circ}e^-_{\text{C}} = N^{\circ}e^-_{\text{TOTAL}} - N^{\circ}e^-_{\text{VAL}} = 24e^- - 20e^- = 4e^- \rightarrow \boxed{2 \text{ PEC}}$$



$$N^{\circ}e^-_{\text{NC}} = N^{\circ}e^-_{\text{VAL}} - N^{\circ}e^-_{\text{C}} = 20e^- - 4e^- = 16e^- \rightarrow \boxed{8 \text{ PENC}}$$



Cálculo carga formal

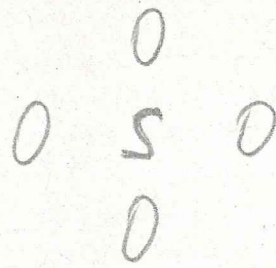
$$CF(\text{O}) = 6 - \left(6 + \frac{1}{2} \cdot 2\right) = 6 - (6 + 1) = 6 - 7 = \underline{\underline{-1}}$$

$$CF(\text{Cl}) = 7 - \left(4 + \frac{1}{2} \cdot 4\right) = 7 - (4 + 2) = 7 - 6 = \underline{\underline{+1}}$$



La suma de todas las cargas formales es igual a la carga del ión.

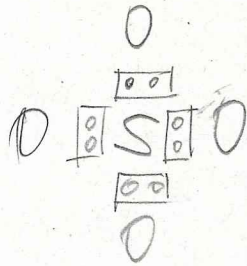
SO_4^{-2}
(anión sulfato)



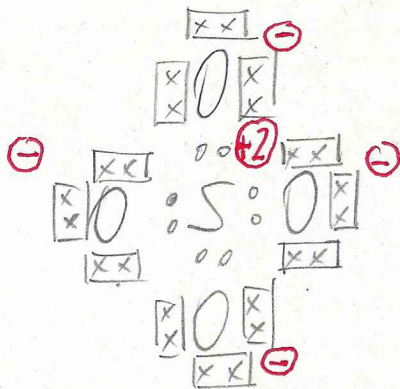
$$N^{\circ}e^{-}_{TOTAL} = 8e^{-}(S) + 4 \times 8e^{-}(O) = 40e^{-}$$

$$N^{\circ}e^{-}_{VAL} = 6e^{-}(S) + 4 \times 6e^{-}(O) + 2e^{-} = 32e^{-}$$

$$N^{\circ}e^{-}_{c} = N^{\circ}e^{-}_{TOTAL} - N^{\circ}e^{-}_{VAL} = 40e^{-} - 32e^{-} = 8e^{-} \rightarrow \boxed{4PEC}$$



$$N^{\circ}e^{-}_{NC} = N^{\circ}e^{-}_{VAL} - N^{\circ}e^{-}_{c} = 32e^{-} - 8e^{-} = 24e^{-} \rightarrow \boxed{12PECNC}$$

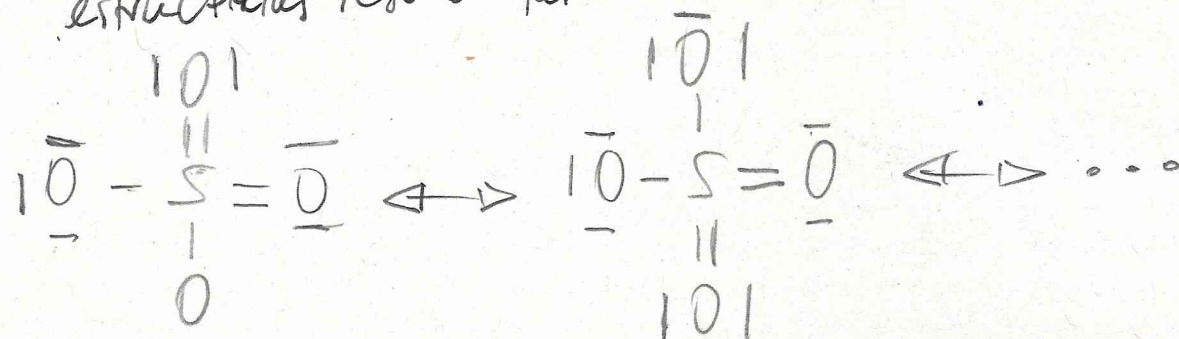


Calculo carga formal

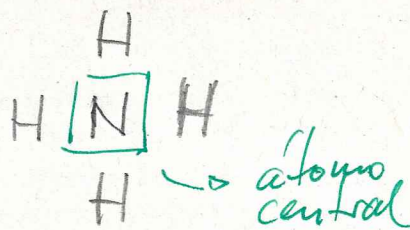
$$CF(S) = 6 - (0 + \frac{1}{2} \cdot 8) = 6 - 4 = +2$$

$$CF(O) = 6 - (6 + \frac{1}{2} \cdot 2) = 6 - (6 + 1) = 6 - 7 = -1$$

En realidad, su estructura sería un híbrido entre varias estructuras resonantes.



NH_4^+
(catión amonio)

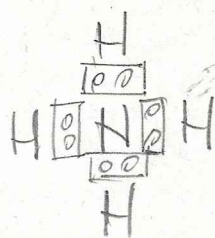


$$N^{\circ}e^-_{\text{TOTAL}} = 8e^- (\text{N}) + 4 \times 2e^- (\text{H}) = 16e^-$$

$$N^{\circ}e^-_{\text{VAL}} = 5e^- (\text{N}) + 4 \times 1e^- - 4e^- = 8e^-$$

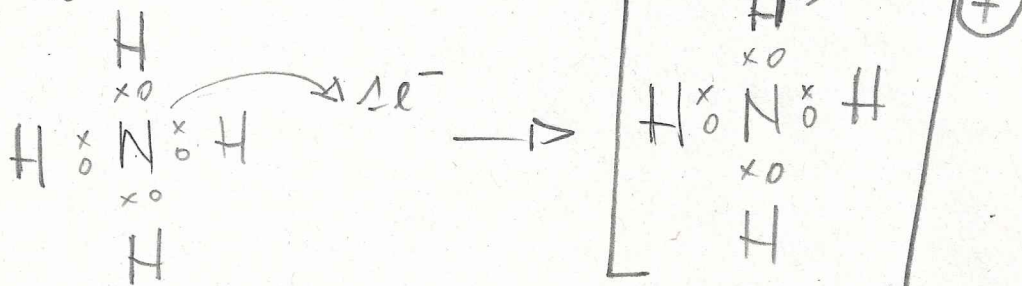
CARGA ION

$$N^{\circ}e^-_{\text{C}} = N^{\circ}e^-_{\text{TOTAL}} - N^{\circ}e^-_{\text{VAL}} = 16e^- - 8e^- = 8e^- \Rightarrow \boxed{4 \text{ PEC}}$$



Cada átomo de H aporta un electrón

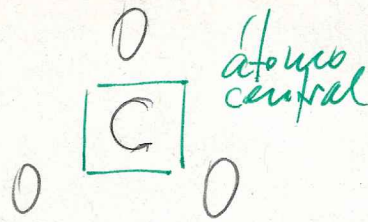
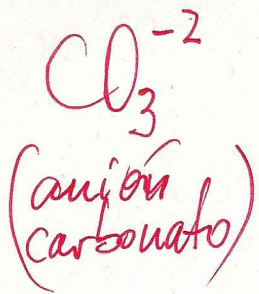
$$N^{\circ}e^-_{\text{NC}} = N^{\circ}e^-_{\text{VAL}} - N^{\circ}e^-_{\text{C}} = 8e^- - 8e^- = 0 \Rightarrow \boxed{0 \text{ PENC}}$$



El N tendría que aportar $5e^-$ y solo aporta $4e^-$, de ahí la carga \oplus .

Cálculo carga formal

$$CF(\text{N}) = 5 - (0 + \frac{1}{2} \cdot 8) = 5 - 4 = \underline{\underline{+1}}$$

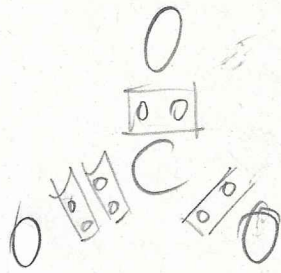


$$N^{\circ}e^{-}_{\text{TOTAL}} = 8e^{-}(\text{C}) + 3 \times 8e^{-}(\text{O}) = 32e^{-}$$

$$N^{\circ}e^{-}_{\text{VAL}} = 4e^{-}(\text{C}) + 3 \times 6e^{-}(\text{O}) + 2e^{-} = 24e^{-}$$

$$N^{\circ}e^{-}_{\text{C}} = N^{\circ}e^{-}_{\text{TOTAL}} - N^{\circ}e^{-}_{\text{VAL}} = 32e^{-} - 24e^{-} = 8e^{-} \Rightarrow \boxed{4 \text{ PEC}}$$

CARGA ION



$$N^{\circ}e^{-}_{\text{NC}} = N^{\circ}e^{-}_{\text{VAL}} - N^{\circ}e^{-}_{\text{C}} = 24e^{-} - 8e^{-} = 16e^{-} \Rightarrow \boxed{8 \text{ PENC}}$$

$$CF(\text{O}) = 6 - (6 + \frac{2}{2}) = -1$$

$\boxed{\text{O}}$

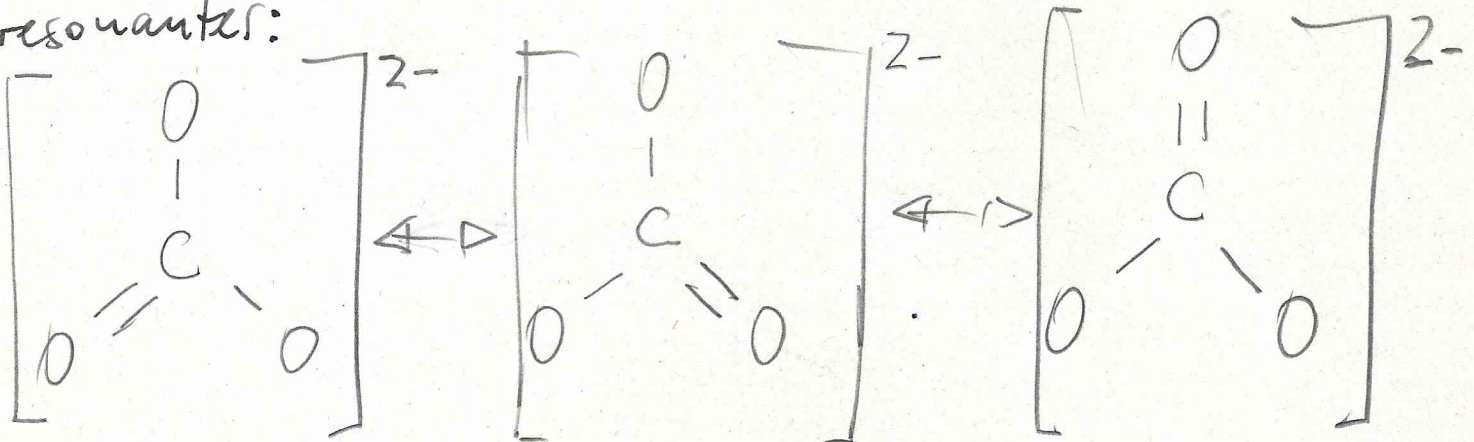
$$CF(\text{C}) = 4 - (0 + \frac{8}{2}) = 4 - 4 = 0$$

$$CF(\text{O}) = 6 - (4 + \frac{4}{2}) = 0$$

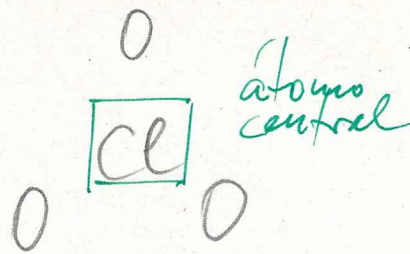
$\boxed{\text{O}}$

$$CF(\text{O}) = 4 - (6 + \frac{2}{2}) = -1$$

En realidad la estructura aparece como 3 formas resonantes:



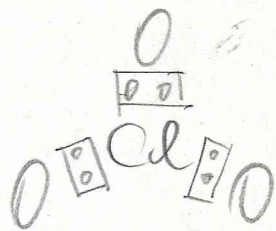
ClO_3^-
(anión clorato)



$$N^\circ e^-_{\text{TOTAL}} = 8e^-(\text{Cl}) + 3 \times 8e^-(\text{O}) = 32e^- \rightarrow \text{CARGA ION}$$

$$N^\circ e^-_{\text{VAL}} = 7e^-(\text{Cl}) + 3 \times 6e^-(\text{O}) + 1e^- = 26e^-$$

$$N^\circ e^-_{\text{C}} = N^\circ e^-_{\text{TOTAL}} - N^\circ e^-_{\text{VAL}} = 32e^- - 26e^- = 6e^- \Rightarrow \boxed{3 \text{ PEC}}$$



$$N^\circ e^-_{\text{NC}} = N^\circ e^-_{\text{VAL}} - N^\circ e^-_{\text{C}} = 26e^- - 6e^- = 20e^- \Rightarrow \boxed{10 \text{ PENC}}$$

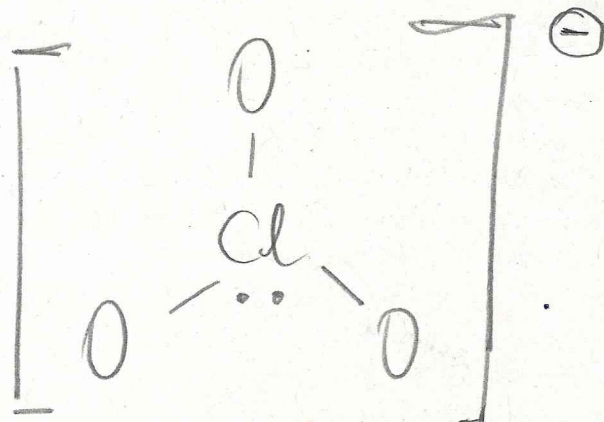
$$C\#(\text{O}) = 6 - (6 + \frac{2}{2}) = -1$$

$$\begin{array}{c} \boxed{\times \times} \\ \boxed{\times} \text{O} \boxed{\times} \\ \circ \circ \end{array} \rightarrow C\#(\text{Cl}) = 7 - (2 + \frac{6}{2}) = +2$$

$$C\#(\text{O}) = 6 - (6 + \frac{2}{2}) = -1$$

$$\begin{array}{c} \boxed{\times \times} \\ \boxed{\times} \text{O} \boxed{\times} \\ \boxed{\times \times} \end{array} \rightarrow C\#(\text{O}) = 6 - (6 + \frac{2}{2}) = -1$$

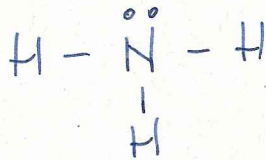
Luego:



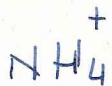
El nitrógeno tiene 5 e⁻ de valencia. Comprueba que se han asignado correctamente las cargas formales de los átomos de nitrógeno en las siguientes estructuras de Lewis:



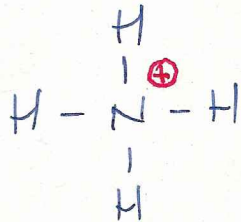
AMONIACO



$$\text{CF}(\text{N}) = 5 - (2 + \frac{1}{2} \cdot 6) = 5 - 5 = \boxed{0}$$



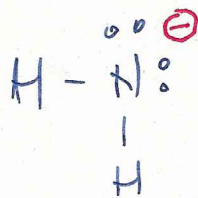
CATION
AMONIO



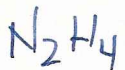
$$\text{CF}(\text{N}) = 5 - (0 + \frac{1}{2} \cdot 8) = 5 - 4 = \boxed{+1}$$



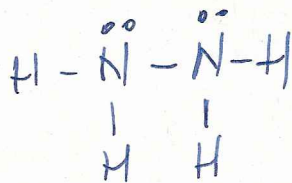
ANION
AMIDA



$$\text{CF}(\text{N}) = 5 - (4 + \frac{1}{2} \cdot 4) = 5 - 6 = \boxed{-1}$$

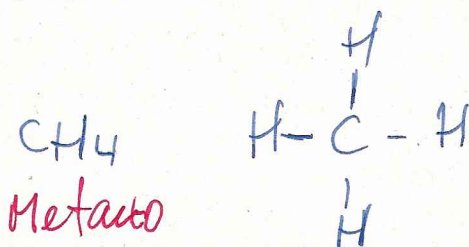


HIDRAZINA

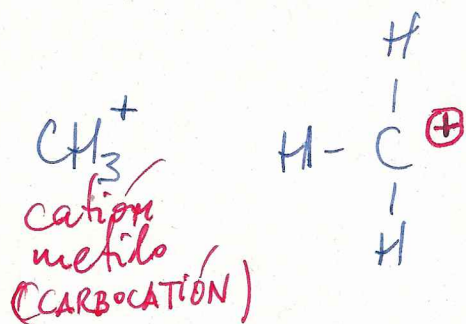


$$\text{CF}(\text{N}) = 5 - (2 + \frac{1}{2} \cdot 6) = 5 - 5 = \boxed{0}$$

El carbono tiene $4e^-$ de valencia. Tómese un momento para estar seguro que se entiende la asignación de cargas formales a los átomos de carbono en las siguientes estructuras de Lewis:

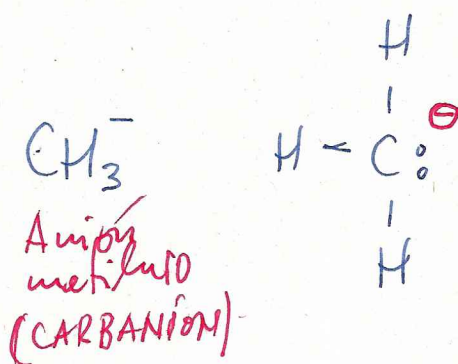


$$CF(\text{C}) = 4 - (0 + \frac{1}{2} 8) = 4 - 4 = \boxed{0}$$



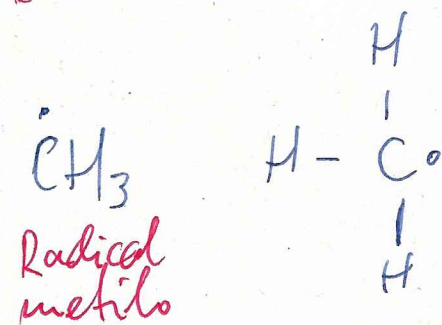
$$CF(\text{C}) = 4 - (0 + \frac{1}{2} 6) = 4 - 3 = \boxed{+1}$$

Un CARBOCATION es una especie con un carbono cargado positivamente.



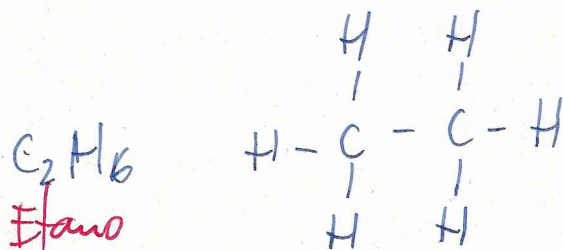
$$CF(\text{C}) = 4 - (2 + \frac{1}{2} 6) = 4 - 5 = \boxed{-1}$$

Un CARBOANION \rightarrow CARBANION es una especie con un carbono cargado negativamente.



$$CF(\text{C}) = 4 - (1 + \frac{1}{2} 6) = 4 - 4 = \boxed{0}$$

Un radical es una especie con un átomo de carbono que tiene un electrón libre.



$$CF(\text{C}) = 4 - (0 + \frac{1}{2} 8) = 4 - 4 = \boxed{0}$$

El hidrógeno tiene un electrón de valencia, y cada halógeno (F, Cl, Br, I) tiene siete electrones de valencia, por lo que cada una de las siguientes especies tienen las cargas formales que se indican.

Ión hidrógeno



Indica que tiene 1e⁻ de menos.

Ión hidruro

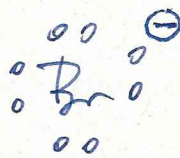


Indica que tiene 1e⁻ de más.

Radical hidrógeno
(átomo de hidrógeno)

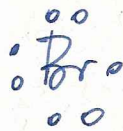


Ión bromuro

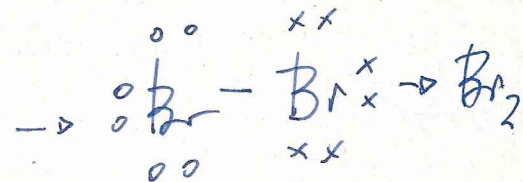
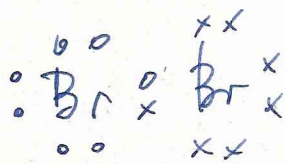


Indica que tiene 1e⁻ de más.

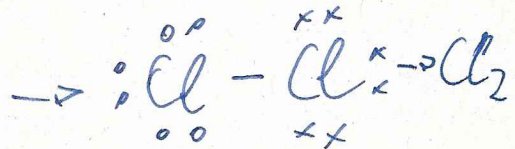
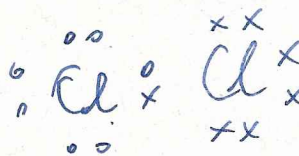
Radical bromo
(átomo bromo)



Bromo

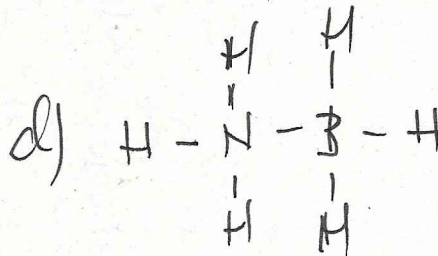
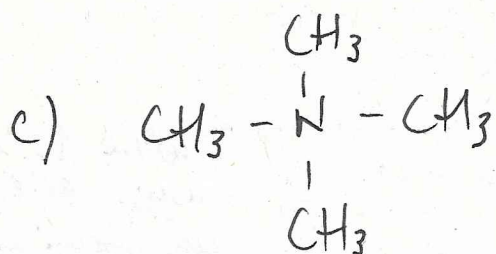
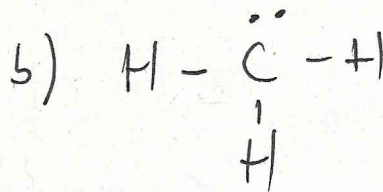
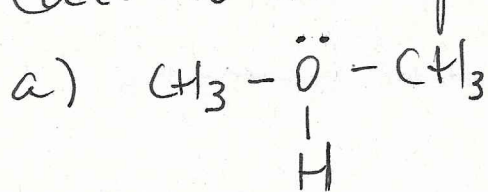


Cloro



Problema 12, p13

Calcule la carga formal de cada átomo.

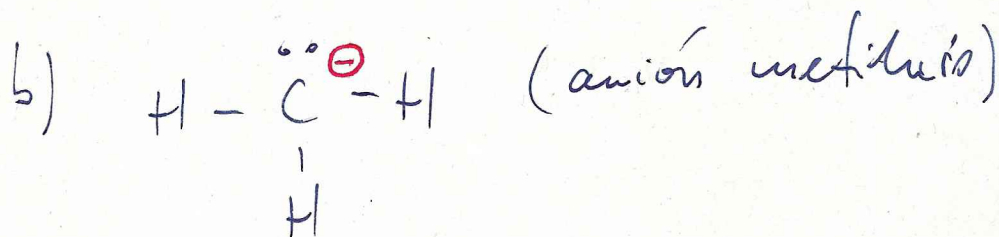


$$CF(\text{H}) = 1 - \left(0 + \frac{2}{2}\right) = 1 - 1 = 0$$

$$CF(\text{C}) = 4 - \left(0 + \frac{8}{2}\right) = 4 - 4 = 0$$

$$CF(\text{O}) = 6 - \left(2 + \frac{6}{2}\right) = 6 - 5 = \boxed{+1}$$

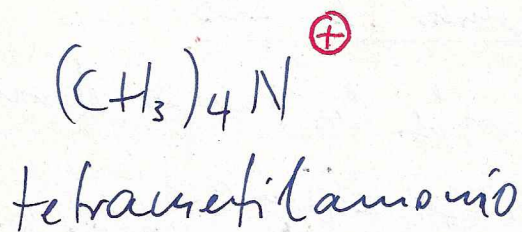
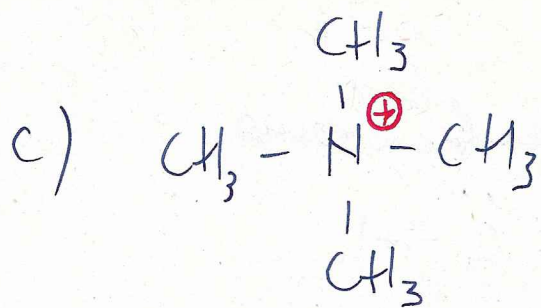
Le faltaria 1e⁻ respecto a la conf. electrónica si estuviera libre.



$$CF(\text{H}) = 1 - \left(0 + \frac{2}{2}\right) = 1 - 1 = 0$$

$$CF(\text{C}) = 4 - \left(2 + \frac{6}{2}\right) = 4 - 5 = \boxed{-1}$$

Le faltaria un e⁻ de más respecto a la conf. elec. del átomo de carbono aislado.

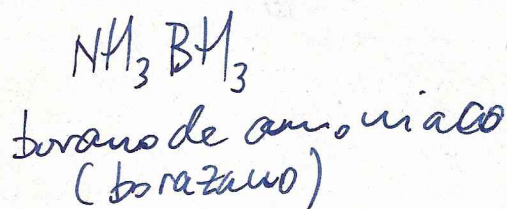
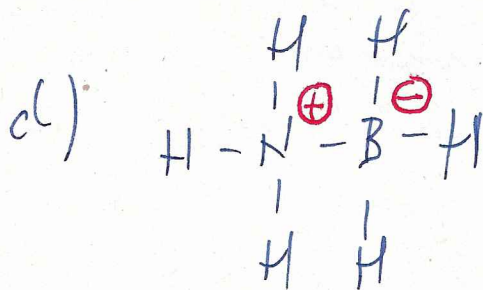


$$CF(\text{H}) = 1 - \left(0 + \frac{2}{2}\right) = 1 - 1 = 0$$

$$CF(\text{C}) = 4 - \left(0 + \frac{8}{2}\right) = 4 - 4 = 0$$

$$CF(\text{N}) = 5 - \left(0 + \frac{8}{2}\right) = 5 - 4 = \boxed{+1}$$

também 1e⁻ de menos respecto del átomo aislado



$$CF(\text{H}) = 1 - \left(0 + \frac{2}{2}\right) = 1 - 1 = 0$$

$$CF(\text{N}) = 5 - \left(0 + \frac{8}{2}\right) = 5 - 4 = \boxed{+1}$$

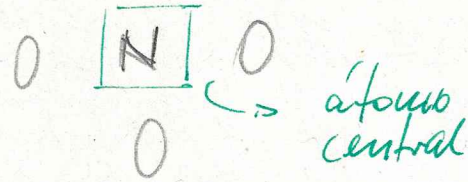
$$CF(\text{B}) = 3 - \left(0 + \frac{8}{2}\right) = 3 - 4 = \boxed{-1}$$

Problema 13, p15. Fundamentos de química orgánica. Paula Yurkaniš Bruce. Pearson. 2015.

Dibuja las estructuras de Lewis de las siguientes especies:

a) NO_3^- , b) NO_2^+ , c) $^- \text{C}_2\text{H}_5$, d) $^+ \text{C}_2\text{H}_5$, e) CH_3NH_3^+

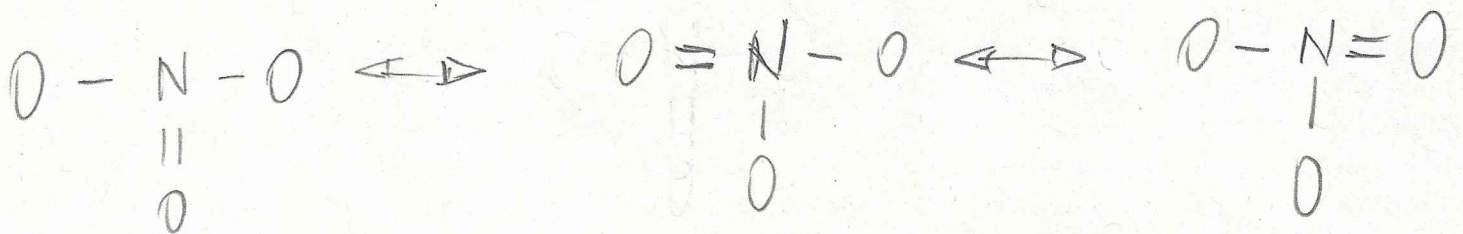
a) NO_3^-
(nitrato)



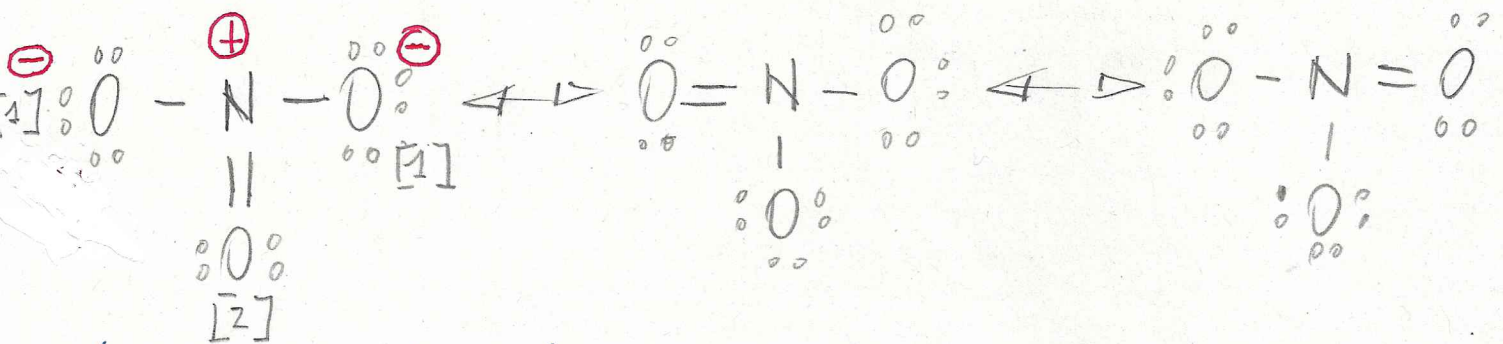
$$N^{\circ}e^-_{\text{TOTAL}} = 8e^-(\text{N}) + 3 \times 8e^-(\text{O}) = 32e^-$$

$$N^{\circ}e^-_{\text{VAL}} = 5e^-(\text{N}) + 3 \times 6e^-(\text{O}) + \underbrace{1e^-}_{\text{CARGA ION}} = 24e^-$$

$$N^{\circ}e^-_{\text{C}} = N^{\circ}e^-_{\text{TOTAL}} - N^{\circ}e^-_{\text{VAL}} = 32e^- - 24e^- = 8e^- \Rightarrow \boxed{4\text{PEC}}$$



$$N^{\circ}e^-_{\text{NC}} = N^{\circ}e^-_{\text{VAL}} - N^{\circ}e^-_{\text{C}} = 24e^- - 8e^- = 16e^- \Rightarrow \boxed{8\text{PENC}}$$



Cálculo carga formal

$$CF(\text{O})_{[1]} = 6 - \left(6 + \frac{1}{2} \cdot 2\right) = 6 - 7 = \underline{\underline{-1}}$$

$$CF(\text{O})_{[2]} = 6 - \left(4 + \frac{1}{2} \cdot 4\right) = 6 - 6 = \underline{\underline{0}}$$

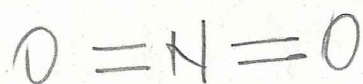
$$CF(\text{N}) = 5 - \left(0 + \frac{1}{2} \cdot 8\right) = 5 - 4 = \underline{\underline{+1}}$$



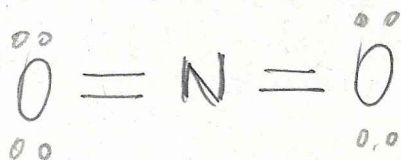
$$N^{\circ}e^{-}_{\text{TOTAL}} = 8e^{-}(\text{N}) + 2 \times 8e^{-}(\text{O}) = 24e^{-}$$

$$N^{\circ}e^{-}_{\text{VAL}} = 5e^{-}(\text{N}) + 2 \times 6e^{-}(\text{O}) - \underbrace{1e^{-}}_{\text{CARGA ION}} = 16e^{-}$$

$$N^{\circ}e^{-}_{\text{C}} = N^{\circ}e^{-}_{\text{TOTAL}} - N^{\circ}e^{-}_{\text{VAL}} = 24e^{-} - 16e^{-} = 8e^{-} \Rightarrow \boxed{4 \text{ PEC}}$$



$$N^{\circ}e^{-}_{\text{NC}} = N^{\circ}e^{-}_{\text{VAL}} - N^{\circ}e^{-}_{\text{C}} = 16e^{-} - 8e^{-} = 8e^{-} \Rightarrow \boxed{4 \text{ PENC}}$$

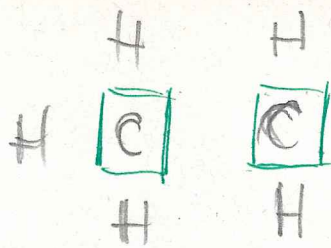
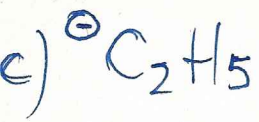


Cálculo carga formal

$$CF(\text{O}) = 6 - (4 + \frac{1}{2} \cdot 4) = 6 - 6 = \underline{\underline{0}}$$

$$CF(\text{N}) = 5 - (0 + \frac{1}{2} \cdot 8) = 5 - 4 = \underline{\underline{+1}}$$

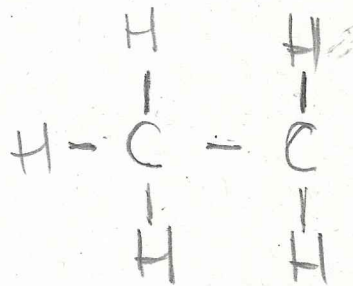




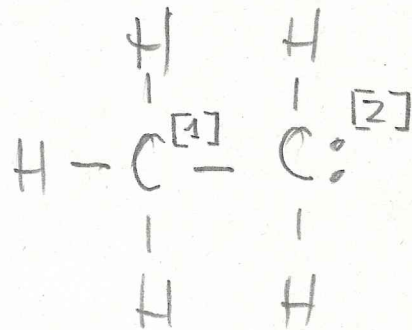
$$N^{\circ}e^-_{TOTAL} = 2 \times 8e^- (C) + 5 \times 2e^- (H) = 26e^-$$

$$N^{\circ}e^-_{VAL} = 2 \times 4e^- (C) + 5 \times 1e^- (H) + 1e^- = 14e^-$$

$$N^{\circ}e^-_C = N^{\circ}e^-_{TOTAL} - N^{\circ}e^-_{VAL} = 26e^- - 14e^- = 12e^- \xrightarrow{ION} \boxed{6PEEC}$$



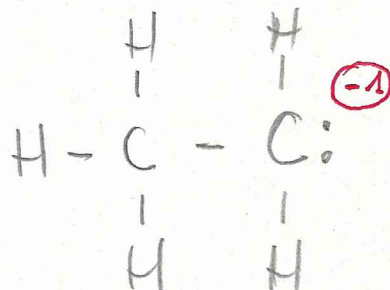
$$N^{\circ}e^-_{NC} = N^{\circ}e^-_{VAL} - N^{\circ}e^-_C = 14e^- - 12e^- = 2e^- \Rightarrow \boxed{1PEEC}$$

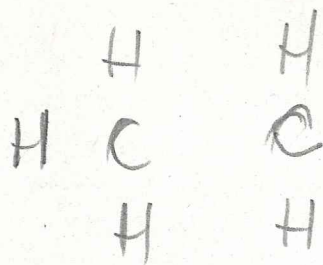


Calculo carga formal

$$CF(C)_{[1]} = 4 - \left(0 + \frac{1}{2} \cdot 8\right) = 4 - 4 = 0$$

$$CF(C)_{[2]} = 4 - \left(2 + \frac{1}{2} \cdot 6\right) = 4 - 5 = -1$$

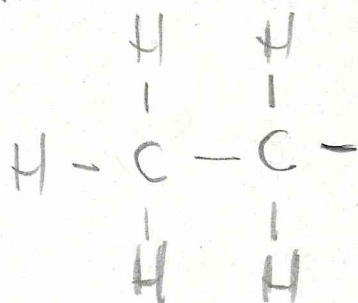




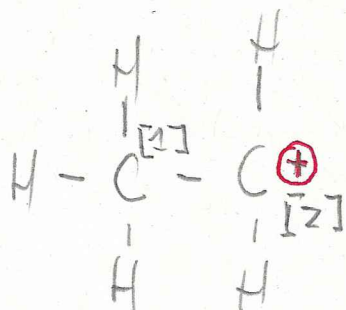
$$N^{\circ}e^-_{\text{TOTAL}} = 2 \times 8e^- (\text{C}) + 5 \times 2e^- (\text{H}) = 26e^-$$

$$N^{\circ}e^-_{\text{VAL}} = 2 \times 4e^- (\text{C}) + 5 \times 1e^- (\text{H}) = 12e^-$$

$$N^{\circ}e^-_{\text{C}} = N^{\circ}e^-_{\text{TOTAL}} - N^{\circ}e^-_{\text{VAL}} = 26e^- - 12e^- = 14e^- \Rightarrow \boxed{7 \text{ PEC}}$$



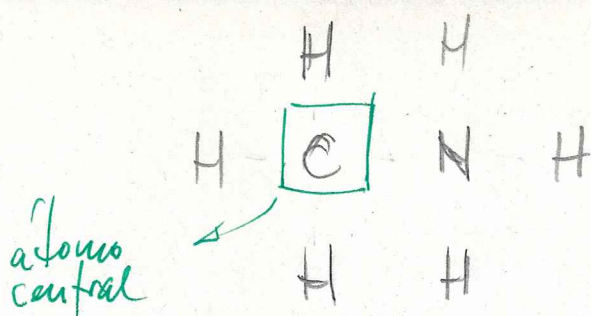
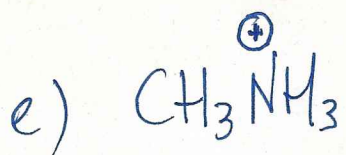
$$N^{\circ}e^-_{\text{NC}} = N^{\circ}e^-_{\text{VAL}} - N^{\circ}e^-_{\text{C}} = 12e^- - 14e^- = -2e^- \Rightarrow \boxed{1 \text{ PENC}}$$



Cálculo carga formal

$$CF(\text{C})_{[1]} = 4 - (0 + \frac{1}{2} \cdot 8) = 4 - 4 = \underline{\underline{0}}$$

$$CF(\text{C})_{[2]} = 4 - (0 + \frac{1}{2} \cdot 6) = 4 - 3 = \underline{\underline{+1}}$$

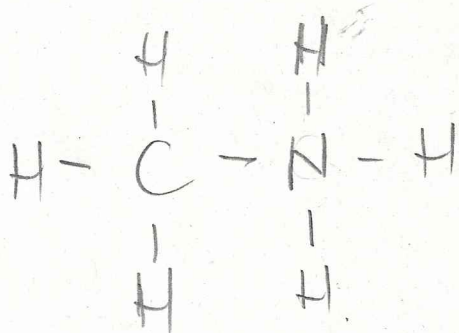


$$N^{\circ}e^-_{\text{TOTAL}} = 8e^-(\text{C}) + 8e^-(\text{N}) + 6 \times 2e^-(\text{H}) = 28e^-$$

$$N^{\circ}e^-_{\text{VAL}} = 4e^-(\text{C}) + 5e^-(\text{N}) + 6 \times 1e^-(\text{H}) - 1e^- = 14e^-$$

±ON

$$N^{\circ}e^-_{\text{C}} = N^{\circ}e^-_{\text{TOTAL}} - N^{\circ}e^-_{\text{VAL}} = 28e^- - 14e^- = 14e^- \Rightarrow \boxed{7 \text{ PEC}}$$



$$N^{\circ}e^-_{\text{NC}} = N^{\circ}e^-_{\text{VAL}} - N^{\circ}e^-_{\text{C}} = 14e^- - 14e^- = 0$$

Cálculo carga formal

$$CF(\text{C}) = 4 - (0 + \frac{1}{2} \cdot 8) = 4 - 4 = 0$$

$$CF(\text{N}) = 5 - (0 + \frac{1}{2} \cdot 8) = 5 - 4 = +1$$

