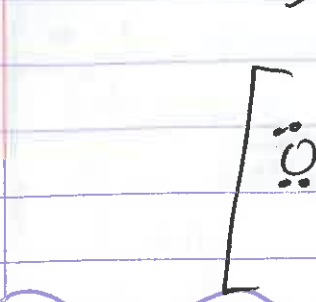
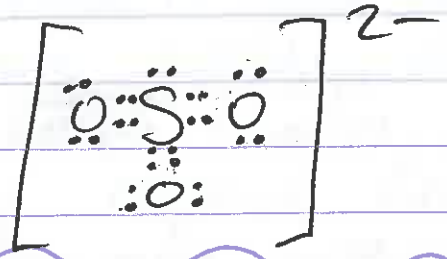
ex. SO_3^{2-}

6 $\quad$ 6x3 $\quad$ 2 $\quad$ 2-



26 valence e^-



26 valence e^-

How do you determine the best Lewis structure? (individual atoms in a molecule)

Formal Charge: the difference between the # of valence e^- on the free atom & the # of valence e^- assigned to the atom in the molecule.

$$\text{Formal Charge} = \left(\begin{matrix}\#\text{ valence } e^- \\ \text{in free atom}\end{matrix}\right) - \left(\begin{matrix}\#\text{ valence } e^- \text{ assigned} \\ \text{to the atom in the} \\ \text{molecule}\end{matrix}\right)$$

- Assigning valence e^- in a molecule:
  1) lone pairs on an atom belong to the atom
  2) shared (bonded) e^- are shared equally between the two atoms involved in the bond.

$$\#\text{ assigned } e^- = \left(\begin{matrix}\#\text{ lone} \\ \text{pair } e^-\end{matrix}\right) + \frac{1}{2}\left(\begin{matrix}\#\text{ shared} \\ e^-\end{matrix}\right)$$

H = 0 + ½(2) = 1

O = 4 + ½(4) = 6 ✓

Rules: The sum of the formal charges in a molecule/ion must add up to the overall charge of the molecule or ion.

✱ follow these rules to determine the Best Lewis Structure(s) for a "more complex" compound.

rules continued:

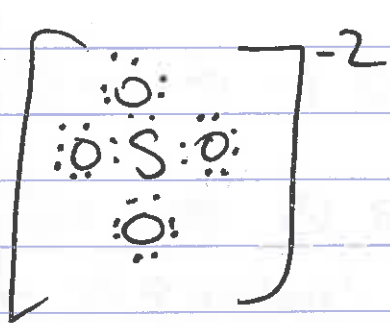
- if there is more than one Lewis Structure possible, the one w/ the formal charges closest to zero & any negative formal charges on the more electronegative atoms is the better structure.

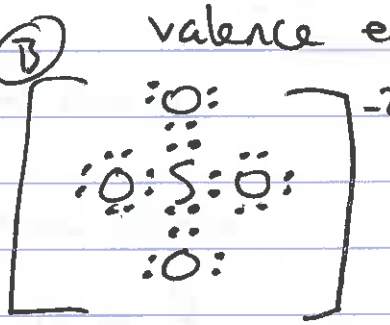
Better structures

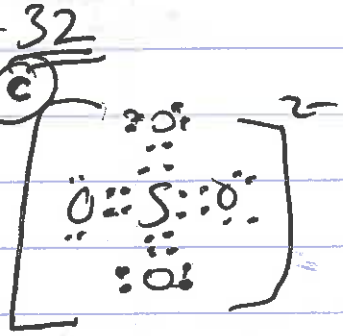
1. - formal charges closer to zero.
2. - negative formal charges on more electronegative atoms.

Ex: SO_4^{2-} S=6 4O=4(6) 2- =2

valence e⁻ = 32

(A) 

(B) 

(C) 

Formal charges for A:

free atom · Ö · ⇒ 6 valence e⁻

in molecule :Ö:⁻ ⇒ 7 valence e⁻ assigned

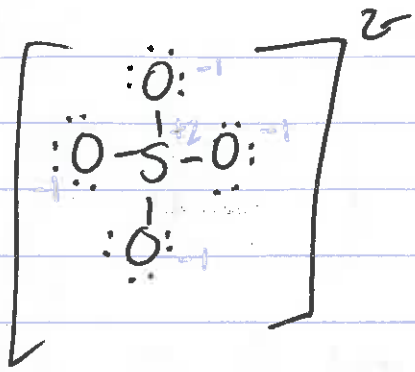
Formal Charge :Ö:⁻ ⇒ 6 − 7 = −1

· Ṡ · ⇒ 6 valence e⁻

−Ṡ− ⇒ 4 valence e⁻ assigned

Formal Charge −Ṡ− ⇒ 6 − 4 = +2

(A)

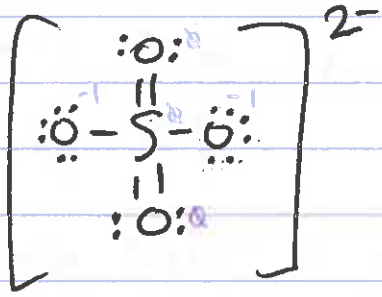


−1
−1
−1
−1
+2
−2 ✓ total charge

✓ more electronegative atom has (−) charge

★ valid Lewis dot structure.

(B)



−1
−1
0
0
0
−2 ✓ total charge

✓ more electronegative

:Ö:⁻ ⇒ −1 formal charge

:Ö: ⇒ 0 formal charge

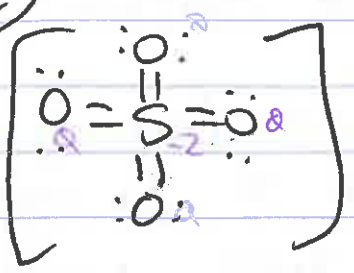
free atom ·Ö: ⇒ 6 valence e⁻
in the molecule :Ö: ⇒ 6 valence e⁻
6 − 6 = 0

⇒ 0

free atom ·S· ⇒ 6 valence e⁻
in the molecule ·S· ⇒ 6 valence e⁻
6 − 6 = 0

★ Valid Lewis Dot Structure

(C)



0
0
0
0
-2
-2

✗ more electronegative atom has (-) charge

✓ total charge.

$\ddot{O}=$ ⇒ 0 formal charge.

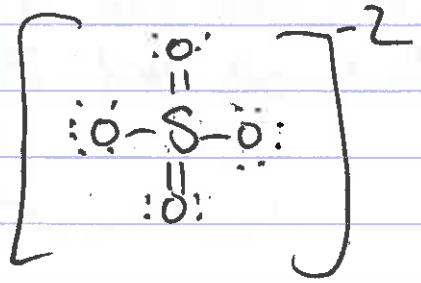
$=\ddot{S}=$ ⇒ -2 formal charge.

free atom $\cdot\ddot{S}:$ ⇒ 6 $\quad 6-8=-2$

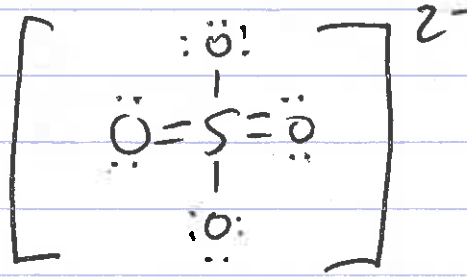
$=\ddot{S}=$ ⇒ 8

⇒ Not a good Lewis Structure.

So... (B) is the Best

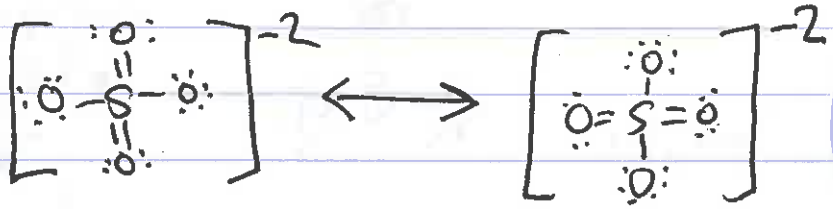


why not



These Lewis structures ar equivalents.

Resonance: more than one equivalent Lewis dot structure is possible.



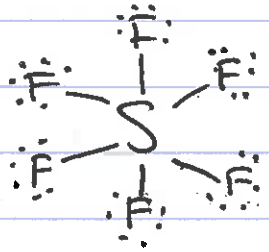
if resonance exists you must show it!

Exceptions to the Octet Rule.

Expanded Octet: (elements in period 3 & beyond only - because they have d orbitals available -)

- The central atom has more than 8 e^- around it.

ex: SF_6 48 valence e^-



bonded e^- = 12 e^-

6 F: = 36 e^-

48 e^- ✓

F has formal charge of 0
S has formal charge of 0

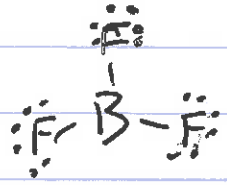
0 ✓

---

e^- deficient: some atoms will commonly form compounds where they have fewer than 8 valence e^-.

E. Boron

BF_3



24 e^-

24 e^- ✓