Problem-solving Examples 12

Write Lewis structure for

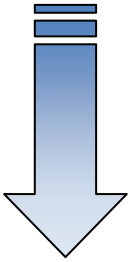
a) CO (Carbon monoxide)

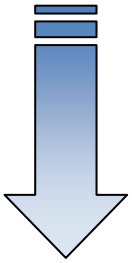
b) N_2O (laughing gas)

c) HN_3 (hydrazoic acid - explosive compound)

d) CN^- (cyanide ion - poison)

Solution





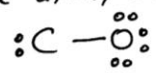
a) Sum of valence electrons in CO:

$$[1 \times C(4e)] + [1 \times O(6e^-)] = 10e^-$$

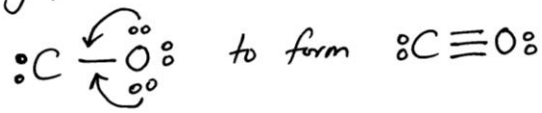
- We start with skeleton structure.

$$C - O$$

- Putting lone pairs around C and O – satisfy octet rule for on of the atom, but not both.



Therefore to make up for the deficiency, lone pairs will become bonding pairs.



b) N_2O (laughing gas)

- Sum of valence e^- = $[2 \times N(5e^-)] + [1 \times O(6e^-)]$
  = $(10 + 6)e^- = 16e^-$

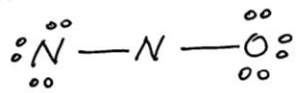
- The skeleton structure

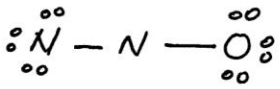
$$N - N - O$$

2 bond (single)

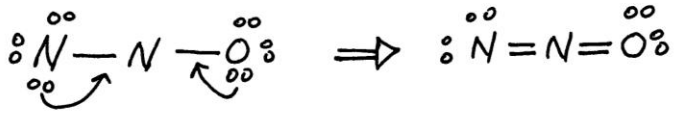
balance of $16 - 4 = 12e^-$

- Placing lone pair on the terminal atom but leaves the central N atom.





The lone pair to be converted to bonding pairs.



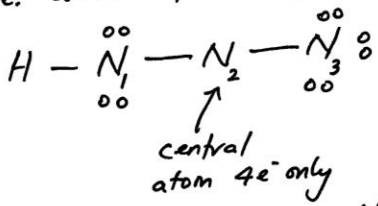
c) HN_3 (hydrazoic acid)

- Sum of valence electron = $[1 \times H(1e^-)] + [3 \times N(5)]$
  $= (1 + 15)e^- = 16e^-$
- Because hydrogen form one bond (single bond), the nitrogen must be central atom
- Skeleton structure.

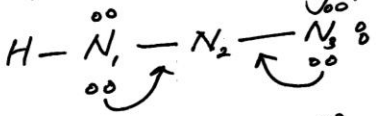
$$H - N_1 - N_2 - N_3$$

$[16e^- - 3(2e^-)] = 16 - 6 = 10e^-$

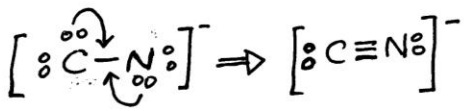
- Remaining e^- should be placed at the surrounding atom, i.e. atom N_1 and N_3 atom.



- So lone pair for N_1 and N_2 (terminal atom) can be shifted to a bonding pair.



d) Sum of valence e^- in CN^- = $[1 \times 1(4e)] + [1 \times 1(5e^-)] + 1e^-$
= $4 + 5 + 1 = 10e^-$



Remaining electron = 10e – 2e(bonding e) = 8e
This 8 e to be placed at both atom – satisfy octet
BUT each has only 6e – So the lone pair shifted to become bonding pair

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