

# 5

## Using Models to Predict Molecular Structure

Name Jaqueline Martinez

Time 1:00

Date

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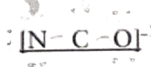
The following questions are designed to lead you to the appropriate structures for the cyanate ion,  $\text{NCO}^-$ . Cyanate ion has a linear structure with the atoms arranged NCO. The "steps" refer to the steps in drawing Lewis structures as described in the lab discussion.

- Find the total number of valence electrons in  $\text{NCO}^-$  (step 2): 16  
 $\text{N} + \text{C} + \text{O}^-$
- Draw a single bond from the central atom to each of the other two atoms (step 3):



- Subtract the number of bonding electrons from the total number of valence electrons (step 3): 12  $16 - 4 \rightarrow 12$

- Redraw the structure above, adding the remaining electrons as lone pairs. Place the electrons around the outer atoms first, then the remaining electrons, if any, around the central atom (step 4):



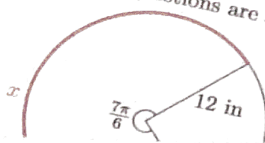
$$\begin{array}{l} 5 + 4 + 6 + 1 \\ 5 + 4 + 7 = 16 \end{array}$$

$$\begin{array}{l} \text{N} = 5 \\ \text{O} = 4 \\ \text{O} = 6 \text{ but } \text{O}^- = +1 \\ 6 + 1 = 7 \end{array}$$

SAMPLE

increase

Following questions are about the pictures below:

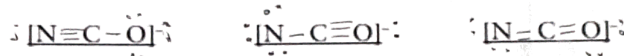


51 ■

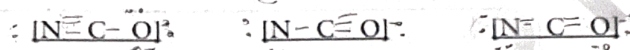
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5. Find three ways to arrange the electrons to achieve an octet around each atom. Multiple bonds may be necessary (step 5):



6. Redraw these structures below and assign formal charges to each atom (step 7):

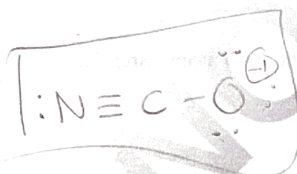


7. Cross out any structures above which have the highest formal charges or in which the most electronegative atom has a positive formal charge (these structures are highly disfavored). Circle the structure with the lowest formal charges and the negative charge on the most electronegative atom (this is the most stable structure) (step 7):

$$\begin{array}{l} n=5 \\ c=4 \\ o=6+1=7 \end{array}$$

16 valence electrons

N	5-5=0	N	5-1=-2	N	5-6=-1
C	4-4=0	C	4-4=0	C	4-4=0
O	6-7=-1	O	6-5=1	O	6-6=0



negative charge → electronegative element  
most stable electron → closest to 8