Lewis Structures

"Everything starts from a dot."

— Wassily Kandinsky

Name: _____

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Date: _____

1. For each atom or ion below, write the number of valence electrons and draw the **Lewis Symbol**.

Cl # val e O # val e K # val e

Br^{1-} # val e N^{3-} # val e Al^{3+} # val e

2. Draw the **Lewis Structure** for each diatomic molecule or ion below. Start by identifying the number of valence electrons.

H_2 # val e CO # val e N_2 # val e

OH^{1-} # val e CO^{2-} # val e CN^{1-} # val e

3. Draw the lewis structure for each polyatomic molecule or ion below.

C_2H_4 $SCCl_2$ $HNBrF$

HCO_2H $BrOH$ C_2H_2

CH_3CHCH_2 $FNCH_2$ H_3O^{1+}

4. Draw the lewis structure for each ionic compound below. Note: some ionic compounds may contain polyatomic ions with covalent bonds.

$LiCl$ MgF_2 Na_3N

NH_4Br $NaOH$ KCN

5. Draw the lewis structure for each molecular compound below. Note: some compounds have an odd number of electrons.

NO ClO_3 NS_2

6. Draw the lewis structure for each compound below. Note: rarely, some central atoms in the 3rd period and below may achieve an expanded octet.

IBr_3 PCl_5 SO_4^{2-}

XeF_6 ClO_4^{1-} $POCl_3$

7. The nitrate ion (NO_3^{1-}) has three possible lewis structures. Draw each and assign formal charge to all atoms in the structures.

8. Draw at least two resonance structure of each molecule below.

(a) $CH_3CO_2^{1-}$ (c) O_3 (c) H_2NCHO

9. Not all resonance structures are equal.

a. The cyanate ion (NCO^{1-}) has a skeleton of N-C-O. Draw three resonance structures of and assign formal charge to each atom in the structures. Circle the most stable cyanate ion.

b. The isocyanate ion (CNO^{1-}) has a skeleton of C-N-O. Draw three resonance structures of and assign formal charge to each atom in the structures. Circle the most table isocyante ion.

c. Which is more stable, the ion you circled in (a) or the ion you circled in (b)? Why?

10. The molecular compound boron trifluoride (BF_3) has at least four possible Lewis structures. Draw resonance structures and assign formal charge. Note: negative charge on a central atom is very unlikely — this is the main reason some atoms prefer less than a full octet of electrons. Circle the most likely resonance structure.

11. Draw the lewis structure for each compound below. Note: a few elements may prefer less than a complete octet. Hydrogen, Beryllium, Boron, and Aluminum are the most common.

HBClF CH_3BeCl AlOBr

12. The sulfur dioxide molecule (SO_2) has four possible lewis structures. Draw each and assign formal charge to each atom in the structures. Circle the most stable structure or structures.

13. Draw at least six resonance structures of $CH_2NO_2^{1-}$. Assign formal charge to each atom in the structure (other than H). Circle the most stable structure or structures.

14. Draw the lewis structure for each polyatomic molecule or ion below. The nitrogen-nitrogen bond in (a) is 125 pm and has a bond strength of 418 kJ/mol; in (b) it's 110 pm and 942 kJ/mol; in (c) it's 145 pm and 167 kJ/mol.

(a) $HNNH$ (c) N_2 (c) H_2NNH_2

15. Consider the three structures in the question above.

(a) Are triple bonds longer or shorter than double bonds? What about single bonds relative to double bonds?

(b) s a double bond twice as strong as a single bond? Do three single bonds hold as much energy as one triple bond?