

- (e) Dishwashing liquid molecules must attract water molecules better than they attract each other because water dissolves the substance and washes it away. Gear oil molecules must attract each other better than they attract water molecules—because water doesn't dissolve the oil or wash it away.
- (f) We observe that the dishwashing liquid will mix with (dissolve) the oil, and the mixture (solution) of the two will dissolve in water, and be washed away. It seems that dishwashing liquid molecules are somehow able to attract both water molecules and oil molecules.
- (g) Dishwasher detergent is thick and viscous, so its molecules are quite cohesive, and seem to be adhesive to glass and water and oil. Gear oil molecules are less cohesive, and not very adhesive to glass or water—only to the dishwashing liquid. This seems logical, since dishwashing liquids are designed to attract and dissolve all kinds of food materials; and gear oil is designed to make metal surfaces slide against each other without wearing down.

4.1 LEWIS THEORY OF BONDING

PRACTICE

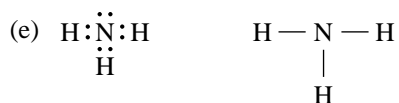
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Understanding Concepts

- Mg - 2, Cl - 1
 - C - 4, H - 1
 - H - 1, O - 2
 - H - 2, S - 2
 - N - 3, H - 1
- In the order that they were created by chemists, we have the (c) Dalton atom, (b) empirical formulas, (d) Kekulé structures, (a) Lewis structures, and (e) Schrödinger quantum mechanics.
- $1s^2 2s^2 2p^6 3s^2 3p^1$ $\cdot\text{Al}\cdot$
 - $1s^2 2s^2 2p^6 3s^2 3p^5$ $:\ddot{\text{Cl}}\cdot$
 - $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$ $\cdot\text{Ca}\cdot$
 - $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^2$ $\cdot\ddot{\text{Ge}}\cdot$
- $:\ddot{\text{O}}\cdot$
 - $\cdot\ddot{\text{P}}\cdot$
 - $:\ddot{\text{Br}}\cdot$
 - Rb \cdot
- $\begin{array}{c} \text{H} \\ | \\ \text{H}:\ddot{\text{C}}:\text{H} \\ | \\ \text{H} \end{array}$

$\begin{array}{c} \text{H} \\ | \\ \text{H}-\text{C}-\text{H} \\ | \\ \text{H} \end{array}$
 - $\begin{array}{c} :\ddot{\text{O}}:\text{H} \\ | \\ \text{H} \end{array}$

$\begin{array}{c} \text{O}-\text{H} \\ | \\ \text{H} \end{array}$



Applying Inquiry Skills

- A new scientific concept must explain existing evidence, and should predict new observations successfully, before it is generally accepted by the scientific community.
- Decompose a known mass of a pure compound. Identify and measure the masses of the products produced.

Extension

- Kekulé structures simply showed which atoms were bonded to which, while Lewis structures explain the bonding in terms of electron arrangement.
- Were Lewis structures derived from quantum theory? Lewis himself said not, and has a body of notes to support this. Others say the parallels with Sommerfeld's work on electron energy sublevels are too great to be due to coincidence. The truth probably lies between, since this was long past any time where scientists worked isolated from knowledge of the work of others.

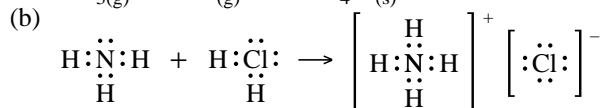
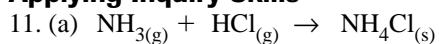
PRACTICE

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Understanding Concepts

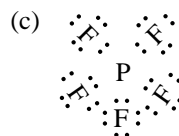
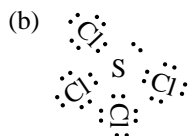
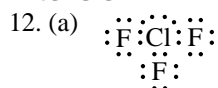
10. (a) $\left[\begin{array}{c} :\ddot{\text{O}}: \\ :\ddot{\text{O}}:\text{Cl}:\ddot{\text{O}}: \\ :\ddot{\text{O}}: \end{array} \right]^-$ 32 e⁻ total
- (b) $\left[\begin{array}{c} :\ddot{\text{O}}: \\ :\ddot{\text{O}}:\text{C}: \\ :\ddot{\text{O}}:\ddot{\text{O}}: \end{array} \right]^{2-}$ 24 e⁻ total
- (c) $[\text{:C}::\text{N:}]^-$ 10 e⁻ total
- (d) $\left[\begin{array}{c} \text{H}:\ddot{\text{O}}:\text{H} \\ | \\ \text{H} \end{array} \right]^+$ 8 e⁻ total
- (e) $\left[\begin{array}{c} :\ddot{\text{O}}:\text{H} \\ | \\ \text{C} \\ :\ddot{\text{O}}:\ddot{\text{O}}: \end{array} \right]^-$ 24 e⁻ total
- (f) $\left[\begin{array}{c} :\ddot{\text{O}}:\text{H} \\ | \\ \text{N} \\ :\ddot{\text{O}}:\ddot{\text{O}}: \end{array} \right]^-$ 24 e⁻ total
- (g) $[\text{:N}::\ddot{\text{O}}:]^+$ 10 e⁻ total

Applying Inquiry Skills



- (c) Test the solubility of the product in water. Measure the electrical conductivity of the aqueous solution and add a few crystals of silver nitrate to test for the presence of chloride ions by precipitating silver chloride.

Extension

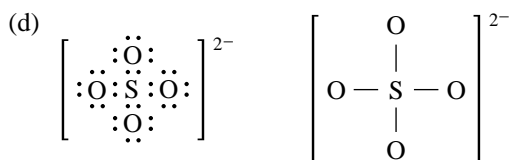
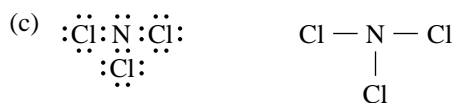
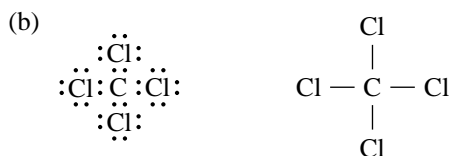
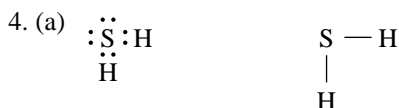
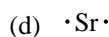
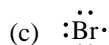
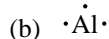
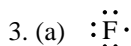
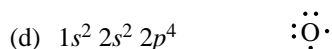
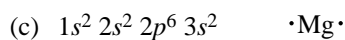
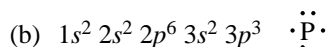


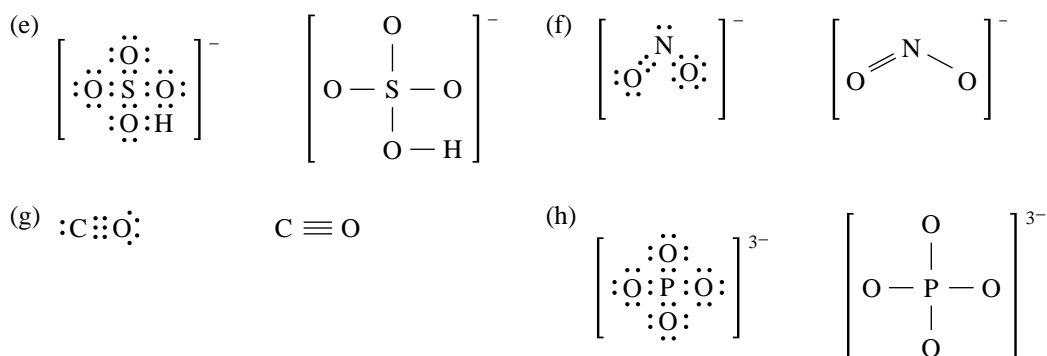
SECTION 4.1 QUESTIONS

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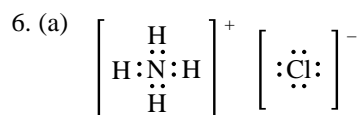
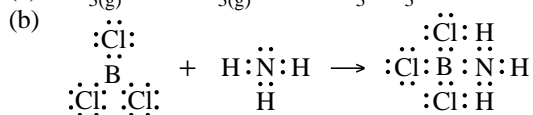
Understanding Concepts

1. The Dalton atom concept made it possible to express chemical composition of compounds as empirical formulas. The later development of electron energy levels in the Bohr atom concept made it possible for Lewis diagrams to show how valence electron rearrangement is involved in reactions.





Extensions



- (b) The compound is easy to represent with Lewis structures once you accept the idea of ammonium as a polyatomic positive ion, with nitrogen able to bond four times to hydrogen if an electron is removed.

4.2 THE NATURE OF THE CHEMICAL BOND

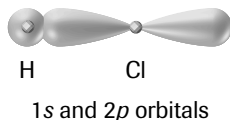
PRACTICE

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Understanding Concepts

1. A helium atom has a single orbital containing a pair of electrons. Generally, two half-filled orbitals overlap to form a bond.
2. An orbital formed from overlap of two atomic orbitals is like an individual atomic orbital in that it is full when two paired electrons occupy it.
3. This overlap is not possible because it would include three electrons occupying one shared orbital.

4. (a)



(b)

