Covalent Bonds

UNIT TWO: BONDING

BIBERDORF

Important Information

No Office Hours for Dr. McCord this week.

Q08 – Q11 are due Friday (9/25) at 9 AM.

Ionic Review

① $\begin{cases} \uparrow \text{charge}, \quad \uparrow LE \text{ (strong)} \\ \downarrow \text{charge}, \quad \downarrow LE \text{ (weak)} \end{cases}$

* transfer e⁻

* metal & non-metal
   (+)   (−)

* evaluate ionic lattice — lattice energy

$$LE \propto \frac{\text{charge}}{\text{radius}}$$

$\uparrow$radius, $\downarrow$LE (weak)

$\downarrow$radius, $\uparrow$LE (strong)

Question

What type of bond will calcium and iodine form? Please draw the corresponding molecule.

A. Ionic
B. Covalent

Question

Calcium iodide will have a _____ lattice energy than potassium iodide.

A. larger +2

B. smaller

$$LE \propto \frac{charge}{radius} \quad +1$$

Covalent Bond
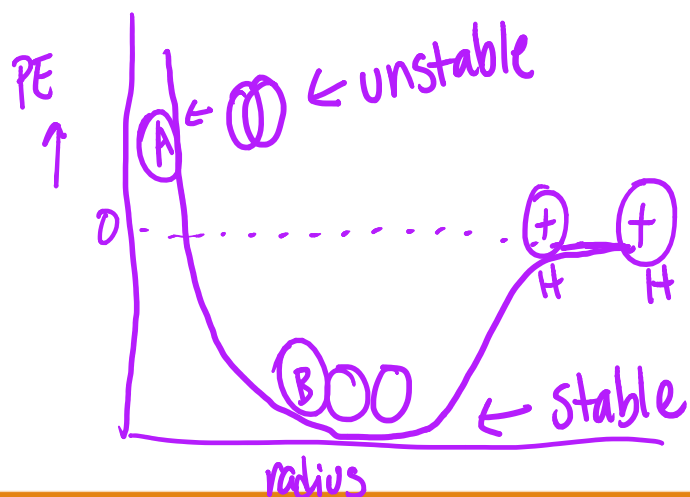
*Sharing e^-

* two non-metals

* bond strength/length

* formal charge

Potential Energy Diagram
Covalent Bond Formation

Question

Will two atoms form a covalent bond if their resulting energy level is higher than their corresponding original energy levels?

A.   Yes

B.   No

Types of Covalent Bonds

$$X-X \qquad \text{single} \qquad 2e^-$$

$$X=X \qquad \text{double} \qquad 4e^-$$

$$X\equiv X \qquad \text{triple} \qquad 6e^-$$

Bond Length vs. Bond Strength

length: single > double > triple

strength: single < double < triple

Lewis Structures

* visual representation of a molecule
  ↓
  covalent

1. Try to put "C" in the center (electropositive)
2. Radicals are unlikely
3. make molecules symmetrical
4. Formal charges = ∅ or 1

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Question

Draw the Lewis structures for O_2, P_2, and At_2. Which molecule will have the longest bond?
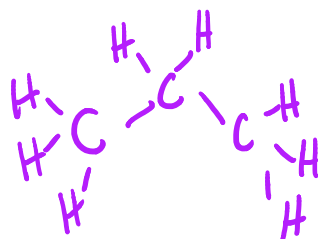
A. O_2

B. P_2

C. At_2

Question

Draw the Lewis structures for O_2, P_2, and At_2. Which molecule will have the strongest bond?

A. O_2

B. P_2

C. At_2

Question

What is the Lewis structure for propane?

Line Drawings

*Shorthand for Lewis structures

1. Draw Lewis

2. convert all "C" to points/dots

3. erase all H connected to C

Question

What is the line drawing for CH_3COOH?

Evaluating Lewis Structures

* Formal Charge
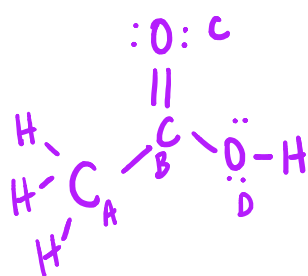 ↳ charge on each atom within a molecule

  ↳ FC = 0 or 1

FC = valence e^- − actual e^-

FC = want − have
                  ↑
               touching

Formal Charges of Acetic Acid

A: 4-4=0

B: 4-4=0

C: 6-6=0

D: 6-6=0

Question

What are the formal charges on carbon and oxygen in carbon monoxide, respectively?

A. 0, 0

B. -1, 0

C. 0, -1

D. +1, -1

E. -1, +1

$\ominus$ $\oplus$

:C≡O:

C: 4 − 5 = −1

O: 6 − 5 = +1

Octet Rule

Octet Rule Exceptions

Question

What is the Lewis Structure for sulfur hexafluoride?

Question

What is the Lewis Structure for boron trichloride?