

CHEM 1411. Chapter 7. Chemical Bonding I (homework) W

Multiple Choice

Identify the choice that best completes the statement or answers the question.

- _____ 1. Which response includes only the true statements concerning the characteristics of covalent compounds?
- These compounds can be gases, liquids, or solids with low melting points.
 - Most are soluble in polar solvents.
 - Liquid and molten compounds do not conduct electricity.
 - Aqueous solutions of these compounds are very good conductors of electricity.
- I and III
 - II and IV
 - I, III, and IV
 - I, II, and III
 - IV
- _____ 2. Which Lewis Dot Formula below is **incorrect**?
- $\begin{array}{c} \cdot\cdot \\ \cdot\text{N}\cdot \\ \cdot\cdot \end{array}$
 - $\begin{array}{c} \cdot\cdot \\ \cdot\text{C}\cdot \\ \cdot\cdot \end{array}$
 - $\begin{array}{c} \cdot\cdot \\ \cdot\text{I}\cdot \\ \cdot\cdot \end{array}$
 - Ca:
 - $\begin{array}{c} \cdot\cdot \\ \text{Al}\cdot \end{array}$
- _____ 3. How many valence electrons does an iodine atom have?
- 6
 - 4
 - 3
 - 5
 - 7
- _____ 4. How many unpaired electrons are shown in a Lewis Dot Formula for silicon?
- 4
 - 3
 - 1
 - 0
 - 2
- _____ 5. The negative ion F^- has the same electronic configuration as the positive ion _____.
- K^+
 - Li^+
 - Ca^{2+}
 - Mg^{2+}
 - Sc^{3+}

- ___ 6. Calcium and chlorine react to form CaCl_2 , an ionic compound. The chloride ion, Cl^- , has ___ electrons in its outermost occupied shell.
- 6
 - 2
 - 7
 - 18
 - 8
- ___ 7. Which of the following compounds has the **most** ionic bond?
- NF_3
 - NaF
 - NF_3
 - MgF_2
 - BCl_3
- ___ 8. When one mole of calcium, Ca , combines with one-half mole of oxygen, O_2 , to form calcium oxide, CaO , ___ mole(s) of electrons are transferred from ___ atoms to ___ atoms.
- two; calcium; oxygen
 - one; oxygen; calcium
 - two; oxygen; calcium
 - one; calcium; oxygen
 - one-half; oxygen; calcium
- ___ 9. Consider the formation of one formula unit of AlF_3 from neutral atoms. In the process, each aluminum atom ___ electron(s) and each fluorine atom ___ electron(s).
- gains one; loses three
 - loses three; gains one
 - loses three; gains three
 - gains three; loses one
 - loses one; gains three
- ___ 10. What is the formula for the binary compound of calcium and bromine?
- CaB
 - CaBr_2
 - Ca_2Br
 - CaB_2
 - CaBr
- ___ 11. The formula for the simple ionic compound of barium and nitrogen is ___.
- Ba_2N_3
 - Ba_3N_2
 - Ba_2N
 - BaN_2
 - BaN
- ___ 12. Which one of the formulas below is **incorrect**?
- Cs_2S
 - AlP
 - CaSe_2
 - SrCl_2

e. AlBr_3

- ___ 13. A chemical bond formed by two atoms sharing one or more pairs of electrons is called a(n) ___ bond.
- polar
 - ionic
 - nonpolar
 - coordinate covalent
 - covalent
- ___ 14. When the diatomic molecule H_2 forms, all of the following are **true except**:
- The $1s$ orbitals overlap so that both electrons are now in the orbitals of both atoms.
 - The bonded atoms are at higher energy than the separated atoms.
 - A pair of electrons is shared between the two hydrogen atoms.
 - A single covalent bond is formed.
 - Each hydrogen atom has the helium configuration $1s^2$.
- ___ 15. The ___ bonds there are between atoms of the same two elements, the ___ the bond length and the ___ the bond.
- fewer; greater; stronger
 - more; shorter; weaker
 - more; shorter; stronger
 - fewer; shorter; stronger
 - more; greater; weaker
- ___ 16. Draw the Lewis dot formula for PCl_3 . The number of **unshared pairs** of electrons in the outer shell of the central atom is ___.
- two
 - four
 - one
 - zero
 - three
- ___ 17. The number of **unshared pairs** of electrons in the outer shell of sulfur in H_2S is ___.
- two
 - four
 - one
 - zero
 - three
- ___ 18. In applying the relationship $S = N - A$ for the PF_3 molecule $N =$ ___, $A =$ ___, and $S =$ ___.
- | | <u>N</u> | <u>A</u> | <u>S</u> |
|----|----------|----------|----------|
| a. | 34 | 26 | 8 |
| b. | 32 | 24 | 8 |
| c. | 30 | 22 | 8 |
| d. | 30 | 24 | 6 |
| e. | 32 | 26 | 6 |
- ___ 19. In constructing the dot formula for H_3AsO_4 , $N =$ ___, $A =$ ___, and $S =$ ___.

- a. 46 32 14
- b. 44 32 12
- c. 46 30 12
- d. 44 30 14
- e. 42 30 12

- ___ 20. The number of **unshared pairs** of electrons in the outer shell of oxygen in Cl₂O is ____.
- a. four
 - b. zero
 - c. one
 - d. two
 - e. three
- ___ 21. Draw the dot formula for ethylene, C₂H₄. Each carbon–hydrogen bond is a ____ bond and each carbon–carbon bond is a ____ bond.
- a. double; single
 - b. double; double
 - c. single; triple
 - d. single; single
 - e. single; double
- ___ 22. The Lewis dot formula for N₂ shows
- a. a triple covalent bond.
 - b. a total of $8 \times 2 = 16$ electrons.
 - c. a single ionic bond.
 - d. a double covalent bond.
 - e. a single covalent bond.
- ___ 23. Which of the following guidelines for drawing Lewis formulas for covalent compounds is **incorrect**?
- a. Representative elements (except hydrogen) usually follow the octet rule.
 - b. Hydrogen can never be a central atom.
 - c. In neutral species, nitrogen forms 3 bonds and oxygen forms 2 bonds.
 - d. Carbon always forms 4 bonds.
 - e. One carbon atom in a compound may form both a double bond and a triple bond.
- ___ 24. Assign a formal charge to each atom of
- $$\begin{array}{c}
 \text{:}\ddot{\text{Cl}}\text{:}\ddot{\text{As}}\text{:}\ddot{\text{Cl}}\text{:} \\
 \text{:}\ddot{\text{Cl}}\text{:}
 \end{array}$$
- a. As = 3+; Cl = 1–
 - b. As = 5–; Cl = 7+
 - c. As = 6+; Cl = 2–
 - d. As = 0; Cl = 0
 - e. As = 5+; Cl = 1–
- ___ 25. Assign a formal charge to each atom of PH₄⁺.
- a. P = 0; H = $\frac{1}{4}$ +

- b. P = 0; H = 1+
- c. P = 1+; H = 0
- d. P = 0; H = 0
- e. P = 4+; H = 1-

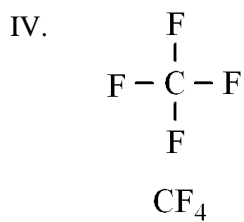
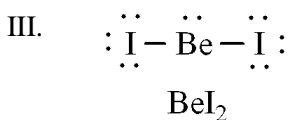
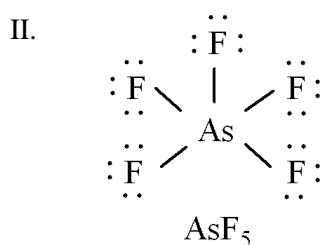
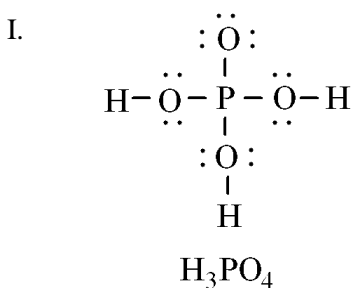
___ 26. Which of the following statements about Lewis structures is **false**?

- a. Quadruple bonds are not possible.
- b. N, P and As can sometimes share more than 8 e⁻.
- c. H can never make more than one bond.
- d. Carbon and oxygen may form a double bond.
- e. Any Noble gas involved in a bond must be violating the octet rule.

___ 27. Which one of the following dot formulas is **incorrect**?

- a. C₂H₄, $\begin{array}{c} \text{H} \quad \text{H} \\ \cdot \\ \cdot \\ \text{C} :: \text{C} \\ \cdot \\ \cdot \\ \text{H} \quad \text{H} \end{array}$
- b. SiF₄, $\begin{array}{c} \quad \quad \cdot \cdot \\ \quad \quad \text{F} \\ \cdot \cdot \\ \cdot \cdot \\ \text{F} : \text{Si} : \text{F} \\ \cdot \cdot \\ \cdot \cdot \\ \text{F} \\ \cdot \cdot \end{array}$
- c. PH₃, $\begin{array}{c} \quad \cdot \cdot \\ \quad \quad \text{P} \\ \cdot \cdot \\ \text{H} : \text{P} : \text{H} \end{array}$
- d. BCl₃, $\begin{array}{c} \quad \quad \cdot \cdot \\ \quad \quad \text{H} \\ \cdot \cdot \\ \cdot \cdot \\ \text{Cl} : \text{B} : \text{Cl} \\ \cdot \cdot \\ \cdot \cdot \\ \text{Cl} \\ \cdot \cdot \end{array}$
- e. SO₃²⁻, $\left[\begin{array}{c} \cdot \cdot \quad \cdot \cdot \quad \cdot \cdot \\ \cdot \cdot \quad \text{O} \quad \text{S} \quad \text{O} \quad \cdot \cdot \\ \cdot \cdot \quad \cdot \cdot \quad \cdot \cdot \\ \cdot \cdot \quad \text{O} \quad \cdot \cdot \end{array} \right]^{2-}$

___ 28. Which response lists all of the correct Lewis dot formulas and no **incorrect** ones?



- a. I and II
 - b. II, III, and IV
 - c. III and IV
 - d. II and III
 - e. I, II, and III
- ___ 29. How many **lone pairs** of electrons are there on the S atom in the SCl_4 molecule?
- a. three
 - b. zero
 - c. one
 - d. two
 - e. four
- ___ 30. Which response lists all the molecules below that have **one** unshared pair of electrons on the central atom, and no other molecules?
 H_2O , NF_3 , BF_3 , OF_2
- a. NF_3 and OF_2
 - b. H_2O , NF_3 , and OF_2
 - c. H_2O and NF_3
 - d. H_2O
 - e. NF_3
- ___ 31. Which one of the following molecules violates the octet rule?
- a. OF_2
 - b. PCl_3
 - c. AsF_5
 - d. CBr_4
 - e. NF_3
- ___ 32. Which response contains all the molecules below that violate the octet rule, and no others?
 SF_4 , SiCl_4 , H_2Te , AsF_5 , BeI_2
- a. H_2Te , BeI_2
 - b. SF_4 , AsF_5 , BeI_2
 - c. SF_4 , SiCl_4
 - d. AsF_5
 - e. BeI_2
- ___ 33. Which numbered response lists all the molecules below that exhibit resonance and none that do not?
- I. PF_5
 - II. HNO_3
 - III. SO_2
 - IV. H_2O
- a. I and II
 - b. II and III
 - c. III and IV
 - d. I and III

e. II, III, and IV

- ___ 34. How many resonance structures does the nitrate ion, NO_3^- , have?
- 1
 - 4
 - 0
 - 3
 - 2
- ___ 35. How many resonance structures does the bicarbonate ion, HCO_3^- , have?
- 3
 - 1
 - 2
 - 4
 - 0
- ___ 36. Which response includes all of the molecules that have **nonpolar** bonds, and no others?
 Cl_2 , BeCl_2 , I_2 , BrCl , BCl_3
- Cl_2 , BeCl_2 , and I_2
 - Cl_2 , BeCl_2 , and BrCl
 - BrCl
 - Cl_2 and I_2
 - BeCl_2 and BCl_3
- ___ 37. Which molecule contains the **least** polar bonds? (Electronegativities: H = 2.1, C = 2.5, F = 4.0, Cl = 3.0, Br = 2.8, I = 2.5)
- Cl_4
 - CBr_4
 - CCl_4
 - CF_4
 - CH_4
- ___ 38. Which of the following molecules has the **least polar** bonds?
- HF
 - NH_3
 - HI
 - BrI
 - H_2O
- ___ 39. Which one of the following molecules has a dipole moment?
- H_2
 - Cl_2
 - I_2
 - N_2
 - BrCl
- ___ 40. Which molecule would have the **strongest** dipole moment?
- HI
 - HF
 - H_2

- d. HCl
- e. HBr

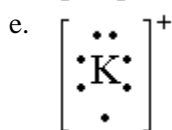
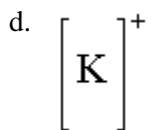
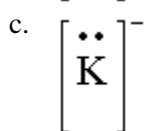
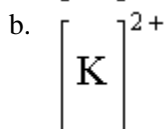
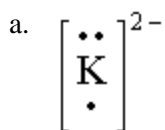
___ 41. Which one of the following compounds involves **both** ionic and covalent bonding?

- a. HCN
- b. Na_2SO_4
- c. Cl_2
- d. KCl
- e. HF

___ 42. Which one of the following compounds contains **both** ionic and covalent bonding?

- a. MgO
- b. KNO_3
- c. HCl
- d. Rb_3N
- e. CaCl_2

___ 43. Which of the following is the Lewis dot structure for the potassium ion?



___ 44. How many valence electrons does a chlorine atom have?

- a. 8
- b. 1
- c. 7
- d. 4
- e. 3

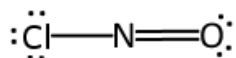
___ 45. How many unpaired electrons are shown in the Lewis dot formula of an aluminum atom?

- a. 2
- b. 3
- c. 5
- d. 0

e. 1

- ___ 46. How many valence electrons are present in the Lewis dot formula of the chlorate ion, ClO_3^- ?
- 32
 - 26
 - 30
 - 28
 - 24

- ___ 47. What is the formal charge of N?



- 1
- 0
- +1
- 2
- +2

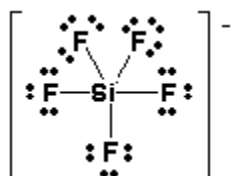
- ___ 48. The Lewis structure of which of the following formula violates the octet rule?

- PF_3
- HF
- SiF_4
- OF_2
- ClF_3

- ___ 49. When you draw a Lewis structure for $\text{CH}_3\text{OCH}_2\text{CH}_3$, what is the total number of lone pair electrons?

- 3
- 1
- 4
- 2
- 0

- ___ 50. Based on the Lewis structure for SiF_5^- given below, what is the formal charge on the central silicon atom?



- +1
- 1
- 0
- 2
- +2

- ___ 51. What is the formal charge on the nitrogen in NO_2Cl ?

- 0
- 2
- 1
- +2
- +1

- ___ 52. A molecule will always be polar if it _____.

- contains atoms with different electronegativities
- consists of more than three atoms
- is diatomic with different electronegativities
- contains both carbon and chlorine
- has polar bonds

Other

1. Why are *d* orbital electrons usually not shown in Lewis dot formulas?
2. Why must atomic orbitals overlap to form a covalent bond? What prevents the orbitals from overlapping completely?
3. Why must a compound have at least one double bond to have resonance structures? Why do none of the resonance structures actually represent the real molecule?
4. Suppose on Planet X three electrons can occupy each orbital and there are 4 *p* orbitals instead of 3. How would this change the "octet" rule?
5. Explain why boron is considered *electron deficient* and how this makes it impossible to complete an octet.
6. Comment on the validity of the following statement: Any noble gas atom involved in a bond must violate the octet rule.
7. How is a formal charge different than a charge on an ion?

Answer Section

MULTIPLE CHOICE

- ANS: A PTS: 1
OBJ: Identify the chemical and physical properties of covalent compounds.
TOP: Ionic and Covalent Bonding MSC: Conceptual question
- ANS: B PTS: 1 DIF: Harder Question
OBJ: Identify the correct Lewis Dot Formulas. TOP: Lewis Dot Formulas of Atoms
- ANS: E PTS: 1 OBJ: Determine the number of valence electrons.
TOP: Lewis Dot Formulas of Atoms
- ANS: E PTS: 1 OBJ: Determine the number of unpaired electrons.
TOP: Lewis Dot Formulas of Atoms
- ANS: D PTS: 1 OBJ: Identify the isoelectronic ion.
TOP: Formation of Ionic Compounds
- ANS: E PTS: 1 OBJ: Determine the number of valence electrons.
TOP: Formation of Ionic Compounds
- ANS: B PTS: 1 OBJ: Identify the compound with the greatest ionic character.
TOP: Formation of Ionic Compounds
- ANS: A PTS: 1
OBJ: Determine the number of electrons transferred given the balanced reaction. | Identify the species that lose and gain electrons. TOP: Formation of Ionic Compounds
- ANS: B PTS: 1
OBJ: Identify the number of electrons lost and gained in the reaction.
TOP: Formation of Ionic Compounds
- ANS: B PTS: 1 OBJ: Identify the formula of a binary compound.
TOP: Formation of Ionic Compounds
- ANS: B PTS: 1 OBJ: Identify the formula of a binary compound.
TOP: Formation of Ionic Compounds
- ANS: C PTS: 1 OBJ: Identify the incorrect formula of a binary compound.
TOP: Formation of Ionic Compounds
- ANS: E PTS: 1 OBJ: Define covalent bond.
TOP: Formation of Covalent Bonds
- ANS: B PTS: 1 OBJ: Describe the bonding in hydrogen.
TOP: Formation of Covalent Bonds
- ANS: C PTS: 1
OBJ: Understand the relationship between bond order, bond length, and bond strength.
TOP: Bond Lengths and Bond Energies
- ANS: C PTS: 1
OBJ: Draw the Lewis structure given the formula and determine the number of unshared outer shell electrons on the central atom. TOP: Writing Lewis Formulas: The Octet Rule
- ANS: A PTS: 1
OBJ: Draw the Lewis structure given the formula and determine the number of unshared outer shell

- electrons on the central atom. TOP: Writing Lewis Formulas: The Octet Rule
18. ANS: E PTS: 1
OBJ: Determine the number of electrons shared, needed, and available.
TOP: Writing Lewis Formulas: The Octet Rule
19. ANS: A PTS: 1
OBJ: Determine the number of electrons shared, needed, and available.
TOP: Writing Lewis Formulas: The Octet Rule
20. ANS: D PTS: 1
OBJ: Draw the Lewis structure given the formula and determine the number of unshared outer shell electrons on the central atom. TOP: Writing Lewis Formulas: The Octet Rule
21. ANS: E PTS: 1
OBJ: Draw the Lewis structure given the formula and identify the covalent bonds.
TOP: Writing Lewis Formulas: The Octet Rule
22. ANS: A PTS: 1
OBJ: Draw the Lewis structure given the formula and identify the covalent bonds.
TOP: Writing Lewis Formulas: The Octet Rule
23. ANS: E PTS: 1
OBJ: Identify the guidelines for drawing valid Lewis Dot Formulas.
TOP: Writing Lewis Formulas: The Octet Rule
24. ANS: D PTS: 1 OBJ: Assign formal charges given the Lewis structure.
TOP: Formal Charge
25. ANS: C PTS: 1 OBJ: Assign formal charges given the formula.
TOP: Formal Charge
26. ANS: B PTS: 1 OBJ: Know the limits and exceptions to the octet rule.
TOP: Writing Lewis Formulas: Limitations of the Octet Rule for Lewis Formulas
27. ANS: D PTS: 1 OBJ: Identify the correct Lewis Dot Formulas.
TOP: Writing Lewis Formulas: Limitations of the Octet Rule for Lewis Formulas
28. ANS: A PTS: 1 OBJ: Identify the correct Lewis Dot Formulas.
TOP: Writing Lewis Formulas: Limitations of the Octet Rule for Lewis Formulas
29. ANS: C PTS: 1
OBJ: Draw the Lewis structure given the formula and determine the number of unshared electrons on the central atom. TOP: Writing Lewis Formulas: Limitations of the Octet Rule for Lewis Formulas
30. ANS: E PTS: 1
OBJ: Draw the Lewis structures given the formulas and determine the number of unshared electrons on the central atoms. TOP: Writing Lewis Formulas: Limitations of the Octet Rule for Lewis Formulas
31. ANS: C PTS: 1
OBJ: Identify the molecule whose Lewis structure violates the octet rule.
TOP: Writing Lewis Formulas: Limitations of the Octet Rule for Lewis Formulas
32. ANS: B PTS: 1
OBJ: Identify the molecules with Lewis structures that violate the octet rule.
TOP: Writing Lewis Formulas: Limitations of the Octet Rule for Lewis Formulas
33. ANS: B PTS: 1
OBJ: Identify the molecules with more than one valid Lewis structure.
TOP: Resonance
34. ANS: D PTS: 1
OBJ: Determine the number of valid Lewis structures given the formula.
TOP: Resonance

35. ANS: C PTS: 1
OBJ: Determine the number of valid Lewis structures given the formula.
TOP: Resonance
36. ANS: D PTS: 1 OBJ: Identify the molecules with nonpolar covalent bonds
TOP: Polar and Nonpolar Covalent Bonds
37. ANS: A PTS: 1 OBJ: Identify the least polar covalent bond.
TOP: Polar and Nonpolar Covalent Bonds
38. ANS: D PTS: 1 OBJ: Identify the least polar covalent bond.
TOP: Polar and Nonpolar Covalent Bonds
39. ANS: E PTS: 1 OBJ: Identify the molecule with a dipole moment.
TOP: Dipole Moments
40. ANS: B PTS: 1 OBJ: Identify the molecule with the largest dipole moment.
TOP: Dipole Moments
41. ANS: B PTS: 1
OBJ: Identify the compound with both ionic and covalent bonds.
TOP: The Continuous Range of Bonding Types
42. ANS: B PTS: 1
OBJ: Identify the compound with both ionic and covalent bonds.
TOP: The Continuous Range of Bonding Types
43. ANS: D PTS: 1 DIF: Easy TOP: Lewis Dot Formulas of Atoms
OBJ: Identify the ion Lewis dot formula given ion name.
NOT: Dynamic Question
44. ANS: C PTS: 1 OBJ: Determine the number of valence electrons.
TOP: Lewis Dot Formulas of Atoms NOT: Dynamic Question
45. ANS: E PTS: 1 OBJ: Determine the number of unpaired valence electrons.
TOP: Lewis Dot Formulas of Atoms NOT: Dynamic Question
46. ANS: B PTS: 1
OBJ: Determine the total number of valence electrons given the polyatomic ion formula.
TOP: Lewis Dot Formulas of Atoms NOT: Dynamic Question
47. ANS: B PTS: 1 OBJ: Determine the formal charge of the specified atom.
TOP: Lewis Dot Formulas of Atoms NOT: Dynamic Question
48. ANS: E PTS: 1
OBJ: Determine the formula whose Lewis structure violates the octet rule.
TOP: Lewis Formulas for Molecules and Polyatomic Ions NOT: Dynamic Question
49. ANS: D PTS: 1
OBJ: Determine the Lewis structure and number of lone pairs of electrons.
TOP: Lewis Formulas for Molecules and Polyatomic Ions NOT: OWL
50. ANS: B PTS: 1 OBJ: Calculate the formal charge.
TOP: Formal Charge NOT: OWL
51. ANS: E PTS: 1 OBJ: Calculate the formal charge.
TOP: Formal Charge NOT: OWL
52. ANS: C PTS: 1 OBJ: Odentify molecules that are always polar.
TOP: Dipole Moments NOT: OWL

OTHER

1. ANS:

Answer not provided.

PTS: 1 OBJ: Explain the limitations of Lewis formulas with respect to d-orbital electrons.

TOP: Lewis Dot Formulas of Atoms | Lewis Formulas for Molecules and Polyatomic Ions

MSC: Conceptual question

2. ANS:

Answer not provided.

PTS: 1 OBJ: Explain orbital overlap with respect to bond formation.

TOP: Formation of Covalent Bonds MSC: Conceptual question

3. ANS:

Answer not provided.

PTS: 1 OBJ: Explain the limitations of resonance with respect to multiple bonding.

TOP: Resonance MSC: Conceptual question

4. ANS:

Answer not provided.

PTS: 1 OBJ: Imagine a world in which the octet rule is not the same as this world.

TOP: Writing Lewis Formulas: The Octet Rule MSC: Conceptual question

5. ANS:

Answer not provided.

PTS: 1 OBJ: Explain what is meant by electron deficient and how it effects Lewis structures.

TOP: Writing Lewis Formulas: Limitations of the Octet Rule for Lewis Formulas

MSC: Conceptual question

6. ANS:

Answer not provided.

PTS: 1 OBJ: Explore the limits of the octet rule in noble gas compounds.

TOP: Writing Lewis Formulas: Limitations of the Octet Rule for Lewis Formulas

MSC: Conceptual question

7. ANS:

Answer not provided.

PTS: 1 OBJ: Compare and contrast the calculation of formal charge and oxidation state.

TOP: Formal Charge MSC: Conceptual question