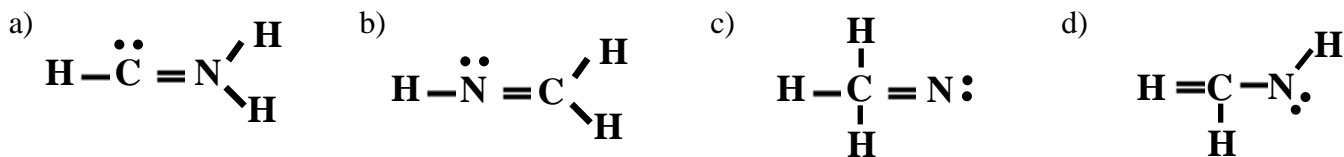


## Review for Unit Test #2: Chemical Bonding

### Practice Multiple Choice Questions:

- Atoms form chemical bonds to:
  - attain a more stable electron configuration
  - neutralize their charge
  - increase their energy
  - get more electrons
- In an ionic bond, the two elements:
  - transfer electrons
  - both lose electrons
  - share electrons
  - both gain electrons
- The Noble gases do not form chemical bonds with other elements because:
  - their atomic radius is too small
  - their density is too low
  - their electronegativity is too high
  - they have an  $s^2p^6$  valence electron configuration
- Ionic bonding occurs:
  - in gases
  - between two metal elements
  - between Groups 1 and 17 on the Periodic Table
  - in all carbon compounds
- A covalent bond is:
  - a bond between ions
  - a bond between the molecules of a liquid
  - a pair of electrons being shared between atoms
  - commonly found between metals and non-metals
- A molecule is polar when:
  - electrons are shared equally among its atoms
  - one region of the molecule has a small negative charge while another region has a small positive charge
  - the molecule has no charged regions
  - the molecule is symmetrical
- A non-metal atom becomes an ion when it:
  - loses electrons to a metal
  - loses protons to a metal
  - gains electrons from a metal
  - gains neutrons in a nuclear reaction
- Ionic bonding is best explained by the:
  - bonding of atoms of the same electronegativity
  - bonding of atoms of slightly different electronegativity
  - transfer of electron(s) between atoms with widely different electronegativities
  - equal sharing of electrons between atoms
- The bonding electrons in a non-polar bond are:
  - shared equally
  - shared unequally
  - transferred from a metal to a non-metal
  - transferred from a non-metal to a metal
- Which of the following bonds will be the most polar?
  - Sr – I
  - Mg – O
  - Li – Cl
  - Ag – S
- Which of the following compounds is/are electrolytes?
  - CS<sub>2</sub>
  - Ca<sub>3</sub>N<sub>2</sub>
  - BH<sub>3</sub>
  - all of the above are electrolytes
- Which of the following substances will form a crystal lattice?
  - CH<sub>4</sub>
  - NH<sub>3</sub>
  - Al<sub>2</sub>O<sub>3</sub>
  - all of the above

13. Which of the following is the correct Lewis diagram for CH<sub>3</sub>N?



14. Which of the following electron dot diagrams represents the unknown atom X, if X has the electron configuration:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2$



15. An unknown compound is dissolved in distilled water. The solution does not conduct electricity. This compound will:

- a) have a very high melting point
- b) be a hard crystalline solid
- c) probably have a distinctive odour
- d) only "a" and "b"

16. A new element is discovered that belongs to Group 15. Predict its bonding capacity.

- a) 2
- b) 3
- c) 4
- d) 5

17. In the compound PCl<sub>3</sub>,

- a) P will have a δ<sup>+</sup> charge, and Cl will have a δ<sup>-</sup> charge
- b) P will have a δ<sup>-</sup> charge, and Cl will have a δ<sup>+</sup> charge
- c) P will have a 1<sup>+</sup> charge, and Cl will have a 1<sup>-</sup> charge
- d) P will have a 1<sup>-</sup> charge, and Cl will have a 1<sup>+</sup> charge
- e) there are no full or partial charges in this molecule

18. Which of the following atoms will form an ionic bond with nitrogen?

- a) calcium
- b) phosphorus
- c) oxygen
- d) all of the above

19. A neutral atom of selenium has a bonding capacity of:

- a) one
- b) two
- c) six
- d) eight

20. Which of the following pairs of elements will form an ionic compound?

- a) boron and fluorine
- b) carbon and fluorine
- c) nitrogen and fluorine
- d) oxygen and fluorine

21. The atoms of bromine in a molecule of Br<sub>2</sub> are held together by:

- a) a single covalent bond
- b) a double covalent bond
- c) a triple covalent bond
- d) an ionic bond

22. Which formula represents a molecular substance?

- a) CaO
- b) Li<sub>2</sub>O
- c) CO
- d) Al<sub>2</sub>O<sub>3</sub>

23. Which of the following substances will form a crystal lattice?

- a) NO<sub>2</sub>
- b) CO<sub>2</sub>
- c) SO<sub>2</sub>
- d) MnO<sub>2</sub>

24. Which combination of atoms can form a polar covalent bond?
- C and H
  - N and H
  - B and H
  - Ne and H
25. Which of the following bonds is the most polar?
- Rb – F
  - Ca – S
  - Mg – P
  - H – O
26. Which of the following atoms has the smallest attraction for the electrons in a bond?
- Ca
  - Co
  - Cu
  - Cr
27. Which of the following is a possible Lewis diagram for a molecule of HSNO?
- $$\begin{array}{c} \text{:}\ddot{\text{O}}\text{:} \\ | \\ \text{H}-\text{S}=\text{N:} \end{array}$$
  - $$\begin{array}{c} \text{:}\ddot{\text{S}}\text{:} \\ | \\ \text{H}-\text{O}=\text{N:} \end{array}$$
  - $$\text{H}-\ddot{\text{S}}-\ddot{\text{N}}=\ddot{\text{O}}\text{:}$$
  - $$\text{H}=\ddot{\text{S}}-\ddot{\text{N}}-\ddot{\text{O}}\text{:}$$
28. The atoms of nitrogen in a molecule of  $\text{N}_2$  are held together by:
- a single covalent bond
  - a double covalent bond
  - a triple covalent bond
  - an ionic bond
29. The number of lone pairs of electrons in the outer shell of sulfur in a molecule of  $\text{H}_2\text{S}$  is:
- one pair
  - two pairs
  - three pairs
  - four pairs
30. Which of the following molecules is non-polar?
- $\text{O}_2$
  - $\text{H}_2\text{O}$
  - $\text{NaCl}$
  - $\text{NH}_3$
31. Which one of the following is NOT a form of chemical bonding?
- covalent bonding
  - ionic bonding
  - hydrogen bonding
  - all of the above are types of chemical bonding
32. In which of the following compounds is carbon found as a fully charged negative ion?
- $\text{CH}_4$
  - $\text{Be}_2\text{C}$
  - $\text{CCl}_4$
  - $\text{Rb}_4\text{C}$
33. Acetic acid (used to make vinegar) is a liquid at SATP, with a distinctive odour. Based on its physical properties, acetic acid is a:
- non-polar covalent compound
  - polar covalent compound
  - ionic compound
  - non-metal element
34. Which of the following is not a property of magnesium chloride?
- it has a high melting point
  - it has a strong odour
  - it is an electrolyte
  - it is solid at SATP
35. Which of the following molecules is capable of hydrogen bonding?
- HF
  - $\text{H}_2\text{S}$
  - HBr
  - all of the above will form hydrogen bonds

36. A binary compound is most likely to be non-polar covalent if the bonding atoms:
- a) both have high electronegativity
  - b) both have low electronegativity
  - c) have very different values for electronegativity
  - d) are both Noble gases
37. Which of the following is the best example of inter-molecular attraction?
- a) a non-polar covalent bond
  - b) a polar covalent bond
  - c) the bond between nitrogen atoms in  $\text{N}_2$
  - d) a hydrogen bond
38. Which of the following substances is the best electrolyte?
- a)  $\text{C}_6\text{H}_{12}\text{O}_6$
  - b)  $\text{CaCl}_2$
  - c)  $\text{CH}_3\text{COOH}$
  - d)  $\text{H}_2\text{O}$
39. Which of the following groups of gases includes only actual, existing diatomic elements?
- a)  $\text{B}_2$ ,  $\text{C}_2$ ,  $\text{N}_2$  and  $\text{O}_2$
  - b)  $\text{Br}_2$ ,  $\text{I}_2$ ,  $\text{F}_2$  and  $\text{Cl}_2$
  - c)  $\text{N}_2$ ,  $\text{O}_2$ ,  $\text{He}_2$  and  $\text{Xe}_2$
  - d)  $\text{N}_2$ ,  $\text{Ar}_2$ ,  $\text{F}_2$ , and  $\text{O}_3$
40. Which of the following statements is true about the compound  $\text{ScCl}_3$ :
- a) inter-molecular forces of attraction are very weak
  - b) intra-molecular forces of attraction are very weak
  - c) each molecule (formula unit) is a separate, discrete particle
  - d) the ratio of scandium ions to chlorine ions in the compound is 1 to 3
41. An atom has the electron configuration  $1s^2 2s^2 2p^6 3s^2 3p^5$ . Which of the following statements is/are true?
- a) this atom can form ionic bonds
  - b) this atom has a bonding capacity of one
  - c) this atom can form covalent bonds
  - d) all of the above
42. Which of the following is/are formula units?
- a)  $\text{C}_6\text{H}_{12}\text{O}_6$
  - b)  $\text{H}_2\text{O}_2$
  - c)  $\text{Al}_2\text{O}_3$
  - d) all of the above are formula units

## Review for Unit Test #2: Chemical Bonding

### Long and Short Answer Questions:

1. Be able to define the following terms. Include one additional piece of information such as an example or application.

element

compound

octet rule

bonding capacity

chemical bond

ionic bond

formula unit

crystal lattice

electronegativity

non-polar covalent bond

polar covalent bond

molecule

molecular formula

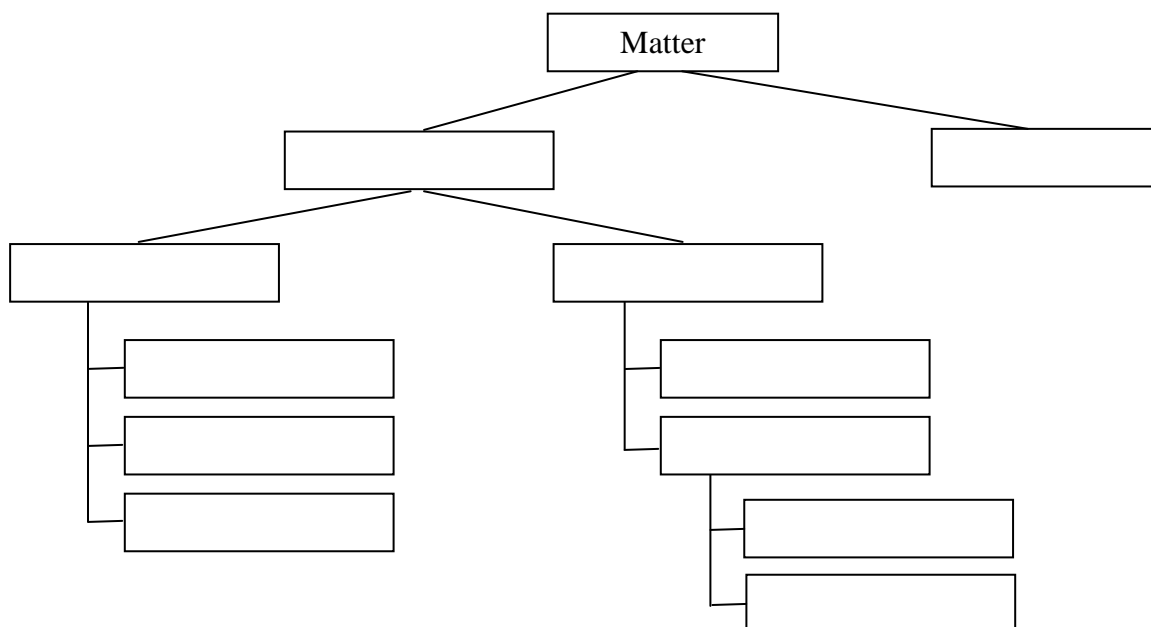
intra-molecular forces

inter-molecular forces

hydrogen bonding

electrolyte

2. Complete the organization of matter chart. Include the terms: non-polar covalent compound, metal, compound, pure substance, polar covalent compound, ionic compound, metalloid, element, mixture, non-metal, covalent compound



3. Which of the following are pure substances: metals, non-metals, ionic compounds, covalent compounds, solutions? For each, explain why or why not.
4. Represent the following atoms three ways: using Rutherford-Bohr diagrams, electron configurations and Lewis Dot (electron dot) diagrams: Al, C, Mg, O, K, N and Ar
5. Why are Lewis dot diagrams acceptable to use to show bonding?
6. Explain why the Noble Gas elements do not form chemical bonds.
7. Complete the following table to compare the “typical” characteristics of ionic compounds and NON-POLAR covalent compounds.

Property	Ionic Compound	Non-polar Covalent Compound
Melting point		
Hardness of solid		
Presence of odour		
Solubility in water		
Conduct electricity as a solid?		
Conduct electricity in solution?		

8. Clearly distinguish between inter-molecular and intra-molecular forces of attraction.
9. Use the strength of inter-molecular attraction to explain why:
  - a) Ionic compounds have very high melting points
  - b) Non-polar covalent compounds have low melting points and many are gases at room temperature.
  - c) Non-polar covalent compounds often have odours and ionic compounds do not.
10. Explain why ionic compounds are strong electrolytes in solution, and polar covalent compounds are not.
11. Predict four physical properties of  $\text{BaCl}_2$ .
12. Classify the following compounds as either **ionic** or **covalent** compounds:
  - a) A compound has a strong odour, low melting point and does not dissolve in water: \_\_\_\_\_
  - b) A compound dissolves in water, has a high melting point and no odour: \_\_\_\_\_
  - c)  $\text{C}_6\text{H}_{12}\text{O}_6$ : \_\_\_\_\_
  - d) A compound is a liquid at room temperature and does not conduct an electric current: \_\_\_\_\_
  - e)  $\text{MgCO}_3$ : \_\_\_\_\_
13. Use electron dot diagrams to show the formation of the ionic compound between the following:
 

a) sodium and oxygen	c) potassium and chlorine
b) barium and carbon	d) aluminum and sulfur

Remember to show the three steps:  
 Step 1: draw the neutral atoms and indicate the direction that the electrons will tend to move  
 Step 2: draw the ions that form and show their charges. Arrange the ions appropriately for their charges.  
 Step 3: write the chemical formula for the final compound.
14. List the seven diatomic elements and be able to draw their Lewis structures (aka stick diagrams or structural diagrams). Are these elements classified as atoms or molecules? Explain.
15. Which of the following are impossible molecules? Why?  $\text{Ar}_2$ ,  $\text{Ba}_2$ ,  $\text{NeO}$ ,  $\text{He}_2$ ,  $\text{LiNa}$ ,  $\text{HeH}$ ,  $\text{Mg}_3\text{Al}_2$
16. What **two** factors determine the electronegativity of an atom? (refer back to Atomic Theory Unit). Which element on the Periodic Table has the highest electronegativity, and why? Which element has the lowest, and why?
17. Give three examples of bonds that have an electronegativity difference ( $\Delta\text{EN}$ ) of zero.
18. Explain the concept of a “bonding continuum”. Arrange the following bonds along a continuum from least to greatest polarity (increasing  $\Delta\text{EN}$ ):  $\text{Na} - \text{Br}$ ,  $\text{P} - \text{H}$ ,  $\text{F} - \text{F}$ ,  $\text{C} - \text{S}$ ,  $\text{O} - \text{H}$ ,  $\text{Cs} - \text{F}$ ,  $\text{Ca} - \text{Cl}$ ,  $\text{Mg} - \text{I}$ .
19. Use the octet rule to draw the Lewis structures (aka stick diagrams or structural diagrams) for the following molecules. Remember to include all lone pairs (unshared electron pairs).  
 $\text{N}_2$ ,  $\text{NF}_3$ ,  $\text{N}_2\text{H}_4$ ,  $\text{N}_2\text{H}_2$ ,  $\text{CH}_4$ ,  $\text{PH}_3$ ,  $\text{C}_2\text{H}_4$ ,  $\text{CH}_2\text{O}$ ,  $\text{CO}_2$ ,  $\text{CS}_2$ ,  $\text{HSCN}$ ,  $\text{HCOOH}$ ,  $\text{C}_2\text{H}_5\text{OH}$ ,  $\text{HSiN}$ ,  $\text{H}_2\text{CO}_3$ ,  $\text{HCCl}_3$ ,  $\text{CH}_3\text{COCH}_3$ ,  $\text{CH}_3\text{COOH}$ ,  $\text{CHONH}_2$ ,  $\text{CH}_3\text{CONH}_2$ ,  $\text{OF}_2$ ,  $\text{HNO}_2$ ,  $\text{H}_2\text{O}_2$ ,  $\text{CH}_3\text{OH}$ 
  - a) Write the AXE notation and name the molecular shape.
  - c) Determine the symmetry of the molecule. Look at both the symmetry of the shape and the bonding atoms.
  - d) Calculate the  $\Delta\text{EN}$  of all bonds.
  - e) Determine the overall polarity of the molecule. If the molecule is **very polar covalent** (asymmetrical and has polar bonds), then label partial negative ( $\delta^-$ ) and partial positive ( $\delta^+$ ) charges on the appropriate atoms. If the molecule is only slightly polar (asymmetrical but no polar bonds), the partial charges are very slight, so do not label them on the molecule.
20. Explain why a molecule can contain polar bonds, but be a non-polar molecule.
21. Explain the relationship between the polarity of a molecule, the strength of inter-molecular attraction and melting point.