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Gizmos

Name: Julia Kim Date: 1/15/20

Student Exploration: Center of Mass

Background: Center of mass (center of gravity)

Prior Knowledge: How do you think a hammer balances on your finger? (Does an object's mass affect its center of mass?)

1. The head of the hammer is made of metal. The handle is made of wood. Which is heavier? (The head is heavier.)

2. How do you think the hammer balances on your finger? (The center of mass is located on the handle.)

Student Response:

The head of the hammer is heavier than the handle.

Gizmo Instructions:

Imagine you had to balance a hammer on your finger. The hammer would not balance if the center of mass was not directly above the point of support. In this gizmo, you can move the center of mass of the hammer. The center of mass is the point where the hammer would balance if it were suspended from that point.

3. How do you think the center of mass affects the hammer's motion? (The center of mass affects the hammer's motion. If the center of mass is not directly above the point of support, the hammer will rotate.)

4. How do you think the center of mass affects the hammer's motion? (The center of mass affects the hammer's motion. If the center of mass is not directly above the point of support, the hammer will rotate.)

Questions:

1. Calculate the electronegativity difference and determine the bond type for each of the following bonds:

Bond	Electronegativity difference	Bond Type
H-O	1.24	P
H-N	0.91	P
Br-Cl	0.21	P
H-S	0.38	P
H-C	0.35	P
C-O	1.01	P
K-Br	2.14	I

2. Rank the bonds in question 1 in order of increasing polarity (lowest to highest)

Br-Cl < H-C < H-S < H-N < C-O < H-O < K-Br

3. Classify each of the following molecules as ionic, polar covalent or non-polar covalent:

Br ₂ % <u>NPC</u>	MgS % <u>PC</u>	MgO % <u>I</u>
CCl ₄ % <u>NPC</u>	BeO % <u>I</u>	HI % <u>PC</u>
CO ₂ % <u>NPC</u>	H ₂ O % <u>PC</u>	N ₂ % <u>NPC</u>
BaO % <u>I</u>	AlN % <u>PC</u>	CaO % <u>I</u>
KCl % <u>I</u>	LiBr % <u>I</u>	CO % <u>PC</u>

3. Both water and carbon dioxide are tri-atomic molecules with similar formulas. Explain why one of these is polar and the other is non-polar.

Water is bent shape due to the pair of non-bonding electrons on oxygen, while CO₂ is linear (see Lewis structures). The polarity of bonds in CO₂ is cancelled while in H₂O it is not.

H-O-H :O=C=O:

Writing Compound Names

(a bond between a metal and a nonmetal)

Naming a Binary Ionic Compound
(two elements with no transition metal)

NaCl → sodium chloride
K₂O → potassium oxide

Naming a Compound with a Transition Metal

FeCl₂ → iron (II) chloride
Ag₂S → silver (I) sulfide

Naming a Compound with a Polyatomic Ion

(NH₄)₂S → ammonium sulfide
Ca(ClO₃)₂ → calcium chlorate

Molecular Polarity

Explains the molecular polarity prediction of the electronegativity difference between atoms.

Start with the Two Atoms tab.

1. Add the electronegativity of atom A and atom B.

2. Explain what the bond dipole arrow shows.

3. Turn on the electric field for a series of different non-polar molecules. Explain why the molecule more or less is polar.

The polarity of a covalent bond can be judged by determining the difference in the electronegativities of the two atoms making the bond. (a) The electrons in the covalent bond are equally shared by both hydrogen atoms. Medium? Learning Objectives Covalent bonds have certain characteristics that depend on the identities of the atoms participating in the bond. Exercise Describe the electronegativity difference between each pair of atoms and the resulting polarity (or bond type). You're Reading a Free Preview Page 2 is not shown in this preview. Figure 1 (PageIndex(21)) shows one of the most popular—the Pauling scale. Thus, carbon dioxide molecules are nonpolar overall. 2. When two atoms share a pair of electrons equally it is a nonpolar covalent bond but when they share it inequally then it's polar. How does a polar covalent bond differ from a non-polar covalent bond? This is a polar covalent bond. Content Locked Electronegativity sheet answers key Course: Molecular Biology (BP 723) Electronegativity Worksheet 1. Fill in the values to complete the following table for predicting bond type based on differences in electronegativity. C and H H and H Na and Cl O and H Solution Carbon has an electronegativity of 2.5, while the value for hydrogen is 2.1. The difference is 0.4, which is rather small. In short, the molecule itself is polar. With 2.1 for hydrogen and 3.5 for oxygen, the electronegativity difference is 1.4. We would expect a very polar bond, but not so polar that the O-H bond is considered ionic. Print Answer Key PDF Take Now Schedule Copy Print Answer Key (Only the test content will print) Instructions: The following questions require the use of a reference table that contains the electronegativities of different elements. Large? Two characteristics are bond length and bond polarity. -Ionic bonds are the result of giving or taking electrons. The more there is difference in electronegativity, the more a bond is polarised 4. C and O N and H N and N C and F When a molecule's bonds are polar, the molecule as a whole can display an uneven distribution of charge, depending on how the individual bonds are oriented. The physical properties of water and carbon dioxide are affected by their polarities. Any covalent bond between atoms of different elements is a polar bond, but the degree of polarity varies widely. Although we defined covalent bonding as electron sharing, the electrons in a covalent bond are not always shared equally by the two bonded atoms. Concept Review Exercises What does the electronegativity of an atom indicate? To judge the relative polarity of a covalent bond, chemists use electronegativity, which is a relative measure of how strongly an atom attracts electrons when it forms a covalent bond. How are ionic bonds and covalent bonds different? How do electronegativity values help us determine the polarity of a bond? Sodium's electronegativity is 0.9, while chlorine's is 3.0. The difference is 2.1, which is rather high, and so sodium and chlorine form an ionic compound. An electronegativity difference of zero, of course, indicates a nonpolar covalent bond. 3. When such an imbalance occurs, there is a resulting buildup of some negative charge (called a partial negative charge and designated δ-) on one side of the bond and some positive charge (designated δ+) on the other side of the bond. Some bonds between different elements are only minimally polar, while others are strongly polar. Unless the bond connects two

atoms of the same element, there will always be one atom that attracts the electrons in the bond more strongly than the other atom does, as shown in Figure 1. Does electronegativity increase or decrease when you go across a period on the periodic table? The C-H bond is therefore considered nonpolar. Key Takeaways Covalent bonds between different atoms have different bond lengths. There are various numerical scales for rating electronegativity. Figure 2 Electronegativities of Various Elements. Electronegativity increases across a period and decreases down a group. Although there are no hard and fast rules, the general rule is if the difference in electronegativities is less than about 0.4, the bond is considered nonpolar; if the difference is greater than 0.4, the bond is considered polar. The greater the difference in electronegativities, the greater the imbalance of electron sharing in the bond. Answers Electronegativity is a qualitative measure of how much an atom attracts electrons in a covalent bond. (For example, the boiling point of water [100°C] is high for such a small molecule and is due to the fact that polar molecules attract each other strongly.) In contrast, while the two C=O bonds in carbon dioxide are polar, they lie directly opposite each other and so cancel each other's effects. (For example, carbon dioxide becomes a gas at -77°C, almost 200° lower than the temperature at which water boils.) Figure 3 Physical Properties and Polarity. If the difference in electronegativities is large enough (generally greater than about 1.8), the resulting compound is considered ionic rather than covalent. This is a nonpolar covalent bond. This lack of polarity influences some of carbon dioxide's properties. For example, the orientation of the two O-H bonds in a water molecule (Figure 3) is bent: one end of the molecule has a partial positive charge, and the other end has a partial negative charge. Ionic bonds can be considered the ultimate in polarity, with electrons being transferred rather than shared. Example 1 Describe the electronegativity difference between each pair of atoms and the resulting polarity (or bond type). 0.0 0.5 2.1 3.3 5. What type of bond is formed between two atoms if the difference in electronegativities is small? (b) The fluorine atom attracts the electrons in the bond more than the hydrogen atom does, leading to an imbalance in the electron distribution. Both hydrogen atoms have the same electronegativity value—2.1. The difference is zero, so the bond is nonpolar. Does it increase or decrease when you move down a group on the periodic table? A covalent bond that has an equal sharing of electrons (part (a) of Figure 1) is called a nonpolar covalent bond. Covalent bonds can be polar or nonpolar, depending on the electronegativity difference between the atoms involved. The polarity of water has an enormous impact on its physical and chemical properties. Whereas covalent bonds are the result of sharing electrons. A covalent bond that has an unequal sharing of electrons, as in part (b) of Figure 1, is called a polar covalent bond. Figure 1 Polar versus Nonpolar Covalent Bonds. A popular scale for electronegativities has the value for fluorine atoms set at 4.0, the highest value.

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