Introduction o A chemical bond is the force that holds a group of atoms together. 15/29 Evaluation of bond polarity I The electronegativity scale, developed by L. Pauling in the 1930s, was based on measurements of the strengths of covalent bonds between di erent elements I Fluorine was arbitrarily set an electronegativity of 4.0 (now refined to 3.98), thereby creating a scale in which all elements have values between 0 and 4.0 o Bond polarity is evaluated by determining the electronegativity di erence between two adjacent atoms that compose the bond o Regarding the electronegativity di erence (EN) between them, a bond can be classified as: I ionic if EN O 2.0 I polar (covalent) if 0.4 I covalent if EN AE 0.4 16/29 Example 5 Given the relative electronegativity values (EN) below: Atoms H C K F Cl EN 2.1 2.5 0.8 4.0 3.0 classify the following bonds as ionic, polar or covalent : (a) HCl , (b) KF, and (c) C!=C and H!=C bonds in C2H6 17/29 Dipole moment I The asymmetrical charge distribution in a polar substance such as HCl produces a dipole moment (u). For example: I C(C)C bond has a length of 120.3 pm in C2H2 molecule I C=C bond has a length of 133.9 pm in C2H4 molecule I C–C bond has a length of 153.5 pm in C2H6 molecule 19/29 Lewis structure o A Lewis structure represents the covalent bonding in a molecule in which : I only valence electrons are shown I shared electrons between two atoms are shown either as lines or as pairs of dots I lone pairs are shown as pairs of dots 20/29 Drawing Lewis structure o Lewis structures of compounds such as HF or Cl2 are simple to draw; however, many complexes molecules and ions (CH2O, CO2!= 3 ...) are not o Therefore, basic steps should be followed to draw these complexes compounds: 1.o The ions are oppositely charged; therefore they attract each other to form ionic networks, lattices o Generally, ionic compound are formed from the reaction of metals with non–metals: I electrons are transferred from the metal to the non metal I the metal becomes + ion and the non–metal becomes != ion o For example, Li (Z=3) reacts with F (Z=9) as follow: o the VE 2s1 of Li is transferred to the F atom to form the LiF ionic compound.o For example the elements lithium (Z = 3), beryllium (Z=4) and boron (Z=5) are written using the Lewis dot symbols o The Lewis dot symbols explains why : I lithium, with one unpaired valence electron, tends to form one bond I beryllium, with two unpaired valence electrons, tends to form two bonds I boron, with three unpaired valence electrons, tends to form three bonds 5/29 Example 1 1– Draw the Lewis dot symbols for these elements C, N, O, F, Ne. 2– Predict the number of bonds that can be formed in a compound from these elements ? I and metallic bonds: Cu, Fe ... (solid pure metals) o In the 20th century, a system has been devised to predict the number of bonds formed by most elements in their compounds, the Lewis dot symbols 4/29 The Lewis dot symbols o The Lewis symbols consists of the chemical symbol for the element with a dot for each valence electron.o The covalent bond is: I non–polar in H2 molecule because the electrons are equally shared I polar in HF molecule because the electrons are not equally shared o Bond polarity is evaluated by determining the electronegativity di erence between two adjacent atoms that compose the bond.o With regard to the electronegativity di erence (EN) between two atoms in a compound, the formed bond can be: I ionic (Na–Cl), I polar (H–Cl) I or non–polar (Cl–Cl, H–H, C–C,...) 14/29 Electronegativity variation o In a periodic table, electronegativity increases from lower left to upper right.o For example, the formation reaction of the molecule Cl2 is as follow : I each Cl atom has 7 VEs; but only the unpaired electron is involved in the covalent bond I the non–bonding electrons are called lone pairs, which are not involved in covalent bond I Each Cl in Cl2 molecule has three lone pairs of electrons 11/29

Example 4 1.I atoms such as F, Cl and Br (p block) have higher electronegativities I atoms such as Li, Na and K (s block) have lower electronegativities I electronegativity of the d block elements is intermediate between the alkali and the halogens elements.o A covalent bond between many-electron atoms involves only the VEs.Explain 2.