21_01_27

HW03: Related to the Electronic Structure of Bonds

`Table: Electronegativity of Elements`

Explore the chemical elements through this periodic table

Group	1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Period 1	1 H 1.008 Hydrogen																		2 He 4.0026 Helium
2	3 Li 6.94 Lithium	4 Be 9.0122 Beryllium												5 B 10.81 Boron	6 C 12.011 Carbon	7 N 14.007 Nitrogen	8 O 15.999 Oxygen	9 F 18.998 Fluorine	10 Ne 20.180 Neon
3	11 Na 22.990 Sodium	12 Mg 24.305 Magnesium												13 Al 26.982 Aluminium	14 Si 28.085 Silicon	15 P 30.974 Phosphorus	16 S 32.06 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.948 Argon
4	19 K 39.098 Potassium	20 Ca 40.078 Calcium		21 Sc 44.956 Scandium	22 Ti 47.867 Titanium	23 V 50.942 Vanadium	24 Cr 51.996 Chromium	25 Mn 54.938 Manganese	26 Fe 55.845 Iron	27 Co 58.933 Cobalt	28 Ni 58.693 Nickel	29 Cu 63.546 Copper	30 Zn 65.38 Zinc	31 Ga 69.723 Gallium	32 Ge 72.630 Germanium	33 As 74.922 Arsenic	34 Se 78.971 Selenium	35 Br 79.904 Bromine	36 Kr 83.798 Krypton
5	37 Rb 85.468 Rubidium	38 Sr 87.62 Strontium		39 Y 88.906 Yttrium	40 Zr 91.224 Zirconium	41 Nb 92.906 Niobium	42 Mo 95.95 Molybdenum	43 Tc 96.906 Technetium	44 Ru 101.07 Ruthenium	45 Rh 102.91 Rhodium	46 Pd 106.42 Palladium	47 Ag 107.87 Silver	48 Cd 112.41 Cadmium	49 In 114.82 Indium	50 Sn 118.71 Tin	51 Sb 121.76 Antimony	52 Te 127.60 Tellurium	53 I 126.90 Iodine	54 Xe 131.29 Xenon
6	55 Cs 132.91 Caesium	56 Ba 137.33 Barium	*	71 Lu 174.97 Lutetium	72 Hf 178.49 Hafnium	73 Ta 180.95 Tantalum	74 W 183.84 Tungsten	75 Re 186.21 Rhenium	76 Os 190.23 Osmium	77 Ir 192.22 Iridium	78 Pt 195.08 Platinum	79 Au 196.97 Gold	80 Hg 200.59 Mercury	81 Tl 204.38 Thallium	82 Pb 207.2 Lead	83 Bi 208.98 Bismuth	84 Po 208.98 Polonium	85 At 209.99 Astatine	86 Rn 222.02 Radon
7	87 Fr 223.02 Francium	88 Ra 226.03 Radium	**	103 Lr 262.11 Lawrencium	104 Rf 267.12 Rutherfordium	105 Db 270.13 Dubnium	106 Sg 269.13 Seaborgium	107 Bh 270.13 Bohrium	108 Hs 269.13 Hassium	109 Mt 278.16 Meitnerium	110 Ds 281.17 Darmstadtium	111 Rg 281.17 Roentgenium	112 Cn 285.18 Copernicium	113 Nh 286.18 Nihonium	114 Fl 289.19 Flerovium	115 Mc 289.20 Moscovium	116 Lv 293.20 Livermorium	117 Ts 293.21 Tennessine	118 Og 294.21 Oganesson
*Lanthanoids			*	57 La 138.91 Lanthanum	58 Ce 140.12 Cerium	59 Pr 140.91 Praseodymium	60 Nd 144.24 Neodymium	61 Pm 144.91 Promethium	62 Sm 150.36 Samarium	63 Eu 151.96 Europium	64 Gd 157.25 Gadolinium	65 Tb 158.93 Terbium	66 Dy 162.50 Dysprosium	67 Ho 164.93 Holmium	68 Er 167.26 Erbium	69 Tm 168.93 Thulium	70 Yb 173.05 Ytterbium		
**Actinoids			**	89 Ac 227.03 Actinium	90 Th 232.04 Thorium	91 Pa 231.04 Protactinium	92 U 238.03 Uranium	93 Np 237.05 Neptunium	94 Pu 244.06 Plutonium	95 Am 243.06 Americium	96 Cm 247.07 Curium	97 Bk 247.07 Berkelium	98 Cf 251.08 Californium	99 Es 252.08 Einsteinium	100 Fm 257.10 Fermium	101 Md 258.10 Mendelevium	102 No 259.10 Nobelium		

The standard form of the periodic table shown here includes periods (shown horizontally) and groups (shown vertically). The properties of elements in groups are similar in some respects to each other.

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                                     H
                                     2.1
Li   Be   B                                                                     C    N    O    F
1.0  1.5  2.0                                                                   2.5  3.0  3.5  4.0
Na   Mg   Al                                                                    Si   P    S    Cl
0.9  1.2  1.5                                                                   1.8  2.1  2.5  3.0
K    Ca   Sc      Ti   V    Cr   Mn       Fe   Co   Ni   Cu   Zn   Ga   Ge   As   Se   Br
0.8  1.0  1.3     1.5  1.6  1.6  1.5      1.8  1.9  1.9  1.9  1.6  1.6  1.8  2.0  2.4  2.8
Rb   Sr   Y       Zr   Nb   Mo   Tc       Ru   Rh   Pd   Ag   Cd   In   Sn   Sb   Te   I
0.8  1.0  1.2     1.4  1.6  1.8  1.9      2.2  2.2  2.2  1.9  1.7  1.7  1.8  1.9  2.1  2.5
Cs   Ba   La-Lu   Hf   Ta   W    Re       Os   Ir   Pt   Au   Hg   Tl   Pb   Bi   Po   At
0.7  0.9  1.0-1.2 1.3  1.5  17   1.9      2.2  2.2  2.2  2.4  1.9  1.8  1.9  1.9  2.0  2.2
Fr   Ra   Ac      Th   Pa   U    Np-No
0.7  0.9  1.1     1.3  1.4  1.4  1.4-1.3
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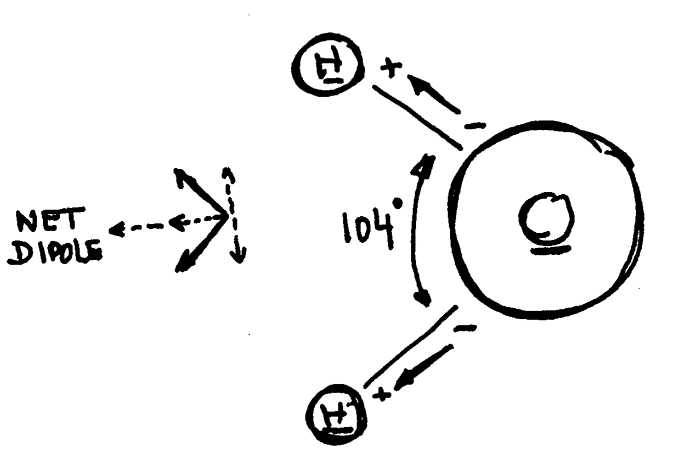
1. Explain why the middle columns in the first three rows are empty. (They start to fill in 4th row downwards)

2. Why is metallic bonding prevalent on the left hand side of the periodic table.

3. In metallic bonding atoms give up electrons in general to complete their shell. For example Al with has three electrons, gives then up (approximately) to the crystal. All atoms then share the donated electrons to create a metallic bond.

The question is that Al atoms will now have a charge of Al+++ on them. Normally if these ions were to be by themselves they would repel each other. How is this effect counteracted to create cohesion amongst the atoms.

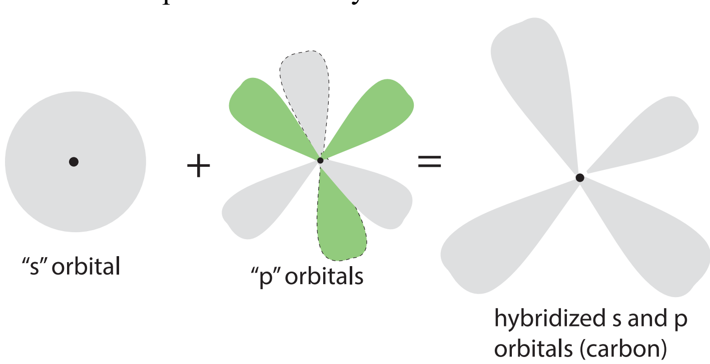
4. The water molecule has the structure given below. The length of the O-H bond is 96 pm and the angle between the OH bonds is 104°. The experimental value of the dipole moment of a water molecule i 1.855 μ. Calculate the % ionic character of the OH bond.

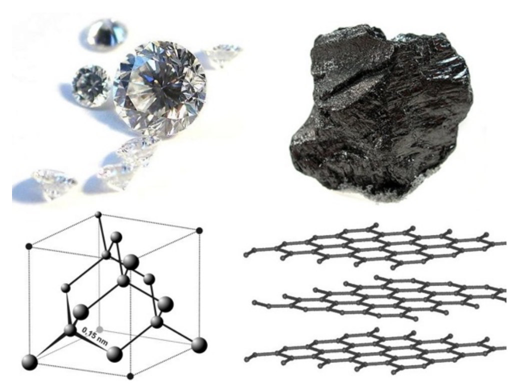


5. The NaCl molecule in the gas phase had a dipole moment of about 10 μ. Why is this number so large (qualitatively speaking)?

Even though the molecule is polar, the salt crystal is non-polar. Why?

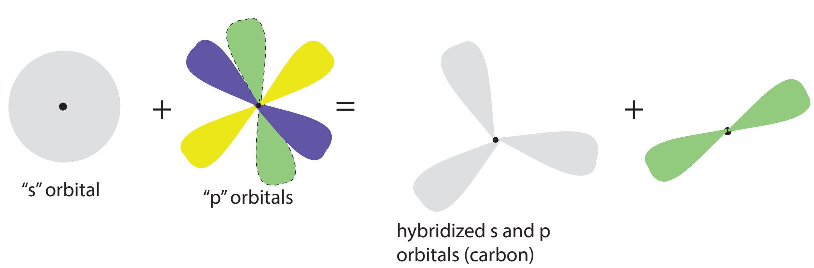
6. The s and p orbitals can hybridize as follows





The above is called sp3 hybridization. Indeed this is the structure of diamond - it has tetragonal symmetry.

However, carbon also exists is graphite which is a planar structure. This arises from sp2 hybridization of s and p orbitals as follows



The sp2 hybridization leads to the planar structure with three fold symmetry. The carbon-carbon bond length in diamond is 154 pm but it is 142 pm in graphite.. can you give an argument for this behavior.