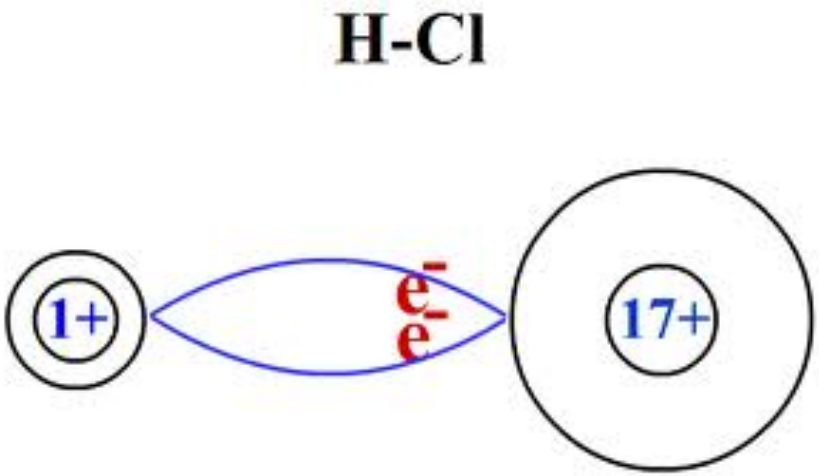
A perfect bond

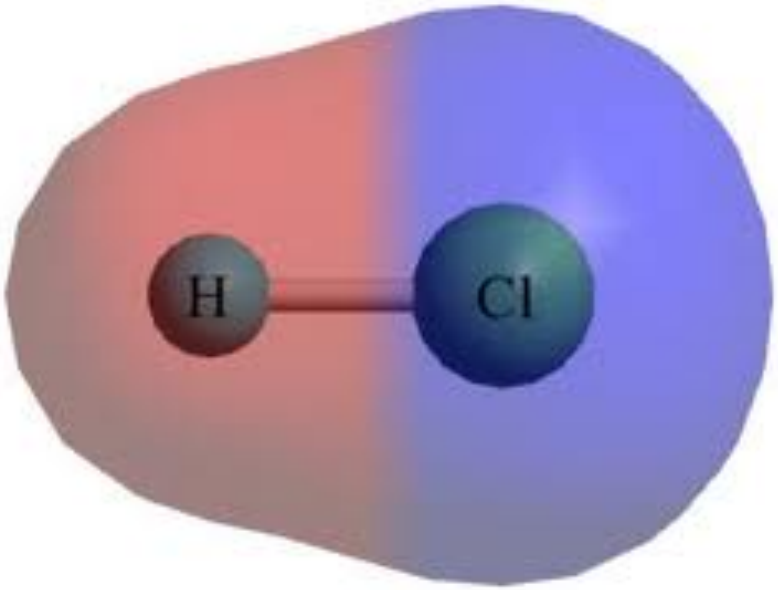
- H_2
- 0_2
- Cl_2

A not so perfect bond

- HCl
- HCl is a covalent compound with a single bond.
- The hydrogen is the submissive atom. The chlorine is the dominant atom. Chlorine has greater pulling power over hydrogen.
- Why?
- $^{\delta+}H$ and $Cl^{\delta-}$
- δ this is called a small amount of charge(dipole)

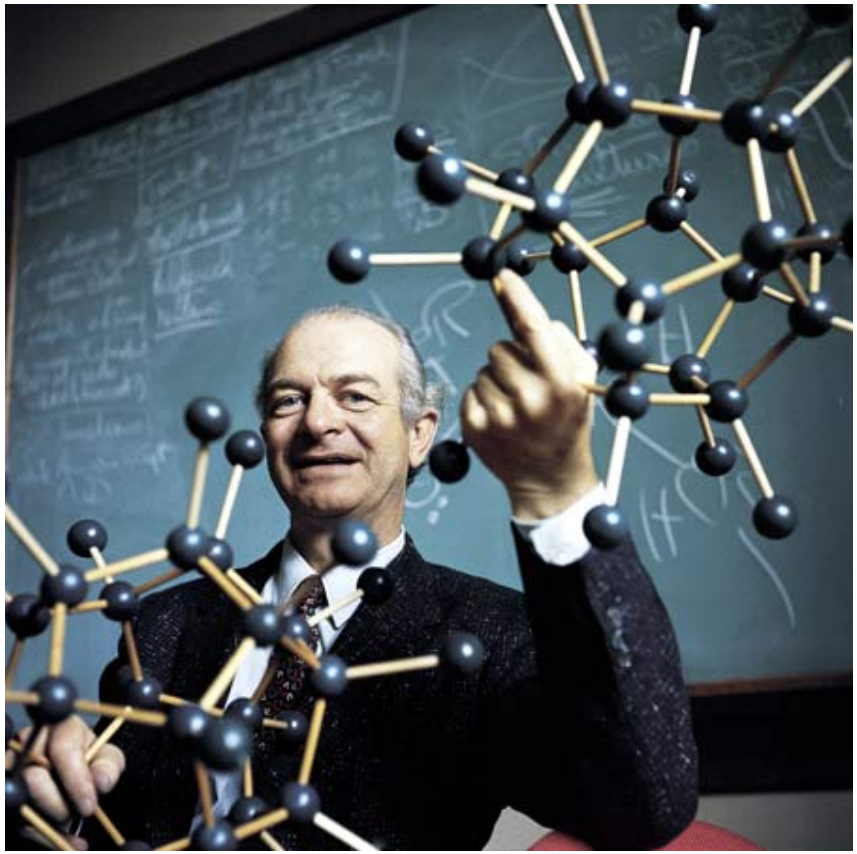
The unequal bonding in HCL
Called a polar molecule





Linus Pauling (peace and chemistry noble prize winner)

- Electronegativity is the relative attraction that an atom in a molecule has for the shared pair of electrons in a covalent bond



Electronegativity table

Periodic Table of the Elements

Electronegativity

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About Chemistry

1.0 1.3 1.6 1.9 2.2 2.5 2.8 3.1

1A	2A	3B	4B	5B	6B	7B	8B			1B	2B	3A	4A	5A	6A	7A	8A
1 H 2.20																	2 He no data
3 Li 0.98	4 Be 1.57											5 B 2.04	6 C 2.55	7 N 3.04	8 O 3.44	9 F 3.98	10 Ne no data
11 Na 0.93	12 Mg 1.31											13 Al 1.61	14 Si 1.90	15 P 2.19	16 S 2.58	17 Cl 3.16	18 Ar no data
19 K 0.82	20 Ca 1.00	21 Sc 1.36	22 Ti 1.54	23 V 1.63	24 Cr 1.66	25 Mn 1.55	26 Fe 1.83	27 Co 1.88	28 Ni 1.91	29 Cu 1.90	30 Zn 1.65	31 Ga 1.81	32 Ge 2.01	33 As 2.18	34 Se 2.55	35 Br 2.96	36 Kr 3.00
37 Rb 0.82	38 Sr 0.95	39 Y 1.22	40 Zr 1.33	41 Nb 1.6	42 Mo 2.16	43 Tc 1.9	44 Ru 2.2	45 Rh 2.28	46 Pd 2.20	47 Ag 1.93	48 Cd 1.69	49 In 1.78	50 Sn 1.96	51 Sb 2.05	52 Te 2.1	53 I 2.66	54 Xe 2.6
55 Cs 0.79	56 Ba 0.89	57-71 Lanthanides	72 Hf 1.3	73 Ta 1.5	74 W 2.36	75 Re 1.9	76 Os 2.2	77 Ir 2.20	78 Pt 2.28	79 Au 2.54	80 Hg 2.00	81 Tl 1.62	82 Pb 2.33	83 Bi 2.02	84 Po 2.0	85 At 2.2	86 Rn no data
87 Fr 0.7	88 Ra 0.89	89-103 Actinides															

*** Elements > 104 exist only for very short half-lifes and the data is unknown.***

Lanthanides	57 La 1.10	58 Ce 1.12	59 Pr 1.13	60 Nd 1.14	61 Pm 1.13	62 Sm 1.17	63 Eu 1.2	64 Gd 1.2	65 Tb 1.2	66 Dy 1.22	67 Ho 1.23	68 Er 1.24	69 Tm 1.25	70 Yb 1.1	71 Lu 1.27
Actinides	89 Ac 1.1	90 Th 1.3	91 Pa 1.5	92 U 1.38	93 Np 1.36	94 Pu 1.28	95 Am 1.3	96 Cm 1.3	97 Bk 1.3	98 Cf 1.3	99 Es 1.3	100 Fm 1.3	101 Md 1.3	102 No 1.3	103 Lr no data

Electronegativity values:

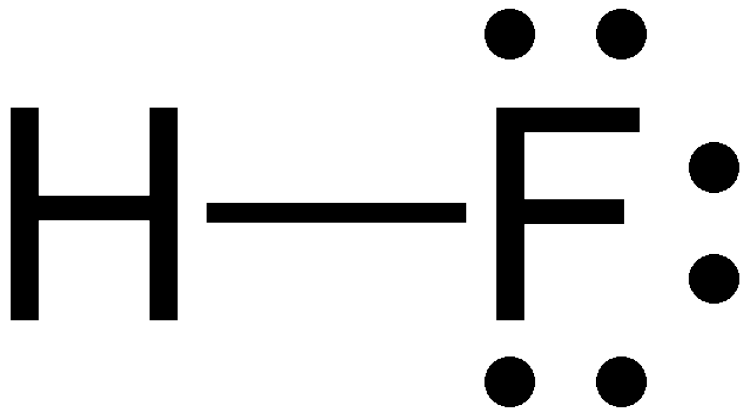
- increase across a period, why?
- increased nuclear charge and decreased atomic radius.
- What does nuclear charge mean?
- What does atomic radius mean?
- We will look at this in chapter 7.

- Generally decrease down a group;
- Extra shell of electrons going down a group.
- Because screening affect and an increase in atomic radius.
- are not given for the noble gases because noble gases do bond with other elements.

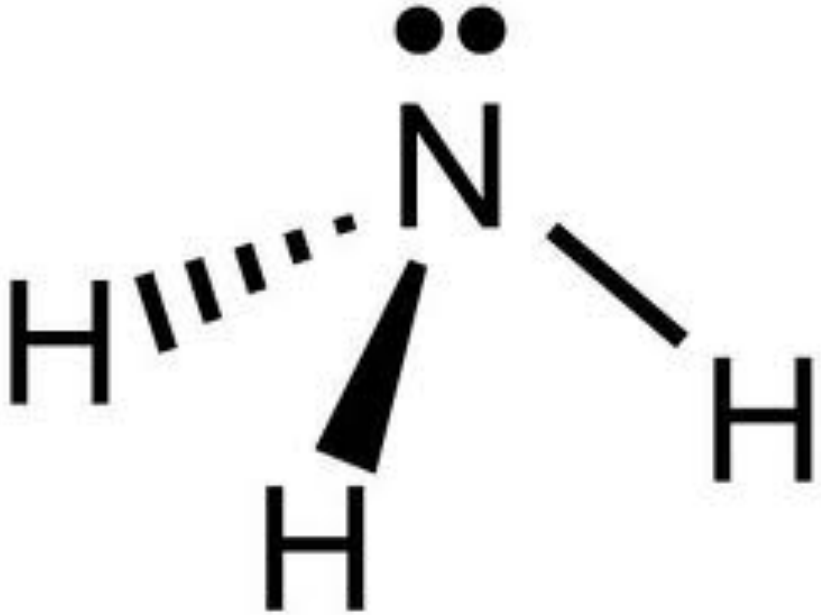
Using electronegativity values to predict the polarity of covalent bonds

Electronegativity difference	Bond type
$X = 0$	Pure covalent
$0 \leq x \leq 1.7$	Polar covalent
$x \geq 1.7$	Ionic

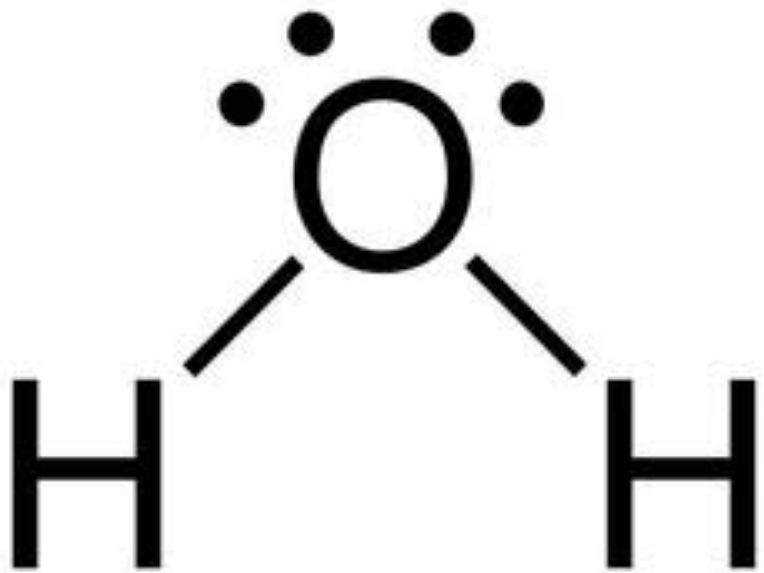
Predict the polarity of :



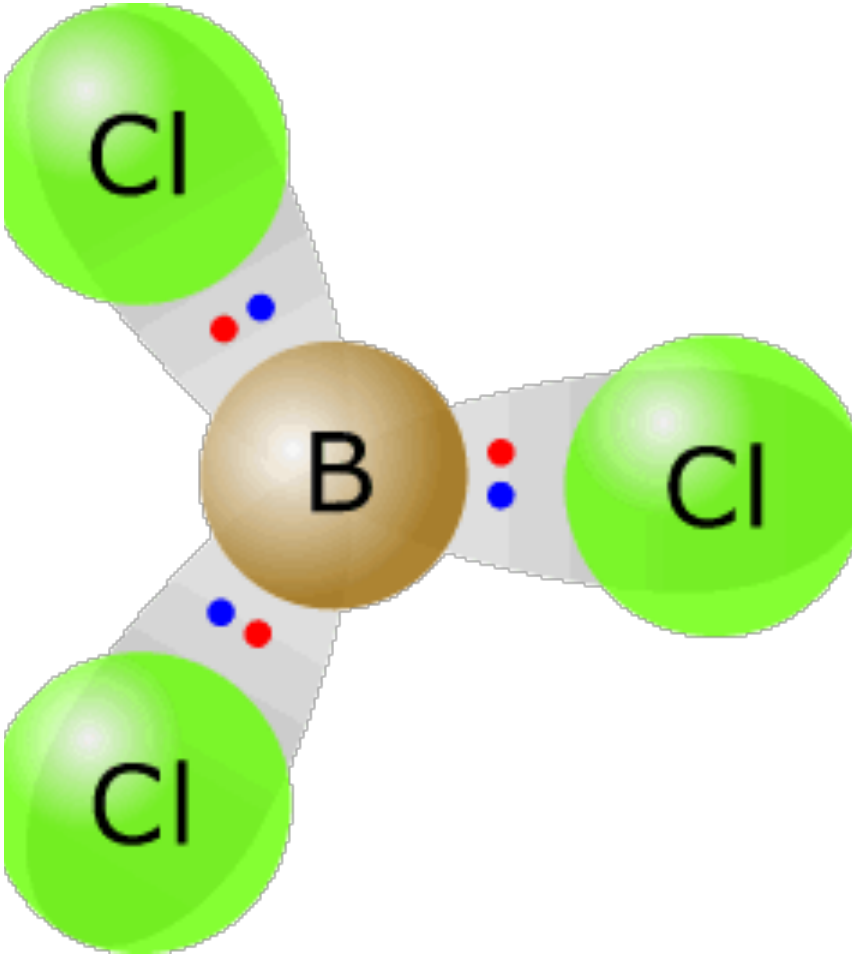
Predict the polarity of :



Predict the polarity of :

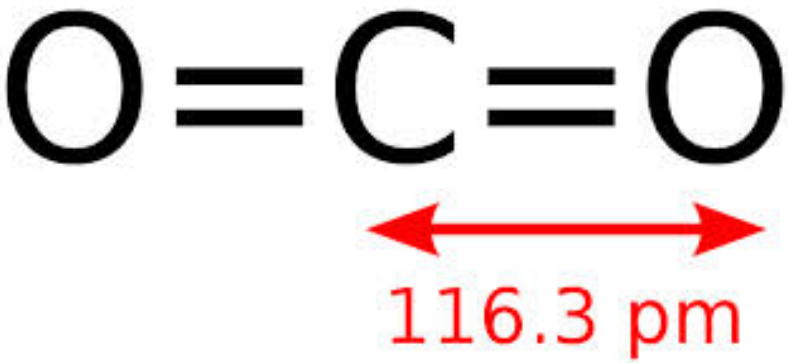


Some molecules can have polar bonds but are not a polar molecule.



- Work out the electronegativity of B and Cl
- Why is the molecule not considered polar covalent?

Predict the polarity of :



Compound	Electronegativity values	Electronegativity difference	Bond type	Polar molecule/ non-polar molecule
Phosphine(PH_3)				
Water(H_20)				
Calcium oxide(CaO)				
Carbon tetrachloromethane (CCl_4)				
HCl				
Sodium fluoride NaF				
NITROGEN GAS (N_2)				
OXYGEN GAS (O_2)				

Compound	Electronegativity values	Electronegativity difference	Bond type	Polar molecule/ non-polar molecule
Phosphine(PH_3)	P =2.1 H=2.1	2.1 - 2.1 = 0	Pure covalent	Non-polar
Water(H_20)	H=2.1 O=3.5	3.5-2.1= 1.4	Polar covalent	Polar molecule
Calcium oxide (CaO)	Ca=1.0 O=3.5	3.5 – 1.0 = 2.5	ionic	Strong Polar molecule
Carbon tetrachloromethane (CCl_4)	C=2.5 Cl=3.0	3.0-2.5= 0.5	Pure covalent ?	**symmetrical** molecule
HCl	H=2.1 Cl=3.0	3.0- 2.1 =0.9	Polar covalent	
Sodium fluoride NaF	Na =0 .9 F= 4.0	4.0- 0.9 = 3.1	ionic	
NITROGEN GAS (N_2)	N=3.0 N=3.0	3.0-3.0 = 0	Pure covalent	
OXYGEN GAS (O_2)	O=3.5 O=3.5	3.5-3.5 = 0	Pure covalent	