# H2 Chem Chemical Bonding Cheat Sheet

by L_Wen via cheatography.com/193987/cs/40409/

## Chemical Bonding

## Physical Properties

| | | | |
|---|---|---|---|
| Melting/ boiling point | strength of bonding | amount of energy required to overcome bond | id-id< pd-pd< H-bond< (metallic/ ionic/ covalent) |
| Solubility | favourable bonds formed? | bonds formed stronger than bonds broken | |
| | water + polar => ion-dipole | polar + polar | non-polar + non-polar |
| Electrical conductivity | presence of electrical carriers | mobile delocalised $e^-$ or ions | |

## Covalent Compounds

| | | | |
|---|---|---|---|
| covalent bonds | EFoA between shared pair of $e^-$ and positively charged nuclei | | |
| | dative covalent | one atom contributes both bonding $e^-$ | |
| overlap or orbitals | sigma (σ) bond | head-on overlap | s- and p-orbital |
| | pi (π) bond | side-on overlap | p-orbitals only |
| Strength = bond energy | no of bonding $e^-$ (bond order) | effectiveness of orbital overlap | bond polarity (incr ionic character) |
| | more bonding $e^-$ = stronger EFoA | larger orbital = more diffused = less effective overlap | more polar = stronger EFoA |
| simple covalent structure | simple discrete molecules | | |
| | id id | non-polar; weak | size of electron cloud; polarisability |
| | pd pd | polar; stronger than id id | strength of dipole moment |
| | H bond | H bonded to NOF + lone pair of electrons on NOF | optimal ratio of H:e- (1:1) |
| giant covalent structure: | | | |
| diamond | each C bonded to 4 other C atoms | giant covalent lattice | |
| graphite | each C bonded to 3 other C atoms | giant extensive planar layers | weak id id between layers |

## Molecular Shape and Arrangement

| | | | | | |
|---|---|---|---|---|---|
| Valence shell electron repulsion theory | VSEPR | | | | |
| Conditions | $e^-$ pairs arranged as far apart as possible | minimise repulsion | | | |
| | LP-LP > | LP-BP> | BP-BP> | BP- Lone $e^-$ | |
| | Repulsion of $e^-$ incr as electroneg incr | electroneg incr = $e^-$ closer to central atom | = stronger repulsion | | |
| No of $e^-$ pairs | $e^-$ pair geometry | No of BP | No of LP | molecular geometry | Bond angle |
| 2 | linear | 2 | 0 | linear | 180 |
| 3 | trigonal planar | 3 | 0 | trigonal planar | 120 |
| | | 2 | 1 | bent | <120 |
| 4 | tetrahedral | 4 | 0 | tetrahedral | 109 |
| | | 3 | 1 | trigonal pyramidal | 107 |
| | | 2 | 2 | bent | 105 |
| 5 | trigonal bipyramidal | 5 | 0 | trigonal bipyramidal | equatorial - 120; axial - 180 |
| | | 4 | 1 | see-saw (remove from equatorial plane) | equatorial - <120; axial - 180 |
| | | 3 | 2 | T-shaped | 90 |
| | | 2 | 3 | linear | 180 |
| 6 | octahedral | 6 | 0 | octahedral | 90 |
| | | 5 | 1 | square pyramidal | 90 |

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## Molecular Shape and Arrangement (cont)

| | | | |
|---|---|---|---|
| 4 | 2 | square planar | 90 |

## Electronegativity

| | | |
|---|---|---|
| tendency of an atom to pull electrons towards itself | nuclear charge | stronger = greater pull |
| | distance of $e^-$ from nucleus | further = weaker pull |
| trend | down group | decrease |
| | across period | increase |

## Ionic compounds

| | | |
|---|---|---|
| Ionic bond | IMFOA between oppositely charge ions | |
| structure | giant ionic lattice structure | |
| strength | lattice energy | (product of charges)/(sum of ionic radius) |
| coordination number | number of opp-charged ions surrounding central ion | ligand size increase, coordination number decrease |

## IONIC vs COVALENT CHARACTER

| | | | |
|---|---|---|---|
| Pure covalent | Approx equal electroneg | no distortion of electron cloud | |
| Covalent with ionic character | atoms with electroneg diff | dipole moment ($\delta^+$, $\delta^-$) | incr electroneg diff = incr dipole |
| Ionic with covalent character | polarisation distorts anion $e^-$ cloud | stronger polarising power of cation (charge density) | = increase distortion = increase covalent character |
| | some form of $e^-$ sharing | larger $e^-$ cloud = incr polarisability | = increase distortion = increase covalent character |
| Pure ionic character | complete transfer of $e^-$ | $e^-$ cloud remains intact and spherical | |

## Metallic compounds

| | | | |
|---|---|---|---|
| Metallic bond | EFoA between metallic cations and sea of delocalised, mobile $e^-$ | | |
| | in giant metallic lattice structure | | |
| Factors affecting strength | Charge density | No of $e^-$ delocalised per atom | |
| Unique physical properties | Malleable (beat into sheets) | Ductile (drawn into wire) | orderly arrangement of cation |
| | Alloy formation | non-metal atoms disrupts orderly arrangement | tensile strength increase |
| | Reflectivity | Delocalised $e^-$ absorb light and excited | promoted to higher level |
| | | De-excitation => release E | => light |

## Special Cases

| | | | |
|---|---|---|---|
| Anomalous Mr of organic acid in gaseous phase/-benzene solvent | Apparent Mr twice of anomalous Mr | dimerisation | either achieve octet, or due to favourable bonds formed (release E) |
| Different physical properties of structural isomers | 1,2-nitrophenol has lower BP than 1,4-nitrophenol | 1,2-nitrophenol has **intramolecular** H-bond | less extensive **inter-molecular** H bond |
| Bp of HI> HBr>HCl | incr in id-id down group | decrease dipole moment down group | incr id-id more significant |
| Density of water > ice | ice - hexagonal arrangement of water | large amount of empty spaces | |

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