#Foundation

CHEMICAL NOMENCLATURE & TYPES OF CHEMICAL REACTIONS

- Relate names to formulas of molecular compounds and vice versa
- Relate names to formulas and charges of simple ions and vice versa
- Combine simple ions to write formulas and names of some ionic compounds
- Balance chemical equations
- Recognise and describe different types of chemical reactions

[NOMENCLATURE]

the process of naming chemicals

standardised by IUPAC!

1 Ionic compound

metal cation (+ve ion) + non-metal anion (-ve ion)

electrostatic attraction

2 Covalent compound

non-metal + non-metal

sharing of valence electrons (outermost)

3 Binary compound

element A + element B

(two elements only)

Binary Ionic Compounds

Type I

(for metal cations that have only one possible charge)

Sodium chloride, NaCl (Na^+, Cl^-)

simple anions end with suffix ide — VS — complex ions

charge of cation & anion cancel out

Li^+ O^{2-} → Li_2O (subscript)

Type II

transition elements

(for metal cations that have more than 1 possible charge)

Fe^{2+} → Iron(II) (capital roman numeral)

complex ions
- charged molecule (two/more atoms bonded together)
- mostly anions

POLYATOMIC IONS

add H^+

$S^{2-} \rightarrow HS^-$

$SO_4^{2-} \rightarrow HSO_4^-$

increasing number of oxygen atoms ↑

ClO_4^- perchlorate

ClO_3^- chlorate

ClO_2^- chlorite

ClO^- hypochlorite

Binary Covalent Compounds

(no ions involved)

prefixes indicate number of atoms

1 mono — never used for 1st element
2 di
3 tri
4 tetra
5 penta
6 hexa
7 hepta
8 octa
9 nona
10 deca

ie. CO_2

✗ monocarbon dioxide

✓ carbon dioxide

P_4O_{10}

omit "a"

✗ tetraphosphorus decaoxide

✓ tetraphosphorus decoxide

Binary Acids

Acids — substance that produces H^+ ions in water

hydro____ic acid

hydrochloric acid

hydrobromic acid

Oxy-acids

"ate"	"ite"
NO_3^- nitrate	NO_2^- nitrite
____ic acid	____ous acid
nitric acid	nitrous acid

CHEMICAL NOMENCLATURE & TYPES OF CHEMICAL REACTIONS

II 30042024

CHEMICAL EQUATION

conditions of reaction
heating, catalyst
(Δ) (Pt)

Reactants — Products

$$2H_2(g) + O_2(g) \xrightarrow{\Delta} 2H_2O(l)$$

coefficient
relative number of molecules

state of substance
gas (g) liquid (l)
solid (s) aqueous (aq)

Balanced equations

atoms cannot be gained / lost / changed
number of atoms in reactants = products

Types of Chemical Reactions

A Combination
$A + B \longrightarrow AB$

B Decomposition
$AB \longrightarrow A + B$

C Single Replacement
$AB + C \longrightarrow A + BC$

D Double Replacement
$AB + CD \longrightarrow AD + CB$

E Combustion
$AH_4 + 2O_2 \longrightarrow AO_2 + 2H_2O$
$B + O_2 \longrightarrow BO_2$

reaction with oxygen usually
products: an oxide, water, heat / energy

incomplete combustion
= carbon monoxide

CALCULATIONS WITH CHEMICAL FORMULAS AND EQUATIONS

- Calculate molecular weight and formula weight
- Know the mole concept and Avogadro's number
- Find molar mass of elements and compounds
- Convert between mass and moles
- Calculate number of particles
- Calculate mass and mass percentage of elements
- Find empirical formula from mass percentage
- Obtain molecular formula from molar mass
- Interpret chemical equation at molecular, molar and mass level
- Calculate mole, mass, number of molecules / atoms based on given chemical equation and based on the limiting reagent determined
- Find theoretical, actual and percentage yield

Molecular weight — molecular substance
Formula weight — ionic substance

} sum of all atomic weight (amu)

from PTE

amu: atomic mass unit

Mole (mol)
└ the amount of matter that contains as many entities as the number of atoms in 12g of carbon
atoms, molecules, ions

Mass of ^{12}C = 12 amu
$1 \text{ amu} = \frac{1}{12}$ mass of ^{12}C

Avogadro's number, N_A
$6.02 \times 10^{23} = 1 \text{ mol}$

$$\boxed{\text{No of mol (mol)} = \frac{\text{No of particles}}{\text{Avogadro's number}}}$$

mol^{-1}

Molar mass ($g\ mol^{-1}$)
└ mass of one mole of substance
= atomic, molecular, formula weight (amu)

$$\boxed{\text{No of mol (mol)} = \frac{\text{Mass (g)}}{\text{Molar mass } (g\ mol^{-1})}}$$

[PERCENT COMPOSITION] / percentage by mass of each element

$$\boxed{\text{Mass \% of A} = \frac{\text{mass of A}}{\text{mass of compound}} \times 100\%}$$

[EMPIRICAL FORMULA] / the simplest formula of a compound written with smallest integer subscripts

* Ascorbic acid (Vitamin C)

40.92% C
4.58% H
54.50% O
} assume 100g

Empirical formula: $C_3H_4O_3$

Molecular formula = (Empirical formula)$_n$

$n = \frac{\text{molecular weight}}{\text{empirical weight}}$

Element	C	H	O
Mass by percentage	40.92	4.58	54.50
No of mol	$\frac{40.92}{12.01} = 3.407$	$\frac{4.58}{1.008} = 4.58$	$\frac{54.50}{16.00} = 3.406$
Ratio	$\frac{3.407}{3.406} = 1$	$\frac{4.58}{3.406} = 1.33$	$\frac{3.406}{3.406} = 1$
Simplest ratio	$1 \times 3 = 3$	$1.33 \times 3 = 4$	$1 \times 3 = 3$

CALCULATIONS WITH CHEMICAL FORMULAS AND EQUATIONS

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Interpreting Chemical Equations

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

(Haber process)

Mass: 28.0g of N_2 reacts with 3 × 2.02g (6.06g) of H_2 to produce 2 × 17.0g (34.0g) of NH_3.

Ratio!

1 mol N_2 = 2 mol NH_3

4 mol N_2 = 8 mol NH_3

Molecular: one N_2 molecule reacts with three H_2 molecules to produce two NH_3 molecules

Molar: one mole of N_2 reacts with three moles of H_2 to produce two moles of NH_3

Theoretical yield

∟ amount of product calculated with the assumption that the reaction proceeded to completion // when all limiting reactant has reacted

Actual yield

∟ Experimentally measured yield of the product of a reaction. often less than the theoretical yield

Percent yield

$$\frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100\%$$

Limiting Reactant (entirely consumed in a reaction)

Excess Reactant (not completely consumed)

Given:
10.0g H_2
10.0g N_2

1 Write a balanced equation

$N_2 + 3H_2 \longrightarrow 2NH_3$

2 Convert mass to moles

$$\left.\begin{array}{l} \dfrac{10.0g\ N_2}{(14.0g)(2)} = 0.357 \text{ mol of } N_2 \\[2ex] \dfrac{10.0g\ H_2}{(1.01g)(2)} = 4.95 \text{ mol of } H_2 \end{array}\right\} \text{amount HAVE}$$

3 Calculate number of moles used

$$\frac{4.95 \text{ mol } H_2}{3 \text{ mol } H_2} \times 1 \text{ mol } N_2 = 1.65 \text{ mol of } N_2$$

amount NEEDED

$$\frac{0.357 \text{ mol } N_2}{1 \text{ mol } N_2} \times 3 \text{ mol } H_2 = 1.07 \text{ mol of } H_2$$

4 Compare "moles have" with "moles needed"

N_2 have < N_2 needed ⇒ limiting

H_2 have > H_2 needed ⇒ excess

THE STRUCTURE OF ATOMS I: SUBATOMIC PARTICLES

HISTORY!

1. Democritus

ATOMOS (greek for indivisible)

smallest piece = ATOM!

matter cannot be broken down at some point

2. John Dalton

Father of Atomic Theory (the indivisible spheres)

- invisible
- indivisible
- solid

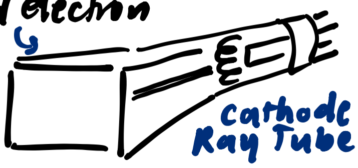
} sphere

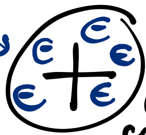
1. all matter is made up of indivisible and indestructible atoms
2. all atoms of an element have the same mass and physical properties
3. different elements = different physical & chemical properties
4. atoms combine in simple whole-number ratios to form compounds
5. chemical reactions
   - combination
   - separation
   - rearrangement

3. J.J. Thomson

ELECTRONS

- plum-pudding model
- negatively-charged electron
- isotope

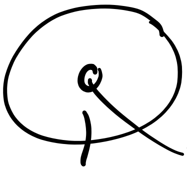




electrons spread out

4. Rutherford

NUCLEUS



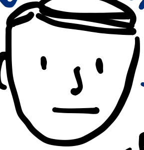
atoms are mostly empty space

-ve electrons + protons!

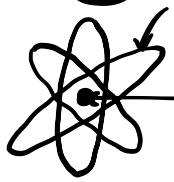
+ve nucleus (dense, 99.9% of mass)

alpha particles (+ve helium atoms)

5. Chadwick



NEUTRON



ATOMS — protons, neutrons, electrons } subatomic particles

- smallest unit of an element

Z ATOMIC NUMBER (proton number)

- integer equal to the number of protons in the nucleus of an atom

A MASS NUMBER (nucleon number)

- integer equal to the sum of the number of protons and neutrons in the nucleus

NUCLEAR SYMBOL $^{A}_{Z}X$

IONS

- anion (-ve) add e^-
  electron > proton
- cation (+ve) remove e^-
  proton > electron

ISOTOPES

- atoms of the same element with the same number of protons but different number of neutrons

ISOTOPIC ABUNDANCE

% - percentage of that isotope found in the sample of element

$^{35}Cl : ^{37}Cl$

3 : 1

75% 25%

RADIOISOTOPES high energy

- cobalt-60 (treat cancer)
- plutonium-238 (heart pacemaker)
- carbon-14 (radiochemical dating)

- Describe the history of an atom
- Describe Dalton's theory of atoms
- Describe J.J. Thomson's experimental evidence for the existence of electrons
- Describe Rutherford's scattering experiments and show how the results of the experiments imply the existence of atomic nuclei.
- State the definitions of an atom, subatomic particles, and isotopes
- Give appropriate info of atomic number, number of protons, number of electrons, number of neutrons, and mass number of an atom/ion
- Calculation of atomic weight
- Understanding of mass spectrometry

in nucleus

	Symbol	Charge	Relative mass
Proton	$^{1}_{1}H/p$	+1	1
Neutron	$^{1}_{0}n/n$	0	1
Electron	$^{0}_{-1}e/e^-$	-1	0

same chemical properties (electrons)

diff. physical properties (mass)

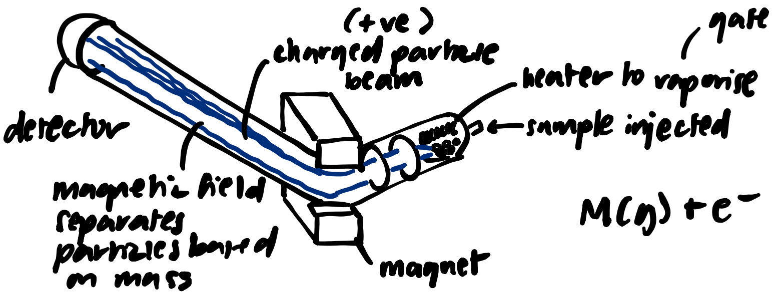
THE STRUCTURE OF ATOMS I: SUBATOMIC PARTICLES

Atomic MASS	Atomic WEIGHT
mass of 1 atom / isotope	average weight of an element (incl. isotopes & abundance)
mass of neutrons + protons	relative mass x fractional abundance

Br-79	Br-81
51%	49%
78.92 amu	80.92 amu

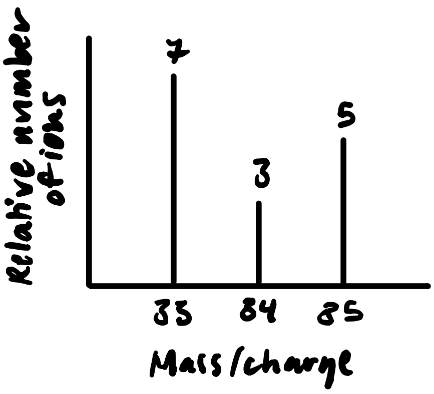
Atomic weight
$= 78.92(0.51) + 80.92(0.49)$
$= 79.9$

MASS SPECTROSCOPY



always positive!

$M(g) + e^- \longrightarrow M^+(g) + 2e^-$ } ionise



Element Y

Ion: Y^+

Isotopes: $^{33}Y^+$, $^{34}Y^+$, $^{35}Y^+$

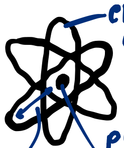
Relative abundance: $7/15 \times 100\%$, ...

Average atomic mass: 33.8667 amu

THE STRUCTURE OF ATOMS II:
THE ELECTRONIC STRUCTURE OF ATOMS

NIELS BOHR

atom



✗ only applies to simplest atom (Hydrogen, 1 proton, 1 electron)

LOUIS DE BROGLIE

"matter has wave-like properties"

ERWIN SCHRÖDINGER's

wave equation:

electrons < wave / particles

occupy 3D space (electron cloud)

* Understand the differences and relations between Bohr's Model and Quantum Mechanic model
* Define quantum numbers and understand the principles of quantum numbers
* Recall usual order of their relative energies and describe the shape of orbitals
* Define Aufbau Principle, the Pauli Exclusion Principle and Hund's Rule
* Write the electron configurations of an atom in orbital box notations, simplified notations and noble gas notation
* Determine the relationship between quantum numbers, valence electron and the periodic table

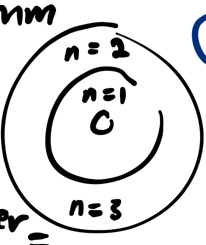
ORBITAL

↳ the probability of finding the electron in a specific place around the nucleus } determined by **QUANTUM NUMBERS** (address of electrons)

① Principal Quantum Number, n

($n = 1, 2, 3, 4 \ldots$

energy level of electrons



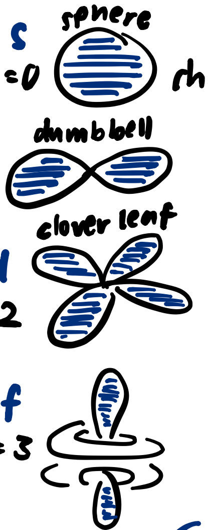
↑n, ↑e (further from nucleus)

number of shells = period!

max no of $e^- = 2n^2$

② Angular Momentum Quantum Number, l

shape of sublevel within an energy level



$l \leq n-1$

when $n = 1$,
$l = 0$ — s

when $n = 4$,
$l = 0, 1, 2, 3$
s p d f

③ Magnetic Quantum Number, m_l

orbital orientation within sublevel

each orbital max 2 electrons

$-l \leq m_l \leq l$

l	m_l	number of orbitals / orientations
0	0	1
1	-1 0 1	3
2	-2 -1 0 1 2	5
3	-3 -2 -1 0 1 2 3	7

④ Electron Spin, m_s

$m_s = \pm 1/2$

$+1/2$ ↑↓ $-1/2$

$\boxed{3d^8}$

$n = 3$ $m_l = 0$
$l = 2$ $m_s = -1/2$

↑↓ ↑↓ ↑↓ ↑ ↑
-2 -1 0 1 2

8

O (Z=8)

Pauli Exclusion Principle

each orbital hold max 2 electrons with opposite spin

Aufbau Principle

electrons fill lower energy orbitals before higher ones

Hund's Rule

one electron is added into each subshell before two electrons are added

Aufbau Diagram

1s
2s 2p
3s 3p 3d
4s 4p 4d 4f
5s 5p 5d 5f

↑↓ ↑↓ ↑
1 4 2 5 3

ELECTRON CONFIGURATION

Simplified notation

$1s^2 2s^2 2p^4$

Orbital notation

[↑↓] [↑↓] [↑↓|↑|↑]
1s 2s 2p

Noble gas notation

$[He] 2s^2 2p^4$

THE STRUCTURE OF ATOMS II:
THE ELECTRONIC STRUCTURE OF ATOMS

Exceptional cases!

Chromium ($Z = 24$)

✓ $4s^1\ 3d^5$ ✗ $4s^2\ 3d^4$

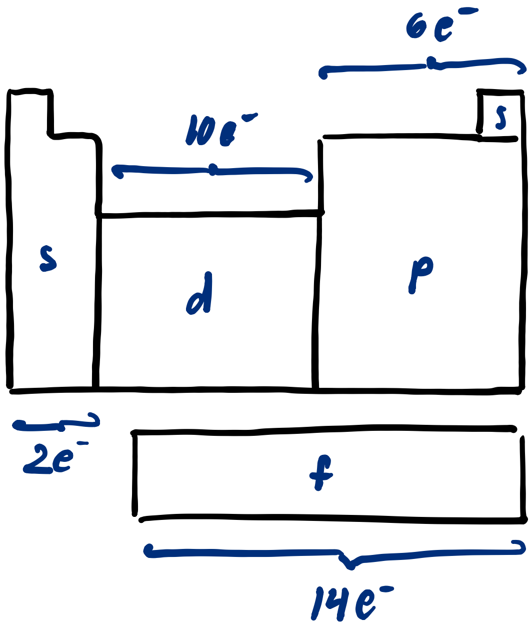
Copper ($Z = 29$)

✓ $4s^1\ 3d^{10}$ ✗ $4s^2\ 3d^{10}$

full half full

Valence Electrons

- electrons on outer shell
- determine chemical properties



CHEMICAL PERIODICITY: PERIODIC PROPERTIES OF THE ELEMENT

In the periodic table, elements are arranged in order of atomic number (proton) x atomic weight!

① metals on the left

② non-metals on the right

alkali metal

alkali earth metal

Groups (18) ↓ ↓

└ same number of valence electrons

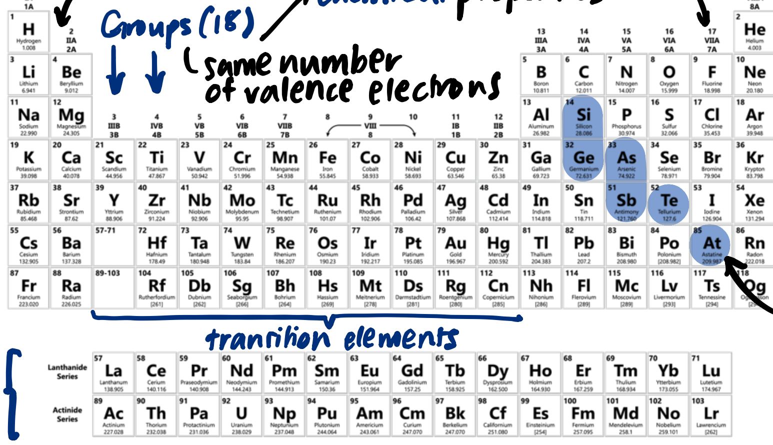
similar physical & chemical properties

halogen

noble gas

Periods (7) ← ←

elements have the same number of shells



transition elements

inner transition elements

③ metalloids

Metals
- lustrous (shiny)
- good electricity & heat conductor
- malleable & ductile (sheets) (wire)
- solid
- ≤3 valence e^-
- form cations
- form ionic comp.

Non-metals
- not lustrous
- poor electricity & heat conductor
- low melting point
- low density
- solid / liquid / gas
- ≥4 valence e^-
- form anions
- form ionic & molecular comp.

physical property

chemical property

Metalloids
- semimetal
- both metal & non-metal properties

Periodicity
└ similarities in behaviour and reactivity due to similar outer shell electron config.

└ atomic radius, ionic size, ionization energy

Electronegativity
└ measure of an atom's ability to attract and hold onto electrons

↑ electronegativity, ↑ e^- attraction

Period →
- ↑ nuclear charge
- ↓ size

Group ↑
- shielding effect
- ↑ size

* F has highest electronegativity

* electrons between valence e^- & nucleus shield the valence e^-

$Z_{eff} = Z - S$

no of protons

inner core e^-

Atomic radius

Period ←
- ↑ protons,
- ↑ nuclear charge
- ↑ nuclear attract
- ↓ size

Group ↓
- ↑ shells
- valence e^- further
- shielding effect *
- ↓ nuclear attract
- ↑ size

Ionic size
cations < neutral $e^- < p$

anions > neutral $e^- > p$

Ionization energy

↑ Energy required to remove an electron from a gaseous atom

- ↑ . nuclear charge
- ↓ . size of atom
- ↓ . shielding effect
- ↓ . e-e repulsion

$M(g) + IE \rightarrow M^+(g) + e^-$

Period →
- ↑ nuclear charge
- ↓ size
- hard to remove e^-
- ↑ IE

Group ↑
- shielding effect
- ↑ e-e repulsion
- ↑ size
- ↓ IE

does not apply to

Mg > Al
$3s^2$ $3p^1$
experiences more shielding

P > S
$3p^3$ $3p^4$
more e-e repulsion

2^{nd} IE: energy to remove 2^{nd} e^-
> 1^{st} IE, increases subsequently

IE1	IE2	IE3	IE4
736	1450	7740	10500

big jump

∴ element is in group 2

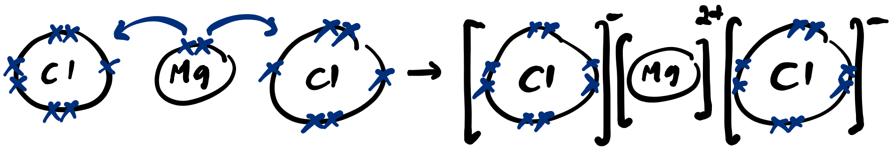
CHEMICAL BONDING & SHAPES OF MOLECULES

Noble gas structure — eight electrons in their outer energy levels (, or two for He!)
- desirable structure for atoms } octet rule
- can be achieved by loss or gain of electrons
  - cation
  - anion

Ionic Bonding

metal + non-metal = ionic compound

↑ electrostatic attraction



- solid
- high melting point
- soluble in water
- electrolyte (conduct electric)

Lewis Structure

(only valence e shown)

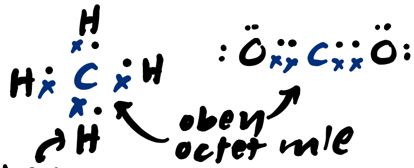
bonding pair (BP)

non-bonding pair (NBP)

Covalent Bonding

sharing of electrons

single bond   double bond



obey duplet rule

obey octet rule

- gas / liquid / solid
- low melting point
- soluble in organic solvent
- non-electrolyte

Steps!

	NH_3	CO_2
1. Decide central atom	N	C
2. Count valence electrons	VE = (3×1) + 5 = 8	VE = (2×6) + 4 = 16

3. Form sigma bonds (single bond) between central atom & surrounding atoms

H ˣ• N ˣ• H, with H ˣ• below N   O ˣ• C ˣ• O

4. Remaining electrons as NBP

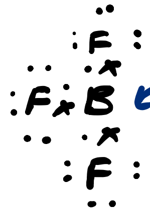
H ˣ• N̈ ˣ• H, with H ˣ• below N   :Ö ˣ• C ˣ• Ö:

5. To give C an octet, form pi bonds (double bond)

:Ö ˣ• C ˣ• Ö: →   :Ö ˣˣ•• C ˣˣ•• Ö:

Exception to octet rule

- electron deficient
  - B or Be

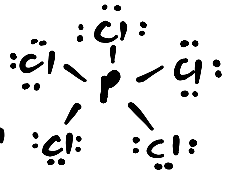


only 6 electrons!

- odd electron
  - NO or NO_2

•N̈ ˣˣ Ö: ← radical / reactive

- valence shell expansion
  - central atom > 8 VE (period 3 onwards)



Formal Charge

- the charge of an atom in any compound if the electrons are shared equally in a comp.

FC = VE − NBE − BP

$[:\ddot{O}-C\equiv N:]^-$

C : 4 − 4 − 0 = 0
O : 6 − 6 − 1 = −1
N : 5 − 5 − 0 = 0

} −1

closer to 0 = more stable

CHEMICAL BONDING & SHAPES OF MOLECULES

Electronegativity ⟷ Type of bond

0 — 0.4 — 1.7 — 3.3 →

Covalent | Ionic

Non polar | Polar

NH_3, N=3, H=2.1

3 − 2.1 = 0.9

∴ polar covalent

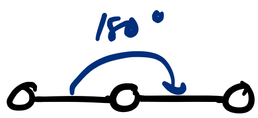
Valence **S**hell **E**lectron **P**air **R**epulsion } electron groups position themselves around the nucleus to minimize interactions

Electron-pair geometry
∟ arrangement of structural electron pairs around the central atom

Molecular geometry
∟ 3D arrangement of atoms in a molecule (when central atom has lone pairs)

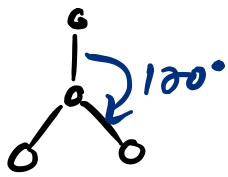
Steric Number
= NBP + BP

2



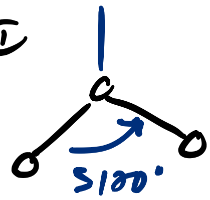
Linear

3



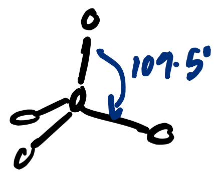
Trigonal planar

①



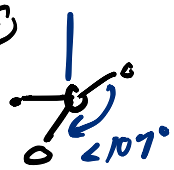
Bent

4



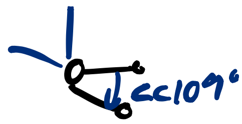
Tetrahedral

①



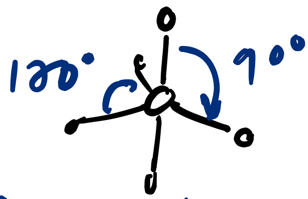
Trigonal pyramid

②



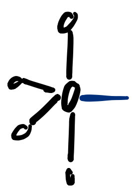
Bent

5



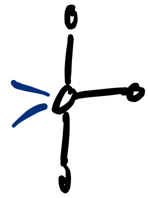
Trigonal bipyramidal (two pyramids)

①



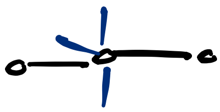
see-saw

②



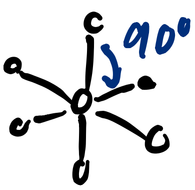
T-shaped

③



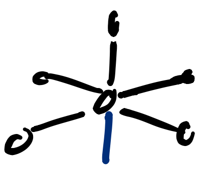
Linear

6



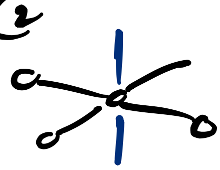
octahedral

①



Square pyramidal

②



Square planar

INTRODUCTION TO ORGANIC CHEMISTRY

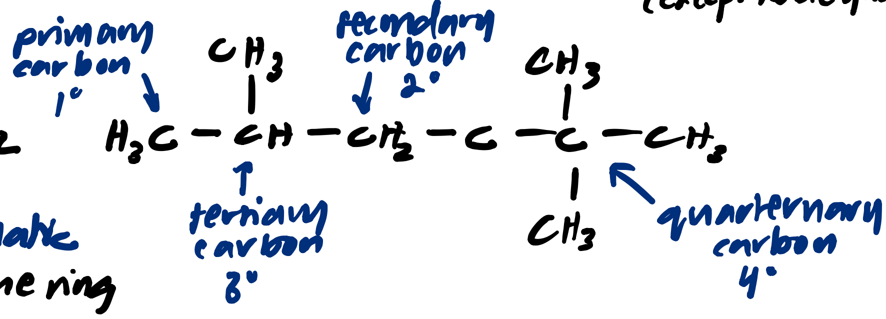
obtained from living things → **Organic** vs **Inorganic** ← from non-living things

contains carbon!

Organic	Inorganic
covalent	ionic
gas / liquid	solid
low melting point	high melting point
insoluble in water	soluble in water
nonconductors	conductor in aqueous & molten

Carbon!
└ no ions, only covalent bonds! up to 4 → to P, H, O, N, S & all non-metals (except noble gas)
forms → **chains or rings**

Hydrocarbon
└ compounds containing only **carbon** and **hydrogen**
└ nonpolar, soluble in organic solvents



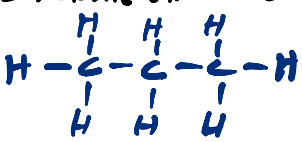
① **Aliphatic**
nonbenzenoid rings
- alkanes, alkenes, alkynes etc.

② **Aromatic**
benzene ring
- benzene
- naphtalene } has smell

Molecular Representation

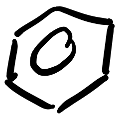
1 Condensed formula
$CH_3(CH_2)_3CH_3$

2 Kekule Structure



3 Skeletal Structure

Functional Group
(structural features that classifies compounds by reactivity / chemical behaviour

Alkane	C − C (single bond)
Alkene	C = C (double bond)
Alkyne	C ≡ C (triple bond)
Arene	 (benzene ring)
Alcohol / Phenol	−OH
Ether	−O−
Haloalkane	− halogen, −F, −Cl, −Br
Aldehyde	$-\overset{O}{\overset{\|}{C}}-H$
Ketone	$-\overset{O}{\overset{\|}{C}}-$
Carboxylic acid	−COOH
Ester	−COO−
Amine	$-NH_2$
Amide	$-CONH_2$

ALKANE, C_nH_{2n+2}
- non-polar
- tetrahedral
- suffix −ane

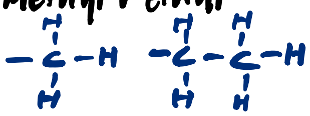
meth, dec, prop, but, pent, hex, hept, oct, non, dec

> 3 Carbons = > 1 molecular arrangement
Isomers: same number & kinds of atom, different arrangement

remove one hydrogen ↓

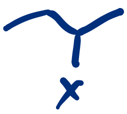
ALKYL, C_nH_{2n+1}

methyl & ethyl

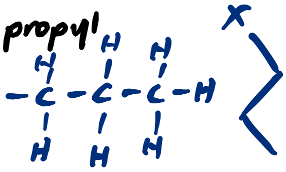


butyl

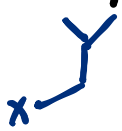
sec-butyl



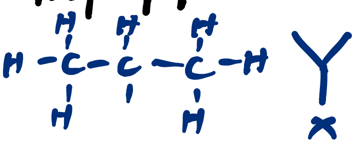
propyl



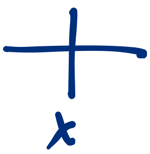
isobutyl



isopropyl



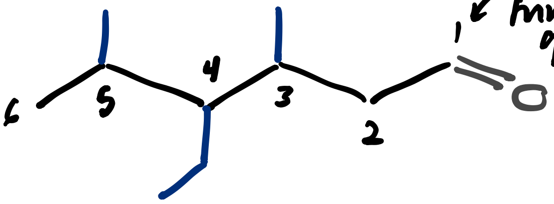
t-butyl



INTRODUCTION TO ORGANIC CHEMISTRY

[IUPAC Naming]

prefix parent suffix



start from functional group

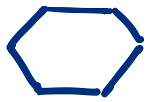
4-ethyl-3,5-dimethyldecanal

alphabetical (ignoring prefixes)

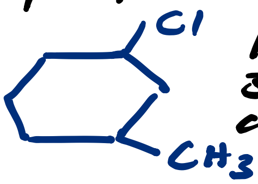
trimethyl, diethyl, sec-butyl
sec-butyl, diethyl, trimethyl

CYCLOALKANE

remove two hydrogens



cyclohexane



1-chloro-3-methylcyclohexane

Physical Properties of Alkanes

1. increase in melting / boiling point

$CH_4 \rightarrow C_4H_{10}$ gas

$C_5H_{12} \rightarrow C_{16}H_{34}$ liquid

$C_{16}H_{34}$ onwards solid

↑ size, ↑ surface area, ↑ Van der Waals

2. branched vs unbranched

boiling point of branched < unb

↓ surface area, ↓ Van der Waals

melting point of odd < even

↑ less tightly-packed

Reaction of Alkanes

1. Combustion

$$C_xH_y + \left(x + \frac{y}{4}\right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$$

* Collect 22.0g CO_2 and 13.5g H_2O * 11.5g of sample

$$\frac{12.01}{44.01} \times 22.0g = 6.0gC = 0.5\ mol\ C$$

$$\frac{2.016}{18.016} \times 13.5g = 1.5gH = 1.5\ mol\ H$$

$$11.5g - 6.0g - 1.5g = 4g\ O = 0.25\ mol\ O$$

$C_{0.5}H_{1.5}O_{0.25}$

C_2H_6O

2. Halogenation

Alkane → Haloalkane

hydrogen atoms replaced with halogen atoms

> 100°C or irradiated by UV

$$CH_4 + Cl_2 \xrightarrow{\text{heat or light}} CH_3Cl + HCl$$

Mechanism of Free Radical Substitution

1. Initiation

$$Br-Br \rightarrow Br^{\bullet} + Br^{\bullet}$$

2. Propagation

$$Br^{\bullet} + C_2H_6 \rightarrow HBr + {}^{\bullet}C_2H_5$$

$${}^{\bullet}C_2H_5 + Br-Br \rightarrow C_2H_5Br + Br^{\bullet}$$

3. Termination

$$Br^{\bullet} + Br^{\bullet} \rightarrow Br_2$$

$$Br^{\bullet} + {}^{\bullet}C_2H_5 \rightarrow C_2H_5Br$$

$${}^{\bullet}C_2H_5 + {}^{\bullet}C_2H_5 \rightarrow C_4H_{10}$$

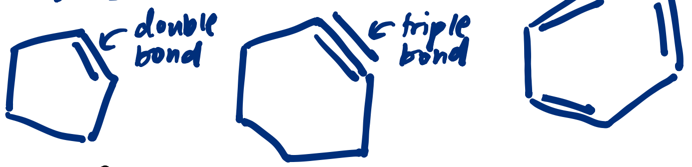
ORGANIC CHEMISTRY

Alkane – Saturated (max # of H)
Alkene } Unsaturated
Alkyne }

C_nH_{2n} Alkene & Cycloalkene C_nH_{2n-2}

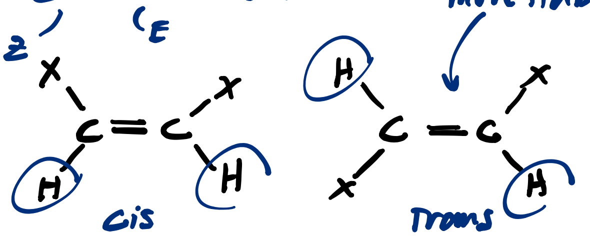
C_nH_{2n-2} Alkyne & Cycloalkyne C_nH_{2n-4}

Aromatic hydrocarbon



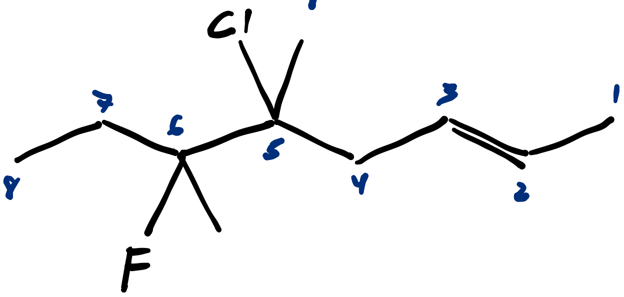
–ene –yne

Cis-Trans Isomers



eg. cis-1,2 dichloroethene

IUPAC Naming

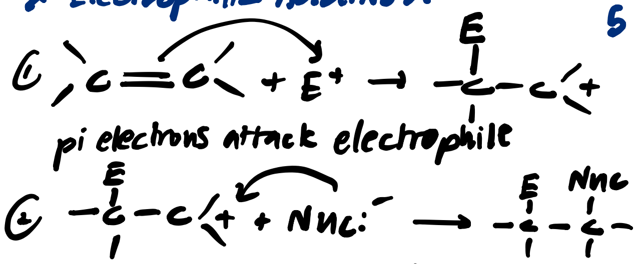


5-chloro-6-fluoro-5,6-dimethyloct-2-ene

Reactions of Alkenes

* Electrophile
chemical compound that is attracted to electrons

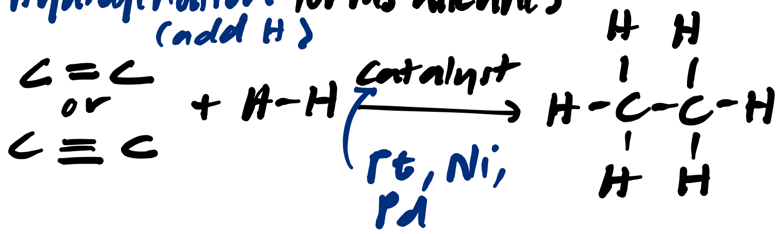
* Electrophilic Addition



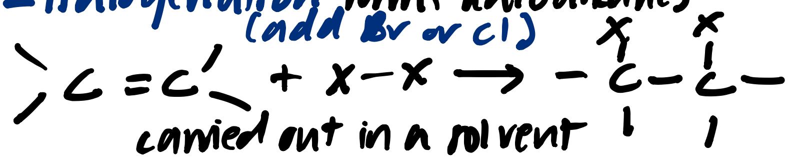
pi electrons attack electrophile

nucleophile attacks carbocation

1 Hydrogenation forms alkanes
(add H)

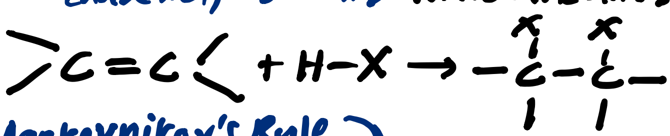


2 Halogenation forms di- or tetra- haloalkanes
(add Br or Cl)

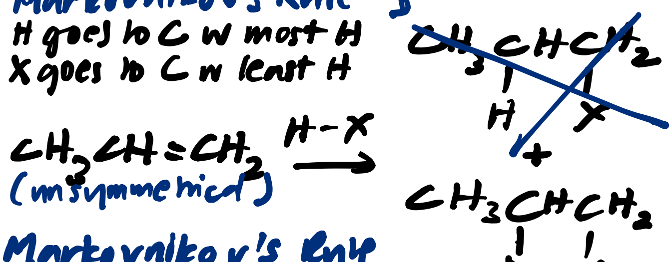


carried out in a solvent

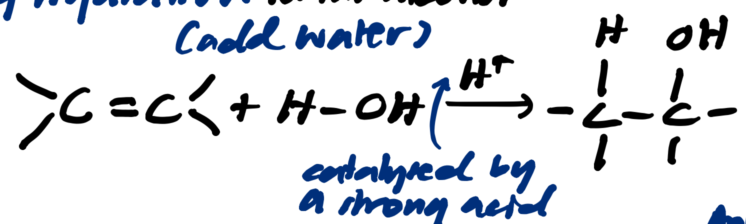
3 Hydrohalogenation forms haloalkanes
(add HCl, HBr or HI)



Markovnikov's Rule
H goes to C w most H
X goes to C w least H

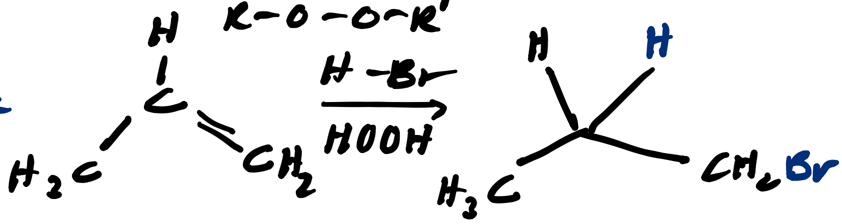


4 Hydration forms Alcohol
(add water)



5 Polymerisation forms polymers
(alkene) m → polyalkene

Anti-Markovnikov's Rule
if the reaction has peroxide R–O–O–R



6 Hydroxylation (with potassium permanganate) ← Baeyer's Reagent