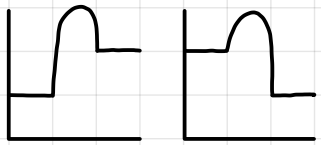
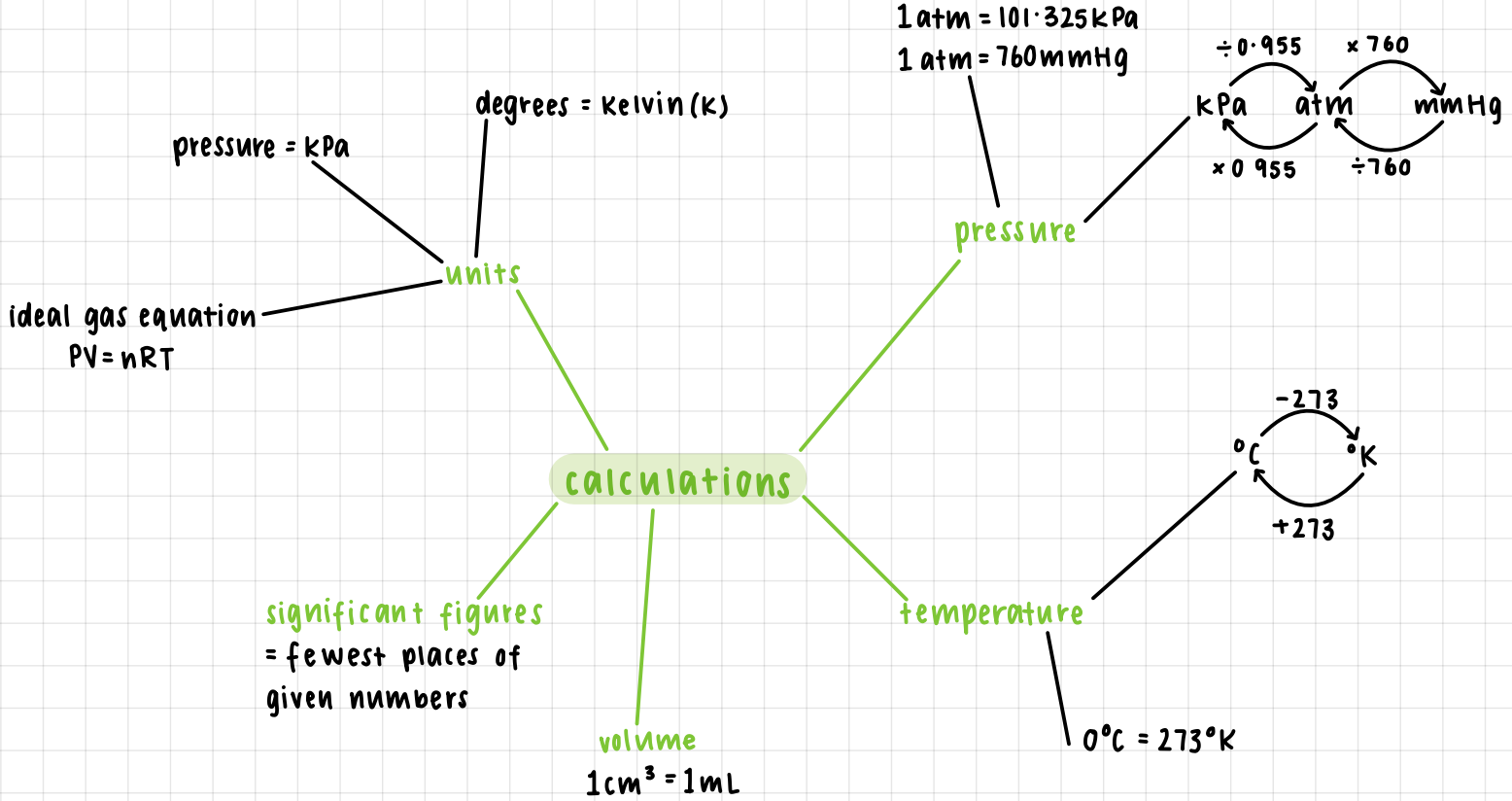
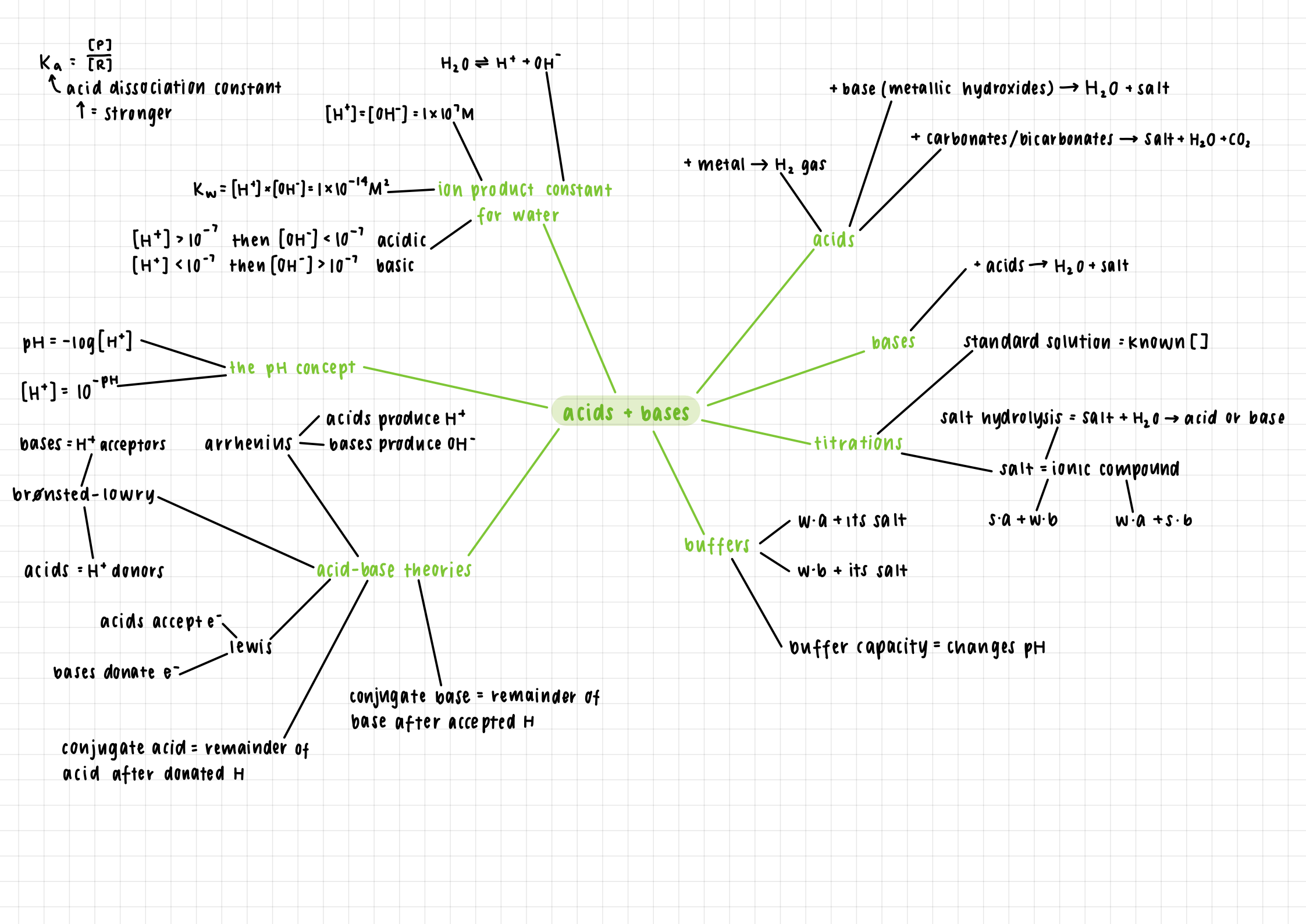
equilibrium

- closed system
- reversible reaction
- FRR = RRR
- $K = \frac{[P1]^{coef\,1}[P2]^{coef\,2}\ etc.}{[R1]^{coef\,1}[R2]^{coef\,2}\ etc.}$
  - doesn't include liquids or solids
- le chatelier's principle = system acts to partially counteract a change
  - change to [] → Keq
  - change to temp → both RR↑
  - surface area
  - change to volume/pressure
  - adding a catalyst → E_a↓ = both RR↑
- Keq
  - [] ⇌ [] Keq > 1
  - [] ⇌ [] Keq = 1
  - [] ⇌ [] Keq < 1
- dynamic equilibrium
  - endo / exo



  - $+\Delta H$ = endo
  - $-\Delta H$ = exo


calculations
units
pressure = kPa
degrees = Kelvin (K)
ideal gas equation
PV = nRT
pressure
1 atm = 101·325 kPa
1 atm = 760 mmHg
kPa
atm
mmHg
÷0·955
×760
×0 955
÷760
temperature
°C
°K
-273
+273
0°C = 273°K
significant figures
= fewest places of
given numbers
volume
1cm³ = 1mL


$K_a = \frac{[P]}{[R]}$
↑ acid dissociation constant
↑ = stronger
$H_2O \rightleftharpoons H^+ + OH^-$
$[H^+]=[OH^-]=1\times10^{-7}M$
$K_w=[H^+]\times[OH^-]=1\times10^{-14}M^2$
ion product constant for water
$[H^+]>10^{-7}$ then $[OH^-]<10^{-7}$ acidic
$[H^+]<10^{-7}$ then $[OH^-]>10^{-7}$ basic
+ base (metallic hydroxides) → H_2O + salt
+ carbonates/bicarbonates → salt + H_2O + CO_2
+ metal → H_2 gas
acids
+ acids → H_2O + salt
bases
standard solution = known [ ]
titrations
salt hydrolysis = salt + H_2O → acid or base
salt = ionic compound
s·a + w·b
w·a + s·b
buffers
w·a + its salt
w·b + its salt
buffer capacity = changes pH
pH = -log[H^+]
[H^+] = 10^{-pH}
the pH concept
acids + bases
arrhenius
acids produce H^+
bases produce OH^-
bases = H^+ acceptors
brønsted-lowry
acids = H^+ donors
acid-base theories
acids accept e^-
bases donate e^-
lewis
conjugate base = remainder of base after accepted H
conjugate acid = remainder of acid after donated H

redox

assigning oxidation numbers

- ion = its charge
- oxygen
  - compounds: -2
  - peroxides: -1
- hydrogen
  - compounds: +1
  - hydride: -1

corrosion

- prevention = sacrificial anode

redox equations

oxidation-number changes:

① assign numbers
② identify oxidised/reduced
③ equalise w/ coefficients
④ balance atoms + charge

½ equations:

① unbalanced
② separate into ½'s
③ balance atoms
- O w/ H_2O
- H w/ H^+

④ + e^-'s
⑤ × by no. of e^-'s
⑥ overall
⑦ + spectator if asked

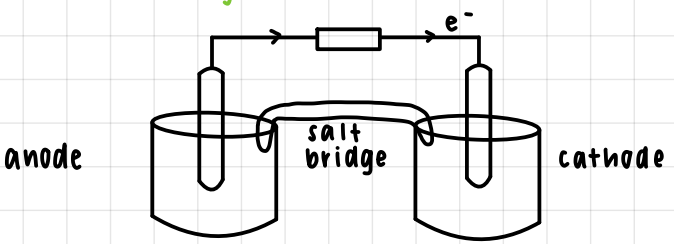
reducing agent = being oxidised

oxidising agent = being reduced

LEO GER

OIL RIG

galvanic cells



oxidised
breaking down

reduced
building up

charging a battery

force e^- backwards (+ ⟶ −)

↑ voltage backwards

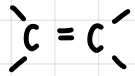
electrical potentials

more positive E° = more likely reduced

steps:

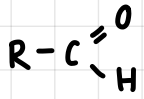
① ½ equations
② balance
③ E° for each
④ flip
⑤ add = E°
- negative E° = not possible
- positive E° = spontaneous reaction

when reversed, E° changes from positive ⇌ negative

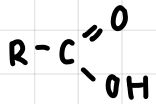


alkenes
(-ene)

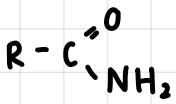
alcohol
(-ol)



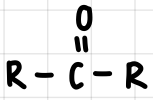
aldehyde
(-al)



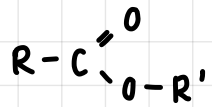
carboxylic acids
(-oic acid)



amide
(-amide)



ketones
(-one)



esters
(-yl -oate)

amines
(-amine)

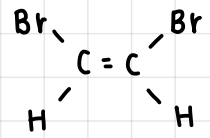
priority list:
1. c.a.
2. amides
3. aldehydes
4. ketones
5. alcohols
6. amines
7. alkenes
8. alkyl groups, halides etc.

methyl
ethyl
propyl
butyl
pentyl
hexyl
heptyl
octyl

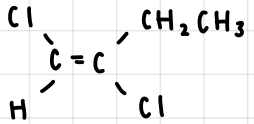
primary alcohol → aldehyde → c.a (strong $KMnO_4$)
secondary alcohol → ketone

$Cr_2K_2O_7$
potassium dichromate

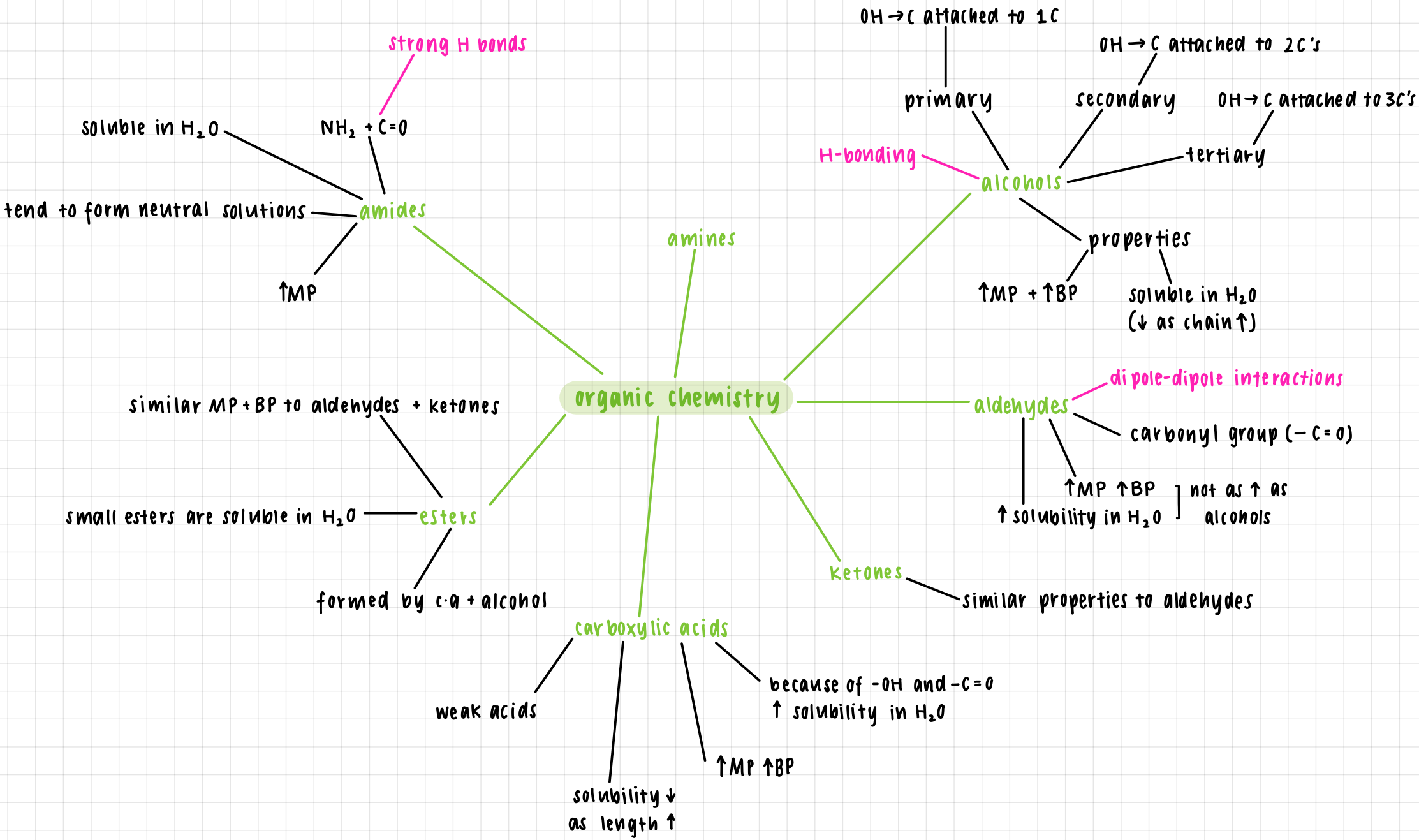
cis + trans:



cis-1,2-dibromoethene

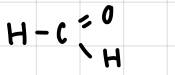


trans-1,2-dichlorobut-1-ene

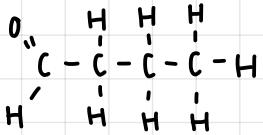

organic chemistry
amides
strong H bonds
NH₂ + C=O
soluble in H₂O
tend to form neutral solutions
↑MP
amines
alcohols
H-bonding
OH → C attached to 1C
primary
OH → C attached to 2C's
secondary
OH → C attached to 3C's
tertiary
properties
↑MP + ↑BP
soluble in H₂O
(↓ as chain ↑)
aldehydes
dipole-dipole interactions
carbonyl group (– C=O)
↑MP ↑BP
not as ↑ as alcohols
↑ solubility in H₂O
ketones
similar properties to aldehydes
esters
similar MP + BP to aldehydes + ketones
small esters are soluble in H₂O
formed by c.a + alcohol
carboxylic acids
weak acids
solubility ↓ as length ↑
↑MP ↑BP
because of -OH and -C=O
↑ solubility in H₂O

examples of organic compounds:

aldehyde:

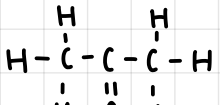


methanal

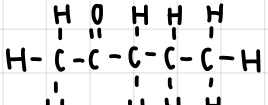


butanal

ketone:

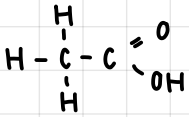


propanone

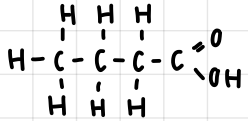


pentan-2-one

carboxylic acid:

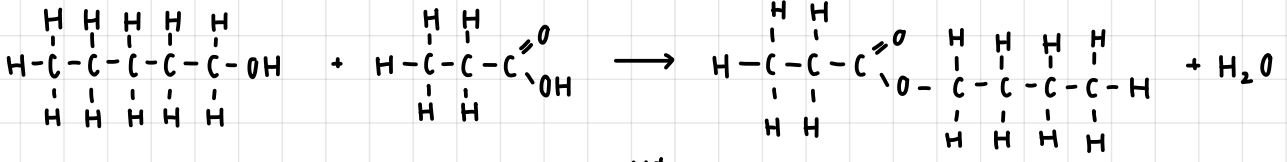


ethanoic acid



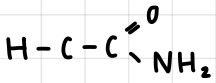
butanoic acid

esterification example:

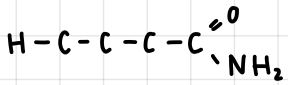


butan-1-ol + propanoic acid $\xrightarrow{H^+}$ butyl propanoate + water

amide:

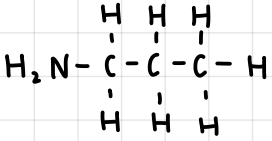


ethanamide

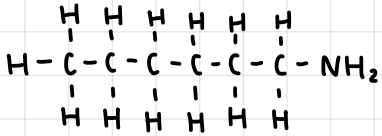


2,3-dichlorobutanamide

amine:

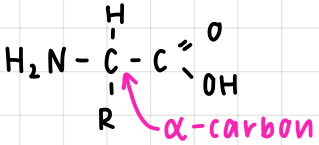


propan-1-amine

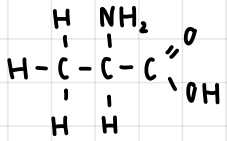


3,3-dichlorohexan-1-amine

α-amino acids



glycine (2-amine ethanoic acid)

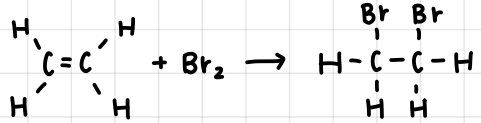


alanine (2-amino propanoic acid)

reactions of hydrocarbons:

addition:

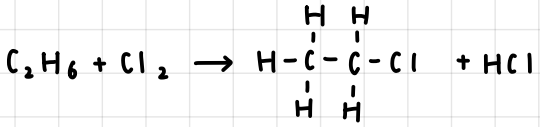
- double or triple bond breaks



ethene + bromine water → 1,2-dibromoethene

substitution:

- H is removed + another element is subbed in



empirical formula

① mass
② mols
③ mol ratio (÷ by smallest no. of mols)
④ simple ratio

↓

molecular formula

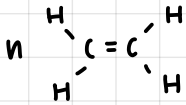
① find empirical mass
② use molecular mass given
③ MF / EF = factor
④ × EF by factor found

polymers + plastics

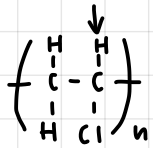
monomer

- small molecules
- react chemically
- link together w/ similar molecules
- to create a polymer

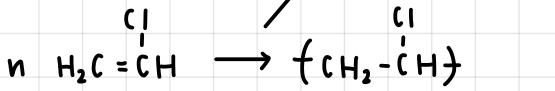
polymerisation



vinyl chloride

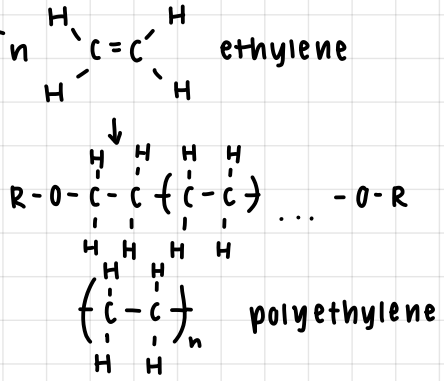


polyvinyl chloride



1-chloro-1-ethene
"vinyl"

polyvinyl chloride
(PVC)



ethylene

polyethylene

soaps + proteins

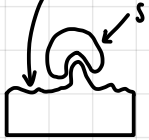
soaps

- long hydrocarbon chain w/ c a· on one end bonded to a metal ion
  - non-ionic
  - bonded ionically
  - $COO^- Na^+$
- advantages
  - eco-friendly + biodegradable
  - insoluble in hard water
- disadvantages
  - weaker at cleansing than detergents

saponification

- hydrolysis of fats
- to create soaps
- heat w/ concentrated NaOH

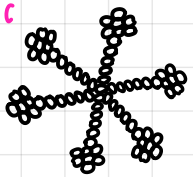
proteins



- bonds in substrate weaken → products released

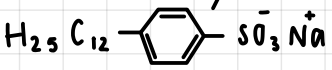
micelles

- 2 ends
  - long hydrocarbon chain
    hydrophobic
  - short ionic part
    hydrophilic



detergents

- form soluble Ca or Mg salts
- Na or K salts of long chain benzene sulphuric acids
  - can lather well in hard water
- ionic group = $SO_3^- Na^+$



- primary surfactants
  - ↓ surface tension of water
  - less likely to stick to itself, more likely to interact w/ oil/ grease