🧪*H2 chem last-minute reminders*

Disclaimer: These are general guidelines I got from my notes, teachers and friends. Reminders and styles of writing may differ from school to school, so please follow your own teachers'/school's guidelines/facts in internal exams. For the actual As…it's kinda up to you lol

🤩👍GENERAL REMINDERS

- !!!! FOR SYNTHESIS QNS, NEVER USE FREE RADICAL SUB AS THE MAIN OPTION. ITS NOT GOOD
- For steric hindrance etc, always say the bulky groups around a SMALL atom (small carbon, small whatever. Unless central atom is not small.)
- !!!!!!FOR ALL STRUCTURAL ELUCIDATION. pls write every reaction (by its reaction name, see below.) even write the basic things like c:h ratio cause you WONT GET THE 1m unless u write it.
    - Eg: W + Na → explosive gas. So write:
    - Redox reaction occurred. Explosive gas is H2 (g)
    - W has -OH group.
    - 1 mole of W reacts with 1 mole of H2 (g) → W has 2 -OH groups
- Anything about like why xxx and yyy react at same rate …what conclusion about the mechanism
    - answer wrt rate determining step
    - Eg this means that the bond breaking (or wtv, eg xxx has greater bond strength) is NOT PART OF RATE DETERMINING STEP
- Why is KMnO4 the favoured oxidising agent in titration compared to K2Cr2O7?
    - KMnO4 colour change: dark purple to colour less /pale pink
    - Cr2O7: orange to green — !!!! end point colour change not distinct because both cr2o7 and cr3+ are coloured and end point cannot be detected sharply without use of a suitable indicator
    - **depends on what species you are oxidising though but if it's like Fe2+ to Fe3+ which is yellow then the end result is yellow + whatever indicator colour was there
- RMB TO WRITE COUNTER IONS!!!
- State and explain type of reaction — unless it's very obviously another type of reaction, it could also be redox so if it's not clear just try calculating redox numbers
- !!DONT FORGET YOUR CYCLIC ISOMERS!!!!!!!

Salts/general

- BaO dissolves in water to form BaOH2 which is actually soluble in water…

Mole

- If they give some super weird reactants that don't immediately balance nicely in an equation, try using redox equations to balance it. Or just try rlly hard to balance the normal eqn…

Chem bonding

- Cations metal don't act as charge carriers as they are not mobile
- Vsepr to MINIMISE REPULSION BETWEEN ELECTRON PAIRS
    - ALWAYS MENTION HOW MANY BOND PAIRS HOW MANY LONE PAIRS WHEN EXPLAINING MOLECULE SHAPE
- square pyramidal <90!!
- if stuff Mr suddenly increases (when dissolved, reacted etc) it has possibly dimerised (dimerisation of carboxylic acids in vapour and non polar stuff!!!)
    - Eg ethanoic acid dimerises with itself in benzene because benzene is non polar and doesn't form bonds with ethanoic
- for all qns rmb to start by mentioning structure/bonding FIRST
- If number of electrons is different, id id is also different , must mention
    - Eg BrF is more polar than ClF hence more pdpd but ALSO BrF more electrons than ClF
- Dative arrow goes from DONOR TO ACCEPTOR
- Dative is sigma too
- MUST SHADE ORBITAL OVERLAP
- Pi bond is weaker than sigma!!!
- bond strength increases with more bonds BECAUSE NO OF SHARED ELECTRONS INCREASES
- state is binding BETWEEN WHAT AND WHAT
- For HX compounds bond energy trend, rmb to consider BOTH: orbital diffuse trend and electronegativity trend
- !!!!!! for AlCl wtv dimers. It is draw two diamonds.
- QUOTE LATTICE ENERGY FORMULA!!!

exceptions	examples
Molecules with less than 8 electrons in the valence shell of an atom - Such molecules are electron deficient - More electrons can be accepted to achieve an octet configuration in the atom to form a dative bond	AlCl3 and BeCl2
Molecules with unpaired electrons in the valence shell of an atom	NO and NO2

- Such molecules are called radicals	

Chem bonding II

- NOTE graphite has HIGHER melting than diamond (still in the3000s) BECAUSE OF DIFF HYBRIDISATION HENCE GREATER OVERLAP HENCE LESS DIFFUSE THAT KINDA THING
- weak idid between layers is only related to lubricant stuffz
- Hybridisation number formula doesn't really apply sometimes:
    - Benzene ring stuff are usually sp2 (eg phenoxide ion)
    - Amides N is sp2 despite getting sp3 from the steric number formula
    - It's like that in stuff that want one normal (unhybridised) p orbital to overlap with electron cloud (like in a double bond, in amides etc)
- Intermediate bond length cannot explain equal bond length. Eg in graphite, must say electrons shared EQUALLY across the atoms hence equal bond length!!!

Atomic Structure

‼ WRITE OUT FULL ELECTRONIC CONFIGURATIONS FIRST!!!

- "nucleus of xxx atom" -> POSITIVELY CHARGED so it will go towards negatively charged plate
    - in the nth electron shell
    - number of sub shells: n
    - number of orbitals n^2
    - (Hence number of e- is 2n^2)
- trends: rmb to write increase decrease in size of electron cloud HENCE decrease radii or wtv
- spdf irregularity: Cr and Cu
- IE trend irregularity: grp 2&13 (s vs p electron, different energy levels) grp 15&16 (paired vs unpaired electrons) FOR FIRST IE
- orbital is a region of space where there is a high probability of finding an electron >95%
- Hund's rule is occupied singly first, parallel spins
- Pauli exclusion is pairs must be opposite spins
- Sample explanation (example only. Not must-follow template) (and for a specific case?) (can't find the question anymore)
    - Element C belongs to group 16 (name group)
    - The sharp decrease in the second ionisation energy from F to G implies that the second electron of F is removed from an electron shell of a lower principal quantum number, n, while the second electron of G is removed from an electron shell of a higher principal quantum number n+1. Hence F has one valence electron and is from Group 1.

    - Since the elements differ by one proton number, elements E, D and C, should have 8, 7, 6 valence electrons respectively. Thus element C has 6 valence electrons and is from group 16 (how to work backwards to explain).

Gaseous State

- main assumptions negligible volume and negligible attractive forces — then also that they are perfectly elastic and all particles at same temp have same KE
- negative deviation due to intermolecular attractive. Decreasing volume. Decreasing pV numerator ‼ AND IT DEPENDS ON THE IMF OF ATTRACTION ❗
- positive deviation due to intermolecular repulsive. Electron cloud bigger = more repulsion ‼ AND IT DEPENDS ON ELECTRON CLOUD SIZE NOT IMF ‼‼
- Boiling when saturated Vapor pressure is equal to external pressure on the liquid.
- When saying why something has discrepancy from what's displayed in ideal gas behaviour, must specify WHY — eg oxygen does not exhibit ideal gas behaviour because it has IDID INTERACTIONS
- At higher temperature will approach ideality more and deviate from ideality LESS
- Kinetic energy is the same for any two ideal gases at the same temperature. But KE = 1/2mv^2, so for two gases with the same KE, the gas with the higher mass will have the lower velocity.

Energetics I

- more negative (exo) Hf means products more stable than reactants and compound less likely to decompose back to reactants
- Theoretical LE : assumes all ions are spherical and have charge evenly distributed around them
- LE is formed!! from GASEOUS IONS
- RMB TO INCLUDE ELECTRONS IN LE ENERGY LEVEL DIAGRAMS AT THE STEP OF IONISATION OF METAL CATIONS‼
- MAGNITUDE of LE!! not larger/smaller
- Rmb to write out the e- lost in born haber
- standard Hneut is -57kJmol or around there
    - for a STRONG DIBASIC acid, Hneut x2 cos there are twice the number of moles of water formed
- Which one is more stable — the whatever energy process is LESS EXOTHERMIC
- rmb mention ENERGETICALLY UNFAVOURABLE for the why ionic salt insoluble in water thing — energy released cannot compensate!!
- 1st EA is exothermic because the attraction between the nucleus of O atom and the added electron is greater than the repulsion between the electrons. 2nd EA is endothermic because energy is required to overcome the repulsion when electrons are added to a negatively charged O- ion.
- Sample "exception" templates (once again can't find the questions for these…)
    - Why experimental value for calorimeter is less exothermic than actual value:

        - Heat capacity of cup/calorimeter not considered. Improvement: account for the heat capacity of the cup/calorimeter by calibrating the calorimeter using sample with known ∆Hsoln
        - Solution formed was not sufficiently dilute. Improvement: use a larger volume of water or use less solid.
        - NOTE: cannot use heat lost to the surroundings! This is already accounted for by extrapolation of cooling curve!!
    - The experimental ΔHc is less exothermic than the value calculated in (b) which made use of average bond energy values. In addition, the use of bond energy values assumes that the chemical species involved are in gaseous state. However DMF is a liquid. The experimental value is less exothermic as it takes into account the energy required to vaporise DMF to a gas.

Energetics II

- spontaneous high T: entropy driven
- spontaneous low T: enthalpy driven
- Mention “more orderliness / more disorderliness” “greater number of ways of arranging particles”
- 1. More particles 2.more ways to arrange particles 3.more ways to distribute energy in system
- Entropy increases even within a certain state if temp increases (eg as ice melts. Even if you’re only referring to solid ice state, as temp increases entropy increases cause particles gain KE in process of melting)
- Spontaneous is always because of delta G!!! being <0. Don’t mention delta S unless really supposed to because usually question is about using delta G to explain delta S.

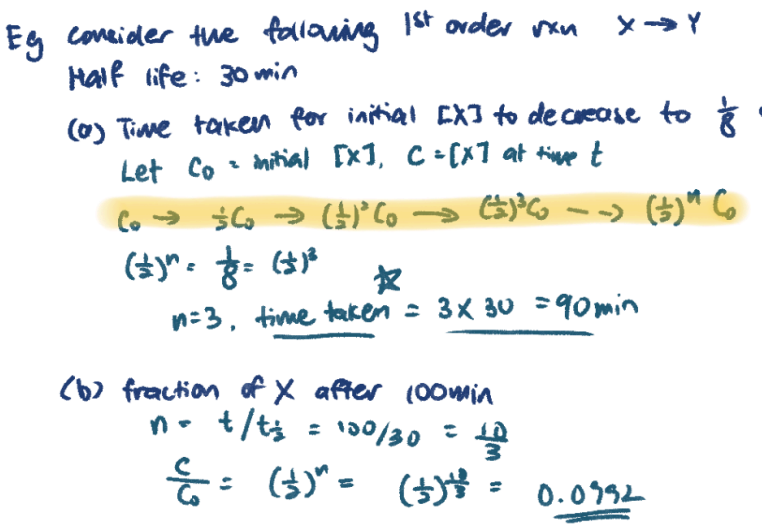
VA

Dilution factor = number of drops of FA1 / number of drops of FA2

- In this case 10 drops of FA2 to 67 drops of FA1 in micro-titration, FA2 needs to be diluted (so it’s / no. of drops of soln that needs to be diluted)

Kinetics

- when in doubt try to draw the t1/2 progression (arrows)



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- explain if addition of halogen will affect reaction: no because it is NOT PART OF RATE DETERMINING STEP. reaction is ZERO ORDER WRT HALOGEN
- Small k rate constant value can be due to
    - High activation energy which can be due to collision of same charge particles
- Rate constant k affected by TEMP and catalyst. Increases with increasing temp/add catalyst
- k is supposed to be a constant for the rxn at a given temp
- on Maxwell Boltzmann rmb to label T2K > T1K!!!
- For anything that asks why increasing temp increases reaction rate, DRAW A MAXWELL BOLTZMANN. EVEN IF THE QN DIDNT ASK YOU TO.
- Quenching — don't just mention ice cold or whatever to quench, say it SLOWS DOWN REACTION BY DECREASING TEMP (if needed) prevent equilibrium position from shifting etc etc
- Reactant conc does not affect rate constant.

Equilibria

- haber
    - 450C
    - molar ratio N2:H2 = 1:3 (similar to stoichio to minimise excess)
    - 200atm
    - Finely divided iron catalyst with aluminium oxide as promoter
    - Nh3 is constantly removed by liquifying at -50C
    - Sample ans for industrial qns:
        - Since the forward reaction is exothermic and produces less gaseous particles, the yield of SO2 will be higher if the reaction is conducted under low temperatures and high pressures.
        - However, low temperatures will result in a low reaction rate and high pressure will incur greater economic costs. Hence a compromise of 400C

and 2atm is used industrially together with the use of a catalyst to speed up the reaction rate.

- Read qn carefully , unless it says initial conc/amt /pressure it is usually assumed to be EQUI amt/conc
    - You can do an ice table in mol, but must convert to conc later
    - You CANNOT do a vol ice table
- Total pressure remains same only if the number of gaseous molecules on both LHS RHS are equal.

STOPP GETTING TRICKED BY KP QUESTIONS bro Kp only changes with temperature so if the mcq or whatv is like “Kp increases/decreases..” IMMEDIATELY that option is wrong if temp is constant

- adding water will favour side of equilibrium that produces more ions. If both LHS RHS have same ions, then no equi position change.
- For esterification H2O is only included in Ksp if reaction is done in a medium where at first only the alcohol and carboxylic were present,, I think?? (Ie the alcohol and carboxylic are both (l) state symbols)

Periodic Table

- SiO2 does not react with NaOH aq, only fused CONC NaOH
- every time “behaviour of xxx in water” must state soluble/dissolves or not, type of interactions formed, RESULTANT PH!!
- AlCl3 SUBLIMES, plus it’s dimer of Al2Cl6 in liquid and gas non high temp. So it has lower bp than the ionic chlorides but higher than the simpler molecular ones
- Melting point of Na2O is LOWER than SiO2, SiO2 lower than Al2O3 which is lower than MgO

Acids/Bases

- buffer is better at resisting pH changes (than eg water) because it can PARTIALLY OFFSET INCREASE IN (H+/OH-) because it CONTAINS (WEAK ACID/WEAK BASE —specify) while water does not
- rmb you can’t compare Kb of something that doesn’t have a conj base per se. eg Al3+ doesn’t actually have a conj base
    - To find which is stronger acid (and hence acts as an acid) you must compare the reactant with the other reactant’s CONJ ACID. eg Al3+ and HCO3-, compare Ka of Al3+ with CONJ ACID of HCO3-
- weaker/stronger acid : why? Cos conj base of stronger acid is more stable (then explain why it’s stable)
- For organic acids why one is more stable - check the e density stability first. Basic stuff like number and type of electron withdrawing groups. If dh diff, move on to the unconventional stuff like stabilised monoanion through hydrogen bonds, etc.

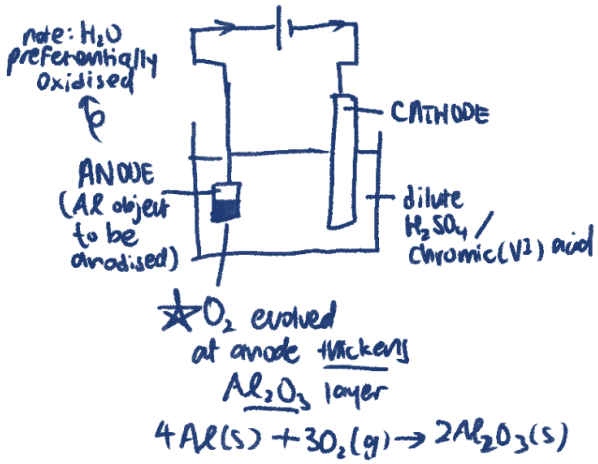
- EQUIVALENCE POINT is neutralisation point, DIFFERENT from endpoint. So in indicator qns, say the rapid colour change corresponds to EQUI point. Not end point.
- Effective buffer range of acidic buffer is pka +/- 1

Solubility

When there is an increase in solubility due to an increase in concentration of one of the component ions, the only explanation is because of complex formation.

Electrochem

- STANDARD CELL!! 298K!! SALT BRIDGEEE SALT BRIDGE! ALL IONS IN THE EQUATIONS MUST BE THERE! !!!!!!!!!!!!!!!!!!
- adding water will favour side of equilibrium that produces more ions. If both LHS RHS have same ions, then no equi position change.
- Ions with greater charge like Fe3+/2+, Cr3+ etc, must consider if they can be reduced FURTHER!! (Multiple step reactions) by a single reducing agent, it's possible. Esp if there are multiple eqns for the ions in data booklet.
- **Anodising!!**



- in hydrogen fuel cell OXYGEN IS REDUCED. OXYGEN IS CATHODE. OXYGEN REDUCED. IDK HOW TO RMB THIS.
- Explain why conc of ions (in copper/silver plating etc other metals that can be plated) remains relatively constant
    - For every ONE MOLE of (name) ion that is oxidised to (metal) at the anode, ONE MOLE of metal is reduced at the cathode to form (ion). MUST STATE THE EQUAL MOLES.
- Graphite electrodes get oxidised by O2 after some time if O2 is produced at that electrode — C and O combine form CO2

- If irregularity in E0 value, check electron pairing, it may have to do with instability or whatever
- !!spontaneity — link to thermodynamic feasibility (Ecell) on top of just mentioning spontaneous or not

Periodic Table II

- number of moles of water of crystallisation depends on cat ionic size. As cationic size increases. Charge density decrease so number of h2o attracted decreases.
- HCl does not decompose upon heating. Only Hbr, Hi.

Transition Metals

- colourless because fully filled d subshell, NO PARTIALLY FILLED D, D-D NOT POSSIBLE.
- Haemoglobin
    - Initially, H2O binds to Fe when oxygen is not bound
    - When explaining why pure oxygen can cure a person, explain in terms of equilibrium poe. Hb-CO vs Hb-O2

Intro to Orgchem

- if the molecule contains only ONE chiral c, then it will ALWAYS have enantio
- for stereo, enantio isomer definitions, always preface by saying EXISTENCE OF 2 COMPOUNDS WITH SAME MOLECULAR AND STRUCTURAL FORMULA BUT diff spatial arrangement
- Star the chiral carbons
- Cis isomer is less stable than trans due to crowding between two alkyl groups - repulsion, steric strain
- when it's why a particular intermediate is formed — state type! Primary, secondary, tertiary (unless it's the delocalisation stabilisation kind)
- The length of the pi electron cloud system is not always the most significant factor in determining stability. If it was, the phenoxide ion would be deemed more stable than carboxylate, which isn't true. The presence of a highly electronegative atom can influence the stability of the pi system, so it's impt to carefully consider the differences in the pi systems to determine significant factors influencing their stability.

Alkanes

- free rad sub
    - State limiting or excess halogen!!!!!
    - Note gas formed might give gas test eg HCl, HBr give acidic litmus test
    - Decolourisation of halogen

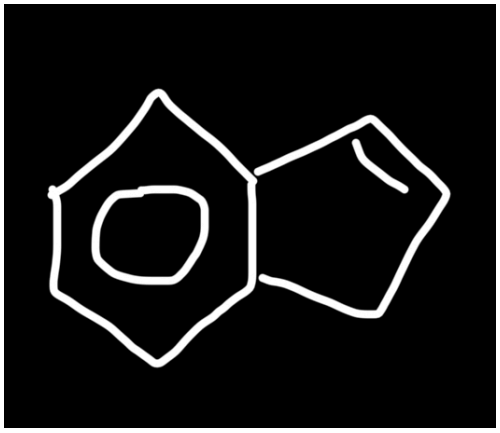
    - The chlorine radical ABSTRACTS the H atom from the og alkane!! The alkane doesn't just become free radical by itself!!
    - !!!! BRO U HAVE TO WRITE THE REACTION CONDITIONS IN FIRST STEP!!!! EG HEAT, UV LIGHT WHATEVER
- DRAW CYCLO IF QN GIVES CYCLO
- I think…? Formula for termination step where the two big radicals combine (trace amount one) is C2xH2y-2 if the original compound is CxHy (see alkanes mcq qn 16)
- Br2 BE is lower than Cl2, hence Br2 free rad sub is more exothermic ❌❌ -> must consider all bonds broken bonds formed

Alkenes

- always must state cis or trans when naming compounds (skeletal formula) unless cannot
- !!!! CIS ISOMER IS LESS STABLE THAN TRANS ISOMER cause of crowding between two alkyl groups hence steric strain!!
- co2H in the displayed formula might be cooh so be mindful
- For explaining why diff atoms substituted to diff Cs (carbocation stability), must always first say that carbocation is formed from what first step before explaining the rest. Eg:
    - Propene undergoes electrophilic addition and the first step involves the addition of the electrophile to carbon-1 as the more stable secondary carbocation is formed. (can draw diagram)
    - The more stable carbocation is the one that <u>has more electron donating alkyl groups bonded to the C with positive charge. This helps to decrease the intensity of the positive charge to a greater extent.</u>
    - <u>In HOCl</u> (HOCl is used as electrophile in this case) Cl is partially positive so that <u>Cl of HOCl is the electrophile and δ+Cl adds to the carbon-1 to form the more stable carbocation.</u>
- Electron withdrawing vs electron- donating
- For spot pattern eg mcq questions, take note of whether some patterns go against common convention. Eg adding of atom to the less substituted carbon instead
- Minor product is actually less stable than major product

Arenes

- Less H than C eg C9H8, it could be a cyclic attachment like



Carbonyl

- LiAlH4 is a stronger reducing agent than NaBH4, WHY
    - Al-H bond strength is weaker as electroneg diff between Al and H is greater!! Increase polarity, negative charge on H intensified
    - Since Al larger than B, orbital used for bonding is more diffuse. Al-H is weaker, so greater tendency for losing H- nucleophile.
- Note CAN OXIDISE AROMATIC KETONE!! THERES A BENZYLIC C!!
- In second step of nucleophilic add, rmb to consider which is the strongest electrophile. Eg you have some acid in water but if the HO bond in water is more diff in electroneg, then water will be the protonation.
- in those like dioic acid cis trans that can form intermolecular h bonds, the absence of trans isomer is not just because the two acid groups are far apart but ALSO because RESTRICTED ROTATION about CC

Nitrogen

- ZWITTERIONS ARE ELECTRICALLY NEUTRAL!!! (Just have oppositely charged ends)