A-level Common Mistakes

Acids and bases

Forgetting to x2 if H_2SO_4 or $Ba(OH)_2$ when calculating the pH.

Not realising that the definition of pH is simply the pH equation.

Getting confused with conjugate acid-base. Acid has an extra H. Just add and remove an H. Not sure which acid is strongest i.e. one with the lowest pKa.

Adding water to solution doesn't affect the moles just concentration.

Water is neutral at any pH as $[H^+]=[OH^-]$ but is endothermic. Students often say I don't know what K_w is. K anything is just an equilibrium constant, the same as K_a, K_c or K_p. They are all just numbers that tell you how far to the right or left equilibrium is. But watch k in the rate topic, it's a small k, so not an equilibrium constant.

Students often have no idea what pK_a is. It's just another scale like pH is a scale. Kind of tells you similar things i.e. the lower the value the more acidic it is.

Not realising that this topic only has one main reaction: acid + base. Most questions are what's the pH of a solution; therefore, no reaction at all. But if acid and base mixed together then yes….reaction! So a subtraction is needed.

Not sure how to draw a pH curve. Need a start and end point, either estimate it or values from a previous calculation. Equivalence point is the important part, vertical section 3-5 pH units high, moles acid = moles base, from this volume a concentration can be calculated.

Buffers is the worst part usually. Students usually have no idea about the theory: 1. excess acid/salt, 2. equilibrium shifts and 3. salt:acid ratio remains almost constant. If they don't know the theory they struggle with the calculations. Only two options when making a buffer: a reaction i.e. acid + base (requires subtraction) or no reaction when salt is already made. Some students use $[H^+]^2$ which is a major major MAJOR error! Why? Go back to the theory and find out ☺

Electrode Potentials

What's the point of the topic? It's a prediction, like thermodynamics. Will the reaction occur or not? Entropy, Gibbs, equilibria and this topic are all predictive or focusing on how much of something you make. Rates is on its own, it's simply how fast.

Not sure when to use platinum or another metal for the electrode.

Not sure how to use the tables of electrode potentials. Main point is the most negative value = best reducing agent and reducing agents are on the right-hand side (vice-versa for oxidation).

To calculate E_{cell} (EMF) students often get confused, do you subtract or reverse the sign first? It's up to you, just get it right! Pick a method and stick to it.

Not seeing the topic for what it is….just reversing the equation with the more negative potential….. a lot! Or they fail to check which equation has been reversed.

No idea when to talk about non-standard conditions (always a change of concentration…. so far) or how to use it if it is mentioned. Also what part kinetics play i.e. reaction does not occur due to a high activation energy despite a positive E_{cell} (EMF) value.

AQA and Edexcel: Not sure on conventional cell representation especially for the standard hydrogen electrode.

Most students are very unclear on fuel cells, what they need to know. The answer is not much!

Equilibria

Not sure on how to calculate the equilibrium moles (the most important part of the whole topic). They will give you the equilibrium moles of something, from that you need to use ratios to get all the equilibrium values.

No idea what to do if titration data is given. It is given so that you can calculate the equilibrium moles of something (usually acid or base) i.e. they don't give you any equilibrium moles.

Getting K_c remaining constant mixed up with equilibrium shifting. Only temperature effects the K_c value but several things effect the equilibrium position. Not sure what to say when K_c value doesn't change when pressure or concentration is changed.

Not sure when you can use moles in the K_c expression and just ignore the volume.

Some students use [ ] for K_p…don't do that.

Rates

Not sure on how to calculate orders from tables of data if the concentrations can't be kept constant (a very very common question in exams).

Getting confused between conc v time and rate v conc curves.

Not clear on rate determining step (RDS). If it's in the rate equation it's in the slow step (RDS) and vice-versa. The equations in the "mechanism" as they like to call it, it's just 2 or more equations, should cancel to give the overall equation.

Not sure how to use the Arrhenius equation using y=mx + c even though you shouldn't need y = mx + c. This question is so common. Just get the gradient and multiply by R → E_a.

Often forgetting the sign for E_a…it's positive!! Always.

Not realising that rates is actually a practical orientated topic so need to be able to monitor reactions and devise experiments. Or other practical questions like why was the concentration of a reactant in excess.

Thermodynamics

Not clear on Born-Haber cycles. Not sure what the arrows up and down mean. Not sure on how to write the equations for some of the steps e.g. when to add electrons, when to use a big 2, when the order can be varied. Not sure what the point of it all is i.e. two ways to make an ionic compound.

Not sure what atomisation is i.e. make only one atom in the gaseous state.

Biggest problem is the calculation. Often students try to rearrange too soon or do some weird thing where they reverse the signs on everything introducing unnecessary problems. Just do Formation = sum of the rest, add up the numbers and subtract at the end.

Multiplying by 2!! Another major error. If it has $2Cl^-$ for example then multiply the atomisation and also electron affinity by 2. Be very careful here, it's worth spending time getting this right. Or dividing by 2, that's possible too.

Enthalpy of solution: unsure how to draw hess or born-haber. Not sure on calculations but can always use solution = hydration – lattice and everything will be alright.

Not sure what affects hydration and lattice. Size and charge!! They are competing against each other but both are affected the same way and both are exothermic.

Again the x2 thing causes problems when calculation hydration enthalpies of for example $2Cl^-$, as need to divide by 2 or for example forgetting to x2 for hydration of $2OH^-$.

Not sure what the point of it is i.e. will it dissolve? Is solution negative or positive?

Entropy: change of state and change of moles to estimate entropy from an equation.

Biggest problem is students actually forget the Gibbs equation! Stamp it on your hand for a few months until the exam, you'll need it at some point. And need to convert entropy units usually from J → kJ as delta H in kJ, must be same units to be used in Gibbs equation.

Negative and positive values. Gibbs is negative when a reaction occurs but entropy is positive. Not clear on the various combinations of positive and negative values and how the effect delta G. No idea how K is related to all of this.

Transition Metals

A bit rusty on what they need to know in the initial theory. Zn and Sc….Cu and Cr…that's about it!

Not sure what complexes are octahedral, tetrahedral etc. Almost all are octahedral if you get stuck.

Often don't know the common mono/bi/multidentate ligands or what those words even mean.

AQA and Edexcel: Get confused with catalyst reactions, not sure what reactant the catalyst reacts with but it is just redox. They tend to use the examples straight from the text book.

Biggest problem: not knowing the table well enough i.e. all the colours and complexes formed or understanding what's going on. Not just a memory test! Usually struggle to write out correct equations for these reactions. The colours are not the priority. Knowing what is going on is vital.

Redox Titrations

Wording and presentation of question causes problems. Getting overwhelmed by the amount of information. Look at the structure of the questions. The titration is at the end of the question so start there. Always look to see what they are titrating. Is it thiosulphate or manganate or acid/base etc?

Realising that there are only two types: acid/base and redox titrations, but there are variations within each.

Need to be crystal clear on how to do a normal calculation. And being able to write half equations without problem….moles and ratios!! Being a half-equation magician is hugely beneficial.

Recognising a back titration (requires a subtraction and excess is involved) versus a normal titration or if they have two or more equations in the question, what's the point in that?? Just several ratios.

A massive error is to try to do a ratio between the same species in different equations. Not possible. Can only do ratios in one equation at a time. You have to carry the value forward to the next equation.

Organic

Generally just not being very good at drawing stuff….even at A2.

The main mistake is thinking organic is HUUGGGEEEE and you need to know 368 reactions (I made that number up). You don't. You only need to know 364 reactions (just kidding). You need to know basic principles and be able to apply them to new situations. Need to learn what reactions each type of molecule does and why. You don't need to remember every single combination…e.g. acyl chlorides always substitute so just swap the nucleophile for the Cl. Look for patterns and organic becomes very easy.

You also don't need to learn every condition ever. Some of them are built into the topic e.g. UV light in radicals or the benzene reactions. Anything else is often reflux or don't, catalyst or not. Just use H_2SO_4 as the catalyst if you are really stuck. Reactions and understanding first, worry about conditions later or don't bother at all, how many marks will you even lose? By that I mean random conditions like do you reflux if doing nucleophilic substitution? Not specific things like UV light in the radical topic, of course you have to know those.

Getting mechanisms mixed up. You only have mainly electrophilic and nucleophilic. Just learn the nucleophiles and electrophiles that they use and therefore how would you recognise one you haven't seen before? And what types of molecules do they react with? Realise that negative goes to positive happens all the time.

Not knowing what reactions **nitriles** do or why they even use nitriles. Look for the extra carbon in the structure, which tells you a nitrile has been used (probably).

Not knowing **organic tests** in depth. They often know the basics but if pushed they couldn't tell you what reaction it is or write out an equation for it.

Chiral: not being able to identify a chiral centre, particularly in cyclic molecules. Cyclic causes problems generally but it's just the same as not cyclic more or less. Not drawing enantiomers in 3D format or not even knowing what an enantiomer is.

AQA and Edexcel: Not saying the correct things for the formation of a racemic mixture….just say planar and 50:50.

Nucleophilic addition: not putting lone pairs on the C of the nitrile or thinking the arrow comes from the N instead of the C. Drawing the arrow from the H^+ to the O^-, massive error. Always draw to the +!!!

Esters/polyesters and **amides/polyamides**….making them is one reaction (condensation). Breaking them…hydrolysis. So two reactions in total. Students make a big deal out of this, just let it be easy. Throw in amino acids here as well as that is also making and breaking amides…look for the patterns!

Hydrolysis always causes problems, particularly the conditions part. The O^- and NH_3^+ thing. It's actually very easy, don't make it difficult.

Repeating units versus polymers. Students don't know when to use the little 'n'. Another mistake is just drawing things that aren't amides or esters but some bizarre thing inbetween.

Benzene: Not knowing exactly which electrophiles they are supposed to know and how to make them. Not being able to write out equations for them. The halogen carrier seems to confuse people….it's just a catalyst. Edexcel and OCR A: Getting confused with Friedel-Crafts alkylation and acylation.

Amines: I don't know why this is done so badly. They are nucleophiles and bases due to the lone pair. Adding an H to an amine → NH_3^+ seems to cause mayhem!

Amine v amide: another disaster. Amides are not nucleophiles, bases or reactive. Don't get them mixed up. If you know why, you will never get them mixed up….in amides, the C=O that pulls away the lone pair from the N therefore it is not "available".

Amino Acids: acidic conditions versus basic. This is so easy but students get it wrong. Amine is a base so reacts with an acid and picks up an H^+. An acid is, well, an acid ☺ so it reacts with a base and loses an H^+. If there is more than one acid or amine then you can put the + or – on all the amines or acids, as long as they used excess in the question.

Edexcel and AQA: **Zwitterions**. If there is more than one acid or amine group, what do you do? Look at the past papers and work it out would be the best option. But zwitterions must be neutral so only one + and one – allowed. Some students talk about hydrogen bonds to explain their high melting points….ZWITTERION!!

Also other reactions e.g. making an ester with an amino acid.

AQA: there are a lot of mechanisms (8 or 9 over the two years). Have to be rock solid on these and not get them mixed up. So spend a lot of time on them and iron out any confusion.

Organic Synthesis

This is more difficult. You must know your basic reactions for every type of molecule. Biggest mistake here? Students just don't know their reactions nearly well enough. If I say alkene, you said electrophilic, if I say halogenoalkane, you say nucleophilic substitution or elimination….it has to be a reflex reaction. Then you focus on past papers looking for the kind of things they have asked before. It's almost predictable. Again, worry about conditions later.

Practicals

This is the worst part for students, particularly Edexcel students who have that "fun" paper 3. They don't know what they are supposed to do with these practicals they have been doing all year. The answer is not a lot. You don't need to go into painstaking detail about how to do every practical. Just look at what they ask in past papers.

There are very few step-by-step procedures that you need to know, for example, recrystallization is one of them, but there's not many. Practicals are there to demonstrate a technique. You need to know about the techniques, not the specifics of the reaction or every single step. For example, everyone seems to make aspirin. The point of this is general organic practice and primarily a chance to do recrystallization. You don't need to know anything about aspirin.

The focus has to be on the past paper questions and tailoring your revision around that. There are lots of practical questions that vary with syllabus. A lot of them are when things go wrong or to devise an experiment. You need exposure to a variety of questions and to analyse papers.

The two big ones are organic techniques and titrations. Students often just don't know the equipment or its purpose well enough in organic. It's factual. Google it if you are unsure. You need to know what is the purpose of this and that's about it. It's also worth knowing the order of a typical organic reaction: reflux → separating funnel → drying agent → filter the drying agent (to remove it) → evaporate the solvent → solid or a liquid → purify (recrystallise for a solid or distil for a liquid) → analysis/purity check.

Recrystallisation: not knowing the steps nearly well enough. It's easy. Minimum and hot → filter → cool → filter → wash and dry. And also not knowing why they do these steps.

Analysis

NMR: ☹ students often can't do it. It is difficult. You must focus on the doing part and not too much on theory. You have to be able to interpret spectra to draw a structure or vice-versa. You don't need to now much or anything about how it all works. Focus on questions again. Focus on the 4 things you need to look at in any spectrum: chemical shift, splitting, environments and peak ratios.

Particularly look at splitting, if there's one part students got wrong, it's here. Also, students struggle with drawing the final structure. Don't worry about it. How many marks will you lose? 1 or 2. Focus on showing them you can do NMR. It's like a calculation. If you get all the working right but do something silly at the end and get the wrong answer it's not fatal.

If given a spectrum, you must focus on fragments. So look in questions for 5 or 6 common fragments then draw them. The structure often then presents itself to you. If given a molecule, focus on a table with the 4 things you always do in NMR. What are they? I just told you above.

Chromatography: students just don't know the basic stationary v mobile phase theory. That's all you really need. Focus on polarity and separation.