

How to do Calculations

Calculations are a problem for many students.

You may get a question worth 6 or 7 marks and have **no idea where to even begin**. But don't worry this is very common.

Questions often have a lot of information, which causes confusion, and students can become overwhelmed.

With calculations I believe there are a number of ways you can approach them **generally**.

The aim is to give students a strategy so that they can do *something* and be able to start questions instead of becoming anxious and doing nothing or even worse, making up the answer.

Imagine you had a $PV = nRT$ question or atom economy or empirical formula. You would have no problem starting and probably would think it's easy. Why?

You know where to begin. There is an equation to use.

You need to do something similar for ALL questions. You need to have a "go to" method every single time so you can start the question.

Mental Approach

Those who struggle with calculations are never going to say that they love doing them or that they love the challenge! And those that are good at them, while they might not love them, they probably don't mind them.

Can you see the link?

Also, those who are good at problem solving see it as a challenge. They don't panic. They prefer this type of situation as they don't have to remember too much. It's more about using one or two rules and applying them to lots of questions.

Students that try to memorise everything generally aren't good at problem solving. They aren't confident enough to rely upon their own ability and one or two rules.

Again, there is a link here.

I'm not saying this is easy to do or that it happens overnight, but try to shift your thinking a little. Try to view calculations as a puzzle or a challenge or just something a little bit less evil.

You must **believe** that you can do it.

If someone in your class can do these questions then you can too, you just haven't found the correct path yet. But hopefully some of the strategies below will help you.

1. See how to do it

The ideal situation is that you can look at a question and can see how to do it from start to finish. This requires a methodical analytical approach (problem solving skills).

But this isn't always going to happen. And for students who struggle with calculations, this might not happen very often.

- ✓ students that can do this **don't** look at a question and suddenly know how to do it. They are using strategy. It takes time.

Don't expect to know how to do it within a few seconds

This is the big problem. Students who "can't" do this, tend to panic if they can't immediately "see" the complete route to the answer and start thinking they can't do it, then they think they are bad at calculations, then they think they are bad at chemistry etc....it goes on and on.

So you need to be patient!!

It is a process. And I am going to try to give you a process in the pages below.

What are you working out?

You need to **minimise the number of variables.**

- ✓ you can only ever have **one unknown** i.e. the thing that you are trying to work out. The other values must either be given to you or you can work them out from the information given.

An easy question would be, for example:

Calculate the number of moles of a 50 cm³ of a 0.2 mol dm⁻³ solution of NaOH.

The unknown is obviously the number of moles and the other variables (concentration and volume) are given to you, so it's no problem.

A more difficult question would be if they **didn't give you the concentration** and you firstly had to work it out, possibly from titration data, before then working out the moles.

In that situation it would seem like there were **two unknowns**. And this is when students get confused.

Assume that one of the two unknowns can be worked out. Otherwise the question is impossible.

So the first thing you must be able to do is identify what the **end result** is; what do they actually *want* at the very end.

The first thing to do: **go to the end of the question** and identify what they want. Now you know the unknown. Everything else can be worked out.

Question everything

To enable you to “see” how to do a question, you have to treat it like a jigsaw, gather all the pieces and then try to put it all together.

So, examine all the pieces. By this I mean, if there is a number in the question, ask yourself *why is it there and how can I use it?* You may not even need it. Again, this takes a bit of time and patience.

Once you have started the question and let’s say you become stuck, you can still question things. In fact, it’s a good way to reduce tension and keeps you thinking logically. For example:

Ok, I have the concentration what can I do with it? I need the moles how can I get them? How would I normally relate concentration and moles? Hmm...I’d use moles = concentration x volume. Do I have volume?

And continue like that.

Analyse questions

What if I told you that you could prepare to the point where you probably won’t have many problems with calculations, even if you are struggling now with them? It’s just preparation.

An approach that works amazingly well, is to look at a lot of questions and **look for patterns** to devise a **general strategy for different types** of questions.

✓ I should actually have this approach in flashing lights. It works wonders for people who think they are hopeless at calculations. I know this as I used to be one of them!

For example, you could be working on Avogadro type calculations. I would look through loads of past papers ONLY for Avogadro and then look at the **different types of question** they ask.

By types, I mean things like calculating the number of ions, the number of moles, the number of atoms, the number of molecules etc. I am trying to exhaust it. I want to see every single thing they have asked regarding Avogadro.

I would then collate a list of **types** of question.

This is great as you will soon see that the list is **not infinite**. There are usually a predictable number of types of question. After while looking through papers you will stop seeing new questions. You will exhaust it.

Next I would then look at **how** each type of question is done using the **marking schemes**. From this a **general strategy** can be developed for each type of question.

The end result is that next time you get a particular type of Avogadro question, you will **recognise** quickly what to do.

This method takes a lot of the unknown out of the questions and any fear or anxiety should go with it.

Of course there will be the odd random never to be seen again question or a twist on the usual question. Well, that's part of the analysis process. Give the questions priority. And later on use the general strategy and adapt it for "other" questions.

- ✓ I have also found that you will then become more confident and better at problem solving. You will then start to "see" questions quicker naturally. Even if they give you a new "type" of question, a lot of the strategies you have been using just require a slight tweak/
- ✓ by doing this process, you will become very good at calculations as you have a strategy. You know where to begin and most times you will "see" how to do the whole question as you have done it before.

2. Make a Start

In complete contrast to "seeing" how to do a question from start to finish, just make a start.

But you could look at this as just another strategy to help get you to the point where you eventually DO see how to do the question.

You must look at this from the correct point of view.

Let's say it is a 6 mark question and you have no idea what to do. Having done thousands of these questions:

There are always a few easy marks.

This is hugely important. You must assume **there is something that you can do**, even if you can't see how to do the whole question.

You must let go of getting 100% in this situation.

Almost treat it as a "free question". If you panic or become anxious, you aren't going to get many/any marks anyway. So you might as well do the exact opposite. Just give it a go, almost carefree.

Accept that you might "only" get 3 out of 6

- ✓ you have to view the 3 out of 6 as three marks gained rather than 3 marks lost. And remember that it's not every question that will be like this.

For example, if it is a moles question, there is a very high chance that you will use moles = concentration x volume or moles = mass/RFM. And you will need to use chemical equations → a ratio.

I **assume** I am going to be able to use very simple things like these in most, if not all, questions.

This will force you to read the question differently. You will now be **looking** for things like concentration or volume and how you can use them. This is miles away from reading a question and becoming anxious.

The magic part:

Once you start the question becomes easier!

It's now not a 6 mark question. You have just gained 2 or 3 marks in about 20 seconds. It now doesn't matter so much. You haven't lost 6 marks.

The chances are you might then "see" how to do the rest of the question.

- ✓ the aim is to not sit still and become tight or tense. By just starting quickly and accepting not getting 100% is ok, you will reduce the chance of panic happening.

3. Putting it all together

The aim is to have a strategy no matter what you are faced with.

In summary:

Mental approach

You must believe you can do it and be patient. And see that the calculations are just another question, don't develop a mental block by believing that you are bad at maths or whatever else.

Analyse questions

Develop general strategies and steps for different "types" of question.

Make a start

If the question is still causing problems, just start. Look for the easy marks.

Then practise difficult questions. Get exposure to different situations but always apply the same strategies. Try questions from different syllabuses.

The more bizarre the question looks, the more you need to stick to your strategy

Another potential place to cause panic is when the question is "weird". You must stick to what you normally do.

Question everything

Remember to try to work out why a number is in the question. Just keep asking why and how can you use it. What can you do next? Etc.

Hopefully after a while, you will see improvement in your results. With that improvement you will gain confidence. And with confidence you will become better at calculations.

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