# Solving a problem in 7 steps

## 1 To read

So what is a good strategy to solve a statics problem? The first thing you should do, is read the problem carefully. It's a very common mistake to miss an important word in the problem, which creates an entirely different problem. So make sure you read the problem well.

## 2 To draw

The next thing you should do is draw a figure of the problem. Especially for 3D problems this may be difficult, because it's often hard to draw them in a clear way, but try to draw them anyway. When you've drawn the problem, try to draw ALL of the forces (and torques, if there are any torques without a force) acting on the object. This is a very important part. For every part in the figure you should ask yourself the question "*what forces can be applied on this point?*". If the answer is "*none*", you don't have to draw any forces. If you're still doubting whether to draw a force or not, just draw it. It might turn out to be 0 eventually, but it's better to draw a force that does not exist, than to not draw a force that does exist.

## 3 To assign names

So now you've got all of the forces. To solve the problem, you should probably find the magnitude or direction of some force or torque, because that's the case with a lot of statics problems. The first thing you ought to do, is to make sure the variable you ought to calculate has a name. Also all the other forces present, which play a role in the problem (which is often the case, otherwise the forces wouldn't be present), should be given a name. This name can, and should be rather simple, like $F_A$ for the force in point $A$.

Another thing that you could do (this is helpful in most problems, but there are a few exceptions), is dissect all the forces along a coordinate system. Give all those dissected forces logical names too. For example, the dissection of force $F_1$ along the $x$-axis can be called $F_{1;x}$.

## 4 To plan

You shouldn't be calculating just yet. What you now should do, is look very carefully at the figure you've drawn (or has been drawn for you). Ask yourself the question "*What kind of formulas can I derive from this data?*". Don't derive the formula just yet, but just wonder what variables will be in the formula, and whether it will be an easy formula. If this is the case, remember it, so you might even write down the formula later. The reason why this is so important, is so you can start planning how you will get your solution in an easy way. You don't want to end up with 20 formulas and get lost in them. Small errors are often made, so the chance to make them should be minimized.

When you've looked at the problem for a little while, and got quite a good idea of the possible formulas you can use, you can continue. Try to ask yourself which variable you can derive from which formula (or group of formulas in difficult cases). Then go step by step towards the variable you were supposed to calculate to solve the problem. If you, for example, want to find $F_C$, and you know that you can use equation 1 to find $F_A$ from known data, equation 2 to find $F_B$ from $F_A$ and known data, and equation 3 to find $F_C$ from $F_A$ and $F_B$, you have solved the problem, without still having written down any formulas!

## 5 To formulate

And now comes one of the most important parts: finding and writing down formulas. If the body is in equilibrium, you can always use the rules that the forces and torques are 0: $F_x = 0$, $F_y = 0$, $T = 0$ (for every center of rotation!). In 3D you even got more formula's (6 of them to be exact). You have to use these data, and any other data that's noted in the problem (that's why you were supposed to read it so well!) to find and write down all the formulas you need. Examples of these formula's are: $F_1 - 2 * F_2 + F_3 = 0$. Or $\frac{aF1}{\sqrt{a^2+2b^2}} - \frac{bF_2}{\sqrt{2a^2+b^2}} = 0$ (I never said they would be easy). Now you know why you had to give every force a name: so you can put the values of them in formulas and equations. If you run into any distance or angle that you need to use in a formula, but doesn't have a name yet, just give it a name.

Next to the amount of values you do know, there is a certain amount of unknown variables in the formulas you just stated. If the number of formulas is equal to the number of unknown variables in the formulas (or greater, but this doesn't occur often), then you can solve the problem by playing around with the formulas. However, if you do not have enough formulas, take a closer look at the problem, and at the picture you've drawn, to see if you can derive another different formula, possibly by choosing a different center of rotation.

An exception to the stated rule, that you need the same amount of formulas as unknown variables, is the following: When you need to express a certain value in another one, you have to end up with 1 equation, containing 2 unknown variables. In the previous case you always needed to end up with 1 equation, containing only 1 unknown variable. So when you need to end up with a certain variable expressed in another one, the amount of formulas should be (at least) the amount of unknown variables minus 1.

## 6 To calculate

And only in the end, we start calculating. We have a number $n$ formulas and the same amount of variables (hopefully). We should solve that now. When you don't have the mathematical skills to use all kinds of fancy tricks, it's just a matter of isolating a single variable at a time, and substituting it in all other functions, to find the final answer, step by step. Take your time and always double check whether you solved the formulas in the right way.

## 7 To evaluate

When you've done all the maths in the equations, you should have a final answer. A good idea is to take another look at the picture to see whether it's a possible and reasonable value. If it is, you probably have the right solution. If it isn't, try to find out why. Have you made a wrong calculation? Or did you draw the picture in the wrong way?