[Measurement problem solving with Scratch]

These questions may not be too challenging, but let's approach them from a problem solving perspective and build some algorithms that we can use to extend them.

This question asks how many inches in 30cm and how many centimetres in 12 inches. But Implicitly it's asking for a model for converting between inches and centimetres.

We get a feel for the problem by specialising, looking at some particular examples. Each inch adds 2.54cm, and this leads us to a general rule, stated as a conjecture, that a length in inches is equal to that number multiplied by 2.54 to give the result in cm.

In scratch we just need to set it up as prompts and variables. We'll first gather user input to see whether we're converting from inches or cm – so this will branch off into two If-then rules. One if we say inches, one if we say cm. We could also think about actions in the case that cm or inches is entered incorrectly – but we won't worry about this for the moment.

In the inches case, we ask how many inches there are, this will be the variable that we'll work with and we can go straight to the computer responding with the number of inches.

Now for cm, we need to go backwards, dividing by 2.54.

The next problem can actually be approached in a very similar way. We specialise and look at what happens when we use the 96cm ruler to measure out a few lengths. Now in this case, we're not simply extending to be able to convert any length, but rather, for any measuring length, whether it overestimates or underestimates a metre, we can work out the final length.

The variables that we're interested in, then become, the length of the ruler, and how many rulers' worth we have measured.

Finally we look at this problem of diluting volumes. Some relevant calculations include what the percentage statement means. And then we can play around with some examples to get a feel for the calculations. In 30ml of whisky that is 40% strong, we get 12ml of alcohol. If we added 10ml of water to this, we'd still have 12ml of alcohol, but now it would be expressed as a percentage of 40ml rather than 30ml.

Starting at 60%, we can look at the effect when we dilute it by 10ml. We can use ratios to solve this problem in general, but lets build a calculator that we could use for more exploration.

The relevant variables are the percentage strength we started with. The volume we started with. And how much water we added.

Setting each of these up, we can then model some equations on the calculations we'd done previously. The total alcohol is equal to the percentage strength multiplied by the starting

volume – or we could set it up so that the percentage is expressed as a percentage rather than a decimal.

Then the new volume is the original volume and whatever was added.

Then the new strength can be found by dividing through.

Something to note here, is that the algorithm simply mirrors the calculations we made earlier, but it doesn't necessarily require us to identify any algebraic relationship between the initial and final values. The solution, which is the model we develop, is a process that the computer can follow, matching our intuition and understanding of the problem. Later on we may use a model like this to further refine our solution and test any algebraic formulas we may find, or we can simply keep it as it is as a tool for solving similar problems.