[MUSIC PLAYING]

KAREN: Well, thank you very much, Charlotte, for coming to talk to me today. You're our next guest. And fortunately, you have the most complicated, in my opinion, sessions where we're going to be looking at ratios and all sorts of difficult things, square roots. But you've brought a bag of shopping in, which fills me with a sense that this might not be so difficult. And you might have a really wonderful way of explaining this to our guests.

So what you'll see now if you're in the Watch and Engage, and even if you've got the live stream running concurrently as well, you'll see that we're going to be showing lots of questions. And I would like to be able to use these within the session. So please, do fill them out if you can.

And Charlotte has designed a lot of puzzles that we're going to be looking through. But they're very, very simple, if you just pay attention. And I think that you'll hopefully guide us through the answers with all of those as well. Now, Charlotte, you're interesting because you like teaching people who are teaching maths, don't you?

CHARLOTTE: Yes.

KAREN: The student's no good?

CHARLOTTE: I like teaching students as well. No. I've been a secondary maths teacher, so I've taught lots of younger students. But now I'm working with people who would like to become teachers. So it's about breaking down topics and working out how to make them clear and understandable.

KAREN: Excellent.

CHARLOTTE: Yeah.

KAREN: Brilliant. It's always so interesting. Whilst we've got so many lecturers at the Open University, it's always very interesting to see what other work people are doing, which is often very exciting. And this is one as well. And you really love dachshunds, don't you, which I do, too.

Normally, we have our study buddies as well. So if you've got a study buddy at home and you'd like to send us a picture of your animal, who is your loyal companion as you're working

through all of your TMAs, then please do send us that. Studenthub@open.ac.uk is our email box. And our hashtag we're picking up the feed on Twitter is #studenthublive17.

OK. So we're going to take a look at ratio, proportion, and percentages. Now, why is this interesting then for students who are not studying maths?

CHARLOTTE: Well, percentages, ratio, and proportion kind of come into all kinds of parts of life. So for students who are doing any sort of social science, or anything where they want to write a convincing argument or show some facts, there are really easy and simple ways to make complicated data very accessible to a reader.

So the really useful way to show something for example, the proportion of students to a teacher. At the moment, the government recommend that there should be no more than 30 pupils for each teacher. So the ratio would be 1 to 30. And it's just a really clear way of showing statistics in reports. So really useful to both interpret. And also, to be able to produce documents.

KAREN: I mean, just thinking in some of my maternal duties, sharing out things appropriately for children who are very, very diligent at noticing if you don't give them an equal proportion and ratio of sweets, for example.

CHARLOTTE: We're going to do that soon.

KAREN: OK, excellent. So ratio is really quantity comparisons, isn't it? So comparing two things. And also, you sort of mentioned class number. So I guess that would relate to statistics. And that's something that in particular social science students are using a lot of, isn't it?

CHARLOTTE: Yeah, of course. I mean, obviously science students are going to use a lot of these kind of proportions as well. But it's just a very clear way to show a comparison of two things. So comparison of boys to girls, for example, studying maths is often looked at. Because in previous and hopefully now, we're a bit more even. But previously, it has been a more male-dominated subject. So ratios of boys to girls studying maths at university, for example, is a really interesting thing to look at.

KAREN: Yeah. I was talking to Susanne about comparing and transferring some of these things. Because often the numbers are the same. If you've got 1 to 30, it's just under a third or so. But it would obviously be more appropriate at some points to talk about a ratio if you looking at the

student number. It wouldn't be right to say, oh, there's a third of a teacher to every student. That just wouldn't really make sense. So sometimes, ratio will be more important. But it's also important to recognise when those can be translated into percentages. So would, I guess, your advice be to students to think about what's most appropriate in terms of how you numerically show that data, even if it might mean the same thing?

CHARLOTTE: Yeah, certainly. I mean, it's totally contextual. And you can often go between two different formats of ratio and proportion. But sometimes, it's just a little bit clearer to, for example, talk about the fraction, the proportion of a particular ingredient for example, in a drink than it is to try and think about parts like you would in a ratio.

KAREN: Excellent. OK. Well, let's take a look at some of these. And as you say, they're commonly used in everyday things. I see you've brought your shopping with you to have a look through. And we've got a lot of our students out there who are studying STEM. So 58%, which I guess is just under 2/3. I'm into my fractions, aren't I, at the moment looking at pizza. OK, so what's the first challenge that we have to look at? Are we going to do some sweet sharing?

CHARLOTTE: Yeah. So we'll look at some ratio to start with. So as you said, children and adults get very cross if things aren't fair, shared out fairly.

KAREN: Well, don't do that to HJ, because you should see how upset he can get if he doesn't get all of his sweets.

CHARLOTTE: Yeah. Well, it's fair enough, isn't it?

KAREN: Yeah.

CHARLOTTE: What I've got here is I've got I counted these because I like counting, being someone who likes maths. I've got 49 sweets here. And what I want to do is share them out in a ratio of 4 to 3. So it might be because there's more children in that class than that class. And I want to make sure they're sort of evenly shared out.

And so what you could do is think about having two separate piles or two bowls of sweets. And what that means is for every 4 that this bowl gets, this bowl gets 3. So what you could do, if you had time and you wanted to do it kind of in a simple way

KAREN: I imagine you would. Because you strike me as being quite thorough.

CHARLOTTE: You could put 4 in that bowl and you could put 3 in that bowl. And you could keep going, keep going, keep going. But obviously, if I've got quite a lot of sweets in here, it's going to take me quite a long time. So instead, I'm going to try and work out how many should go in each bowl by looking at that ratio.

So the first thing I'm going to look at is, well, I've got 4 parts essentially here. So for every 4 here, I've got 3 here. So all together, I'm looking at 4 and 3. I'm looking at 7 parts all together. And every time I put sweets in the bowls, I'm putting 7 parts.

KAREN: Yes.

CHARLOTTE: So what I'm going to do is instead of doing that bit by bit, I'm going to look at the total, which is 49. And see how many 7's will go into that. So luckily, 49 is a rather nice number.

KAREN: I was going to say, I wonder why you had 49, not 50 sweets. That is handy.

CHARLOTTE: If we had a number that wasn't divisible by 7, you'd have to make a decision as to whether you were going to split it into factions or whether you were going to take one away, depending on the context of the situation. But for now, we've got a nice calculation. So 7 times 7, which incidentally is a square number, but we might get time to talk about that later.

KAREN: Order.

CHARLOTTE: We know that we've got 7 times 7, which goes into 49. So that means that we're going to put 7 lots of these piles into each bowl. So this bowl has 4 for every time and this bowl has 3 for every time. So in the left-hand bowl, I'm going to do 4 times 7. And in the right bowl, I'm going to do 3 times 7. So I'm going to have 28 in the left bowl and I'm going to have 21 in the right bowl.

KAREN: Lovely. And we can check that that makes 49.

CHARLOTTE: And that's exactly what you do, yes. You should double check that it adds up.

KAREN: Good. And then, I guess it would be easier to do the 21. So you would just count 21, and then chuck the rest in.

CHARLOTTE: Yes, of course. Yeah. So you could evenly spread them out in that ratio.

KAREN: I see what you're doing there. That's made it really clear. And actually, that's quite useful.

Because just knowing how to do something like that could actually save you a lot of time. Because I do end up doing things like that in my everyday life and thinking about how I can allocate things. And that's a really nice, quick way of doing it.

Evaghn and HJ, did everyone get that?

EVAGHN: Yeah, I think everyone got that. People are saying they're not too confident, but they're happy to see that we're splitting food. So I think that will help the confidence. Domian says he gets 98% brain freeze after drinking a smoothie too fast. And Stewart says that his TMA's only 75% done. So I think everyone's just using the numbers to make sense of their lives.

KAREN: Brilliant. So are people studying and doing TMAs at the moment? Are some people from the October presentations already sort of working their way through?

HJ: I think so. We've got people doing criminology and psychology. That's what Janice is doing at the moment. Libby is doing psychology. And we've got people starting natural sciences. And Adele's doing art. So we've got a really nice mix of different students. Got level 1. [? Kelly's ?] doing level 1 sciences. So this will be a nice kickoff for the math side of that for her. But yes. So a very nice mix.

KAREN: Lovely. And it's really nice to see some familiar names coming up in the chat. And those of you who do come to the Student Hub Live, thank you. And thank you for welcoming the other students. It can be very nerve-wracking when you're first joining something like this. And I bet there are people out there who aren't sure what to type in the chat. And so it's really nice that you're there.

And Charlotte, you're really helping people. I mean, Elizabeth says now that the penny has dropped. And Kate said that it sounded like a very loud clang. So But this is making sense to a lot of people. So that's ratio that we've had to look at. And we can simplify ratio as well, can't we?

CHARLOTTE: Yeah. So what we've done first is sharing

KAREN: Even more.

CHARLOTTE: What we've done here is sharing in a ratio. And we can also take a ratio for example, we could take this ratio, 28 to 21. And we could go backwards and simplify it. So we're going to do an example of that.

KAREN: Tanya says she also gets it now. So thank you. This is going very well.

CHARLOTTE: OK. Well, I've brought in some ingredients for a drink that I quite like, which is basically elderflower fizz. So a bit of elderflower and a bit of fizzy water.

KAREN: And a lot more economical than buying it ready mixed.

CHARLOTTE: Exactly. So yeah. And that's one of the key things about understanding ratios and everything is to be able to get good bargains.

KAREN: Yes.

CHARLOTTE: Yeah. So what we've got here is I know that this whole bottle of cordial will mix perfectly with this whole bottle of sparkling water. At the right consistency, the right taste, and everything. So what I want to know is, if I just wanted to pour one glass, what the proportion and what the ratio is that I need to use? So what I'm going to do is simplify the ratio.

So this bottle here is 500 millilitres. And this bottle here is 2 litres. Now, there is a question on the widget, which is similar to this. So you might want to have a go after we've done this example.

So first thing I notice I don't know if you can notice anything that's different about those two numbers.

KAREN: Yeah. They're not the same. So millilitres is a different unit to litres.

CHARLOTTE: Exactly.

KAREN: I was paying attention earlier.

CHARLOTTE: Exactly. So that's really important to notice because at the moment, we can't really simplify them because they're not in the same unit. Exactly. So what we're going to do is try and change them so that they're the same.

So I'm going to keep because I don't want to go into decimals or anything, I'm going to keep it into millilitres. So I'm going to keep the left-hand side as it is.

KAREN: Because we always try and make things as easy as possible, don't we?

CHARLOTTE: Exactly. And 2 litres. Well, I know that there's 1,000 millilitres in a litre. So 2 litres will be 2,000.

OK. So now, I've got something. And I don't have to write millilitres here because they're both the same now. So I just know that it's a ratio of 500 to 2,000. They're in the same unit, so I can get rid of the units.

KAREN: So ratios don't have units?

CHARLOTTE: Yes, exactly. You can start with looking at units, but you want to try and get rid of them.

KAREN: It's important because some students try and be so thorough with things, and then they'll put things on. But actually, it can demonstrate you don't quite understand the principle.

CHARLOTTE: Yeah, exactly. And actually, getting them into the equivalent form can sometimes be a stumbling block. So just recognising that that's the first step is quite important. And now what I want to do is simplify.

Now, I might be able to know how many times 500 goes into 2,000. But if I can't spot that straightaway, I can do the simplifying in a couple of steps.

So the first thing I notice is that this is 500. It's got the 0's here. And This is 2,000. So I can definitely divide by 100. So I'm going to do that first, just because that's really obvious to me.

KAREN: Kate wants some elderflower fizz. Kate, we can't pour it down I think that was part of the problem a bit earlier, was soggy cables. So I'm afraid you'll have to get your own.

CHARLOTTE: Yeah. At least you'll know how to make it now in the right proportions.

KAREN: Because it never occurred to me, in all honesty, to do this. I always just think, oh, it's about that much. But clearly, I'm doing it wrong.

CHARLOTTE: You don't want it too sweet and you don't want it too you do want to taste it. OK.

So the first thing I did, I'm just going to write at this side just so we kind of keep track of it. So I divide it by 100. But I can see now I've got 5 to 20. That's still not simplified enough because I know that 5 and 20 have some common factors. 5 actually goes into 20. So I can divide by 5 as well. So 5 divided by 5 is 1, and 20 divided by 5 is 4.

Now, I can't simply 1 any further because I don't want to end up with fractions or decimals. Ratios should be using whole numbers. So I have finished. So I know now that for every 1 measurement and this is quite useful because it can be however you can use bottle tops or

you could use a particular glass. It doesn't have to be any particular size measure. But for every 1 measure of cordial, I'm going to have 4 measures of sparkling water. And then I'm finished.

KAREN: Perfect. So how would you pour that then in your glass? Would you just look at it?

CHARLOTTE: Well, as I said, you could because I don't necessarily want to be using a measuring jug every time I make a drink. But a lot of people I know either use bottle tops or you can use a little jug that you've got. Or whatever you've got to kind of just measure roughly that that's 1 lot and that's 4 lots.

KAREN: Perfect. So you sort of know the proportion. And that's how you know that, obviously, that looks a quarter of the size.

CHARLOTTE: Yes.

KAREN: Of that one. Excellent OK. So we asked people at home some questions on the widgets. And if you haven't had a chance to look at those, then please do fill those in as we're going through. All you do is select the item that you think applies to the correct answer, and then you can close the widget. And then you can also see what everyone else is saying as well.

CHARLOTTE: Great. And with that widget, the one that relates quite closely to this, just remember that idea about units. That's really helpful for that question.

KAREN: Yes. No, exactly. So what we're doing is we're making the units more appropriate and we're not displaying the actual number or the indication of that unit because we're looking at a ratio. So it's different to that. Excellent. OK. Well, we'll see how people got on with that as well.

We also wanted to look at this in terms of bargains. Because of course, size and things when we're in the supermarket is really important.

Now, they started displaying how much per mill things are. So when you're doing your shopping, you can start looking at things and saying, well, that's this much and that much and things. But it's quite tricky to work some of those things out. And even though you can look at those numbers, if you can't do the basic maths, there's more to it than that, isn't there? It's an important skill to have to work out which is best to buy.

CHARLOTTE: Definitely. And often, there's offers on. And they don't always change the per millilitre or per

grammes. Because I'm often in the supermarket and thinking, actually, is that still the same deal because now they've changed the price? And so it is worth actually knowing how to have a quick look.

KAREN: Should we see that ratio widget before we move on, Charlotte? And see what students said about that. So let's have a look and see if that's coming up on our screen in a second. So we'll see what the ratio of 1.5 to 10 centimetres is.

And 85% of them said it was 15 to 1. 92, even. So people are clicking on that as we're going. Was that right, Charlotte?

CHARLOTTE: Well, yeah. We can look at it. Do you want to go through the answer?

KAREN: Yes, let's go through this one.

CHARLOTTE: OK. So it was 1.5 metres to 10 centimetres, I believe, was the original question.

KAREN: Yep. 1.5 to 10 centimetres.

CHARLOTTE: Yes. Perfect. So the first step is as here, we need to get rid of the units. Because on first glance, you might think 1.5 to 10. OK, that's 15 to 100. But actually, it's not because here, this is metres and this is centimetres.

KAREN: So we need to do that.

CHARLOTTE: It's very important not to miss that detail. That's very important. So whenever there are units, you must look at them.

So the first thing we're going to do is again, we want to make it simple. So we're not going to start going into decimals. We're going to get rid of the decimals on this side. So 1.5 metres. 100 centimetres in 1 metre. So that's going to be 150 centimetres. And I'm not going to bother writing centimetres because this is already in centimetres.

KAREN: OK. Perfect.

CHARLOTTE: So now, hopefully you can see and this is a little bit easier than this one. We can simplify it in only one step. And I can see that 150 and 10 both divide by 10. So I end up with 15 to 1.

KAREN: Perfect.

CHARLOTTE: All those people

KAREN: So everyone's got it. Well done. Excellent. OK. So that's good. So this is a very self-explanatory way of doing things. And we've sort of covered that.

And this is really what happens in this Maths Help module is that you'll sort of be explained something, then get a few chances to do it. And that can sort of really increase your confidence because then you can think, well, yeah. I can do it. And I can apply those principles in a variety of different contexts.

Evaghn, how's it all going?

EVAGHN: Yeah. No, it's going well. With regards to the drinks question, Libby gave the answer quite a bit before the answer actually came up on the board. Kelly says she likes ratios, but only because it makes them sound so simple. I think that's kind of the key point here, just making sure that you simplify it. And also, if you could use something that you relate to in real life, like food or drink, yeah, it makes it a lot easier to understand, I think.

HJ: I think Davin as well has told us that CAD Academy is a great resource for maths. I've been on it myself. And it gives you lots of practical problems which you can run through and practise this type of thing, which is really great when you can see it all laid out in front of you and go through it as well.

And Stewart recommends an app called Wolfram Alpha. So sharing lots of helpful tools as well to help us with maths, which is very good. So thank you, Stewart and Davin.

EVAGHN: I think confidence is rising as well. Paula says she can't believe that she actually got the right answer.

CHARLOTTE: Great.

EVAGHN: So making sense.

KAREN: Oh, you're are a good teacher, Charlotte. See?

My old physics teacher said to me well, he was actually old. But he said anyone can understand anything. It's just how it's explained to you. And some people just vary in the length of time they take to get something. And I quite agree with that. It certainly worked for me. Right. Shall we move onto proportion now, Charlotte?

CHARLOTTE: Okey dokey. Yes. So proportion is basically very similar to ratio. It's just in terms of instead of writing it as a ratio, you write it like a fraction. So I know that you did a little bit of work on fractions earlier, so that's quite nice.

So for example, if I go back to the elderflower cordial, I had 1 to 4 as a ratio. If I wanted to say, what proportion of elderflower cordial that we're using, then I would look at, well, how much is it out of the total? So again, like we did with the sharing problem, you've got 1 part elderflower and you've got 4 parts of water. So that's all together 5 parts. So I can say that the proportion of elderflower is 1/5 and the proportion of fizzy water is 4/5. So it's basically turning ratios into a standalone figure. So you don't need to know what the other value is. You just need to know how much out of the total have you got.

KAREN: OK. Perfect. And when might this be appropriate to use for changing things around?

CHARLOTTE: Proportions are useful in a number of situations. Again, if you're only interested in one particular ingredient, you might want to know the proportion rather than the ratio. But they're quite interchangeable, to be honest. You can use both of them in lots and lots of situations. Like to do with mixing cement, to do with baking scones, to do with any sort of cookery or measuring, anything which you need to have a relationship.

KAREN: And I've often seen these in the social sciences used to describe statistics mental health statistics, et cetera. So people will often have 1 in 5. Because instead of saying there's a ratio of 1 to 4, if you think, well, there are 5 people in a room and 1 of them might have a mental health problem for example, it can make it a lot easier for people to conceptualise.

And also, it's a lot easier to conceptualise than saying 20% of people. So I guess all numbers and sort of ways of expressing them, even if the numbers the same, have their place and are more appropriate than others. So would you say then for some students, if they are looking at things like statistics. And for example, doing social sciences or STEM and they want to actually add some gravity to the argument, they might want to think about whether they're using a ratio or a proportion, or even a percentage. And think about how that would be expressed in terms of something that has significance not significance statistically, but significance in terms of the point they're trying to make.

CHARLOTTE: Certainly. I think that if you can get something into a proportion, into a simple fraction, like you say, it's much more understandable to kind of the general public and anyone who's reading it.

So where you don't want to use proportion is possibly when you've got quite a fiddly number. So 17.5% you might leave as a percentage.

But if it turns out to be 1/3 pretty exactly, then that's much clearer to everybody reading it. So it kind of depends on the context again, but it's definitely a really clear way to show something. And like you say, with mental health charities, they use those sort of and cancer, and all these kind of health data, it gets used quite a lot.

KAREN: My husband sometimes says I get things right out of proportion. But actually, I don't feel think that's possible. So I might take him through some of this. OK.

So we've talked about proportions and direct proportions, and how those can sort of change. And I guess that's quite useful if you're using recipes, isn't it? Or doubling up on things, if you sort of need to make a lot of cakes for something, like a Student Hub Live event, for example. So you can then use these proportions to multiply things by numbers of things so that you can get more, can't you? And I guess, is that a bit of an easier trick if you do need to change your quantities?

CHARLOTTE: Certainly if you can spot a relationship that you, like you say, double it, or triple it, or times it by even 2 and 1/2, then yeah, it makes everything much easier to calculate. So you mentioned direct proportion. That's basically when as one thing gets bigger, the other thing gets bigger. So there's a direct relationship.

KAREN: As you eat more cake, for example.

CHARLOTTE: That's not necessarily exactly direct. But yeah, there is a correlation I'd say in that case. But yeah, things like presuming that the price of an orange doesn't change. You don't get a multi-buy deal or anything, then the more oranges you buy, the price is going to go up at a steady rate. The price per orange.

It's similar with things like converting euros to pounds. And also, like you said, ingredients.

If I've caught 2 potatoes for 3 people, then if I need to have 6 people, I'm doubling it. Or if I'm having 5 people, I have to think about what proportion, what fraction I need to times it by to get the exact number of potatoes that I need.

KAREN: Mash them. But we'd had direct proportion. And there's also something called indirect proportion, isn't there?

CHARLOTTE: So indirect proportion is sort of the opposite. So it's when one thing increases and the other thing decreases. So for example, the hours of work needed. The more people you have in theory, if everybody's working at the same rate, then it should at the same proportion, it should decrease the amount of hours that it takes to do the job.

KAREN: More hands make light work.

CHARLOTTE: Exactly.

KAREN: OK. So we can see that those proportions go up and down. And that these ratios are sort of a fundamentalist part of that. But these also, as I sort of intimated before, can be the same thing as percentages. Although, percentages are something entirely different.

So we can say 1/5 or 4/5 could be, for example, 80% of something. So percentages are quite a different way of doing things.

What did you want to talk about in terms of how non-math students might use these? I think percentages is perhaps one of the most interesting things for non-math students. And something that comes up a lot.

CHARLOTTE: Yeah. I mean, percentages like ratio and proportion come up in everyday life.

So if you're looking at some food packets, you get proportion you get percentages, sorry, of fat, fibre, protein, all those kinds of things. And it's worth understanding what that actually means.

KAREN: Can we see one of them?

CHARLOTTE: Yeah, sure. So I've got some oats. I was going to look at best bargains for different types of oats.

We've got here some proportions. We've got some percentages of

KAREN: So we can see here

CHARLOTTE: sugar and fat and things.

KAREN: Now, these are quite common, actually. And again, about food labelling. You've often got consistencies in terms of how we measure things. So we've got the energy, the fat, the sugars,

and saturated fat, et cetera, all on here. And those are on the same. And I assume that the quantities are the same in terms of the number of fat and calories, et cetera, even though the bag's bigger.

CHARLOTTE: Yes, I would assume so as well.

KAREN: Well, you should check that. Because like I find with those clementines, they're not always the same.

CHARLOTTE: No. Well, we can have a look at an example, perhaps. So I've got here some wine gums, which obviously you'd expect to have some sugar in. So we can have a look at kind of how much sugar they actually have in them.

KAREN: Oh my goodness.

CHARLOTTE: So I've got here a bag of 250 grammes of sweets, wine gums. And it says on there and like you say, most of the time, they do list what they've got in them. But we can work it out for ourselves. 17 and 1/2% sugar.

So what we want to do is try and work out, well, what is that in terms of grammes in the whole packet of sweets? Usually, they give you sometimes the figures for 100 grammes. But if you've got a bag of crisps that's actually 200 grammes, sometimes you look at it and think, oh, it's got that much fat in it.

KAREN: Yes. Having to be a lot stricter with some of this. Because now, often you'll have the number of grammes per bar, for example, and per percentage. But not always. Yeah, OK. So with these super things, we've got 17% sugar, which is a lot.

CHARLOTTE: So we can work out how many grammes that is per bag. So as you said, percentage is a bit like a proportion. But it's a proportion out of 100%. So percent, which anyone who has done French or anything, might recognise that little bit meaning 100. So we know that out of every 100 parts, or grammes, or whatever, 17 are sugar. So we can calculate how much exactly is in 250 grammes.

KAREN: OK.

CHARLOTTE: So there's a couple of ways of doing this. We can use this fraction to help us. So the simplest way to do it is to find out what 1% is, and then multiply up to 17. So to find out what 1% of 250

grammes is, we just need to divide by 100. OK. So because this represents a whole, this represents 100%. So 250 divided by 100. It's going to give you a 2.5.

KAREN: Yeah. Or we could just move the decimal place, can't we? That clever little trick.

CHARLOTTE: It's all to do with place value, yeah. So I know you looked at some hundreds earlier. So yeah, it's all to do with place value. Exactly. Dividing by 100, which is quite a nice thing about percentages, is quite straightforward. So it's quite nice.

KAREN: Libby has got an answer already, but I won't tell you what it is. She's probably got a calculator. Who's got the calculator out there? I suppose it's not cheating if you're doing maths.

CHARLOTTE: To be honest, when you're doing percentages, most of the time it is sensible to use a calculator. Because a lot of them 17. Or it might be something like 19.5 or 19.52, or something. It's fine to use a calculator in those situations.

So maybe we can see what answer Libby's got. But what we would do as the second step so this is worth 1%. So I'll label that. This is worth 1%. And what we want is 17%. So we're going to take that 1%, 2.5. And we're going to multiply it by 17. And we're going to get our total answer. So this might be something you might want to use a calculator for. We can break it down. 2 times 17.

KAREN: 34.

CHARLOTTE: 34. We can maybe do little calculations over here. And 0.5 times 17 is half, which would be 8 and 1/2. Because half of 16 is 8. And it's halfway between. So then we've got our answer, which is 42.5.

KAREN: Well done, Libby and Kate.

CHARLOTTE: Yay. So well done you two.

KAREN: Excellent. Two ticks.

CHARLOTTE: Sorry One each.

KAREN: OK, excellent.

CHARLOTTE: So we can work out a percentage of an amount. And we can also go the other way. So we can say if we have an amount, we can work up what the percentage is.

KAREN: Yeah. So are you saying like when they say like 25% off discount or something like that?

CHARLOTTE: Well, that's another thing. That would still be calculating a percentage, but that would be a decrease or an increase.

KAREN: A decrease of a percentage. OK, brilliant. I'd like to cover some of those because we're running out of time as we always do. These things go so quickly and it's so complicated.

But often in shops when you do have those decreases, they're something that you want to work out. Because often, whilst these are marked clearly on food packaging. Because we have to sometimes where they say 25% off, it's quite difficult to sort of get to grips with that as well. Can you give us a quick way of doing that?

CHARLOTTE: Yeah of course. So it depends on the number, for example.

So a few tricks is that every time it says 50%, which you all know, that's half price. 25% off. Well, there's two ways you can do it. You can work on a quarter of the total price, because that's what 25% is equal to, and subtract it.

Or you could straightaway work out, well, if it's 25% off, then that means I'm paying 75%. So there's kind of a couple of different ways that you can approach it.

KAREN: And it's good to be able to do that heuristically, I think. And something we can often sort of work out, even if we're sort of just guesstimating. But what I find harder is where they say, like on a bottle of dish-washing liquid or something. You know, 25% extra free. Because that's increasing something, but it's not quite the same, is it?

CHARLOTTE: No. Quite often with packages, they don't necessarily tell you how much it was originally. So you can't kind of go backwards. But in terms of working out an increase, so let's take an example of, say let me see. What should we use?

We can use the oats. So say we've got here 500 grammes of oats. And it says 25% extra free. Normally, it's 500 grammes. Then, what you can do is work out what 25% of 500 is and add it on. So in the same way as before, you can do 500 divided by 100. And times that by your 25. And you can add it on. There are other ways of doing it, which are

KAREN: I was just about to say, it's interesting. Because I would have sort of worked out what 25% of 500 was. So I would have gone 500 divided by 4 equals 125.

One of the things that my students used to really worry about in particular, science students started very early on, is there a right or wrong way of doing this? If we both get to the same answer, is there a better or worse way of thinking about these things?

CHARLOTTE: I think it all depends on the question. So 25%. I showed you the kind of longer way in this sense just because then you can apply it to any other percentage. 13%, something like that. But 25% we know is a quarter. So when you're trying to work things out quickly, obviously it's a lot easier to do it by dividing by 4.

But if you find it easier to do it this way, that's perfectly fine.

KAREN: But it's good, I guess, to know both ways. Because like you say, if it gets more complicated, you might think actually working it out that way is not going to work. So I need to actually do it the more sensible, long-winded way so that you can then convert things appropriately.

CHARLOTTE: There are lots of other ways which are included in the Maths Help module. So you can also think about the fact that if you've got 25% extra, than what you've actually got is 125%/ so you could actually calculate, what's 125% of 500? And so you could do it in one step. And that's a little bit quicker. It's maybe a little bit harder to understand to start with. But if you can find 25%, you can find 125% exactly the same way. You would just take the 5 and times it by 125. So it will give you the same answer.

KAREN: So let's check whether everyone at home has got this. Because we've got a widget about the price of a handbag. And it's called, what is the percentage discount? And the question is, if a handbag is priced at 200 pounds and it's sold at 160 pounds, what then is the percentage discount? And your choices are 40%, 25%, 20%, and 22%. So vote now using the widget. Select which you think is the correct answer. And then you can close that and see what everyone else thinks. And let's see if you got it right.

And if you can't do that or you don't want to, you can type in the chat as well. So let's see, this handbag then. How do we work this out?

CHARLOTTE: It would be good to go through this one because this one's slightly different to the other examples we've done. Because we're talking here about discount. And we're trying to work out, which we haven't done yet, actually what the percentage is from the amount rather than calculating the percentage.

KAREN: Of the amount, yes.

CHARLOTTE: So what we need to do, first of all, well, it's a discount. And it's asking, what's the percentage discount? So first of all, we just need to know what the discount is in pounds. So I can see that it was 200 pounds and it's now 160 pounds. So the discount is 40 pounds.

KAREN: Right, 40 pounds.

CHARLOTTE: So I know I've got a discount of 40 pounds. But I need to turn that into a percentage. So this links quite closely actually with proportion in a way, because we're looking at fractions. And it links to what you were doing earlier with Susanne.

We've got 40% off and we want to know, what percentage of the original amount have I had as a discount? So I can turn that into a fraction. So I've got 40 pounds off. Divided by 200. So divided by is sort of another way of saying out of, which is how it links to proportion. So 40 pounds out of the original 200 pounds that it was going to cost.

And then, because I want to make it into a percentage this is going to give me a decimal. I'm going to multiply by 100 because I want it out of percent. So I don't know if anybody's managed to have a go at working that out yet.

KAREN: I don't know. Let's see. Evaghn, has anybody put an answer in?

EVAGHN: Kate's got 20%.

KAREN: OK, fabulous. Anyone else?

EVAGHN: Not currently, no.

KAREN: No? OK.

EVAGHN: I think the widgets are

[INTERPOSING VOICES]

KAREN: OK, well, so far the widget is 86% of people saying 20%.

CHARLOTTE: Fab. So yeah. So obviously, I haven't finished it off, but you've managed to do that, which is brilliant. What I would do to make things easier is start doing some cancelling. So I can see this. This is dividing by a 100 and this is timesing by 100. So I would just get rid of those. And

then I've ended up with 40 divided by 2, which gives me my 20%.

KAREN: Perfect.

CHARLOTTE: So to break down what I did, instead of dividing by 200, which would give me a decimal, and then multiplying by 100, I know that these will cancel out. This is a divide by 100 and this is times by 100. So I've got rid to them. Made my life easier.

KAREN: I'm clearly not a maths person. I would have lopped off those two, and then gone 40 out of 20.

CHARLOTTE: Well, that's fine as well.

KAREN: And then made that into 1 out of 5. Just transferred it. This is a problem with being a psychologist, I think.

CHARLOTTE: No, not at all. That's a perfectly good way to do it. To be honest, mathematicians are notoriously lazy in trying to find quick ways. So if I can see something that cancels quickly, I'll do it. But there's lots and lots of ways to do it. So your way's good as well.

KAREN: OK, brilliant. Now, Charlotte, we're running out of time, as we do with every single session. And I know that you've prepared something for squares. Can we do it in one minute, or do you think we should leave the students to do that at home? What would you prefer?

CHARLOTTE: I think we can just talk about what squares are, perhaps. Because it's kind of a big topic in a sense to try and squish into a few minutes.

KAREN: We all know they're part of that flapjack, aren't they?

CHARLOTTE: Well, yeah. Exactly. So squares a lot of people sort of wonder, what's the point of square numbers and cube numbers and powers in real life?

KAREN: What is the point?

CHARLOTTE: And what will we use them for? Well, it depends on there's lots of different answers to that question.

If you're ever going to do we had lots of STEM students listening. If you're going to do any calculations with like moles and things with chemistry, you're going to be using scientific notation. You're going to be using things like times 10 to the power of whatever. So that's a power.

And equally, if you're going to be looking if anyone does anything like microbiology, you're going to be looking at very, very small numbers. So you might look at something like times 10 to the minus something. And that's going to help you with very, very, very small numbers. So the scientists will certainly use powers and this sort of notation.

In kind of everyday life, we use squares in all sorts of things. So for example, I'm sure when this was constructed, we've got lots of different areas. And we've got lots of different bits of materials that are going to be using squares in them.

If you were calculating anything to do with your carpet or your tiles, or anything

KAREN: It's really important when you go to a carpet shop. And you think, well, how big is my actual lounge? And then you sort of it's one of those things where you need to work out a price quite quickly. I struggle with that.

CHARLOTTE: It's all in square numbers. And then if you go into anything 3D, you're going to be looking at cubes. Metres cubed and things like that.

KAREN: So how might you work that out then, if we were sort of looking at carpets? What's the quick way of doing it? Is it literally a 4 by 3, 4 times 3 type deal?

CHARLOTTE: Yeah. I mean, that's looking more at area, I suppose. But essentially, squares are just numbers which are times by themselves.

So if we just take some basic examples. 6 squared is just 6 times 6, which is 36. And some of you may know all of your sort of square numbers from the whole numbers. But you can also do things like 1/2 squared. I've put a bracket on there just to show that the whole fraction is squared. And again, that's just 1/2 times 1/2.

And I'm not sure if you did multiplying fractions earlier, but this is something you might want to work on at home. But with fractions when you multiply them, you just multiply the numerators and the denominators. So you can do square numbers with fractions.

KAREN: So it's getting smaller here when you're squaring it.

CHARLOTTE: That's an interesting comment that you've made. So one of the questions that I posed for the widgets was whether the square numbers always get bigger. And when you've got whole numbers, because you're multiplying, even if it's something like 5.2, you're always going to get

a bigger number. You're multiplying by 5.2, it's going to get 5.2 times bigger. Even with negative numbers actually, if you multiply a negative number by itself

KAREN: So let's ask this then for the question with the negative numbers. Because the widget says, is it true or false? So with negative numbers, what's the question then?

CHARLOTTE: So the question is, when you square any number, is the answer always bigger? And if we're going in the comment box, it would be nice to have some examples. If it's not always true, when is it not true? When does squaring a number make it smaller? Or what happens with negative numbers when you square them? What happens with decimals? What happens with fractions? They would all be good things for us to

KAREN: Find out about.

CHARLOTTE: Yeah.

KAREN: OK. Well, the widget balance is swinging at the moment. So let's hope it steadies up soon.

CHARLOTTE: Well, I sort of expected it to. I thought it's quite an interesting thing to talk about. So I'd quite like to hear some comments about why people have chosen either answer.

KAREN: OK. Would you like to see where we'll settle on it for now? Let's see what people said.

OK. All right, it's in the middle. OK. So we've got slightly more saying it's false and slightly less saying it's true. So what is right then?

CHARLOTTE: Well, you kind of gave a bit of an example there, which is that when you get a fraction, you're multiplying by something less than 1, then you're making something smaller.

If I half something, I'm making it smaller. So if I times something by a half, that's the same as halving something.

So if we take this example here, 1/3 times 1/3. Well, what I'm doing to the original number, because that's the question, is I'm multiplying it by a third. And a third means basically the same as dividing by 3.

KAREN: Libby and Nora both say that fractions get smaller when you multiply them.

CHARLOTTE: They are exactly right. That's exactly true. Well, it is true for fractions. Although, actually if you

have a fraction that's bigger than 1, then it's not true. But they are right that it's anything that's smaller than 1.

KAREN: Because we often think of fractions as being less than 1, don't we? But actually, that's a good point.

CHARLOTTE: Yeah. We have these improper fractions where you've got the numerator larger. And in that case, it is actually bigger than 1.

For example, here you're multiplying by 1 and 1/2. So you are still making it bigger. But they're very correct in saying that a fraction that's smaller than 1 will, indeed, get smaller.

What about negative numbers? What do you think might happen with negative numbers?

KAREN: So minus 2 squared. So you're going minus 2 times minus 2. And when you minus a minus, you're getting a positive, aren't you?

CHARLOTTE: Correct. So even negative numbers, if they're bigger than 1

KAREN: There's a way around it. They can be positive, too.

CHARLOTTE: Yes. Even negative numbers, if you square them, then they will give you a positive a larger number. Unless of course, they're a negative very small fraction.

KAREN: Excellent. Well, Charlotte, thank you so much for covering all that. We've got through a lot of content. And I think it's fair to say you've made it a lot easier for people. And there's certainly been some pennies dropping. So thank you so much for coming along today with your bag of groceries and showing us all of these various tricks. Elderflower cordial. I do crave an elderflower cordial right now. But thank you very much, Charlotte Webb, for coming on.

HJ and Evaghn, before I introduce our next guest, how's everything going?

EVAGHN: Yeah, everything's going well.

KAREN: Are people tired of doing the maths yet? Is there brain fatigue?

EVAGHN: Yeah.

KAREN: What percentage are we feeling?

EVAGHN: For me, a little bit. I think it's nice to see that everyone's kind of generally getting the correct

answers. And if not, people are helping them out to understand it. I think it also helps if you add stories. So when you're talking about drinks or you're talking about food, or you try and apply it to everyday life, that helps as well.

HJ: When we were talking about proportions, Stewart was applying it to everyday life. Because he says as long as he gets the biggest proportion, he's happy when it comes to cake. So I agree with that one. And yeah, it's nice to see people gaining confidence. Kate was confident using proportions as well. And Paula said earlier that the penny was slowly dropping. So hopefully, it would have fully dropped now. Let us know. Or, if there's anything that you need help with I'm going to be asking our mathematicians later for some more help on this, perhaps at home.

EVAGHN: Yeah, it's going well. And Kelly says she's eaten 100% of her Monster Munch. She's just been concentrating so hard.

[MUSIC PLAYING]