

Course 6, Lesson 1: Symbols for Advanced Math, Part 1

SPEAKER: Welcome to Nemeth Code Symbols Used in High School and Strategies for Supporting Math Learning. This is Lesson 1: Symbols for Advanced Math, and this is Part 1. There's a lot of symbols for advanced math at this level.

Slide 2 has the objectives. You are going to be able to read and write problems containing vertical bars-- these are what we use in absolute value, set notation; brackets and braces-- for example, with functions and interval notation: the infinity symbol; the hollow dot; and angle brackets. You're going to be able to read and write math word problems that require the use of the opening Nemeth Code indicator, the Nemeth Code terminator, and the single-word switch indicator.

Let's get started on slide 3 with absolute value, and this is a review if you've taken our previous courses. So remember, absolute value takes two cells. It's dot 1-2-5-6 which starts our absolute value, then we'll have a number inside before we have dots 1-2-5-6 which closes out our absolute value.

It's important to remember that we do not use the numeric indicator when we have either a positive or a negative number that is absolute value. So I have some examples here to show you. The first one is the absolute value of negative 8. So you see I start with the vertical bar, dots 1-2-5-6, my negative, which is dots 3-6, my 8, and another vertical bar dots 1-2-5-6.

The second example is also negative, but notice where the negative is placed. It's outside of the absolute value. So this is read negative absolute value of 4. So I'm going to begin with my negative sign, dots 3-6, my vertical bar, dots 1-2-5-6, 4, dots 1-2-5-6 for that second vertical bar. So notice the way these two are read differently based on where the negative sign is placed.

Let's look at the third example, 3 plus the absolute value of x. So I'm going to begin with my numeric indicator 3, my plus sign, my vertical bar dots 1-2-5-6, the letter x, and then dots 1-2-5-6 for my second vertical bar.

Wow. We have a lot of great examples here. Let's look at the fourth one. We've got absolute value of 3x minus 6 close absolute value. So I'm going to begin with that vertical bar 1-2-5-6, 3x minus 6. Then the second vertical bar that closes us, 1-2-5-6.

Let's look at how we would use the absolute value if we had a math problem. So we are going to see how we use our opening Nemeth Code indicator and our Nemeth terminator. So my problem here is problem 28 is negative absolute value of negative 7 positive question mark.

So what I'm going to do here is, I'm going to do numeric indicator 28 period is. I'm in UEB, folks. I need to be able to start my Nemeth. So going to use my opening Nemeth indicator, 4-5-6 1-4-6, then my negative sign dots 3-6, my vertical bar 1-2-5-6, my negative 7, my vertical bar. And now I need to go out of Nemeth

Code with my Nemeth terminator dots 4-5-6 1-5-6. I'm back in UEB, so I have the word positive, and I have a question mark.

Now let's go on to slide 4 and look at some more uses of the vertical bar. And I can't stress enough, folks. At this high school level, this advanced math level, it's really, really important that you're working with the math teacher and that you're looking at the content that your student is learning about and examples from their books so that you make sure that you're reading these expressions properly because there's more than one way that they can be read. So I want to make this really clear.

So I'm going to give you some examples of ways that the vertical bar is potentially being read, and in the examples we're going to go over here with our friend the vertical bar, which again is dots 1-2-5-6. And I'm not going to keep reading you the dot numbers.

But if I have the letter enclosed within two vertical bars, it could be read "the magnitude of". So in my example here, I have my opening vertical bar, V, my closing vertical bar, and this could be read "magnitude of v". In my second example, I have two vertical bars, a letter, and two vertical bars. And so this could be read as "the norm of". So in my example, I have the norm of f, two vertical bars, lowercase f, two vertical bars.

Now when we get to the determinant of a matrix, if I have a capital letter enclosed in single vertical bars, this could be read as determinant of matrix. In my example here, I'm using a capital A. So vertical bar, capital A, vertical bar could be read as the determinant of matrix A.

Two more examples for us to go through here. This is really getting fun. I have the example, the determinant of matrix C equals negative 8. How do I write that in braille? Vertical bar, capital C, vertical bar, space, equal sign, space, negative 8. And this could be read as the determinant of matrix C equals negative 8. An example where it could be read as norm, would be the norm of g minus h. So two vertical bars, g minus h, and two vertical bars.

Let's move on to slide 5 and talk about more uses of the vertical bar. Now that vertical bar again, is dots 1-2-5-6. When we're doing set notation, we read that vertical bar as "such that." Now it's really important when we're doing set notation that we leave a space before and after the vertical bar when we're in Nemeth Code.

Before I go over the two examples, I do want to point out that when we're doing set notation, we're using braces. Braces are grouping symbols. So the opening brace is dots 4-6 1-2-3-5-6, and the closing brace is dots 4-6 2-3-4-5-6. So braces are a sign of grouping.

So let me show you my first example: the set of all x such that x is less than 2. Opening brace x, space, put my vertical bar that is going to be read as "such that," space, x, space, less than, space, 2, and then my closing brace.

My second example is read: the set of all x such that x is greater than or equal to zero. Same process. I'm going to begin with my opening brace, x , space, vertical bar, space, x , and then I have my "is greater than or equal to" comparison sign. If you're not familiar with that, that's dots 4-6, dot 2, dots 1-5-6, space, then my zero and then my closing brace.

Let's go on to slide 6. I want to talk about the symbols that are used in function notation and interval notation. So we have that opening parentheses, dots 1-2-3-5-6, the closing right parentheses-- you can say closing or you can say right-- is dots 2-3-4-5-6. My opening bracket-- you could also say left bracket-- dot 4, 1-2-3-5-6. My closing bracket-- or again, you could say right bracket, dot 4, 2-3-4-5-6.

Now a new symbol is the infinity symbol. Takes two cells, folks. That's dot 6, 1-2-3-4-5-6. And you could also make an infinity symbol negative. So my negative infinity symbol -- very easy. Add that dot 3-6, that negative sign in front of the infinity symbol. So it takes three cells 3-6, dot 6, 1-2-3-4-5-6. So we're going to use these six symbols when we're writing function notation and interval notation.

Let's go on to slide 7 and talk about the expanded use of grouping symbols. First, let's look at two examples of function notation. In the first example, I have f of x . So to braille that, it's going to be the letter f , my opening parentheses, 1-2-3-5-6, the letter x , my close parentheses 2-3-4-5-6.

My second example is f of x equals 2, open parentheses, x minus 7, close parentheses. So I'm going to braille f of x the exact same way. f , open parentheses, x , close parentheses, space, my equals sign, space, and then I'm going to do numeric indicator 2-- I'm going to use those open parentheses for x minus 7-- and that closing parentheses.

Now folks, we're going to talk about interval notation, and with interval notation our students are looking at a number line. And there are two symbols that we use with interval notation and a number line. One is an open circle that means that it doesn't include that number, and one is a closed circle, which means it does include that number. So it's important that your student understands closed circles and open circles, and this is why we need to get with our math teacher so much.

When we're braille for the student, we're going to indicate an open with a parentheses and a closed with a bracket. My first example is open interval, and this does not include the endpoints-- in this case, negative 3 and 1. So what I'm going to braille is open parentheses, negative 3, comma, space, 1 close parentheses.

Let's look at the closed interval example where the endpoints of negative 3 and 1 are included. So you'll see because those are closed circles on the number line, I'm going to use my brackets. So I have open bracket, negative 3, comma, space, 1, closed bracket.

Now what happens if I have one open and one close circle? We call that half open or half closed intervals. Isn't that great? Very handy in the labeling. This means I get to mix and match my parentheses and my bracket based on which endpoint on the number line is open or close.

So in my first example, I have the open circle above the negative 1 and the close circle above the 3. So to braille this I'm going to open parentheses, negative 1, comma, space, 3, and then my closed bracket. Let's look at my second example. This one uses infinity. Remember to braille infinity, it's dot 6, and then the full cell dots 1-2-3-4-5-6.

So for this example, I have a closed point above the two, and then it just goes and goes and goes for infinity, so that would be open. So I'm going to braille open bracket, 2, comma, space, infinity symbol, closed parentheses.

Let's go ahead and go on to slide 8, and it's your turn my friends. We're going to do activity 1A. I want you to braille the five problems that you have on the slide. When you're ready, I want you to come back and check your work.

Alright. Slide 9 is the answer key for activity 1A. Ensure that you brailled all your vertical bars, your brackets, your braces, your parentheses, everything properly. And when you're ready, we can go on to slide 10.

Slide 10 has us back with the hollow dot. Remember, it takes two cells to braille a hollow dot-- dots 4-6 and dots 1-6. The hollow dot is used for degrees and for composite functions, so you should be real familiar with how to braille 90 degrees, for example. So numeric indicator 90, superscript indicator dots 4-5, then my hollow dot dots 4-6, and dots 1-6.

Now when I am going to be reading a function, I'm going to say "of" when I reach the hollow dot or an open parentheses. So I have several examples here for you. So let's take a look at them. My first one is f of g of h. So I have the letter f, hollow dot 4-6 1-6, g, hollow dot again 4-6 1-6, h. There's no spaces when I'm brailing f of g of h.

Let's look at another example. This time I'm going to be using parentheses, and I'm going to have g of f of x. So to braille g of f of x, I'm going to do my open parentheses, dots 1-2-3-5-6 g, my hollow dot 4-6 1-6, f, my close parentheses, 2-3-4-5-6, right away opening parentheses, 1-2-3-5-6, x, close parentheses, 2-3-4-5-6.

Folks, let's look at this last example here on slide 10. And I want to point out that it sounds the same on both sides of the equality, but the use of the hollow dot and the parentheses are different. So they look different, but they sound the same. So I have f of g of x equals f of g of x. But let's take a look carefully at these two sides. Open parentheses, f, hollow dot, g, close parentheses, and then I open parentheses again, x, close parentheses, space equals space.

Now I have f open parentheses g. I'm going to open a parentheses again for my x, and now I have to close the parentheses for the x, and then I have to close the parentheses for of g of x. So that's why you're seeing those two parentheses at the end.

Let's go on to slide 11, and let's look at angle brackets. Angle brackets are another grouping symbol, so my left or my opening angle bracket is 4-6 4-6 1-2-3-5-6, and my right or my closing angle bracket is 4-6 4-6 2-3-4-5-6. So my first example is read open angle bracket, x, comma, y, close angle bracket. So I'm going to do 4-6 4-6 1-2-3-5-6 for my open angle bracket, x, comma y, and then that close angle bracket 4-6 4-6 2-3-4-5-6.

Let's look at our next example, we're going to get to see that hollow dot come back in a degree sign. I have open angle bracket 5, comma, 45 degrees, closed angle bracket. So I'm going to begin with that open angle bracket, 4-6 4-6 1-2-3-5-6, 5, comma, 45, then I'm going to have a degree sign here. So I'm going to do dots 4-5 for my superscript indicator 4-6 1-6 for my hollow. Because I have an exponent in my hollow being a degree sign, I'm up in the air. I'm away from baseline. So folks, I need to put that dot 5 in before I do my closing angle bracket of dots 4-6 4-6 2-3-4-5-6.

Now my third example is b equals open angle bracket 3, comma negative 5, close angle bracket. So I'm going to begin with my letter v, space, equal sign, space, open angle bracket 4-6 4-6 1-2-3-5-6, 3, comma, space, negative 5, then I'm going to close my angle bracket with 4-6 4-6 2-3-4-5-6. Wow. That's a lot of angle brackets, isn't it?

Let's look at that last example here. Capital A equals open angle bracket x sub 1, comma, y sub 1 close angle bracket. So I'm going to do capital A, space, equals, space-- open that angle bracket, folks-- 4-6 4-6 1-2-3-5-6 x sub 1-- so that's just putting the number 1, comma, space, y-- going to do that sub 1. So it's the letter y followed by a 1, and then I'm going to close my angle bracket 4-6 4-6 2-3-4-5-6.

Slide 12, it's time to review the opening and closing Nemeth indicators, and we have worked with these already in this lesson. But let's review that the opening Nemeth indicator is dots 4-5-6 1-4-6, and the closing or Nemeth terminator is dots 4-5-6 1-5-6. So we open with dots 4-5-6 1-4-6, and we terminate or end with dots 4-5-6 1-5-6.

Now you can put the opening Nemeth indicator at the end of a line of literary text or on its own line. How do you decide? I highly recommend that you look at the materials that your student already has, especially if they have a math book, but the most important thing is that you're consistent in the document that you're preparing. So once you make a decision in that document, stick with that decision for the whole document. The Nemeth Code terminator can also be placed after the math it ends, or on its own line.

Let's go on to slide 13 and talk about single words that occur in Nemeth Code within UEB context. We have an indicator that is two cells, dot 6 dot 3, that we use with a single word. So that we avoid switching in and out of Nemeth Code for just one little word. You braille the word UEB, and even if a word does not have a contraction in it, you still must use the single word switch indicator. You don't have a choice. You have to use the single word switch indicator if you have one word that is in Nemeth. We're doing math stuff, and we have one word.

So we have for example watch the plus and minus signs explanation point, because this is important. So I begin with watch at the plus sign. So I need to do opening Nemeth indicator 4-5-6 1-4-6, space, plus-- I need to do the and. So I'm going to do dot 6 dot 3, my single word switch indicator. I'm going to braille and in contracted form, space, my minus sign, which is dots 3-6, space and then dots 4-5-6 1-4-6 my Nemeth terminator. I'm back in UEB, and I can braille the word signs explanation point. So notice that's how I started Nemeth, then I had that one word "and" so I use my single word switch indicator, and then I closed Nemeth.

On slide 14, We're going to talk a little bit more about the Nemeth indicators. So as I said when you are making that decision about where to place them, that consistency is so important and also clarity for the braille reader. What's going to make the most sense so that they understand that Nemeth has started and Nemeth has stopped?

If your math material and its switch indicators will fit on one braille line with the current margins you have, whether you're using 32 or you're using 40, this is what we want you to do. This is the preferred layout. When at all possible get those opening Nemeth indicator, and that terminating Nemeth indicator, and that math stuff in between, all on the same line.

Now we recognize, especially at the higher levels, that it may not be possible to get everything on one line. So your priority is to not divide the math expression. So you really want to look at, OK, what can I do so I can keep this math expression all together. So know only one code switch indicator is going to fit on a line with a math expression. It could be the opening, or it could be the terminator. Really look at what is going to be the most clear for the braille reader so that they know that they're still in Nemeth Code, that they're still in math.

Now folks we're going to go on to slide 15, and I have examples of switch indicators. Now I'm using a short line for the purposes of illustrating with my example how I make my decision when I cannot get all of my math on one line with my switch indicators.

So first off, let's see what you can remember about how to read this problem. OK. So I have the interval of open bracket, negative 4, comma 1.5, close bracket, is all the numbers between negative 4 and 1.5, comma, including negative 4 and 1.5, period. It could also be written as set of all x such that negative 4 is less than or equal to x , which is less than or equal to 1.5, period. Woo. That was a lot for me to get out. Now the first thing I would do if I'm brailleing this and this is not something that is coming out of my fingers really comfortably, is I would make a decision on where am I in Nemeth and where am I in UEB. So the interval, that's going to be in UEB, but then I need to go into Nemeth to do open bracket, negative 4, comma, 1.5, close bracket, and back into UEB I go is all the numbers between.

Now I've got with my negative 4. I'm going to need to open up Nemeth, and do my negative 4. Gosh, I got a word in there. I need my one word switch indicator for the "and". And then I'm going to still be in Nemeth, 1.5. Oh my gosh. Got the word "including" in there. So, again, one word switch indicator, my

single word switch indicator negative 4. Got another "and", so I'm going to use that single word switch indicator, 1.5. And then I'm going to go ahead and close Nemeth with my period.

And then I have it could also be written as, but then I go back into Nemeth for the rest of what I have to write here, that expression, set of all x such that negative 4 is less than or equal to x , which is less than and equal to 1.5. Then I go back into UEB for the period. So it's really important that we think about where do we need our switch indicators before we even go to braille?

Now I have it brailled out for you. Again, I've used a short line because I want to illustrate how I made my decision. So I'm going to start out with the interval, open Nemeth indicator, then I'm going to have my open bracket, negative 4, comma, space, 1.5, closed bracket, Nemeth terminator. No problem. That all fit on one line. I can actually get my word "is" in there. Great.

Then I go with all the numbers between. Now I look and I realize, there is no way I'm going to get everything on one line because I have a lot more to braille here. So I'm going to go ahead and open Nemeth, I'm going to do my negative 4, my one word comes up so I need my single word switch indicator for "and" dot 6 dot 3, contracted and, 1.5, comma.

Since I have kept my Nemeth together, but I'm getting ready to do a word, this is a great spot for me to go ahead and go to the next line, do my single word switch indicator for "including", then I've got my negative 4. I've got to do another single word switch for "and", my 1.5, and now I'm going out of Nemeth, so I'm going to do my Nemeth terminator and my period.

So I go to my second paragraph, and I'm already in UEB, so I'm going to braille, it could also be written "as". Now folks, I could right now go ahead and open Nemeth Code, but I'm looking at my expression that I have to braille, and I can get that all on one line. So even though I'm leaving some space after the word "as", it is better for me to keep all that math stuff on one line between my opening and my terminating Nemeth Code indicators.

So let's look at how I brailled this big expression here. I'm going to start with my opening Nemeth indicator 4-5-6 1-4-6, space, opening brace, 4-6 1-2-3-5-6 x , space, vertical bar, space, negative 4, space, my less than or equal to symbol-- remember that takes three cells-- space, x , space, less than or equal to, space, 1.5, closing brace, space, and then I'm going to use my terminator dots 4-5-6 1-5-6 period. That was a lot of work, folks.

Let me show you another example on slide 16 on how we use our switch indicators. So I've got two more paragraphs here. The first one says the interval, open parentheses, 0 comma 10, close parentheses, is all the numbers between 0 and 10, but not 0 or 10. The second paragraph says, this means open parentheses, 0 comma 10, close parentheses equals set of x such that 0 is less than x is less than 10. Now, I know you know this, but I just want to point this out because I always have to review with myself, when we have a whole number it's in UEB if we're already in UEB. So as I go through, I'm going to keep that in mind as I look to see, where am I going into Nemeth? So the interval, that's UEB. I need to go into

Nemeth for open parentheses, 0 comma 10, close parentheses, and then I'm going to go out of Nemeth with my terminator.

The whole rest of that paragraph, folks, because I have whole numbers, is all in UEB. So then I start my second paragraph. This means open parentheses, 0, comma, 10. Oh, hey. That's back in math. So I'm going to go ahead and open up Nemeth in front of that, and open parentheses 0, comma, 10. I'm going to stay in Nemeth until I get to that close brace, and then I'll do my Nemeth terminator for the period.

So let me go ahead-- again, I'm using a short line because I want to illustrate a couple key points to you. So I start in cell three with the interval space. I'm going to open Nemeth 4-5-6 1-4-6 space, then I'm going to braille open parentheses, 0, comma, space, 10, close parentheses, space. I'm going to terminate Nemeth with 4-5-6 1-5-6. And then what I'm going to braille is all the numbers between 0 and 10, but not 0 or 10, period.

I'm going to start my next paragraph in cell three, which this means. Now it's time for me to open Nemeth, and I'm going to be staying in Nemeth until I get through all the math, and then I'll just have a period at the end. So I know I have a fairly short line, so it makes sense for me to open Nemeth with dots 4-5-6 1-4-6, space, my open parentheses, 0, comma, space, 10, close parentheses.

Now I've got an equal sign folks; very, very, very important. If I need to break, I'm going to break before the equal sign and go to the next line. So when you have to make a decision on where to break your math expression because it's not all going to fit on one line, you're going to break your math expression before the equal sign or the sign and comparison. You might have a different sign of comparison.

So now I'm on my second line. I have equals, space, and then I'm going to braille my open brace, x, space, my vertical bar, space, 0, space, less than, space, x, space, less than, space, 10, close brace, and then I'm going to do a space, and I'm going to terminate Nemeth with 4-5-6 1-5-6, and then my period.

Wow, folks. We have gone over a lot of information. Now it's time on slide 17 for you to do activity 1B. I've got four problems for you to interline. Make sure that you understand all the symbols that we have gone over and that you interline accurately. When you're ready, come on back, and we'll have you check your work.

Alright. Slide 18 gives you the answer key. So you've got the first two problems to check and make sure you're accurate, and slide 19 gives you the second part of activity 1B, problems 3 and 4, to make sure that you're accurate in your brailing. And I bet you you are because I know that you've worked hard to learn this information, as have I.

Alright. Let's go on to slide 20. Now you have an algebra quiz that we want you to transcribe. Make sure that how to braille the title, Algebra Quiz, and the directions. If you're not sure how to braille these and you've taken one of our previous courses, we have gone over this information. Otherwise, I encourage you to look up the way to format a center title and directions. Alright, so you've got your little algebra quiz here to braille on slide 20, Activity 1C. When you're done, you're going to come back and check your work.

Slide 21, I've given you the answer key. So did you center your title, Algebra Quiz, leave a blank line underneath, and then directions begin in cell five? If I were to have run over, it would be in cell three. And then I hope that you've brailled your four problems correctly. Alright, we covered a lot of information. Before you go on to the next lesson, make sure you understand the symbols and the rules that we have gone over in lesson one. Thank you so much.