Hi, this is Anthony Varela. In this video, we're going to find the sum of an arithmetic sequence. So we're going to be adding terms that are in an arithmetic sequence. We're going to develop a formula to calculate this sum. And then, of course, we're going to use that formula to calculate a sum of an arithmetic sequence.

So let's get started by finding the sum of an arithmetic sequence without a formula. So we can just do this by adding these terms concretely. So I could say that 2 plus 6 equals 8. And then I'll add 10 to that to get 18, add 14 to get 32, add 18 to get 50, and finally add 22 to get a sum of 72. So sum of all of these terms in this sequence is 72.

Now that was pretty easy because I only had six terms in my sequence. What if I had 600 terms or something larger that I wouldn't really want to sit there and add all these numbers concretely? I would want a shortcut or a formula. So we're going to develop a formula defined the sum of any arithmetic sequence.

And what I'm going to do is I'm going to add the first and the last terms together. So 2 plus 22 equals 24. Now I'm going to work my way inwards. So next, 6 plus 18 is 24. And finally, 10 plus 14 is also 24.

So what I've done is I've paired two terms together to get this common sum that all the pairs add up to 24. And then I can just add up those pairs, 24 plus 24 plus 24 equals 72, which I know from just a moment ago is the sum to this sequence. And this is going to help me develop a formula to find the sum of any arithmetic sequence.

So here I have s sub n. That means the sum of these n number of terms here. And what this is is it's the sum of the first and then the last terms. But I have to multiply this sum by a value because I have 24 here three times. So in this case, I'm multiplying by 3. But why 3?

Well, I have 1, 2, 3, 4, 5, 6 terms, and I've paired them together. So I have half as many pairs as I do terms, right? So I'm taking my number of terms n and dividing that by 2.

And that is going to be an outside multiplier to the sum of the first term and the last term. So this is my formula for finding the sum of an arithmetic sequence. So let's go ahead and use this formula to find the sum of a different sequence.

So we're going to pull out our sum. And notice, what I need to know is I need to know n, the number of terms in my sequence. I need to know the value of the first term, a sub 1. And I need to know the

value of the nth term, a sub n.

So taking a look at my sequence, I have 1, 2, 3, 4, 5, 6 terms again. So I know that n equals 6. I can go ahead and write 6 in for every instance of n. Now I need to know the value of the first term. I can see that clearly enough as negative 4 and the value of the sixth term, which I see is 11.

So now I have all of the numbers I need to find this sum. So first, I'll go ahead and divide 6 by 2. That gives me 3. And now I can add negative 4 and 11. That gives me a positive 7.

So the sum here then is 3 times 7, which is 21. And if you'd like, you can go ahead and add these up concretely. You would get a sum of 21. Well, now let's calculate the sum of this infinite arithmetic sequence. So we want to find the sum of the first 23 terms. But notice, I don't have 23 terms listed.

So I need to find out what the value of that 23rd term is. So I'm actually going to bring out another formula that's going to help us find the value of any nth term. And so this formula here, we have the value of the nth term equals the value of the first term plus some common difference times n minus 1.

Now, this common difference is a number that we used to go from one term to the next. So we can see here to get from 4 to 11, we add 7. To get from 11 to 18, we add 7. To get from 18 to 25, we add 7. So our common difference here is 7.

So we're going to use this formula to find the value of the 23rd term. So in this case, n equals 23. We're finding the value of the 23rd term. Taking a look at what the value of our first term is, that's 4. And our common difference, as I mentioned before, was 7.

So now I have everything I need then to find the value of the 23rd term. Well, 23 minus 1 is 22. I'll multiply that by 7 to get 154. And finally, I'll add that to 4. So my 23rd term has a value of 158.

So we're going to go ahead and write that formula down in our notes too if you ever need to find the value of a certain term. So now we know everything we need to know to find the sum of the first 23 terms. So let's bring out that formula.

We know that n equals 23. We know that a sub 1, the value of the first term is 4. And we know that the value of the 23rd term is 158. So now we can add 4 and 158 and divide 23 by 2. So we get 11.5 times 162. And that gives us a value of 1,863. That's the sum of the first 23 terms in this sequence.

So let's review our notes for finding the sum of an arithmetic sequence. To find the sum, we use this

formula in which you need to know the number of terms, the value of the first term, and the value of the last term. You add up the first and last terms and multiply that by your number of terms divided by 2.

If you don't know then the value of a certain term, you can use this formula-- that a sub n equals a sub 1 plus a d, that common difference, times n minus 1. And here are all the definitions of the variables that we see in our two formulas. So thanks for watching this video on finding the sum of an arithmetic sequence. Hope to see you next time.