How to Create a Generator Polynomial

By default, this page demonstrates how to create a generator polynomial for 13 error correction code words. If you would like to see the steps for creating generator polynomial for a different number of code words (up to 68), use the form below.

Show steps for

error correction code words

Show Steps

Introduction to Creating a Generator Polynomial

Below, I will show the steps to create a generator polynomial for 13 error correction code words.

However, since we are working with the galois field GF256, we need to use special methods to make sure our numbers don't get too big or too small to stay in the galois field.

When we multiply two alpha values, normally we add the two exponents together. But if the result is bigger than 255, we have a problem.

For example, consider $\alpha^{251} * \alpha^{10}$. Multiplying these two gives us α^{261}, but that is too big.

To prevent that from happening, we put the resulting exponent through the following formula:
(exponent % 256) + floor(exponent / 256)

Using the exponent of 261 from the above example, this gives us:
(261 % 256) + floor(261 / 256) = (5) + floor(1.01953125) = (5 + 1) = 6.

So when we multiply $\alpha^{251} * \alpha^{10}$, the result is α^6.

Another problem is combining like terms. Because of the nature of the galois field, we can't simply add the numbers together. We have to XOR them.

This will cause some unexpected results. For example:
$\alpha^{201}x^2 + \alpha^{199}x^2 = 56x^2 + 14x^2$

If we add those together normally, we get $70x^2$. This number is not larger than 255, so it would seem acceptable. However, if we perform an XOR instead of addition, we get:
$56 \oplus 14 = 54$.

This is the correct result. When adding like terms during the creation of a generator polynomial, you must always XOR the integers rather than adding them.

How to Create a Generator Polynomial

In each step of creating a generator polynomial, you multiply a polynomial by a polynomial. The very first polynomial that you start with in the first step is always *($\alpha^0x^1 + \alpha^0x^0$)*. For each multiplication step, you multiply the current polynomial by *($\alpha^0x^1 + \alpha^jx^0$)* where *j* is 1 for the first multiplication, 2 for the second multiplication, 3 for the third, and so on.

Multiplication Step #1

We will multiply ($\alpha^0x^1 + \alpha^0x^0$) by ($\alpha^0x^1 + \alpha^1x^0$)

After multiplying each term from the first part with each term from the second part, we get:
$(\alpha^0x^1 * \alpha^0x^1) + (\alpha^0x^0 * \alpha^0x^1) + (\alpha^0x^1 * \alpha^1x^0) + (\alpha^0x^0 * \alpha^1x^0)$

To multiply, you add the exponents together like this:
$(\alpha^{(0+0)}x^{(1+1)}) + (\alpha^{(0+0)}x^{(0+1)}) + (\alpha^{(0+1)}x^{(1+0)}) + (\alpha^{(0+1)}x^{(0+0)})$

After adding the exponents, this is the result:
$\alpha^0x^2 + \alpha^0x^1 + \alpha^1x^1 + \alpha^1x^0$

If there are any exponents that are larger than 255, fix them by putting them through the formula (exponent % 256) + floor(exponent / 256). In this case, all the exponents are less than or equal to 255, so we can continue.

Now you have to combine terms that have the same exponent. In this case, there is more than one x^1 term.

We will now combine the x^1 terms. they are:
$\alpha^0x^1 + \alpha^1x^1$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$1x^1 + 2x^1$

After XORing the integers, we convert the result back to an alpha term.
$(1 \oplus 2)x^1 = 3x^1 = \alpha^{25}x^1$

Below is the final polynomial from this step after combining the like terms. **If we needed 2 error correction code words, this would be the generator polynomial required.**
$\alpha^0x^2 + \alpha^{25}x^1 + \alpha^1x^0$

Multiplication Step #2

Using the polynomial that we got from the previous step, we will multiply ($\alpha^0x^2 + \alpha^{25}x^1 + \alpha^1x^0$) by ($\alpha^0x^1 + \alpha^2x^0$)

After multiplying each term from the first part with each term from the second part, we get:
$(\alpha^0x^2 * \alpha^0x^1) + (\alpha^{25}x^1 * \alpha^0x^1) + (\alpha^1x^0 * \alpha^0x^1) + (\alpha^0x^2 * \alpha^2x^0) + (\alpha^{25}x^1 * \alpha^2x^0) + (\alpha^1x^0 * \alpha^2x^0)$

To multiply, you add the exponents together like this:
$(\alpha^{(0+0)}x^{(2+1)}) + (\alpha^{(25+0)}x^{(1+1)}) + (\alpha^{(1+0)}x^{(0+1)}) + (\alpha^{(0+2)}x^{(2+0)}) + (\alpha^{(25+2)}x^{(1+0)}) + (\alpha^{(1+2)}x^{(0+0)})$

After adding the exponents, this is the result:
$\alpha^0x^3 + \alpha^{25}x^2 + \alpha^1x^1 + \alpha^2x^2 + \alpha^{27}x^1 + \alpha^3x^0$

If there are any exponents that are larger than 255, fix them by putting them through the formula (exponent % 256) + floor(exponent / 256). In this case, all the exponents are less than or equal to 255, so we can continue.

Now you have to combine terms that have the same exponent. In this case, there is more than one x^2 and x^1 term.

We will now combine the x^2 terms. they are:
$\alpha^{25}x^2 + \alpha^2x^2$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$3x^2 + 4x^2$

After XORing the integers, we convert the result back to an alpha term.
$(3 \oplus 4)x^2 = 7x^2 = \alpha^{198}x^2$

We will now combine the x^1 terms. they are:
$\alpha^1x^1 + \alpha^{27}x^1$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$2x^1 + 12x^1$

After XORing the integers, we convert the result back to an alpha term.
$(2 \oplus 12)x^1 = 14x^1 = \alpha^{199}x^1$

Below is the final polynomial from this step after combining the like terms. **If we needed 3 error correction code words, this would be the generator polynomial required.**
$\alpha^0x^3 + \alpha^{198}x^2 + \alpha^{199}x^1 + \alpha^3x^0$

Multiplication Step #3

Using the polynomial that we got from the previous step, we will multiply $(\alpha^0x^3 + \alpha^{198}x^2 + \alpha^{199}x^1 + \alpha^3x^0)$ by $(\alpha^0x^1 + \alpha^3x^0)$

After multiplying each term from the first part with each term from the second part, we get:
$(\alpha^0x^3 * \alpha^0x^1) + (\alpha^{198}x^2 * \alpha^0x^1) + (\alpha^{199}x^1 * \alpha^0x^1) + (\alpha^3x^0 * \alpha^0x^1) + (\alpha^0x^3 * \alpha^3x^0) + (\alpha^{198}x^2 * \alpha^3x^0) + (\alpha^{199}x^1 * \alpha^3x^0) + (\alpha^3x^0 * \alpha^3x^0)$

To multiply, you add the exponents together like this:
$(\alpha^{(0+0)}x^{(3+1)}) + (\alpha^{(198+0)}x^{(2+1)}) + (\alpha^{(199+0)}x^{(1+1)}) + (\alpha^{(3+0)}x^{(0+1)}) + (\alpha^{(0+3)}x^{(3+0)}) + (\alpha^{(198+3)}x^{(2+0)}) + (\alpha^{(199+3)}x^{(1+0)}) + (\alpha^{(3+3)}x^{(0+0)})$

After adding the exponents, this is the result:
$\alpha^0x^4 + \alpha^{198}x^3 + \alpha^{199}x^2 + \alpha^3x^1 + \alpha^3x^3 + \alpha^{201}x^2 + \alpha^{202}x^1 + \alpha^6x^0$

If there are any exponents that are larger than 255, fix them by putting them through the formula (exponent % 256) + floor(exponent / 256). In this case, all the exponents are less than or equal to 255, so we can continue.

Now you have to combine terms that have the same exponent. In this case, there is more than one x^3, x^2 and x^1 term.

We will now combine the x^3 terms. they are:
$\alpha^{198}x^3 + \alpha^3x^3$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$7x^3 + 8x^3$

After XORing the integers, we convert the result back to an alpha term.
$(7 \oplus 8)x^3 = 15x^3 = \alpha^{75}x^3$

We will now combine the x^2 terms. they are:
$\alpha^{199}x^2 + \alpha^{201}x^2$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$14x^2 + 56x^2$

After XORing the integers, we convert the result back to an alpha term.
$(14 \oplus 56)x^2 = 54x^2 = \alpha^{249}x^2$

We will now combine the x^1 terms. they are:
$\alpha^3x^1 + \alpha^{202}x^1$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$8x^1 + 112x^1$

After XORing the integers, we convert the result back to an alpha term.
$(8 \oplus 112)x^1 = 120x^1 = \alpha^{78}x^1$

Below is the final polynomial from this step after combining the like terms. **If we needed 4 error correction code words, this would be the generator polynomial required.**
$\alpha^0x^4 + \alpha^{75}x^3 + \alpha^{249}x^2 + \alpha^{78}x^1 + \alpha^6x^0$

Multiplication Step #4

Using the polynomial that we got from the previous step, we will multiply $(\alpha^0x^4 + \alpha^{75}x^3 + \alpha^{249}x^2 + \alpha^{78}x^1 + \alpha^6x^0)$ by $(\alpha^0x^1 + \alpha^4x^0)$

After multiplying each term from the first part with each term from the second part, we get:
$(\alpha^0x^4 * \alpha^0x^1) + (\alpha^{75}x^3 * \alpha^0x^1) + (\alpha^{249}x^2 * \alpha^0x^1) + (\alpha^{78}x^1 * \alpha^0x^1) + (\alpha^6x^0 * \alpha^0x^1) + (\alpha^0x^4 * \alpha^4x^0) + (\alpha^{75}x^3 * \alpha^4x^0) + (\alpha^{249}x^2 * \alpha^4x^0) + (\alpha^{78}x^1 * \alpha^4x^0) + (\alpha^6x^0 * \alpha^4x^0)$

To multiply, you add the exponents together like this:
$(\alpha^{(0+0)}x^{(4+1)}) + (\alpha^{(75+0)}x^{(3+1)}) + (\alpha^{(249+0)}x^{(2+1)}) + (\alpha^{(78+0)}x^{(1+1)}) + (\alpha^{(6+0)}x^{(0+1)}) + (\alpha^{(0+4)}x^{(4+0)}) + (\alpha^{(75+4)}x^{(3+0)}) + (\alpha^{(249+4)}x^{(2+0)}) + (\alpha^{(78+4)}x^{(1+0)}) + (\alpha^{(6+4)}x^{(0+0)})$

After adding the exponents, this is the result:
$\alpha^0x^5 + \alpha^{75}x^4 + \alpha^{249}x^3 + \alpha^{78}x^2 + \alpha^6x^1 + \alpha^4x^4 + \alpha^{79}x^3 + \alpha^{253}x^2 + \alpha^{82}x^1 + \alpha^{10}x^0$

If there are any exponents that are larger than 255, fix them by putting them through the formula (exponent % 256) + floor(exponent / 256). In this case, all the exponents are less than or equal to 255, so we can continue.

Now you have to combine terms that have the same exponent. In this case, there is more than one x^4, x^3, x^2 and x^1 term.

We will now combine the x^4 terms. they are:
$\alpha^{75}x^4 + \alpha^4x^4$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$15x^4 + 16x^4$

After XORing the integers, we convert the result back to an alpha term.
$(15 \oplus 16)x^4 = 31x^4 = \alpha^{113}x^4$

We will now combine the x^3 terms. they are:
$\alpha^{249}x^3 + \alpha^{79}x^3$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$54x^3 + 240x^3$

After XORing the integers, we convert the result back to an alpha term.
$(54 \oplus 240)x^3 = 198x^3 = \alpha^{164}x^3$

We will now combine the x^2 terms. they are:
$\alpha^{78}x^2 + \alpha^{253}x^2$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$120x^2 + 71x^2$

After XORing the integers, we convert the result back to an alpha term.
$(120 \oplus 71)x^2 = 63x^2 = \alpha^{166}x^2$

We will now combine the x^1 terms. they are:
$\alpha^6x^1 + \alpha^{82}x^1$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$64x^1 + 211x^1$

After XORing the integers, we convert the result back to an alpha term.
$(64 \oplus 211)x^1 = 147x^1 = \alpha^{119}x^1$

Below is the final polynomial from this step after combining the like terms. **If we needed 5 error correction code words, this would be the generator polynomial required.**
$\alpha^0x^5 + \alpha^{113}x^4 + \alpha^{164}x^3 + \alpha^{166}x^2 + \alpha^{119}x^1 + \alpha^{10}x^0$

Multiplication Step #5

Using the polynomial that we got from the previous step, we will multiply ($\alpha^0x^5 + \alpha^{113}x^4 + \alpha^{164}x^3 + \alpha^{166}x^2 + \alpha^{119}x^1 + \alpha^{10}x^0$) by ($\alpha^0x^1 + \alpha^5x^0$)

After multiplying each term from the first part with each term from the second part, we get:
$(\alpha^{0}x^{5} * \alpha^{0}x^{1}) + (\alpha^{113}x^{4} * \alpha^{0}x^{1}) + (\alpha^{164}x^{3} * \alpha^{0}x^{1}) + (\alpha^{166}x^{2} * \alpha^{0}x^{1}) + (\alpha^{119}x^{1} * \alpha^{0}x^{1}) + (\alpha^{10}x^{0} * \alpha^{0}x^{1}) + (\alpha^{0}x^{5} * \alpha^{5}x^{0}) + (\alpha^{113}x^{4} * \alpha^{5}x^{0}) + (\alpha^{164}x^{3} * \alpha^{5}x^{0}) + (\alpha^{166}x^{2} * \alpha^{5}x^{0}) + (\alpha^{119}x^{1} * \alpha^{5}x^{0}) + (\alpha^{10}x^{0} * \alpha^{5}x^{0})$

To multiply, you add the exponents together like this:
$(\alpha^{(0+0)}x^{(5+1)}) + (\alpha^{(113+0)}x^{(4+1)}) + (\alpha^{(164+0)}x^{(3+1)}) + (\alpha^{(166+0)}x^{(2+1)}) + (\alpha^{(119+0)}x^{(1+1)}) + (\alpha^{(10+0)}x^{(0+1)}) + (\alpha^{(0+5)}x^{(5+0)}) + (\alpha^{(113+5)}x^{(4+0)}) + (\alpha^{(164+5)}x^{(3+0)}) + (\alpha^{(166+5)}x^{(2+0)}) + (\alpha^{(119+5)}x^{(1+0)}) + (\alpha^{(10+5)}x^{(0+0)})$

After adding the exponents, this is the result:
$\alpha^{0}x^{6} + \alpha^{113}x^{5} + \alpha^{164}x^{4} + \alpha^{166}x^{3} + \alpha^{119}x^{2} + \alpha^{10}x^{1} + \alpha^{5}x^{5} + \alpha^{118}x^{4} + \alpha^{169}x^{3} + \alpha^{171}x^{2} + \alpha^{124}x^{1} + \alpha^{15}x^{0}$

If there are any exponents that are larger than 255, fix them by putting them through the formula (exponent % 256) + floor(exponent / 256). In this case, all the exponents are less than or equal to 255, so we can continue.

Now you have to combine terms that have the same exponent. In this case, there is more than one x^5, x^4, x^3, x^2 and x^1 term.

We will now combine the x^5 terms. they are:
$\alpha^{113}x^{5} + \alpha^{5}x^{5}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$31x^{5} + 32x^{5}$

After XORing the integers, we convert the result back to an alpha term.
$(31 \oplus 32)x^{5} = 63x^{5} = \alpha^{166}x^{5}$

We will now combine the x^4 terms. they are:
$\alpha^{164}x^{4} + \alpha^{118}x^{4}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$198x^{4} + 199x^{4}$

After XORing the integers, we convert the result back to an alpha term.
$(198 \oplus 199)x^{4} = 1x^{4} = \alpha^{0}x^{4}$

We will now combine the x^3 terms. they are:
$\alpha^{166}x^{3} + \alpha^{169}x^{3}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$63x^{3} + 229x^{3}$

After XORing the integers, we convert the result back to an alpha term.
$(63 \oplus 229)x^{3} = 218x^{3} = \alpha^{134}x^{3}$

We will now combine the x^2 terms. they are:
$\alpha^{119}x^{2} + \alpha^{171}x^{2}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$147x^{2} + 179x^{2}$

After XORing the integers, we convert the result back to an alpha term.
$(147 \oplus 179)x^2 = 32x^2 = \alpha^5x^2$

We will now combine the x^1 terms. they are:
$\alpha^{10}x^1 + \alpha^{124}x^1$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$116x^1 + 151x^1$

After XORing the integers, we convert the result back to an alpha term.
$(116 \oplus 151)x^1 = 227x^1 = \alpha^{176}x^1$

Below is the final polynomial from this step after combining the like terms. **If we needed 6 error correction code words, this would be the generator polynomial required.**
$\alpha^0x^6 + \alpha^{166}x^5 + \alpha^0x^4 + \alpha^{134}x^3 + \alpha^5x^2 + \alpha^{176}x^1 + \alpha^{15}x^0$

Multiplication Step #6

Using the polynomial that we got from the previous step, we will multiply $(\alpha^0x^6 + \alpha^{166}x^5 + \alpha^0x^4 + \alpha^{134}x^3 + \alpha^5x^2 + \alpha^{176}x^1 + \alpha^{15}x^0)$ by $(\alpha^0x^1 + \alpha^6x^0)$

After multiplying each term from the first part with each term from the second part, we get:
$(\alpha^0x^6 * \alpha^0x^1) + (\alpha^{166}x^5 * \alpha^0x^1) + (\alpha^0x^4 * \alpha^0x^1) + (\alpha^{134}x^3 * \alpha^0x^1) + (\alpha^5x^2 * \alpha^0x^1) + (\alpha^{176}x^1 * \alpha^0x^1) + (\alpha^{15}x^0 * \alpha^0x^1) + (\alpha^0x^6 * \alpha^6x^0) + (\alpha^{166}x^5 * \alpha^6x^0) + (\alpha^0x^4 * \alpha^6x^0) + (\alpha^{134}x^3 * \alpha^6x^0) + (\alpha^5x^2 * \alpha^6x^0) + (\alpha^{176}x^1 * \alpha^6x^0) + (\alpha^{15}x^0 * \alpha^6x^0)$

To multiply, you add the exponents together like this:
$(\alpha^{(0+0)}x^{(6+1)}) + (\alpha^{(166+0)}x^{(5+1)}) + (\alpha^{(0+0)}x^{(4+1)}) + (\alpha^{(134+0)}x^{(3+1)}) + (\alpha^{(5+0)}x^{(2+1)}) + (\alpha^{(176+0)}x^{(1+1)}) + (\alpha^{(15+0)}x^{(0+1)}) + (\alpha^{(0+6)}x^{(6+0)}) + (\alpha^{(166+6)}x^{(5+0)}) + (\alpha^{(0+6)}x^{(4+0)}) + (\alpha^{(134+6)}x^{(3+0)}) + (\alpha^{(5+6)}x^{(2+0)}) + (\alpha^{(176+6)}x^{(1+0)}) + (\alpha^{(15+6)}x^{(0+0)})$

After adding the exponents, this is the result:
$\alpha^0x^7 + \alpha^{166}x^6 + \alpha^0x^5 + \alpha^{134}x^4 + \alpha^5x^3 + \alpha^{176}x^2 + \alpha^{15}x^1 + \alpha^6x^6 + \alpha^{172}x^5 + \alpha^6x^4 + \alpha^{140}x^3 + \alpha^{11}x^2 + \alpha^{182}x^1 + \alpha^{21}x^0$

If there are any exponents that are larger than 255, fix them by putting them through the formula (exponent % 256) + floor(exponent / 256). In this case, all the exponents are less than or equal to 255, so we can continue.

Now you have to combine terms that have the same exponent. In this case, there is more than one x^6, x^5, x^4, x^3, x^2 and x^1 term.

We will now combine the x^6 terms. they are:
$\alpha^{166}x^6 + \alpha^6x^6$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$63x^6 + 64x^6$

After XORing the integers, we convert the result back to an alpha term.
$(63 \oplus 64)x^6 = 127x^6 = \alpha^{87}x^6$

We will now combine the x^5 terms. they are:
$\alpha^0x^5 + \alpha^{172}x^5$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$1x^5 + 123x^5$

After XORing the integers, we convert the result back to an alpha term.
$(1 \oplus 123)x^5 = 122x^5 = \alpha^{229}x^5$

We will now combine the x^4 terms. they are:
$\alpha^{134}x^4 + \alpha^6x^4$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$218x^4 + 64x^4$

After XORing the integers, we convert the result back to an alpha term.
$(218 \oplus 64)x^4 = 154x^4 = \alpha^{146}x^4$

We will now combine the x^3 terms. they are:
$\alpha^5x^3 + \alpha^{140}x^3$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$32x^3 + 132x^3$

After XORing the integers, we convert the result back to an alpha term.
$(32 \oplus 132)x^3 = 164x^3 = \alpha^{149}x^3$

We will now combine the x^2 terms. they are:
$\alpha^{176}x^2 + \alpha^{11}x^2$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$227x^2 + 232x^2$

After XORing the integers, we convert the result back to an alpha term.
$(227 \oplus 232)x^2 = 11x^2 = \alpha^{238}x^2$

We will now combine the x^1 terms. they are:
$\alpha^{15}x^1 + \alpha^{182}x^1$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$38x^1 + 98x^1$

After XORing the integers, we convert the result back to an alpha term.
$(38 \oplus 98)x^1 = 68x^1 = \alpha^{102}x^1$

Below is the final polynomial from this step after combining the like terms. **If we needed 7 error correction code words, this would be the generator polynomial required.**
$\alpha^0x^7 + \alpha^{87}x^6 + \alpha^{229}x^5 + \alpha^{146}x^4 + \alpha^{149}x^3 + \alpha^{238}x^2 + \alpha^{102}x^1 + \alpha^{21}x^0$

Multiplication Step #7

Using the polynomial that we got from the previous step, we will multiply ($\alpha^0x^7 + \alpha^{87}x^6 + \alpha^{229}x^5 + \alpha^{146}x^4 + \alpha^{149}x^3 + \alpha^{238}x^2 + \alpha^{102}x^1 + \alpha^{21}x^0$) by ($\alpha^0x^1 + \alpha^7x^0$)

After multiplying each term from the first part with each term from the second part, we get:
$(\alpha^0x^7 * \alpha^0x^1) + (\alpha^{87}x^6 * \alpha^0x^1) + (\alpha^{229}x^5 * \alpha^0x^1) + (\alpha^{146}x^4 * \alpha^0x^1) + (\alpha^{149}x^3 * \alpha^0x^1) + (\alpha^{238}x^2 * \alpha^0x^1) + (\alpha^{102}x^1 * \alpha^0x^1) + (\alpha^{21}x^0 * \alpha^0x^1) + (\alpha^0x^7 * \alpha^7x^0) + (\alpha^{87}x^6 * \alpha^7x^0) + (\alpha^{229}x^5 * \alpha^7x^0) + (\alpha^{146}x^4 * \alpha^7x^0) + (\alpha^{149}x^3 * \alpha^7x^0) + (\alpha^{238}x^2 * \alpha^7x^0) + (\alpha^{102}x^1 * \alpha^7x^0) + (\alpha^{21}x^0 * \alpha^7x^0)$

To multiply, you add the exponents together like this:
$(\alpha^{(0+0)}x^{(7+1)}) + (\alpha^{(87+0)}x^{(6+1)}) + (\alpha^{(229+0)}x^{(5+1)}) + (\alpha^{(146+0)}x^{(4+1)}) + (\alpha^{(149+0)}x^{(3+1)}) + (\alpha^{(238+0)}x^{(2+1)}) + (\alpha^{(102+0)}x^{(1+1)}) + (\alpha^{(21+0)}x^{(0+1)}) + (\alpha^{(0+7)}x^{(7+0)}) + (\alpha^{(87+7)}x^{(6+0)}) + (\alpha^{(229+7)}x^{(5+0)}) + (\alpha^{(146+7)}x^{(4+0)}) + (\alpha^{(149+7)}x^{(3+0)}) + (\alpha^{(238+7)}x^{(2+0)}) + (\alpha^{(102+7)}x^{(1+0)}) + (\alpha^{(21+7)}x^{(0+0)})$

After adding the exponents, this is the result:
$\alpha^0x^8 + \alpha^{87}x^7 + \alpha^{229}x^6 + \alpha^{146}x^5 + \alpha^{149}x^4 + \alpha^{238}x^3 + \alpha^{102}x^2 + \alpha^{21}x^1 + \alpha^7x^7 + \alpha^{94}x^6 + \alpha^{236}x^5 + \alpha^{153}x^4 + \alpha^{156}x^3 + \alpha^{245}x^2 + \alpha^{109}x^1 + \alpha^{28}x^0$

If there are any exponents that are larger than 255, fix them by putting them through the formula (exponent % 256) + floor(exponent / 256). In this case, all the exponents are less than or equal to 255, so we can continue.

Now you have to combine terms that have the same exponent. In this case, there is more than one x^7, x^6, x^5, x^4, x^3, x^2 and x^1 term.

We will now combine the x^7 terms. they are:
$\alpha^{87}x^7 + \alpha^7x^7$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$127x^7 + 128x^7$

After XORing the integers, we convert the result back to an alpha term.
$(127 \oplus 128)x^7 = 255x^7 = \alpha^{175}x^7$

We will now combine the x^6 terms. they are:
$\alpha^{229}x^6 + \alpha^{94}x^6$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$122x^6 + 113x^6$

After XORing the integers, we convert the result back to an alpha term.
$(122 \oplus 113)x^6 = 11x^6 = \alpha^{238}x^6$

We will now combine the x^5 terms. they are:
$\alpha^{146}x^5 + \alpha^{236}x^5$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$154x^5 + 203x^5$

After XORing the integers, we convert the result back to an alpha term.
$(154 \oplus 203)x^5 = 81x^5 = \alpha^{208}x^5$

We will now combine the x^4 terms. they are:
$\alpha^{149}x^4 + \alpha^{153}x^4$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$164x^4 + 146x^4$

After XORing the integers, we convert the result back to an alpha term.
$(164 \oplus 146)x^4 = 54x^4 = \alpha^{249}x^4$

We will now combine the x^3 terms. they are:
$\alpha^{238}x^3 + \alpha^{156}x^3$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$11x^3 + 228x^3$

After XORing the integers, we convert the result back to an alpha term.
$(11 \oplus 228)x^3 = 239x^3 = \alpha^{215}x^3$

We will now combine the x^2 terms. they are:
$\alpha^{102}x^2 + \alpha^{245}x^2$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$68x^2 + 233x^2$

After XORing the integers, we convert the result back to an alpha term.
$(68 \oplus 233)x^2 = 173x^2 = \alpha^{252}x^2$

We will now combine the x^1 terms. they are:
$\alpha^{21}x^1 + \alpha^{109}x^1$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$117x^1 + 189x^1$

After XORing the integers, we convert the result back to an alpha term.
$(117 \oplus 189)x^1 = 200x^1 = \alpha^{196}x^1$

Below is the final polynomial from this step after combining the like terms. **If we needed 8 error correction code words, this would be the generator polynomial required.**
$\alpha^0x^8 + \alpha^{175}x^7 + \alpha^{238}x^6 + \alpha^{208}x^5 + \alpha^{249}x^4 + \alpha^{215}x^3 + \alpha^{252}x^2 + \alpha^{196}x^1 + \alpha^{28}x^0$

Multiplication Step #8

Using the polynomial that we got from the previous step, we will multiply $(\alpha^0x^8 + \alpha^{175}x^7 + \alpha^{238}x^6 + \alpha^{208}x^5 + \alpha^{249}x^4 + \alpha^{215}x^3 + \alpha^{252}x^2 + \alpha^{196}x^1 + \alpha^{28}x^0)$ by $(\alpha^0x^1 + \alpha^8x^0)$

After multiplying each term from the first part with each term from the second part, we get:
$(\alpha^0x^8 * \alpha^0x^1) + (\alpha^{175}x^7 * \alpha^0x^1) + (\alpha^{238}x^6 * \alpha^0x^1) + (\alpha^{208}x^5 * \alpha^0x^1) + (\alpha^{249}x^4 * \alpha^0x^1) + (\alpha^{215}x^3 * \alpha^0x^1) + (\alpha^{252}x^2 * \alpha^0x^1) + (\alpha^{196}x^1 * \alpha^0x^1) + (\alpha^{28}x^0 * \alpha^0x^1) + (\alpha^0x^8 * \alpha^8x^0) + (\alpha^{175}x^7 * \alpha^8x^0) + (\alpha^{238}x^6 * \alpha^8x^0) + (\alpha^{208}x^5 * \alpha^8x^0) + (\alpha^{249}x^4 * \alpha^8x^0) + (\alpha^{215}x^3 * \alpha^8x^0) + (\alpha^{252}x^2 * \alpha^8x^0) + (\alpha^{196}x^1 * \alpha^8x^0) + (\alpha^{28}x^0 * \alpha^8x^0)$

To multiply, you add the exponents together like this:
$(\alpha^{(0+0)}x^{(8+1)}) + (\alpha^{(175+0)}x^{(7+1)}) + (\alpha^{(238+0)}x^{(6+1)}) + (\alpha^{(208+0)}x^{(5+1)}) + (\alpha^{(249+0)}x^{(4+1)}) + (\alpha^{(215+0)}x^{(3+1)}) + (\alpha^{(252+0)}x^{(2+1)}) + (\alpha^{(196+0)}x^{(1+1)}) + (\alpha^{(28+0)}x^{(0+1)}) + (\alpha^{(0+8)}x^{(8+0)}) + (\alpha^{(175+8)}x^{(7+0)}) + (\alpha^{(238+8)}x^{(6+0)}) + (\alpha^{(208+8)}x^{(5+0)}) + (\alpha^{(249+8)}x^{(4+0)}) + (\alpha^{(215+8)}x^{(3+0)}) + (\alpha^{(252+8)}x^{(2+0)}) + (\alpha^{(196+8)}x^{(1+0)}) + (\alpha^{(28+8)}x^{(0+0)})$

After adding the exponents, this is the result:
$\alpha^0x^9 + \alpha^{175}x^8 + \alpha^{238}x^7 + \alpha^{208}x^6 + \alpha^{249}x^5 + \alpha^{215}x^4 + \alpha^{252}x^3 + \alpha^{196}x^2 + \alpha^{28}x^1 + \alpha^8x^8 + \alpha^{183}x^7 + \alpha^{246}x^6 + \alpha^{216}x^5 + \alpha^{257}x^4 + \alpha^{223}x^3 + \alpha^{260}x^2 + \alpha^{204}x^1 + \alpha^{36}x^0$

If there are any exponents that are larger than 255, fix them by putting them through the formula (exponent % 256) + floor(exponent / 256)
$\alpha^0x^9 + \alpha^{175}x^8 + \alpha^{238}x^7 + \alpha^{208}x^6 + \alpha^{249}x^5 + \alpha^{215}x^4 + \alpha^{252}x^3 + \alpha^{196}x^2 + \alpha^{28}x^1 + \alpha^8x^8 + \alpha^{183}x^7 + \alpha^{246}x^6 + \alpha^{216}x^5 + \alpha^2x^4 + \alpha^{223}x^3 + \alpha^5x^2 + \alpha^{204}x^1 + \alpha^{36}x^0$

Now you have to combine terms that have the same exponent. In this case, there is more than one x^8, x^7, x^6, x^5, x^4, x^3, x^2 and x^1 term.

We will now combine the x^8 terms. they are:
$\alpha^{175}x^8 + \alpha^8x^8$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$255x^8 + 29x^8$

After XORing the integers, we convert the result back to an alpha term.
$(255 \oplus 29)x^8 = 226x^8 = \alpha^{95}x^8$

We will now combine the x^7 terms. they are:
$\alpha^{238}x^7 + \alpha^{183}x^7$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$11x^7 + 196x^7$

After XORing the integers, we convert the result back to an alpha term.
$(11 \oplus 196)x^7 = 207x^7 = \alpha^{246}x^7$

We will now combine the x^6 terms. they are:
$\alpha^{208}x^6 + \alpha^{246}x^6$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$81x^6 + 207x^6$

After XORing the integers, we convert the result back to an alpha term.
$(81 \oplus 207)x^6 = 158x^6 = \alpha^{137}x^6$

We will now combine the x^5 terms. they are:
$\alpha^{249}x^5 + \alpha^{216}x^5$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$54x^5 + 195x^5$

After XORing the integers, we convert the result back to an alpha term.
$(54 \oplus 195)x^5 = 245x^5 = \alpha^{231}x^5$

We will now combine the x^4 terms. they are:
$\alpha^{215}x^4 + \alpha^2x^4$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$239x^4 + 4x^4$

After XORing the integers, we convert the result back to an alpha term.
$(239 \oplus 4)x^4 = 235x^4 = \alpha^{235}x^4$

We will now combine the x^3 terms. they are:
$\alpha^{252}x^3 + \alpha^{223}x^3$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$173x^3 + 9x^3$

After XORing the integers, we convert the result back to an alpha term.
$(173 \oplus 9)x^3 = 164x^3 = \alpha^{149}x^3$

We will now combine the x^2 terms. they are:
$\alpha^{196}x^2 + \alpha^5x^2$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$200x^2 + 32x^2$

After XORing the integers, we convert the result back to an alpha term.
$(200 \oplus 32)x^2 = 232x^2 = \alpha^{11}x^2$

We will now combine the x^1 terms. they are:
$\alpha^{28}x^1 + \alpha^{204}x^1$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$24x^1 + 221x^1$

After XORing the integers, we convert the result back to an alpha term.
$(24 \oplus 221)x^1 = 197x^1 = \alpha^{123}x^1$

Below is the final polynomial from this step after combining the like terms. **If we needed 9 error correction code words, this would be the generator polynomial required.**
$\alpha^0x^9 + \alpha^{95}x^8 + \alpha^{246}x^7 + \alpha^{137}x^6 + \alpha^{231}x^5 + \alpha^{235}x^4 + \alpha^{149}x^3 + \alpha^{11}x^2 + \alpha^{123}x^1 + \alpha^{36}x^0$

Multiplication Step #9

Using the polynomial that we got from the previous step, we will multiply $(\alpha^0x^9 + \alpha^{95}x^8 + \alpha^{246}x^7 + \alpha^{137}x^6 + \alpha^{231}x^5 + \alpha^{235}x^4 + \alpha^{149}x^3 + \alpha^{11}x^2 + \alpha^{123}x^1 + \alpha^{36}x^0)$ by $(\alpha^0x^1 + \alpha^9x^0)$

After multiplying each term from the first part with each term from the second part, we get:
$(\alpha^0x^9 * \alpha^0x^1) + (\alpha^{95}x^8 * \alpha^0x^1) + (\alpha^{246}x^7 * \alpha^0x^1) + (\alpha^{137}x^6 * \alpha^0x^1) + (\alpha^{231}x^5 * \alpha^0x^1) + (\alpha^{235}x^4 * \alpha^0x^1) + (\alpha^{149}x^3 * \alpha^0x^1) + (\alpha^{11}x^2 * \alpha^0x^1) + (\alpha^{123}x^1 * \alpha^0x^1) + (\alpha^{36}x^0 * \alpha^0x^1) + (\alpha^0x^9 * \alpha^9x^0) + (\alpha^{95}x^8 * \alpha^9x^0) + (\alpha^{246}x^7$

$* \alpha^{9}x^{0}) + (\alpha^{137}x^{6} * \alpha^{9}x^{0}) + (\alpha^{231}x^{5} * \alpha^{9}x^{0}) + (\alpha^{235}x^{4} * \alpha^{9}x^{0}) + (\alpha^{149}x^{3} * \alpha^{9}x^{0}) + (\alpha^{11}x^{2} * \alpha^{9}x^{0}) + (\alpha^{123}x^{1} * \alpha^{9}x^{0}) + (\alpha^{36}x^{0} * \alpha^{9}x^{0})$

To multiply, you add the exponents together like this:
$(\alpha^{(0+0)}x^{(9+1)}) + (\alpha^{(95+0)}x^{(8+1)}) + (\alpha^{(246+0)}x^{(7+1)}) + (\alpha^{(137+0)}x^{(6+1)}) + (\alpha^{(231+0)}x^{(5+1)}) + (\alpha^{(235+0)}x^{(4+1)}) + (\alpha^{(149+0)}x^{(3+1)}) + (\alpha^{(11+0)}x^{(2+1)}) + (\alpha^{(123+0)}x^{(1+1)}) + (\alpha^{(36+0)}x^{(0+1)}) + (\alpha^{(0+9)}x^{(9+0)}) + (\alpha^{(95+9)}x^{(8+0)}) + (\alpha^{(246+9)}x^{(7+0)}) + (\alpha^{(137+9)}x^{(6+0)}) + (\alpha^{(231+9)}x^{(5+0)}) + (\alpha^{(235+9)}x^{(4+0)}) + (\alpha^{(149+9)}x^{(3+0)}) + (\alpha^{(11+9)}x^{(2+0)}) + (\alpha^{(123+9)}x^{(1+0)}) + (\alpha^{(36+9)}x^{(0+0)})$

After adding the exponents, this is the result:
$\alpha^{0}x^{10} + \alpha^{95}x^{9} + \alpha^{246}x^{8} + \alpha^{137}x^{7} + \alpha^{231}x^{6} + \alpha^{235}x^{5} + \alpha^{149}x^{4} + \alpha^{11}x^{3} + \alpha^{123}x^{2} + \alpha^{36}x^{1} + \alpha^{9}x^{9} + \alpha^{104}x^{8} + \alpha^{255}x^{7} + \alpha^{146}x^{6} + \alpha^{240}x^{5} + \alpha^{244}x^{4} + \alpha^{158}x^{3} + \alpha^{20}x^{2} + \alpha^{132}x^{1} + \alpha^{45}x^{0}$

If there are any exponents that are larger than 255, fix them by putting them through the formula (exponent % 256) + floor(exponent / 256). In this case, all the exponents are less than or equal to 255, so we can continue.

Now you have to combine terms that have the same exponent. In this case, there is more than one x^9, x^8, x^7, x^6, x^5, x^4, x^3, x^2 and x^1 term.

We will now combine the x^9 terms. they are:
$\alpha^{95}x^{9} + \alpha^{9}x^{9}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$226x^{9} + 58x^{9}$

After XORing the integers, we convert the result back to an alpha term.
$(226 \oplus 58)x^{9} = 216x^{9} = \alpha^{251}x^{9}$

We will now combine the x^8 terms. they are:
$\alpha^{246}x^{8} + \alpha^{104}x^{8}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$207x^{8} + 13x^{8}$

After XORing the integers, we convert the result back to an alpha term.
$(207 \oplus 13)x^{8} = 194x^{8} = \alpha^{67}x^{8}$

We will now combine the x^7 terms. they are:
$\alpha^{137}x^{7} + \alpha^{255}x^{7}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$158x^{7} + 1x^{7}$

After XORing the integers, we convert the result back to an alpha term.
$(158 \oplus 1)x^{7} = 159x^{7} = \alpha^{46}x^{7}$

We will now combine the x^6 terms. they are:
$\alpha^{231}x^{6} + \alpha^{146}x^{6}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$245x^{6} + 154x^{6}$

After XORing the integers, we convert the result back to an alpha term.
$(245 \oplus 154)x^6 = 111x^6 = \alpha^{61}x^6$

We will now combine the x^5 terms. they are:
$\alpha^{235}x^5 + \alpha^{240}x^5$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$235x^5 + 44x^5$

After XORing the integers, we convert the result back to an alpha term.
$(235 \oplus 44)x^5 = 199x^5 = \alpha^{118}x^5$

We will now combine the x^4 terms. they are:
$\alpha^{149}x^4 + \alpha^{244}x^4$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$164x^4 + 250x^4$

After XORing the integers, we convert the result back to an alpha term.
$(164 \oplus 250)x^4 = 94x^4 = \alpha^{70}x^4$

We will now combine the x^3 terms. they are:
$\alpha^{11}x^3 + \alpha^{158}x^3$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$232x^3 + 183x^3$

After XORing the integers, we convert the result back to an alpha term.
$(232 \oplus 183)x^3 = 95x^3 = \alpha^{64}x^3$

We will now combine the x^2 terms. they are:
$\alpha^{123}x^2 + \alpha^{20}x^2$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$197x^2 + 180x^2$

After XORing the integers, we convert the result back to an alpha term.
$(197 \oplus 180)x^2 = 113x^2 = \alpha^{94}x^2$

We will now combine the x^1 terms. they are:
$\alpha^{36}x^1 + \alpha^{132}x^1$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$37x^1 + 184x^1$

After XORing the integers, we convert the result back to an alpha term.
$(37 \oplus 184)x^1 = 157x^1 = \alpha^{32}x^1$

Below is the final polynomial from this step after combining the like terms. **If we needed 10 error correction code words, this would be the generator polynomial required.**
$\alpha^{0}x^{10} + \alpha^{251}x^9 + \alpha^{67}x^8 + \alpha^{46}x^7 + \alpha^{61}x^6 + \alpha^{118}x^5 + \alpha^{70}x^4 + \alpha^{64}x^3 + \alpha^{94}x^2 + \alpha^{32}x^1 + \alpha^{45}x^0$

Multiplication Step #10

Using the polynomial that we got from the previous step, we will multiply ($\alpha^{0}x^{10} + \alpha^{251}x^{9} + \alpha^{67}x^{8} + \alpha^{46}x^{7} + \alpha^{61}x^{6} + \alpha^{118}x^{5} + \alpha^{70}x^{4} + \alpha^{64}x^{3} + \alpha^{94}x^{2} + \alpha^{32}x^{1} + \alpha^{45}x^{0}$) by ($\alpha^{0}x^{1} + \alpha^{10}x^{0}$)

After multiplying each term from the first part with each term from the second part, we get:
$(\alpha^{0}x^{10} * \alpha^{0}x^{1}) + (\alpha^{251}x^{9} * \alpha^{0}x^{1}) + (\alpha^{67}x^{8} * \alpha^{0}x^{1}) + (\alpha^{46}x^{7} * \alpha^{0}x^{1}) + (\alpha^{61}x^{6} * \alpha^{0}x^{1}) + (\alpha^{118}x^{5} * \alpha^{0}x^{1}) + (\alpha^{70}x^{4} * \alpha^{0}x^{1}) + (\alpha^{64}x^{3} * \alpha^{0}x^{1}) + (\alpha^{94}x^{2} * \alpha^{0}x^{1}) + (\alpha^{32}x^{1} * \alpha^{0}x^{1}) + (\alpha^{45}x^{0} * \alpha^{0}x^{1}) + (\alpha^{0}x^{10} * \alpha^{10}x^{0}) + (\alpha^{251}x^{9} * \alpha^{10}x^{0}) + (\alpha^{67}x^{8} * \alpha^{10}x^{0}) + (\alpha^{46}x^{7} * \alpha^{10}x^{0}) + (\alpha^{61}x^{6} * \alpha^{10}x^{0}) + (\alpha^{118}x^{5} * \alpha^{10}x^{0}) + (\alpha^{70}x^{4} * \alpha^{10}x^{0}) + (\alpha^{64}x^{3} * \alpha^{10}x^{0}) + (\alpha^{94}x^{2} * \alpha^{10}x^{0}) + (\alpha^{32}x^{1} * \alpha^{10}x^{0}) + (\alpha^{45}x^{0} * \alpha^{10}x^{0})$

To multiply, you add the exponents together like this:
$(\alpha^{(0+0)}x^{(10+1)}) + (\alpha^{(251+0)}x^{(9+1)}) + (\alpha^{(67+0)}x^{(8+1)}) + (\alpha^{(46+0)}x^{(7+1)}) + (\alpha^{(61+0)}x^{(6+1)}) + (\alpha^{(118+0)}x^{(5+1)}) + (\alpha^{(70+0)}x^{(4+1)}) + (\alpha^{(64+0)}x^{(3+1)}) + (\alpha^{(94+0)}x^{(2+1)}) + (\alpha^{(32+0)}x^{(1+1)}) + (\alpha^{(45+0)}x^{(0+1)}) + (\alpha^{(0+10)}x^{(10+0)}) + (\alpha^{(251+10)}x^{(9+0)}) + (\alpha^{(67+10)}x^{(8+0)}) + (\alpha^{(46+10)}x^{(7+0)}) + (\alpha^{(61+10)}x^{(6+0)}) + (\alpha^{(118+10)}x^{(5+0)}) + (\alpha^{(70+10)}x^{(4+0)}) + (\alpha^{(64+10)}x^{(3+0)}) + (\alpha^{(94+10)}x^{(2+0)}) + (\alpha^{(32+10)}x^{(1+0)}) + (\alpha^{(45+10)}x^{(0+0)})$

After adding the exponents, this is the result:
$\alpha^{0}x^{11} + \alpha^{251}x^{10} + \alpha^{67}x^{9} + \alpha^{46}x^{8} + \alpha^{61}x^{7} + \alpha^{118}x^{6} + \alpha^{70}x^{5} + \alpha^{64}x^{4} + \alpha^{94}x^{3} + \alpha^{32}x^{2} + \alpha^{45}x^{1} + \alpha^{10}x^{10} + \alpha^{261}x^{9} + \alpha^{77}x^{8} + \alpha^{56}x^{7} + \alpha^{71}x^{6} + \alpha^{128}x^{5} + \alpha^{80}x^{4} + \alpha^{74}x^{3} + \alpha^{104}x^{2} + \alpha^{42}x^{1} + \alpha^{55}x^{0}$

If there are any exponents that are larger than 255, fix them by putting them through the formula (exponent % 256) + floor(exponent / 256)
$\alpha^{0}x^{11} + \alpha^{251}x^{10} + \alpha^{67}x^{9} + \alpha^{46}x^{8} + \alpha^{61}x^{7} + \alpha^{118}x^{6} + \alpha^{70}x^{5} + \alpha^{64}x^{4} + \alpha^{94}x^{3} + \alpha^{32}x^{2} + \alpha^{45}x^{1} + \alpha^{10}x^{10} + \alpha^{6}x^{9} + \alpha^{77}x^{8} + \alpha^{56}x^{7} + \alpha^{71}x^{6} + \alpha^{128}x^{5} + \alpha^{80}x^{4} + \alpha^{74}x^{3} + \alpha^{104}x^{2} + \alpha^{42}x^{1} + \alpha^{55}x^{0}$

Now you have to combine terms that have the same exponent. In this case, there is more than one x^{10}, x^{9}, x^{8}, x^{7}, x^{6}, x^{5}, x^{4}, x^{3}, x^{2} and x^{1} term.

We will now combine the x^{10} terms. they are:
$\alpha^{251}x^{10} + \alpha^{10}x^{10}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$216x^{10} + 116x^{10}$

After XORing the integers, we convert the result back to an alpha term.
$(216 \oplus 116)x^{10} = 172x^{10} = \alpha^{220}x^{10}$

We will now combine the x^{9} terms. they are:
$\alpha^{67}x^{9} + \alpha^{6}x^{9}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$194x^{9} + 64x^{9}$

After XORing the integers, we convert the result back to an alpha term.
$(194 \oplus 64)x^{9} = 130x^{9} = \alpha^{192}x^{9}$

We will now combine the x^{8} terms. they are:
$\alpha^{46}x^{8} + \alpha^{77}x^{8}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$159x^8 + 60x^8$

After XORing the integers, we convert the result back to an alpha term.
$(159 \oplus 60)x^8 = 163x^8 = \alpha^{91}x^8$

We will now combine the x^7 terms. they are:
$\alpha^{61}x^7 + \alpha^{56}x^7$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$111x^7 + 93x^7$

After XORing the integers, we convert the result back to an alpha term.
$(111 \oplus 93)x^7 = 50x^7 = \alpha^{194}x^7$

We will now combine the x^6 terms. they are:
$\alpha^{118}x^6 + \alpha^{71}x^6$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$199x^6 + 188x^6$

After XORing the integers, we convert the result back to an alpha term.
$(199 \oplus 188)x^6 = 123x^6 = \alpha^{172}x^6$

We will now combine the x^5 terms. they are:
$\alpha^{70}x^5 + \alpha^{128}x^5$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$94x^5 + 133x^5$

After XORing the integers, we convert the result back to an alpha term.
$(94 \oplus 133)x^5 = 219x^5 = \alpha^{177}x^5$

We will now combine the x^4 terms. they are:
$\alpha^{64}x^4 + \alpha^{80}x^4$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$95x^4 + 253x^4$

After XORing the integers, we convert the result back to an alpha term.
$(95 \oplus 253)x^4 = 162x^4 = \alpha^{209}x^4$

We will now combine the x^3 terms. they are:
$\alpha^{94}x^3 + \alpha^{74}x^3$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$113x^3 + 137x^3$

After XORing the integers, we convert the result back to an alpha term.
$(113 \oplus 137)x^3 = 248x^3 = \alpha^{116}x^3$

We will now combine the x^2 terms. they are:
$\alpha^{32}x^2 + \alpha^{104}x^2$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$157x^2 + 13x^2$

After XORing the integers, we convert the result back to an alpha term.
$(157 \oplus 13)x^2 = 144x^2 = \alpha^{227}x^2$

We will now combine the x^1 terms. they are:
$\alpha^{45}x^1 + \alpha^{42}x^1$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$193x^1 + 181x^1$

After XORing the integers, we convert the result back to an alpha term.
$(193 \oplus 181)x^1 = 116x^1 = \alpha^{10}x^1$

Below is the final polynomial from this step after combining the like terms. **If we needed 11 error correction code words, this would be the generator polynomial required.**
$\alpha^{0}x^{11} + \alpha^{220}x^{10} + \alpha^{192}x^{9} + \alpha^{91}x^{8} + \alpha^{194}x^{7} + \alpha^{172}x^{6} + \alpha^{177}x^{5} + \alpha^{209}x^{4} + \alpha^{116}x^{3} + \alpha^{227}x^{2} + \alpha^{10}x^{1} + \alpha^{55}x^{0}$

Multiplication Step #11

Using the polynomial that we got from the previous step, we will multiply $(\alpha^{0}x^{11} + \alpha^{220}x^{10} + \alpha^{192}x^{9} + \alpha^{91}x^{8} + \alpha^{194}x^{7} + \alpha^{172}x^{6} + \alpha^{177}x^{5} + \alpha^{209}x^{4} + \alpha^{116}x^{3} + \alpha^{227}x^{2} + \alpha^{10}x^{1} + \alpha^{55}x^{0})$ by $(\alpha^{0}x^{1} + \alpha^{11}x^{0})$

After multiplying each term from the first part with each term from the second part, we get:
$(\alpha^{0}x^{11} * \alpha^{0}x^{1}) + (\alpha^{220}x^{10} * \alpha^{0}x^{1}) + (\alpha^{192}x^{9} * \alpha^{0}x^{1}) + (\alpha^{91}x^{8} * \alpha^{0}x^{1}) + (\alpha^{194}x^{7} * \alpha^{0}x^{1}) + (\alpha^{172}x^{6} * \alpha^{0}x^{1}) + (\alpha^{177}x^{5} * \alpha^{0}x^{1}) + (\alpha^{209}x^{4} * \alpha^{0}x^{1}) + (\alpha^{116}x^{3} * \alpha^{0}x^{1}) + (\alpha^{227}x^{2} * \alpha^{0}x^{1}) + (\alpha^{10}x^{1} * \alpha^{0}x^{1}) + (\alpha^{55}x^{0} * \alpha^{0}x^{1}) + (\alpha^{0}x^{11} * \alpha^{11}x^{0}) + (\alpha^{220}x^{10} * \alpha^{11}x^{0}) + (\alpha^{192}x^{9} * \alpha^{11}x^{0}) + (\alpha^{91}x^{8} * \alpha^{11}x^{0}) + (\alpha^{194}x^{7} * \alpha^{11}x^{0}) + (\alpha^{172}x^{6} * \alpha^{11}x^{0}) + (\alpha^{177}x^{5} * \alpha^{11}x^{0}) + (\alpha^{209}x^{4} * \alpha^{11}x^{0}) + (\alpha^{116}x^{3} * \alpha^{11}x^{0}) + (\alpha^{227}x^{2} * \alpha^{11}x^{0}) + (\alpha^{10}x^{1} * \alpha^{11}x^{0}) + (\alpha^{55}x^{0} * \alpha^{11}x^{0})$

To multiply, you add the exponents together like this:
$(\alpha^{(0+0)}x^{(11+1)}) + (\alpha^{(220+0)}x^{(10+1)}) + (\alpha^{(192+0)}x^{(9+1)}) + (\alpha^{(91+0)}x^{(8+1)}) + (\alpha^{(194+0)}x^{(7+1)}) + (\alpha^{(172+0)}x^{(6+1)}) + (\alpha^{(177+0)}x^{(5+1)}) + (\alpha^{(209+0)}x^{(4+1)}) + (\alpha^{(116+0)}x^{(3+1)}) + (\alpha^{(227+0)}x^{(2+1)}) + (\alpha^{(10+0)}x^{(1+1)}) + (\alpha^{(55+0)}x^{(0+1)}) + (\alpha^{(0+11)}x^{(11+0)}) + (\alpha^{(220+11)}x^{(10+0)}) + (\alpha^{(192+11)}x^{(9+0)}) + (\alpha^{(91+11)}x^{(8+0)}) + (\alpha^{(194+11)}x^{(7+0)}) + (\alpha^{(172+11)}x^{(6+0)}) + (\alpha^{(177+11)}x^{(5+0)}) + (\alpha^{(209+11)}x^{(4+0)}) + (\alpha^{(116+11)}x^{(3+0)}) + (\alpha^{(227+11)}x^{(2+0)}) + (\alpha^{(10+11)}x^{(1+0)}) + (\alpha^{(55+11)}x^{(0+0)})$

After adding the exponents, this is the result:
$\alpha^{0}x^{12} + \alpha^{220}x^{11} + \alpha^{192}x^{10} + \alpha^{91}x^{9} + \alpha^{194}x^{8} + \alpha^{172}x^{7} + \alpha^{177}x^{6} + \alpha^{209}x^{5} + \alpha^{116}x^{4} + \alpha^{227}x^{3} + \alpha^{10}x^{2} + \alpha^{55}x^{1} + \alpha^{11}x^{11} + \alpha^{231}x^{10} + \alpha^{203}x^{9} + \alpha^{102}x^{8} + \alpha^{205}x^{7} + \alpha^{183}x^{6} + \alpha^{188}x^{5} + \alpha^{220}x^{4} + \alpha^{127}x^{3} + \alpha^{238}x^{2} + \alpha^{21}x^{1} + \alpha^{66}x^{0}$

If there are any exponents that are larger than 255, fix them by putting them through the formula (exponent % 256) + floor(exponent / 256). In this case, all the exponents are less than or equal to 255, so we can continue.

Now you have to combine terms that have the same exponent. In this case, there is more than one x^{11}, x^{10}, x^9, x^8, x^7, x^6, x^5, x^4, x^3, x^2 and x^1 term.

We will now combine the x^{11} terms. they are:
$\alpha^{220}x^{11} + \alpha^{11}x^{11}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$172x^{11} + 232x^{11}$

After XORing the integers, we convert the result back to an alpha term.
$(172 \oplus 232)x^{11} = 68x^{11} = \alpha^{102}x^{11}$

We will now combine the x^{10} terms. they are:
$\alpha^{192}x^{10} + \alpha^{231}x^{10}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$130x^{10} + 245x^{10}$

After XORing the integers, we convert the result back to an alpha term.
$(130 \oplus 245)x^{10} = 119x^{10} = \alpha^{43}x^{10}$

We will now combine the x^9 terms. they are:
$\alpha^{91}x^9 + \alpha^{203}x^9$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$163x^9 + 224x^9$

After XORing the integers, we convert the result back to an alpha term.
$(163 \oplus 224)x^9 = 67x^9 = \alpha^{98}x^9$

We will now combine the x^8 terms. they are:
$\alpha^{194}x^8 + \alpha^{102}x^8$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$50x^8 + 68x^8$

After XORing the integers, we convert the result back to an alpha term.
$(50 \oplus 68)x^8 = 118x^8 = \alpha^{121}x^8$

We will now combine the x^7 terms. they are:
$\alpha^{172}x^7 + \alpha^{205}x^7$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$123x^7 + 167x^7$

After XORing the integers, we convert the result back to an alpha term.
$(123 \oplus 167)x^7 = 220x^7 = \alpha^{187}x^7$

We will now combine the x^6 terms. they are:
$\alpha^{177}x^6 + \alpha^{183}x^6$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$219x^6 + 196x^6$

After XORing the integers, we convert the result back to an alpha term.
$(219 \oplus 196)x^6 = 31x^6 = \alpha^{113}x^6$

We will now combine the x^5 terms. they are:
$\alpha^{209}x^5 + \alpha^{188}x^5$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$162x^5 + 165x^5$

After XORing the integers, we convert the result back to an alpha term.
$(162 \oplus 165)x^5 = 7x^5 = \alpha^{198}x^5$

We will now combine the x^4 terms. they are:
$\alpha^{116}x^4 + \alpha^{220}x^4$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$248x^4 + 172x^4$

After XORing the integers, we convert the result back to an alpha term.
$(248 \oplus 172)x^4 = 84x^4 = \alpha^{143}x^4$

We will now combine the x^3 terms. they are:
$\alpha^{227}x^3 + \alpha^{127}x^3$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$144x^3 + 204x^3$

After XORing the integers, we convert the result back to an alpha term.
$(144 \oplus 204)x^3 = 92x^3 = \alpha^{131}x^3$

We will now combine the x^2 terms. they are:
$\alpha^{10}x^2 + \alpha^{238}x^2$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$116x^2 + 11x^2$

After XORing the integers, we convert the result back to an alpha term.
$(116 \oplus 11)x^2 = 127x^2 = \alpha^{87}x^2$

We will now combine the x^1 terms. they are:
$\alpha^{55}x^1 + \alpha^{21}x^1$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$160x^1 + 117x^1$

After XORing the integers, we convert the result back to an alpha term.
$(160 \oplus 117)x^1 = 213x^1 = \alpha^{157}x^1$

Below is the final polynomial from this step after combining the like terms. **If we needed 12 error correction code words, this would be the generator polynomial required.**
$α^{0}x^{12} + α^{102}x^{11} + α^{43}x^{10} + α^{98}x^{9} + α^{121}x^{8} + α^{187}x^{7} + α^{113}x^{6} + α^{198}x^{5} + α^{143}x^{4} + α^{131}x^{3} + α^{87}x^{2} + α^{157}x^{1} + α^{66}x^{0}$

Multiplication Step #12

Using the polynomial that we got from the previous step, we will multiply $(α^{0}x^{12} + α^{102}x^{11} + α^{43}x^{10} + α^{98}x^{9} + α^{121}x^{8} + α^{187}x^{7} + α^{113}x^{6} + α^{198}x^{5} + α^{143}x^{4} + α^{131}x^{3} + α^{87}x^{2} + α^{157}x^{1} + α^{66}x^{0})$ by $(α^{0}x^{1} + α^{12}x^{0})$

After multiplying each term from the first part with each term from the second part, we get:
$(α^{0}x^{12} * α^{0}x^{1}) + (α^{102}x^{11} * α^{0}x^{1}) + (α^{43}x^{10} * α^{0}x^{1}) + (α^{98}x^{9} * α^{0}x^{1}) + (α^{121}x^{8} * α^{0}x^{1}) + (α^{187}x^{7} * α^{0}x^{1}) + (α^{113}x^{6} * α^{0}x^{1}) + (α^{198}x^{5} * α^{0}x^{1}) + (α^{143}x^{4} * α^{0}x^{1}) + (α^{131}x^{3} * α^{0}x^{1}) + (α^{87}x^{2} * α^{0}x^{1}) + (α^{157}x^{1} * α^{0}x^{1}) + (α^{66}x^{0} * α^{0}x^{1}) + (α^{0}x^{12} * α^{12}x^{0}) + (α^{102}x^{11} * α^{12}x^{0}) + (α^{43}x^{10} * α^{12}x^{0}) + (α^{98}x^{9} * α^{12}x^{0}) + (α^{121}x^{8} * α^{12}x^{0}) + (α^{187}x^{7} * α^{12}x^{0}) + (α^{113}x^{6} * α^{12}x^{0}) + (α^{198}x^{5} * α^{12}x^{0}) + (α^{143}x^{4} * α^{12}x^{0}) + (α^{131}x^{3} * α^{12}x^{0}) + (α^{87}x^{2} * α^{12}x^{0}) + (α^{157}x^{1} * α^{12}x^{0}) + (α^{66}x^{0} * α^{12}x^{0})$

To multiply, you add the exponents together like this:
$(α^{(0+0)}x^{(12+1)}) + (α^{(102+0)}x^{(11+1)}) + (α^{(43+0)}x^{(10+1)}) + (α^{(98+0)}x^{(9+1)}) + (α^{(121+0)}x^{(8+1)}) + (α^{(187+0)}x^{(7+1)}) + (α^{(113+0)}x^{(6+1)}) + (α^{(198+0)}x^{(5+1)}) + (α^{(143+0)}x^{(4+1)}) + (α^{(131+0)}x^{(3+1)}) + (α^{(87+0)}x^{(2+1)}) + (α^{(157+0)}x^{(1+1)}) + (α^{(66+0)}x^{(0+1)}) + (α^{(0+12)}x^{(12+0)}) + (α^{(102+12)}x^{(11+0)}) + (α^{(43+12)}x^{(10+0)}) + (α^{(98+12)}x^{(9+0)}) + (α^{(121+12)}x^{(8+0)}) + (α^{(187+12)}x^{(7+0)}) + (α^{(113+12)}x^{(6+0)}) + (α^{(198+12)}x^{(5+0)}) + (α^{(143+12)}x^{(4+0)}) + (α^{(131+12)}x^{(3+0)}) + (α^{(87+12)}x^{(2+0)}) + (α^{(157+12)}x^{(1+0)}) + (α^{(66+12)}x^{(0+0)})$

After adding the exponents, this is the result:
$α^{0}x^{13} + α^{102}x^{12} + α^{43}x^{11} + α^{98}x^{10} + α^{121}x^{9} + α^{187}x^{8} + α^{113}x^{7} + α^{198}x^{6} + α^{143}x^{5} + α^{131}x^{4} + α^{87}x^{3} + α^{157}x^{2} + α^{66}x^{1} + α^{12}x^{12} + α^{114}x^{11} + α^{55}x^{10} + α^{110}x^{9} + α^{133}x^{8} + α^{199}x^{7} + α^{125}x^{6} + α^{210}x^{5} + α^{155}x^{4} + α^{143}x^{3} + α^{99}x^{2} + α^{169}x^{1} + α^{78}x^{0}$

If there are any exponents that are larger than 255, fix them by putting them through the formula (exponent % 256) + floor(exponent / 256). In this case, all the exponents are less than or equal to 255, so we can continue.

Now you have to combine terms that have the same exponent. In this case, there is more than one x^{12}, x^{11}, x^{10}, x^{9}, x^{8}, x^{7}, x^{6}, x^{5}, x^{4}, x^{3}, x^{2} and x^{1} term.

We will now combine the x^{12} terms. they are:
$α^{102}x^{12} + α^{12}x^{12}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$68x^{12} + 205x^{12}$

After XORing the integers, we convert the result back to an alpha term.
$(68 ⊕ 205)x^{12} = 137x^{12} = α^{74}x^{12}$

We will now combine the x^{11} terms. they are:
$α^{43}x^{11} + α^{114}x^{11}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$119x^{11} + 62x^{11}$

After XORing the integers, we convert the result back to an alpha term.
$(119 \oplus 62)x^{11} = 73x^{11} = \alpha^{152}x^{11}$

We will now combine the x^{10} terms. they are:
$\alpha^{98}x^{10} + \alpha^{55}x^{10}$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$67x^{10} + 160x^{10}$

After XORing the integers, we convert the result back to an alpha term.
$(67 \oplus 160)x^{10} = 227x^{10} = \alpha^{176}x^{10}$

We will now combine the x^9 terms. they are:
$\alpha^{121}x^9 + \alpha^{110}x^9$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$118x^9 + 103x^9$

After XORing the integers, we convert the result back to an alpha term.
$(118 \oplus 103)x^9 = 17x^9 = \alpha^{100}x^9$

We will now combine the x^8 terms. they are:
$\alpha^{187}x^8 + \alpha^{133}x^8$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$220x^8 + 109x^8$

After XORing the integers, we convert the result back to an alpha term.
$(220 \oplus 109)x^8 = 177x^8 = \alpha^{86}x^8$

We will now combine the x^7 terms. they are:
$\alpha^{113}x^7 + \alpha^{199}x^7$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$31x^7 + 14x^7$

After XORing the integers, we convert the result back to an alpha term.
$(31 \oplus 14)x^7 = 17x^7 = \alpha^{100}x^7$

We will now combine the x^6 terms. they are:
$\alpha^{198}x^6 + \alpha^{125}x^6$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$7x^6 + 51x^6$

After XORing the integers, we convert the result back to an alpha term.
$(7 \oplus 51)x^6 = 52x^6 = \alpha^{106}x^6$

We will now combine the x^5 terms. they are:
$\alpha^{143}x^5 + \alpha^{210}x^5$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$84x^5 + 89x^5$

After XORing the integers, we convert the result back to an alpha term.
$(84 \oplus 89)x^5 = 13x^5 = \alpha^{104}x^5$

We will now combine the x^4 terms. they are:
$\alpha^{131}x^4 + \alpha^{155}x^4$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$92x^4 + 114x^4$

After XORing the integers, we convert the result back to an alpha term.
$(92 \oplus 114)x^4 = 46x^4 = \alpha^{130}x^4$

We will now combine the x^3 terms. they are:
$\alpha^{87}x^3 + \alpha^{143}x^3$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$127x^3 + 84x^3$

After XORing the integers, we convert the result back to an alpha term.
$(127 \oplus 84)x^3 = 43x^3 = \alpha^{218}x^3$

We will now combine the x^2 terms. they are:
$\alpha^{157}x^2 + \alpha^{99}x^2$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$213x^2 + 134x^2$

After XORing the integers, we convert the result back to an alpha term.
$(213 \oplus 134)x^2 = 83x^2 = \alpha^{206}x^2$

We will now combine the x^1 terms. they are:
$\alpha^{66}x^1 + \alpha^{169}x^1$

We will convert the above alphas to integers using the log antilog table (log-antilog-table) to make this step easier:
$97x^1 + 229x^1$

After XORing the integers, we convert the result back to an alpha term.
$(97 \oplus 229)x^1 = 132x^1 = \alpha^{140}x^1$

Below is the final polynomial from this step after combining the like terms. **If we needed 13 error correction code words, this would be the generator polynomial required.**
$\alpha^{0}x^{13} + \alpha^{74}x^{12} + \alpha^{152}x^{11} + \alpha^{176}x^{10} + \alpha^{100}x^{9} + \alpha^{86}x^{8} + \alpha^{100}x^{7} + \alpha^{106}x^{6} + \alpha^{104}x^{5} + \alpha^{130}x^{4} + \alpha^{218}x^{3} + \alpha^{206}x^{2} + \alpha^{140}x^{1} + \alpha^{78}x^{0}$

Final result:
$(\alpha^{0}x^{13} + \alpha^{74}x^{12} + \alpha^{152}x^{11} + \alpha^{176}x^{10} + \alpha^{100}x^{9} + \alpha^{86}x^{8} + \alpha^{100}x^{7} + \alpha^{106}x^{6} + \alpha^{104}x^{5} + \alpha^{130}x^{4} + \alpha^{218}x^{3} + \alpha^{206}x^{2} + \alpha^{140}x^{1} + \alpha^{78}x^{0})$

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