

# POLYNOME IN MAPLE

## Eingabe von Polynomen

```
> restart;
```

```
> f:=3*x^2+7*x^5-2*x^3+x+1;
```

$$f := 3x^2 + 7x^5 - 2x^3 + x + 1$$

```
> f:=sort(f);
```

$$f := 7x^5 - 2x^3 + 3x^2 + x + 1$$

```
> g:=randpoly(x,degree=8);
```

$$g := -73 + 87x^8 - 56x^6 - 62x^4 + 97x$$

## Grad, Koeffizienten, Leitkoeffizient

```
> degree(f);
```

5

```
> degree(g);
```

8

```
> coeff(f,x,5);
```

7

```
> coeff(f,x,4);
```

0

```
> lcoeff(f);
```

7

```
> lcoeff(g);
```

## Rechenoperationen

> **f+g;**

$$7x^5 - 2x^3 + 3x^2 + 98x - 72 + 87x^8 - 56x^6 - 62x^4$$

> **sort(f+g);**

$$87x^8 - 56x^6 + 7x^5 - 62x^4 - 2x^3 + 3x^2 + 98x - 72$$

> **f\*g;**

$$(7x^5 - 2x^3 + 3x^2 + x + 1)$$

$$(-73 + 87x^8 - 56x^6 - 62x^4 + 97x)$$

> **expand(f\*g);**

$$\begin{aligned} & -73 - 122x^2 - 573x^5 + 437x^3 + 24x - 81x^8 + 437x^6 - 256x^4 \\ & + 609x^{13} - 566x^{11} - 235x^9 + 68x^7 + 261x^{10} \end{aligned}$$

> **sort(%);**

$$\begin{aligned} & 609x^{13} - 566x^{11} + 261x^{10} - 235x^9 - 81x^8 + 68x^7 + 437x^6 \\ & - 573x^5 - 256x^4 + 437x^3 - 122x^2 + 24x - 73 \end{aligned}$$

> **f^2;**

$$(7x^5 - 2x^3 + 3x^2 + x + 1)^2$$

> **sort(expand(%));**

$$\begin{aligned} & 49x^{10} - 28x^8 + 42x^7 + 18x^6 + 2x^5 + 5x^4 + 2x^3 + 7x^2 + 2x \\ & + 1 \end{aligned}$$

## Division mit Rest

> **rem(g, f, x, m);**

$$-\frac{3316}{49} - \frac{4083}{49}x^4 + \frac{5232}{49}x - \frac{477}{49}x^3 + \frac{143}{7}x^2$$

> **m;**

$$\frac{87}{7}x^3 - \frac{218}{49}x - \frac{261}{49}$$

> **quo(g,f,x,r);**

$$\frac{87}{7}x^3 - \frac{218}{49}x - \frac{261}{49}$$

> **r;**

$$-\frac{3316}{49} - \frac{4083}{49}x^4 + \frac{5232}{49}x - \frac{477}{49}x^3 + \frac{143}{7}x^2$$

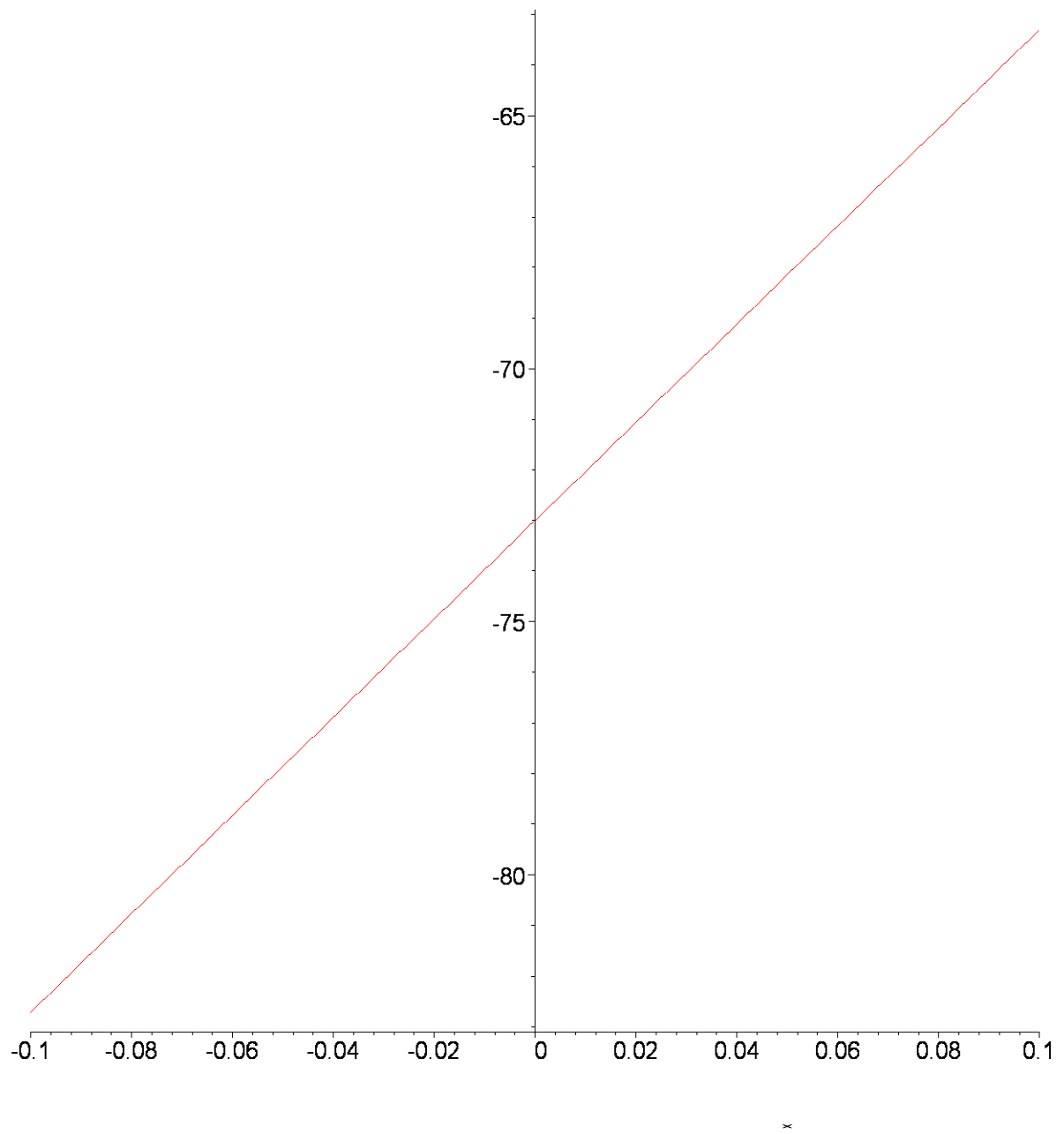
## Interpolation

> **interp([-1,0,1,2,3],[5,4,4,-2,-2],x);**

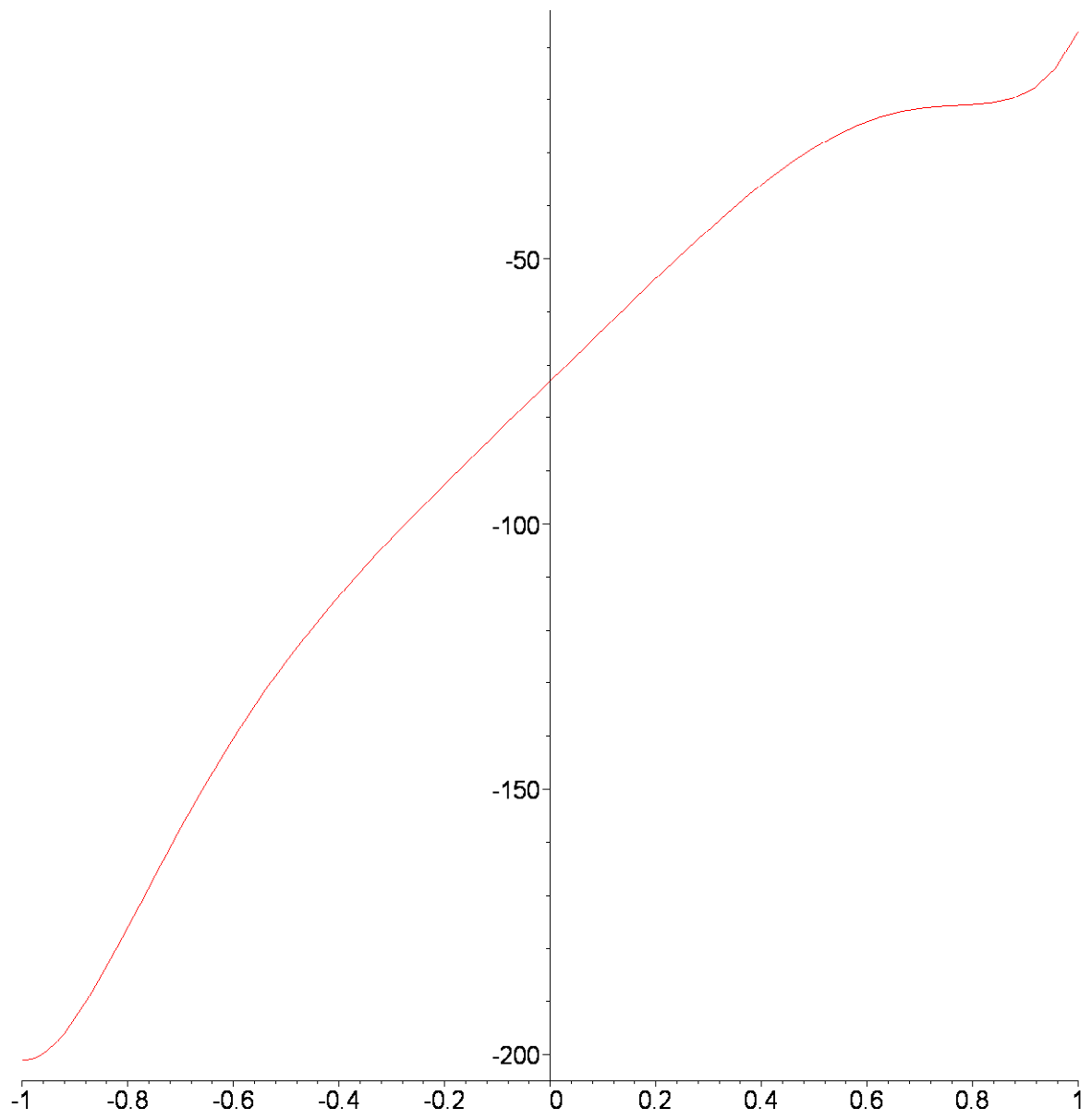
$$\frac{19}{24}x^4 - \frac{11}{4}x^3 - \frac{7}{24}x^2 + \frac{9}{4}x + 4$$

## Graph einer Polynomfunktion

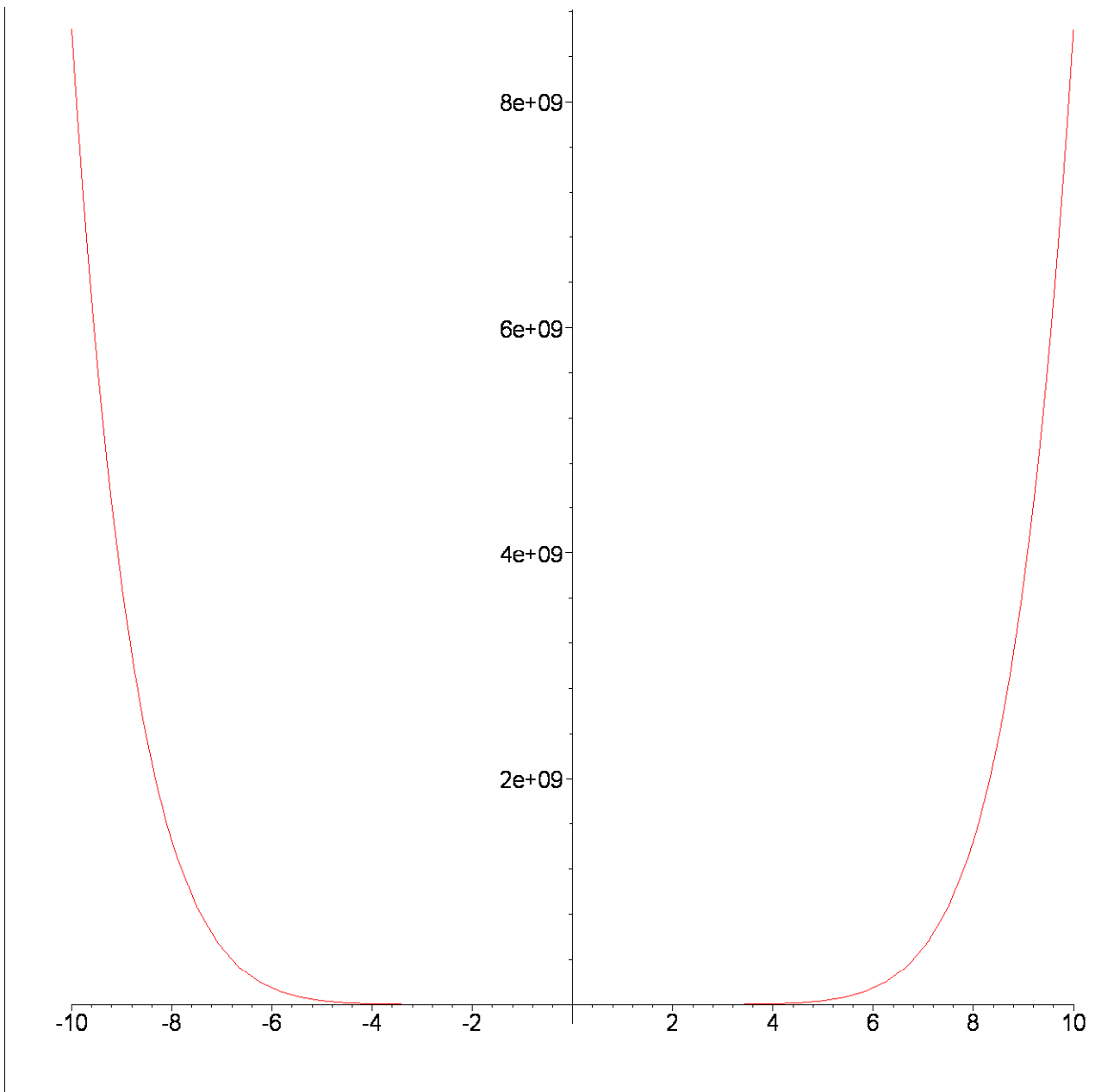
> **plot(g, x=-0.1..0.1);**



```
> plot(g, x=-1..1);
```



```
> plot(g, x=-10..10);
```



## Nullstellen von Polynomen

```
> restart;
```

```
> solve(x^2+3*x-1);
```

$$-\frac{3}{2} + \frac{\sqrt{13}}{2}, -\frac{3}{2} - \frac{\sqrt{13}}{2}$$

```
> h:=x^6+x^5-2*x^3+4*x+3;
```

$$h := x^6 + x^5 - 2x^3 + 4x + 3$$

> **solve(h);**

RootOf( $_Z^6 + _Z^5 - 2_Z^3 + 4_Z + 3$ , *index* = 1),

RootOf( $_Z^6 + _Z^5 - 2_Z^3 + 4_Z + 3$ , *index* = 2),

RootOf( $_Z^6 + _Z^5 - 2_Z^3 + 4_Z + 3$ , *index* = 3),

RootOf( $_Z^6 + _Z^5 - 2_Z^3 + 4_Z + 3$ , *index* = 4),

RootOf( $_Z^6 + _Z^5 - 2_Z^3 + 4_Z + 3$ , *index* = 5),

RootOf( $_Z^6 + _Z^5 - 2_Z^3 + 4_Z + 3$ , *index* = 6)

> **f :=**

$$56*x^{18} - 2583*x^{17} - 7336*x^{16} - 9995*x^{15} - 14190*x^{14} - 6023*x^{13} - 4515*x^{12} - 9722*x^{11} - 547*x^{10} - 11223*x^9 + 9179*x^8 + 14584*x^7 - 1597*x^6 + 9537*x^5 - 6702*x^4 - 5561*x^3 + 8057*x^2 - 4534*x + 688;$$

$$f := 56x^{18} - 2583x^{17} - 7336x^{16} - 9995x^{15} - 14190x^{14} - 6023x^{13} - 4515x^{12} - 9722x^{11} - 547x^{10} - 11223x^9 + 9179x^8 + 14584x^7 - 1597x^6 + 9537x^5 - 6702x^4 - 5561x^3 + 8057x^2 - 4534x + 688$$

> **solve(f);**

RootOf(

$$56_Z^6 + 49_Z^5 + 63_Z^4 + 57_Z^3 - 59_Z^2 + 45_Z - 8,$$

*index* = 1), RootOf(

$$56_Z^6 + 49_Z^5 + 63_Z^4 + 57_Z^3 - 59_Z^2 + 45_Z - 8,$$

*index* = 2), RootOf(

$$56_Z^6 + 49_Z^5 + 63_Z^4 + 57_Z^3 - 59_Z^2 + 45_Z - 8,$$

*index* = 3), RootOf(

$$56 \_Z^6 + 49 \_Z^5 + 63 \_Z^4 + 57 \_Z^3 - 59 \_Z^2 + 45 \_Z - 8,$$

*index* = 4), RootOf(

$$56 \_Z^6 + 49 \_Z^5 + 63 \_Z^4 + 57 \_Z^3 - 59 \_Z^2 + 45 \_Z - 8,$$

*index* = 5), RootOf(

$$56 \_Z^6 + 49 \_Z^5 + 63 \_Z^4 + 57 \_Z^3 - 59 \_Z^2 + 45 \_Z - 8,$$

*index* = 6), RootOf( $\_Z^{12} - 47 \_Z^{11} - 91 \_Z^{10} - 47 \_Z^9 - 61 \_Z^8$

$$+ 41 \_Z^7 - 58 \_Z^6 - 90 \_Z^5 + 53 \_Z^4 - \_Z^3 + 94 \_Z^2 + 83 \_Z$$

$$- 86, \textit{index} = 1), \text{RootOf}(\_Z^{12} - 47 \_Z^{11} - 91 \_Z^{10} - 47 \_Z^9$$

$$- 61 \_Z^8 + 41 \_Z^7 - 58 \_Z^6 - 90 \_Z^5 + 53 \_Z^4 - \_Z^3 + 94 \_Z^2$$

$$+ 83 \_Z - 86, \textit{index} = 2), \text{RootOf}(\_Z^{12} - 47 \_Z^{11} - 91 \_Z^{10}$$

$$- 47 \_Z^9 - 61 \_Z^8 + 41 \_Z^7 - 58 \_Z^6 - 90 \_Z^5 + 53 \_Z^4 - \_Z^3$$

$$+ 94 \_Z^2 + 83 \_Z - 86, \textit{index} = 3), \text{RootOf}(\_Z^{12} - 47 \_Z^{11}$$

$$- 91 \_Z^{10} - 47 \_Z^9 - 61 \_Z^8 + 41 \_Z^7 - 58 \_Z^6 - 90 \_Z^5$$

$$+ 53 \_Z^4 - \_Z^3 + 94 \_Z^2 + 83 \_Z - 86, \textit{index} = 4), \text{RootOf}(\_Z^{12}$$

$$- 47 \_Z^{11} - 91 \_Z^{10} - 47 \_Z^9 - 61 \_Z^8 + 41 \_Z^7 - 58 \_Z^6$$

$$- 90 \_Z^5 + 53 \_Z^4 - \_Z^3 + 94 \_Z^2 + 83 \_Z - 86, \textit{index} = 5),$$

$$\text{RootOf}(\_Z^{12} - 47 \_Z^{11} - 91 \_Z^{10} - 47 \_Z^9 - 61 \_Z^8 + 41 \_Z^7$$

$$- 58 \_Z^6 - 90 \_Z^5 + 53 \_Z^4 - \_Z^3 + 94 \_Z^2 + 83 \_Z - 86,$$

*index* = 6), RootOf( $\_Z^{12} - 47 \_Z^{11} - 91 \_Z^{10} - 47 \_Z^9 - 61 \_Z^8$

$$+ 41 \_Z^7 - 58 \_Z^6 - 90 \_Z^5 + 53 \_Z^4 - \_Z^3 + 94 \_Z^2 + 83 \_Z$$

$$- 86, \textit{index} = 7), \text{RootOf}(\_Z^{12} - 47 \_Z^{11} - 91 \_Z^{10} - 47 \_Z^9$$

$$- 61 \_Z^8 + 41 \_Z^7 - 58 \_Z^6 - 90 \_Z^5 + 53 \_Z^4 - \_Z^3 + 94 \_Z^2$$

$$+ 83 \_Z - 86, \textit{index} = 8), \text{RootOf}(\_Z^{12} - 47 \_Z^{11} - 91 \_Z^{10}$$



$-47 Z^9 - 61 Z^8 + 41 Z^7 - 58 Z^6 - 90 Z^5 + 53 Z^4 - Z^3$   
 $+ 94 Z^2 + 83 Z - 86, index = 9), \text{RootOf}(Z^{12} - 47 Z^{11}$   
 $- 91 Z^{10} - 47 Z^9 - 61 Z^8 + 41 Z^7 - 58 Z^6 - 90 Z^5$   
 $+ 53 Z^4 - Z^3 + 94 Z^2 + 83 Z - 86, index = 10), \text{RootOf}($   
 $Z^{12} - 47 Z^{11} - 91 Z^{10} - 47 Z^9 - 61 Z^8 + 41 Z^7 - 58 Z^6$   
 $- 90 Z^5 + 53 Z^4 - Z^3 + 94 Z^2 + 83 Z - 86, index = 11),$   
 $\text{RootOf}(Z^{12} - 47 Z^{11} - 91 Z^{10} - 47 Z^9 - 61 Z^8 + 41 Z^7$   
 $- 58 Z^6 - 90 Z^5 + 53 Z^4 - Z^3 + 94 Z^2 + 83 Z - 86,$   
 $index = 12)$

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