

```
> restart;
```

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> # Backwards Differentiation Formula
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```
> sigma0:=w->w^s;
```

$$\sigma_0 := w \rightarrow w^s$$

```
> s:=6;
```

$$s := 6$$

```
> logseries:=convert(subs(v=1/w-1,series(log(1+v),v,s+1)),polynom);
```

$$\begin{aligned} \logseries := & \frac{1}{w} - 1 - \frac{1}{2} \left(\frac{1}{w} - 1 \right)^2 + \frac{1}{3} \left(\frac{1}{w} - 1 \right)^3 - \frac{1}{4} \left(\frac{1}{w} - 1 \right)^4 + \frac{1}{5} \left(\frac{1}{w} - 1 \right)^5 \\ & - \frac{1}{6} \left(\frac{1}{w} - 1 \right)^6 \end{aligned}$$

```
> rho0:=-simplify(sigma0(w)*logseries);
```

$$\rho_0 := -6 w^5 + \frac{15}{2} w^4 - \frac{20}{3} w^3 - \frac{6}{5} w + \frac{1}{6} + \frac{15}{4} w^2 + \frac{49}{20} w^6$$

```
> beta:=1/coeff(rho0,w,s);
```

$$\beta := \frac{20}{49}$$

```
> sigma:=beta*sigma0(w);
```

$$\sigma := \frac{20}{49} w^6$$

```
> rho:=beta*rho0;
```

$$\rho := -\frac{120}{49} w^5 + \frac{150}{49} w^4 - \frac{400}{147} w^3 - \frac{24}{49} w + \frac{10}{147} + \frac{75}{49} w^2 + w^6$$

```
> R:=[solve(rho=0)];
```

$$\begin{aligned} R := & [1, \text{RootOf}(147_Z^5 - 213_Z^4 + 237_Z^3 - 163_Z^2 + 62_Z - 10, \text{index} = 1), \\ & \text{RootOf}(147_Z^5 - 213_Z^4 + 237_Z^3 - 163_Z^2 + 62_Z - 10, \text{index} = 2), \\ & \text{RootOf}(147_Z^5 - 213_Z^4 + 237_Z^3 - 163_Z^2 + 62_Z - 10, \text{index} = 3), \\ & \text{RootOf}(147_Z^5 - 213_Z^4 + 237_Z^3 - 163_Z^2 + 62_Z - 10, \text{index} = 4), \\ & \text{RootOf}(147_Z^5 - 213_Z^4 + 237_Z^3 - 163_Z^2 + 62_Z - 10, \text{index} = 5)] \end{aligned}$$

```
> seq(abs(evalf(R[i])),i=1..s);
```

$$1., 0.4061232669, 0.4740348577, 0.8633802679, 0.8633802679, 0.4740348577$$

