

```
> restart;
```

```
> #Section 4.7 number 3b
```

```
N:=4;
```

$$N := 4$$

```
> #Create the Legendre Polynomials
```

```
P[0]:=1;
```

```
for n from 1 to N
```

```
do
```

```
  P[n]:=1/(n!*2^n)*diff((x^2-1)^n,x^n);
```

```
end;
```

$$P_0 := 1$$
$$P_1 := x$$
$$P_2 := \frac{3}{2}x^2 - \frac{1}{2}$$
$$P_3 := x^3 + \frac{3}{2}(x^2 - 1)x$$
$$P_4 := x^4 + 3(x^2 - 1)x^2 + \frac{3}{8}(x^2 - 1)^2$$

```
> dp:=(f,g)->int(f*g,x=-1..1);
```

```
nm:=f->sqrt(dp(f,f));
```

$$dp := (f, g) \rightarrow \int_{-1}^1 f g dx$$
$$nm := f \rightarrow \sqrt{dp(f, f)}$$

```
> f:=log(1+x^2);
```

$$f := \ln(1 + x^2)$$

```
> for n from 0 to N
```

```
do
```

```
  beta[n]:=dp(f,P[n])/dp(P[n],P[n]);
```

```
end;
```

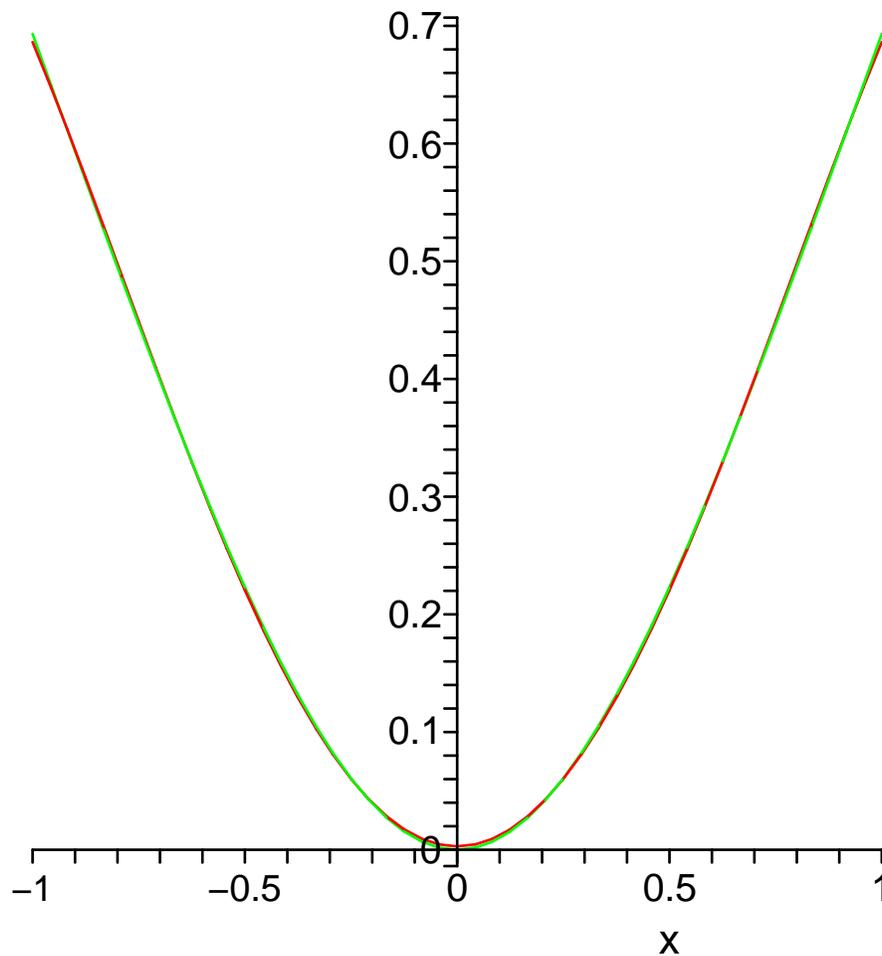
$$\beta_0 := \ln(2) - 2 + \frac{1}{2} \pi$$
$$\beta_1 := 0$$
$$\beta_2 := -\frac{5}{2} \pi + \frac{25}{3}$$
$$\beta_3 := 0$$

$$\beta_4 := \frac{45}{4} \pi - \frac{177}{5}$$

```
> p:=collect(sum(beta[j]*P[j],j=0..N),x);
```

$$p := \left( \frac{1575}{32} \pi - \frac{1239}{8} \right) x^4 + \left( -\frac{735}{16} \pi + \frac{581}{4} \right) x^2 + \ln(2) - \frac{2333}{120} + \frac{191}{32} \pi$$

```
> plot({p,f},x=-1..1);
```



```
> #plot of the errors on [-1,1]  
plot(f-p,x=-1..1);
```

