# Lösungen

## 1

### a

```
D[a5 t^5+3 t^4 +2 x^2+a2 t^2-8 t-11,t]
```

$$-8+2\,a2\,t+12\,t^3+5\,a5\,t^4$$

### b

```
D[Tan[x]-E^x+E^(-x)-1/2,x]
```

$$-e^{-x}-e^{x}+\text{Sec}[x]^2$$

### v

```
D[Cos[x]-Log[pi x] Sqrt[x],x]
```

$$-\frac{1}{\sqrt{x}}-\frac{\text{Log}[\text{pi}\,x]}{2\sqrt{x}}-\text{Sin}[x]$$

### d

```
D[Sin[x] Log[x]-E^x/x,x]
```

$$\frac{e^x}{x^2}-\frac{e^x}{x}+\text{Cos}[x]\,\text{Log}[x]+\frac{\text{Sin}[x]}{x}$$

### e

```
D[Sin[3 E^x]+2 E^(-x^3),x]
```

$$-6\,e^{-x^3}\,x^2+3\,e^{x}\,\text{Cos}[3\,e^{x}]$$

### f

```
D[ArcSin[-Sin[x]],x]
```

$$-\frac{\text{Cos}[x]}{\sqrt{1-\text{Sin}[x]^2}}$$

**D[ArcSin[-Sin[x]],x]/.x->1.0**

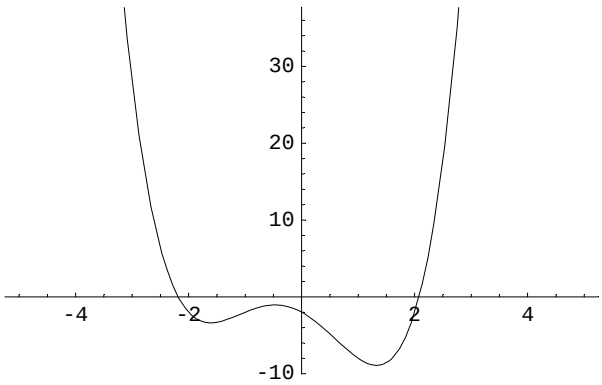
```
-1.
```

---

# 2

**f[x_]:=(x-2) x (x+1) (x+2)-2**

**Plot[(x-2) x (x+1) (x+2)-2,{x,-5,5}];**




**FindRoot[f[x]==0,{x,-2}]**

$$\{x \to -2.18467\}$$

**FindRoot[f[x]==0,{x,2}]**

$$\{x \to 2.07678\}$$

**Solve[(x-2) x (x+1) (x+2)==0,{x}]**

$$\{\{x \to -2\}, \{x \to -1\}, \{x \to 0\}, \{x \to 2\}\}$$

**(x-2) x (x+1) (x+2)//Expand**

$$-4\,x - 4\,x^2 + x^3 + x^4$$

**D[(x-2) x (x+1) (x+2),x]**

$$(-2+x)\,x\,(1+x) + (-2+x)\,x\,(2+x) + (-2+x)\,(1+x)\,(2+x) + x\,(1+x)\,(2+x)$$

**D[(x-2) x (x+1) (x+2),x]//Expand**

$$-4 - 8\,x + 3\,x^2 + 4\,x^3$$

**Solve[Evaluate[D[(x-2) x (x+1) (x+2)-2,x]==0],{x}]**

$$\left\{\left\{x \to -\frac{1}{4} + \frac{7\,5^{2/3}}{4\left(3\left(27+8\,i\sqrt{69}\right)\right)^{1/3}} + \frac{\left(5\left(27+8\,i\sqrt{69}\right)\right)^{1/3}}{4\,3^{2/3}}\right\},\right.$$

$$\left\{x \to -\frac{1}{4} - \frac{7\,5^{2/3}\left(1+i\sqrt{3}\right)}{8\left(3\left(27+8\,i\sqrt{69}\right)\right)^{1/3}} - \frac{\left(1-i\sqrt{3}\right)\left(5\left(27+8\,i\sqrt{69}\right)\right)^{1/3}}{8\,3^{2/3}}\right\},$$

$$\left.\left\{x \to -\frac{1}{4} - \frac{7\,5^{2/3}\left(1-i\sqrt{3}\right)}{8\left(3\left(27+8\,i\sqrt{69}\right)\right)^{1/3}} - \frac{\left(1+i\sqrt{3}\right)\left(5\left(27+8\,i\sqrt{69}\right)\right)^{1/3}}{8\,3^{2/3}}\right\}\right\}$$

**solv1=Solve[Evaluate[D[(x-2) x (x+1) (x+2)-2,x]==0],{x}]//N//Chop//Flatten**

$\{x \to 1.32635, x \to -1.60725, x \to -0.469093\}$

**Table[f[x]/.solv1[[k]],{k,1,3}]**

$\{-8.9141, -3.38275, -1.05862\}$

**D[(x-2) x (x+1) (x+2),{x,2}]**

$2\,(-2+x)\,x+2\,(1+x)\,(2+x)+2\,(-2+2\,x)\,(3+2\,x)$

**D[(x-2) x (x+1) (x+2),{x,2}]//Expand**

$-8+6\,x+12\,x^2$

**solv2=Solve[Evaluate[D[(x-2) x (x+1) (x+2),{x,2}]==0],{x}]//N//Chop//Flatten**

$\{x \to -1.10391, x \to 0.603913\}$

**Table[f[x]/.solv2[[k]],{k,1,2}]**

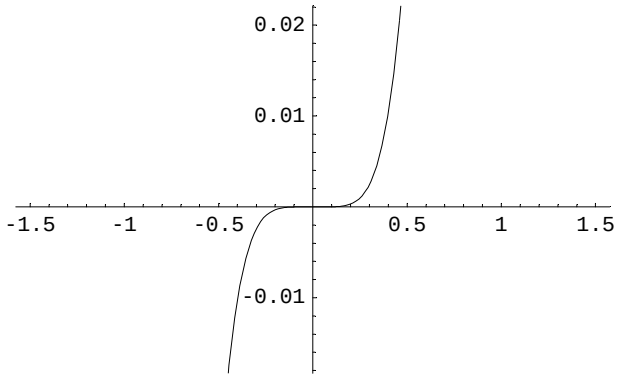
$\{-2.31905, -5.52122\}$

---

## 3

**f[x_]:=x^5**

**Plot[x^5,{x,-1.5,1.5}];**




**t[x_,x0_]:=Evaluate[f'[x0](x-x0)+f[x0]]**

**t[x,x0]**

$5\,(x-x0)\,x0^4+x0^5$

**Solve[t[x,x0]==0,{x}]**

$\left\{\left\{x \to \frac{4\,x0}{5}\right\}\right\}$

**t[0,x0]**

$-4\,x0^5$

**n[x_,x0_]:=Evaluate[-1/f'[x0](x-x0)+f[x0]]**

```
solv=Solve[n[x,x0]==0,{x}]//Flatten
```

$$\{x \to x0\ (1 + 5\ x0^8)\}$$

```
n[0,x0]
```

$$\frac{1}{5\ x0^3} + x0^5$$

## 1

```
(x0-4/5 x0)f[x0]/2
```

$$\frac{x0^6}{10}$$

```
(x0-4/5 x0)f[x0]/2 /.x0->2.
```

```
6.4
```

## 2

```
4/5 x0 (-4x0^5)/2
```

$$-\frac{8\ x0^6}{5}$$

```
4/5 x0 (-4x0^5)/2/.x0->2.
```

```
-102.4
```

## 3

```
n[0,x0] x/2/.solv
```

$$\frac{1}{2}\ x0\ \left(\frac{1}{5\ x0^3} + x0^5\right)\ (1 + 5\ x0^8)$$

```
n[0,x0] x/2/.solv /.x0->2.
```

```
41024.
```

```
n[0,x0] x/2/.solv //Expand
```

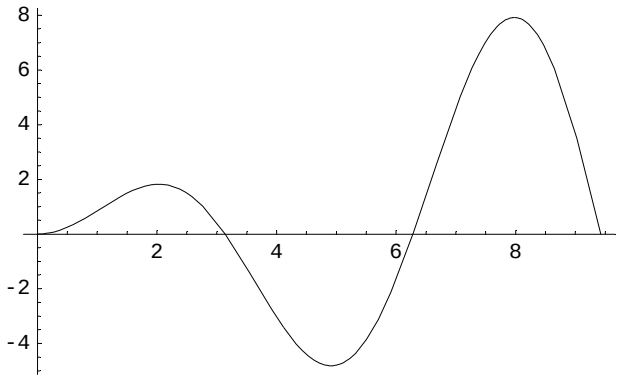
$$\frac{1}{10\ x0^2} + x0^6 + \frac{5\ x0^{14}}{2}$$

---

## 4

```
f[x_]:=x Sin[x]
```

**Plot[f[x],{x,0,3Pi}];**




**D[x Sin[x],x]**

```
x Cos[x] + Sin[x]
```

**fr=FindRoot[Evaluate[D[x Sin[x],x]==0],{x,0}]**

```
{x → 0.}
```

**f[x]/.fr**

```
0.
```

**fr=FindRoot[Evaluate[D[x Sin[x],x]==0],{x,2}]**

```
{x → 2.02876}
```

**f[x]/.fr**

```
1.81971
```

**fr=FindRoot[Evaluate[D[x Sin[x],x]==0],{x,5}]**

```
{x → 4.91318}
```

**f[x]/.fr**

```
-4.81447
```

**fr=FindRoot[Evaluate[D[x Sin[x],x]==0],{x,8}]**

```
{x → 7.97867}
```

**f[x]/.fr**

```
7.91673
```

**D[x Sin[x],{x,2}]**

```
2 Cos[x] - x Sin[x]
```

**fr=FindRoot[Evaluate[D[x Sin[x],{x,2}]==0],{x,1}]**

```
{x → 1.07687}
```

**f[x]/.fr**

```
0.948166
```

```
fr=FindRoot[Evaluate[D[x Sin[x],{x,2}]==0],{x,4}]
```

```
{x → 3.6436}
```

```
f[x]/.fr
```

```
-1.75324
```

```
fr=FindRoot[Evaluate[D[x Sin[x],{x,2}]==0],{x,6}]
```

```
{x → 6.57833}
```

```
f[x]/.fr
```

```
1.91352
```

```
fr=FindRoot[Evaluate[D[x Sin[x],{x,2}]==0],{x,9}]
```

```
{x → 9.62956}
```

```
f[x]/.fr
```

```
-1.95821
```

---

## 5

```
Limit[(4x+Tan[2x])/Sin[x],x->0]
```

```
6
```

```
Limit[α (x^3+x^2-2+Log[x-1])/(Pi x^3-Pi),x->1]
```

```
α (-∞)
```