

# Uebungen ■ Exercices

## 4. Graphiken ■ Graphiques

Die Gliederung dieses Kurses folgt in groben Zügen dem Buch von Nancy Blachman: A Practical Approach....

Hinweis: Kapitel 4 lesen!

Run mit WIN+*Mathematica* Version 5.2

■ L'articulation de ce cours correspond à peu près à celle du livre de Nancy Blachman: A Practical Approach....

Indication: Lire le chapitre 4.

Testé avec *Mathematica* version 5.2+WIN

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## Aufgabe 1 ■ Problème 1

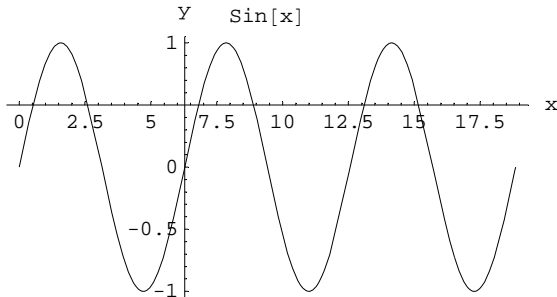
**Spiele ein wenig mit den Options**

■ **Joue un peu avec les options**

Sinus ohne ";"

■ Sinus sans ";"

```
In[1]:= Plot[Sin[x],{x,0,6 Pi},
  AspectRatio -> 1/2,
  PlotLabel -> "Sin[x]",
  AxesLabel -> {"x", "y"},
  AxesOrigin -> {2 Pi, 1/2} ]
```

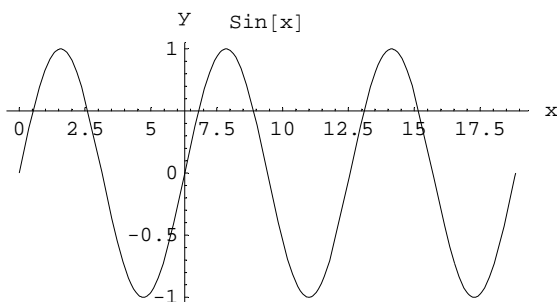


Out[1]= - Graphics -

Sinus mit ";" --- Unterschied?

■ Sinus avec ";" --- y a-t-il une différence?

```
In[3]:= Plot[Sin[x],{x,0,6 Pi},
  AspectRatio -> 1/2,
  PlotLabel -> "Sin[x]",
  AxesLabel -> {"x", "y"},
  AxesOrigin -> {2 Pi, 1/2} ];
```




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## Aufgabe 2 ■ Problème 2

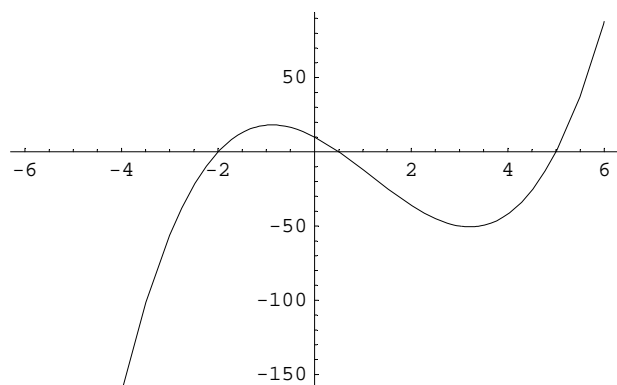
### (a) Nullstellen schätzen

#### ■ Evaluer les zéros (estimer...)

Schätze die Nullstellen mit Hilfe des Plots:

■ Evaluer les zéros à l'aide de "Plots":

```
In[5]:= Plot[2x^3-7x^2-17x+10,{x,-6,6}];
```



Verifiziere die Schätzung mit "Solve":

Vérifier l'évaluation par "Solve":

```
In[6]:= Solve[2x^3-7x^2-17x+10==0,x]
```

```
Out[6]= {{x -> -2}, {x -> 1/2}, {x -> 5}}
```

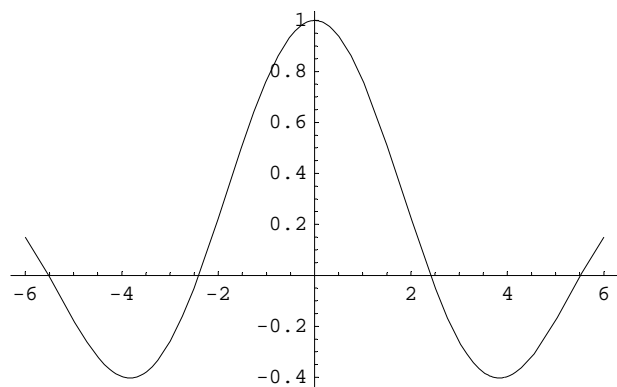
### (a) Nullstellen schätzen aus Graph:

#### ■ Evaluer les zéros d'un graphe:

Schätze die Nullstellen mit Hilfe des Plots auf 3 Stellen (herauszoomen):

■ Evalue les zéros à l'aide des "Plots" (3 places, zoom):

```
In[7]:= Plot[BesselJ[0,x],{x,-6,6}];
```



Verifiziere die Schätzung mit "Solve":

■ Vérifie l'évaluation par "Solve":

```
In[8]:= Solve[2x^3-7x^2-17x+10==0,x]
```

```
Out[8]= {{x -> -2}, {x -> 1/2}, {x -> 5}}
```

## Aufgabe 3 ■ Problème 3

### Verschiedene Dinge in einem Graphen:

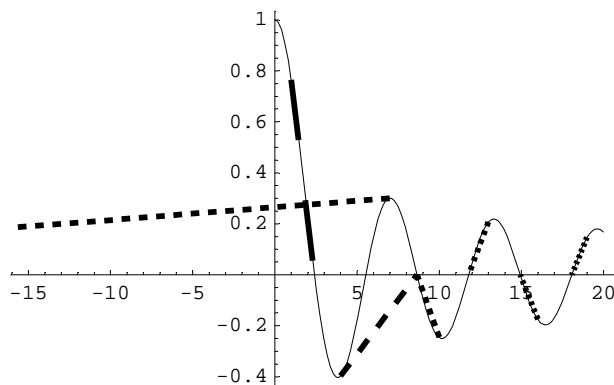
#### ■ Plusieurs choses dans un graphe:

Zeichne den Graphen der Besselfunktion  $J_0$  sowie Liniensegmente, die vom Startpunkt der Newton-Iteration für die Nullstellen schliesslich zur Nullstelle führen:

■ Dessine le graphe de la fonction d'après Bessel  $J_0$  ainsi que des segments de lignes, qui vont du point de départ de l'itération d'après Newton pour les zéros au zéro:

```
In[9]:= Remove[t, x, y]
```

```
In[10]:= Show[
  Plot[BesselJ[0,x],{x,0,20},
    DisplayFunction -> Identity],
  Table[Graphics[{Dashing[{1/(10 t)}],
    Thickness[0.01],
    Evaluate[Line[{
      {t,BesselJ[0,t]},
      Evaluate[{y/. FindRoot[BesselJ[0,y]==0,
        {y,t}],0}]}]}],
    {t,1,20,3}],
  DisplayFunction -> $DisplayFunction
];
```



## Aufgabe 4 ■ Problème 4

### (a) Plot einer Funktion und ihrer Potenzreihe:

#### ■ Plot d'une fonction et sa série de puissances:

f definieren:

■ Définir f:

```
In[11]:= Clear[f]; f[x_]:=1/(1 + Sin[Sqrt[Pi^2 + x]^2]); f[x]
```

$$\text{Out[11]} = \frac{1}{1 + \sin[\pi^2 + x]}$$

Verwende Series und Normal: Achtung: Viel Output!

■ Utilise "Series" et "Normal": Attention: Beaucoup d'Output!

```
In[12]:= n[x_]:=Normal[Series[f[x],{x,0,8}]];
nTest[x_]:=Normal[Series[f[x],{x,0,3}]];
nTest[x]
```

$$\begin{aligned} \text{Out[14]} = & -\frac{x \cos[\pi^2]}{(1 + \sin[\pi^2])^2} + \frac{1}{1 + \sin[\pi^2]} + \\ & x^3 \left( -\frac{\cos[\pi^2]^3}{(1 + \sin[\pi^2])^4} - \frac{\cos[\pi^2] \sin[\pi^2]}{(1 + \sin[\pi^2])^3} + \frac{\cos[\pi^2]}{6 (1 + \sin[\pi^2])^2} \right) + \\ & x^2 \left( \frac{\cos[\pi^2]^2}{(1 + \sin[\pi^2])^3} + \frac{\sin[\pi^2]}{2 (1 + \sin[\pi^2])^2} \right) \end{aligned}$$

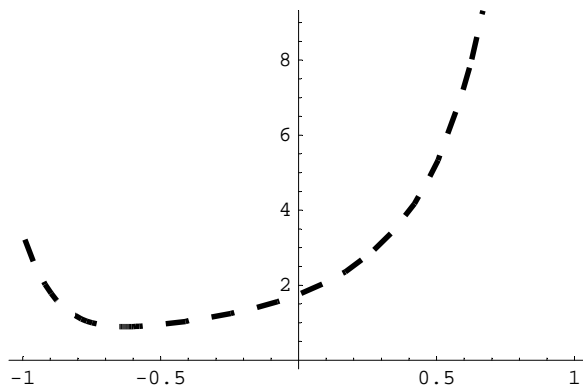
Plot von f und n:

■ Plot de f et n:

```
In[15]:= Print[N[n[x]]]
```

$$1.75531 + 2.78129 x + 3.74403 x^2 + 4.41848 x^3 + 4.90786 x^4 + 5.22979 x^5 + 5.41896 x^6 + 5.5002 x^7 + 5.49547 x^8$$

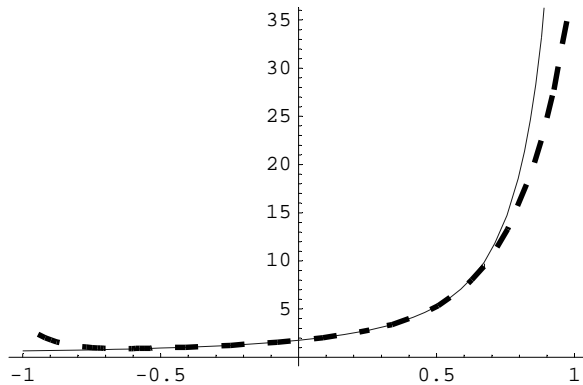
```
In[16]:= a = 1;
Plot[Evaluate[N[n[x]]], Evaluate[{x, -a, a}],
PlotStyle->{{Thickness[0.01],
Dashing[{0.04]}}];
```



```

In[18]:= a = 1; (*PlotRange*)
Show[
  Plot[f[x],Evaluate[{x,-a,a}],
    DisplayFunction -> Identity,
    PlotStyle->{GrayLevel[0.1]}],
  Plot[Evaluate[N[n[x]]],Evaluate[{x,-a,a}],
    DisplayFunction -> Identity,
    PlotStyle->{{Thickness[0.01],
    Dashing[{0.04}]}},
    DisplayFunction :> $DisplayFunction];

```



## Aufgabe 5 ■ Problème 5

### (a) Probleme mit PlotPoints ■ Problèmes avec Plotpoints

$x^2 + \cos(22x)$  :

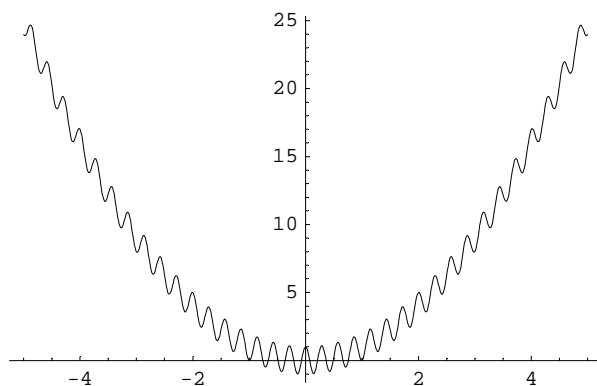
Fehler beim Plotten bei normal vielen PlotPoints (in alten Versionen):

■ Erreurs qui apparaissent en plotant avec un nombre normal de Plotpoints (vieilles versions):

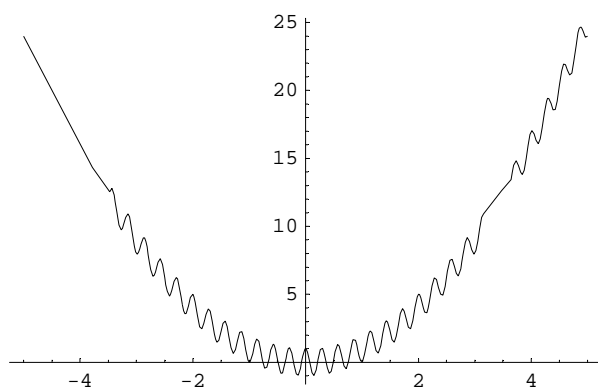
```

In[22]:= Plot[x^2 + Cos[22x], {x,-5,5}];

```



```
In[23]:= Plot[x^2 + Cos[22 x], {x, -5, 5}, PlotPoints -> 9];
```



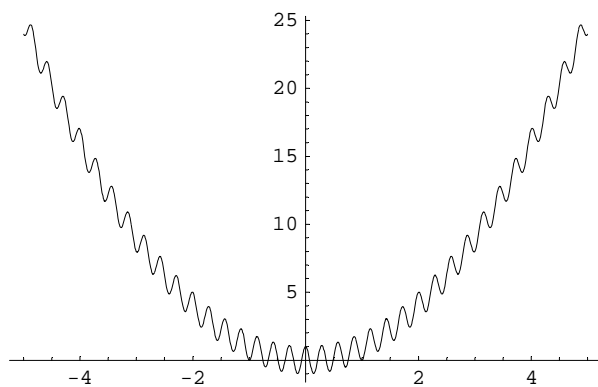
### (b) Korrektur mit PlotPoints

$x^2 + \cos(22x)$  :

Wähle 70 PlotPoints:

■ Choisir 70 "PlotPoints":

```
In[24]:= Plot[x^2 + Cos[22 x], {x, -5, 5}, PlotPoints -> 70];
```



---

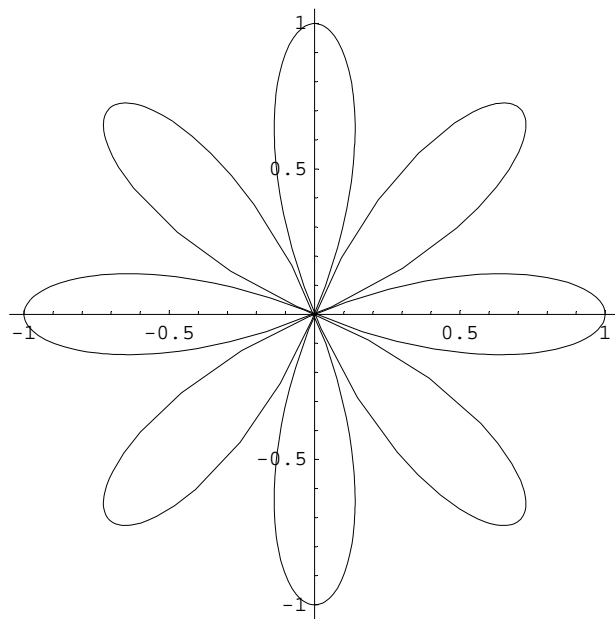
## Aufgabe 6 ■ Problème 6

Einige ParametricPlots:

■ Quelques "ParametricPlots":

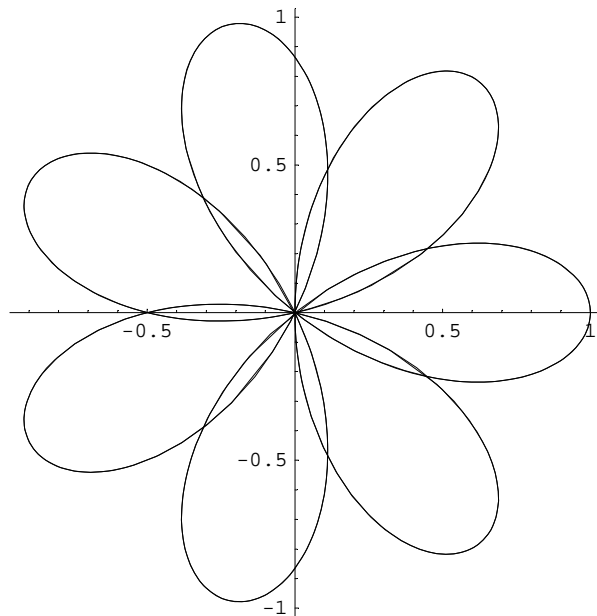
(a)

```
In[25]:= ParametricPlot[{Cos[4t] Cos[t], Cos[4t] Sin[t]}, {t, 0, 2 Pi},  
  AspectRatio->Automatic];
```

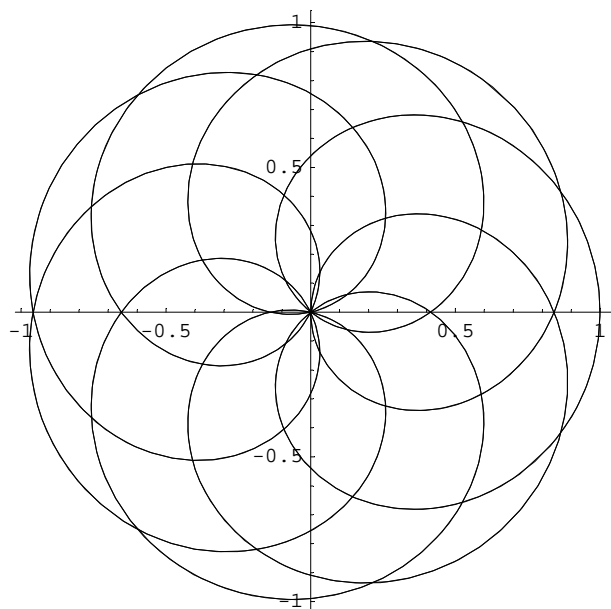


**(b)**

```
In[26]:= ParametricPlot[{Cos[7t] Cos[3t], Cos[7t] Sin[3t]}, {t, 0, 2 Pi},  
AspectRatio->Automatic];
```

**(c)**

```
In[27]:= ParametricPlot[{Cos[7t] Cos[11t], Cos[7t] Sin[11t]}, {t, 0, 2 Pi},  
AspectRatio->Automatic];
```



---

## Aufgabe 7 ■ Problème 7

### Spiel mit dem Package "Polyhedra.m" ■ Jeu avec le Package "Polyhedra.m"

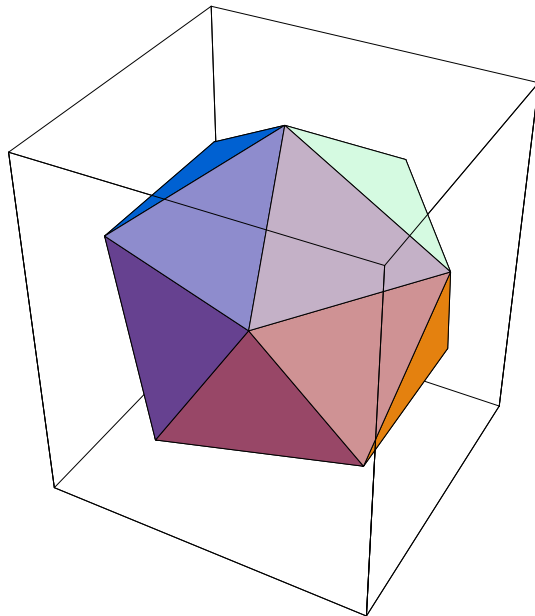
Einbinden: ■ Lier:

```
In[28]:= Needs["Graphics`Polyhedra`"];
```

Graphik ansehen:

■ Regarder le graphique:

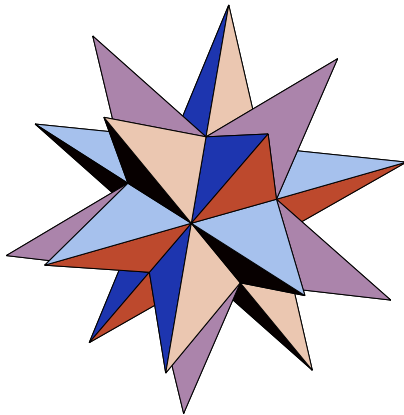
```
In[29]:= Show[Graphics3D[Icosahedron[[]]];
```



Graphik ansehen:

■ Regarder le graphique:

```
In[30]:= Show[Graphics3D[Stellate[Icosahedron[],3]],  
Boxed->False];
```



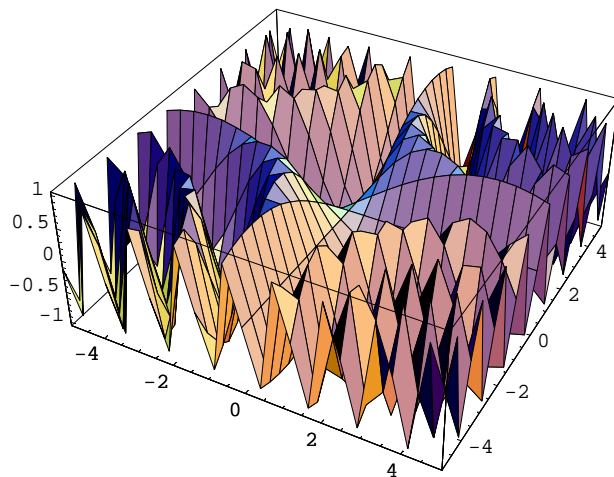
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## Aufgabe 8 ■ Problème 8

### Lighting

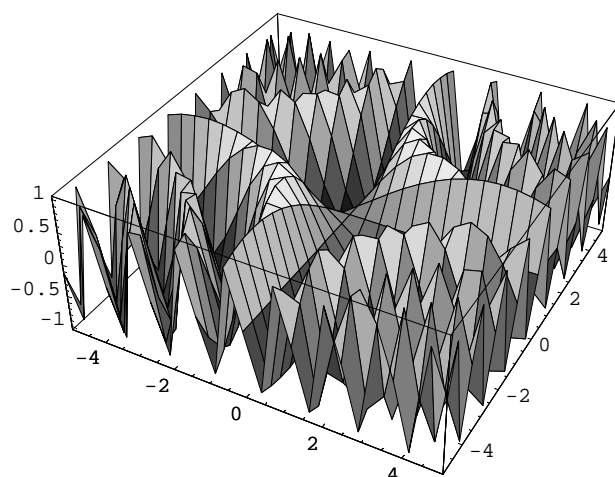
Normal: ■ Normal:

```
In[31]:= Plot3D[Sin[x y],{x,-5,5},{y,-5,5}];
```



Lighting false: ■ Lighting false:

```
In[32]:= Plot3D[Sin[x y],{x,-5,5},{y,-5,5},Lighting->False];
```

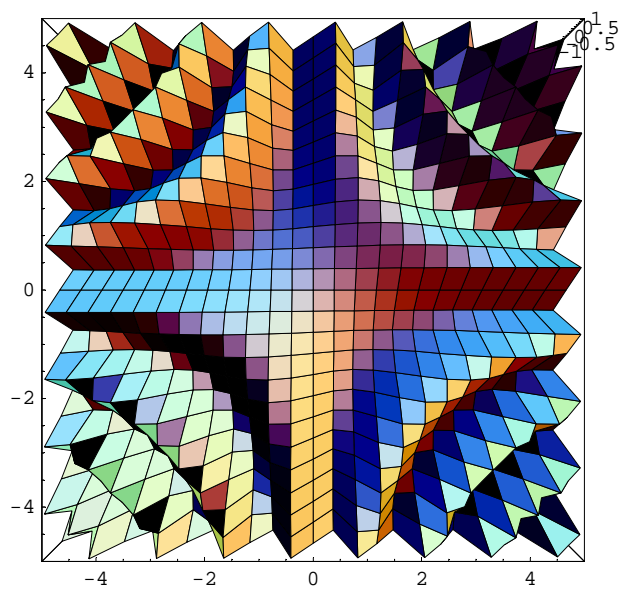


## Aufgabe 9 ■ Problème 9

### ViewPoint

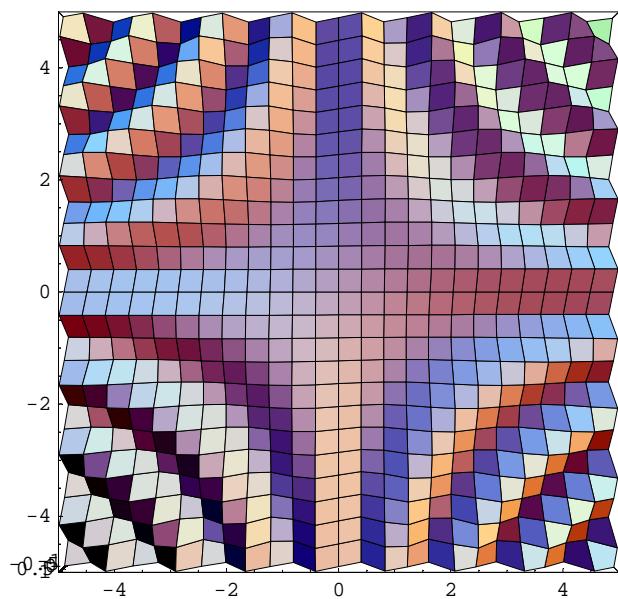
Normal: ■ Normal:

```
In[33]:= Plot3D[Sin[x y],{x,-5,5},{y,-5,5},Lighting->True,  
ViewPoint->{0,0,3}];
```



Anders: ■ Autrement:

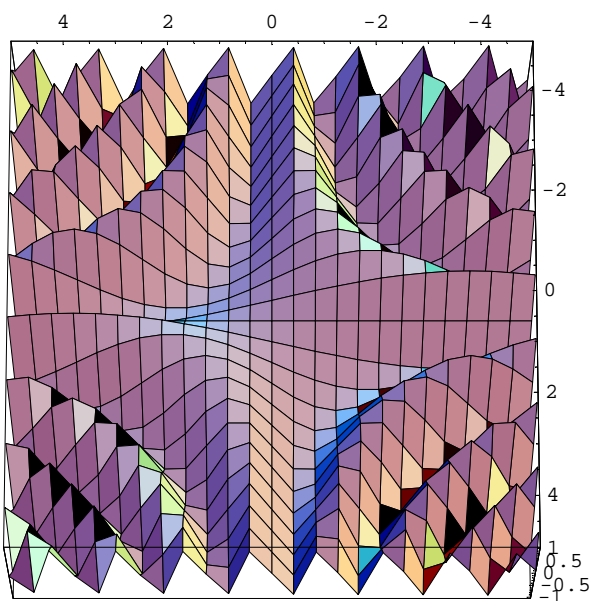
```
In[34]:= Plot3D[Sin[x y],{x,-5,5},{y,-5,5},Lighting->True,
ViewPoint->{0,0,10}];
```



Nochmals anders:

■ Encore autrement:

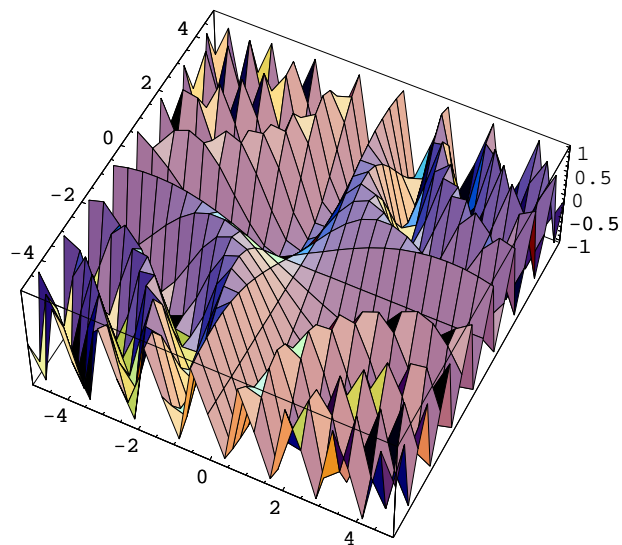
```
In[35]:= Plot3D[Sin[x y],{x,-5,5},{y,-5,5},Lighting->True,
ViewPoint->{0,3,10}];
```



Oder so:

■ Ou ainsi:

```
In[36]:= Plot3D[Sin[x y],{x,-5,5},{y,-5,5},Lighting->True,  
ViewPoint->{2,-4,6}];
```

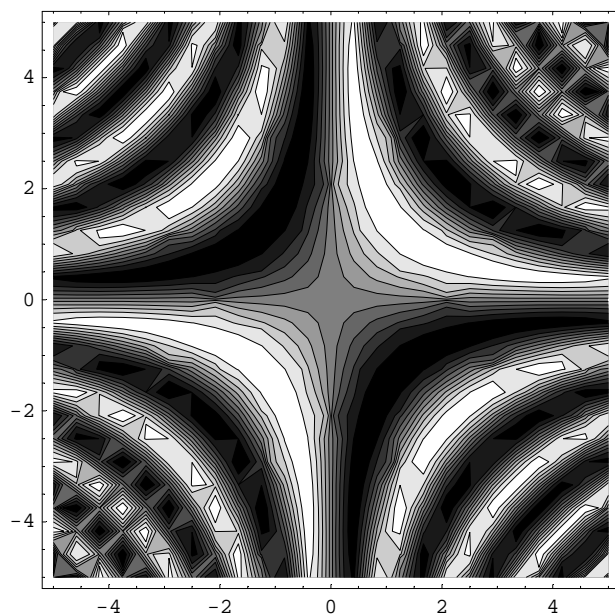


## Aufgabe 10 ■ Problème 10

### Contour- und DensityPlot ■ Contour- et DensityPlot

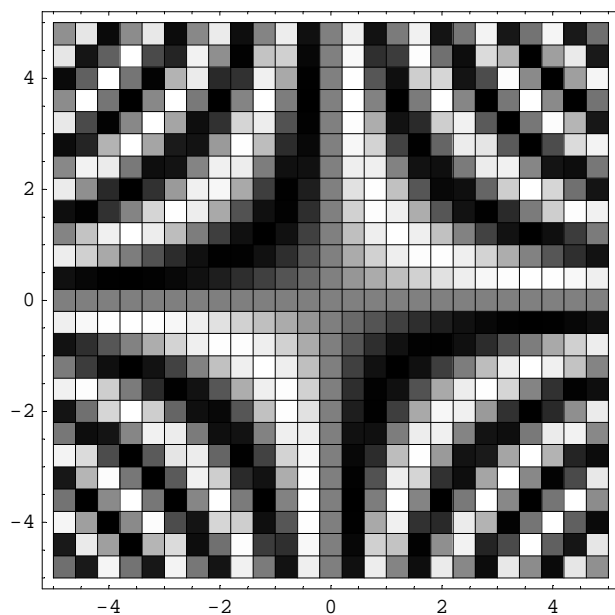
Contour: ■ Contour:

```
In[37]:= ContourPlot[Sin[x y],{x,-5,5},{y,-5,5}];
```



Density: ■ Density:

```
In[38]:= DensityPlot[Sin[x y],{x,-5,5},{y,-5,5}];
```



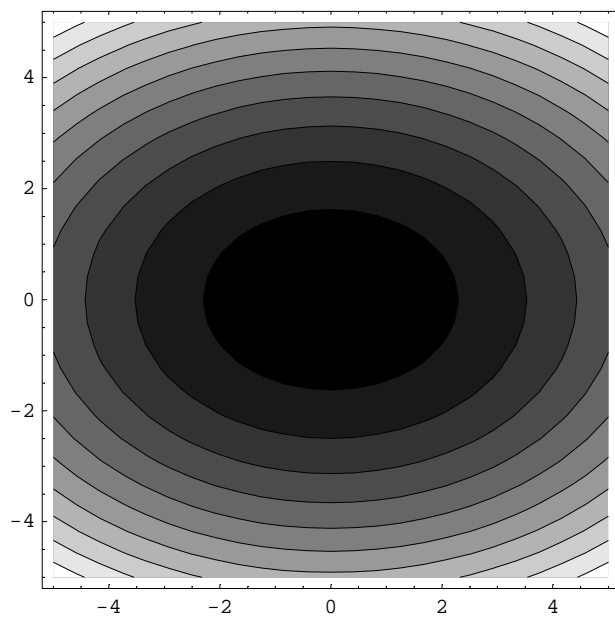
## Aufgabe 11 ■ Problème 11

Mit ContourPlot zu Ellipsen:

■ Faire des ellipses avec ContourPlot

Contour: ■ Contour:

```
In[39]:= ContourPlot[x^2 + 2 y^2,{x,-5,5},{y,-5,5},  
AspectRatio->Automatic];
```



## Aufgabe 12 ■ Problème 12

### Spiel mit Listen:

#### ■ Jouer avec des listes

Primzahlen generieren:

■ Générer des nombres premiers:

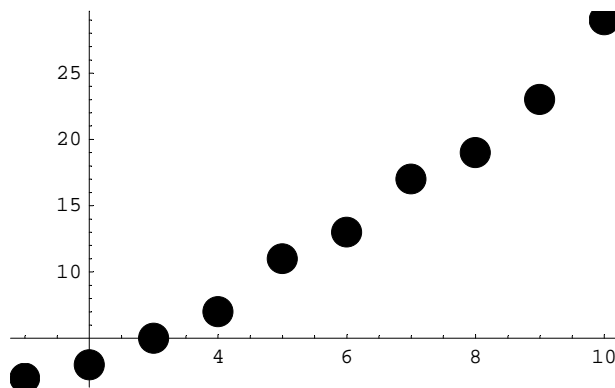
```
In[40]:= t = Table[Prime[n],{n,10}]
```

```
Out[40]= {2, 3, 5, 7, 11, 13, 17, 19, 23, 29}
```

```
In[41]:=
```

Plot: ■ Plot:

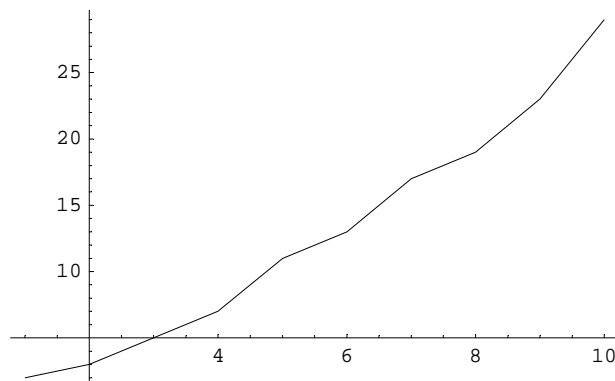
```
In[41]:= ListPlot[t,PlotStyle->{PointSize[0.05]}];
```



Punkte verbinden:

■ Relier des points:

```
In[42]:= ListPlot[t,PlotStyle->{PointSize[0.05]},  
PlotJoined->True];
```



Fit: ■ Fit:

In[43]:= **?Fit**

Fit[data, funs, vars] finds a least-squares fit to a list of data as a linear combination of the functions funs of variables vars. The data can have the form {{x1, y1, ... , f1}, {x2, y2, ... , f2}, ... }, where the number of coordinates x, y, ... is equal to the number of variables in the list vars. The data can also be of the form {f1, f2, ... }, with a single coordinate assumed to take values 1, 2, ... . The argument funs can be any list of functions that depend only on the objects vars. Mehr...

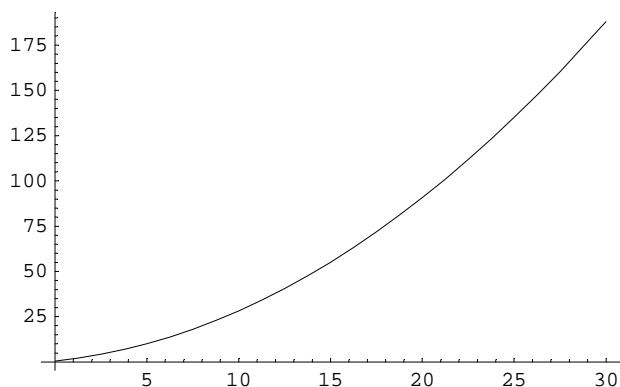
In[44]:= **tfit = Fit[t,{1,x,x^2},x]**

Out[44]=  $0.566667 + 1.02273 x + 0.174242 x^2$

Fit-Kurve ansehen:

Regarder la courbe Fit:

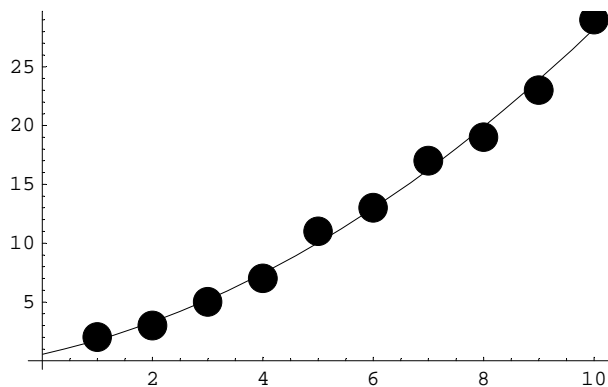
In[45]:= **Plot[tfit,{x,0,30}];**



Kurve zusammen mit Punkten ansehen:

■ Regarder la courbe et les points ensemble:

```
In[46]:= Show[
  ListPlot[t,PlotStyle->{PointSize[0.05]},
    DisplayFunction -> Identity],
  Plot[tfit,{x,0,10},DisplayFunction -> Identity], DisplayFunction ->
  $DisplayFunction
];
```



Abweichungen: ■ Ecart:

```
In[47]:= t = Table[Prime[n],{n,10}];
rang=Range[Length[t]]
```

Out[48]= {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}

```

In[49]:= tNew=Transpose[{rang,t}]
Out[49]= {{1, 2}, {2, 3}, {3, 5}, {4, 7}, {5, 11}, {6, 13}, {7, 17}, {8, 19}, {9, 23}, {10, 29}}

In[50]:= Clear[tfit]; tfit[x_] := Fit[tNew,{1,x,x^2},x];
In[51]:= tfit[x]
Out[51]= 0.566667 + 1.02273 x + 0.174242 x^2

In[52]:= tfit[x] /.x->3
Out[52]= 5.20303

In[53]:= te = Table[Prime[n]-(tfit[x]/.x->n),{n,10}]
Out[53]= {0.236364, -0.309091, -0.20303, -0.445455,
          0.963636, 0.0242424, 0.736364, -0.9, -0.884848, 0.781818}

```

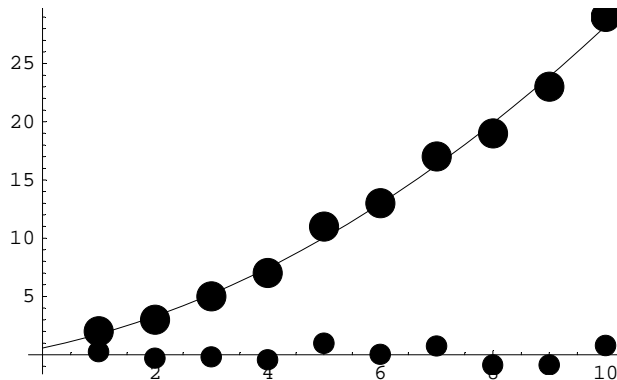
Abweichungen im Plot:

■ Ecart dans le Plot:

```

In[54]:= Show[
  ListPlot[tNew,PlotStyle->{PointSize[0.05]},
    DisplayFunction -> Identity],
  ListPlot[te,PlotStyle->{PointSize[0.035]},
    DisplayFunction -> Identity],
  Plot[Evaluate[(tfit[x]/.x->n)],{n,0,10},DisplayFunction -> Identity],
  DisplayFunction -> $DisplayFunction
];

```



## Aufgabe 13 ■ Problème 13

Zeichnen mit *Mathematica*

■ Dessiner avec *Mathematica*

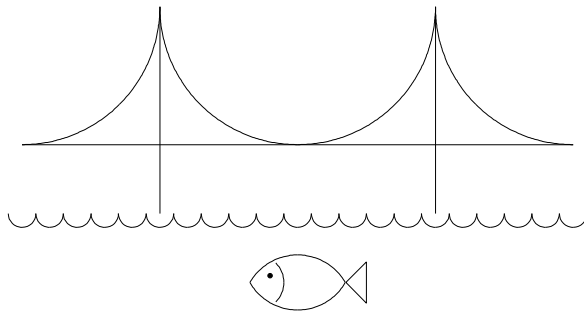
Also los (Golden Gate Bridge):

■ Allez-y (Golden Gate Bridge):

```

In[55]:= Show[
  Graphics[{ (*Brücke*)
    Circle[{-2,1},1,{3 Pi/2, 2 Pi}],
    Circle[{0,1},1,{Pi, 2 Pi}],
    Circle[{2,1},1,{Pi, 3 Pi/2}],
    Line[{{-2,0},{2,0}}],
    Line[{{-1,-0.5},{-1,1}}],
    Line[{{1,-0.5},{1,1}}]      }],
  Graphics[ (*Wasser*)
    Table[Circle[{x,-0.5},0.1,{Pi, 2Pi}],
      {x, -2, 2, 0.2}      ],
  Graphics[{ (*Fisch*)
    Circle[{0,-1.2},0.4,{Pi/6, 5 Pi/6}],
    Circle[{0,-0.8},0.4,{7 Pi/6, 11 Pi/6}],
    Point[{-0.2,-0.95}],
    Circle[{-0.3,-1},0.2,{- Pi/4, Pi/4}],
    Line[{{0.35,-1},{0.5,-0.85},
      {0.5,-1.15},{0.35,-1}}]
    }],
  AspectRatio->Automatic,
  PlotRange->All ];

```




---

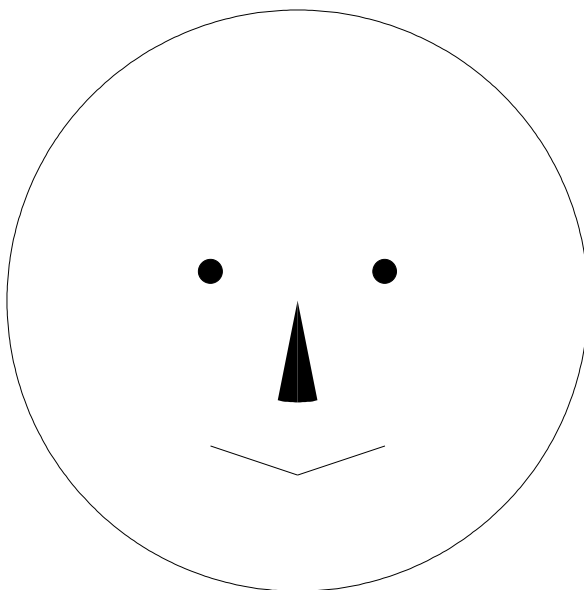
## Aufgabe 14 ■ Problème 14

### Zeichnen mit *Mathematica* ■ Dessiner avec *Mathematica*

Also los (geometrisches Gesicht):

■ Allez-y (visage géométrique):

```
In[57]:= Show[
  Graphics[
    (*Augen*)
    PointSize[0.04],
    Point[{-0.3,0.1}],
    Point[{0.3,0.1}],
    (*Nase*)
    Disk[{0,0},0.35,{23 Pi/16, 25 Pi/16}],
    (*Mund*)
    Line[{{-0.3,-0.5},{0,-0.6}}],
    Line[{{0,-0.6},{0.3,-0.5}}],
    (*Kopf*)
    Circle[{0,0},1]
  ],
  AspectRatio->Automatic,
  PlotRange->All ];
```



---

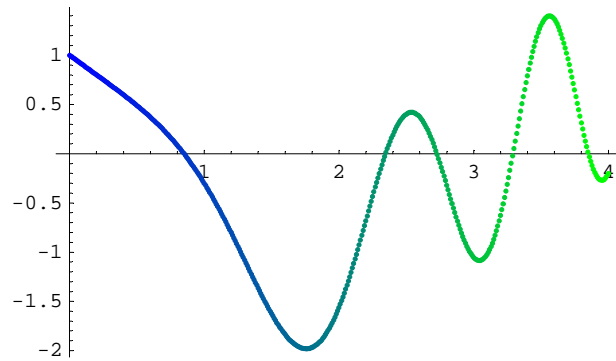
## Aufgabe 15 ■ Problème 15

### Zeichnen mit *Mathematica* ■ Dessiner avec *Mathematica*

Wie wirken Farben?:

- Quels sont les effets des couleurs?

```
In[59]:= Show[
  Graphics[
    Table[{
      RGBColor[0,x/4.,1.-x/4.],
      Point[{x, Cos[x^2] - Sin[x]}],
      {x,0,4,0.01}
    ]
  ],
  Axes->Automatic
];
```



---

## "Putzmaschine" einsetzen

### ■ Employer la "machine de nettoyage"

```
In[61]:= (* Old Form: Remove["Global`*"] *)
```

```
In[62]:= Remove["Global`*"]
```