Lösungen

1. Teil

I / 1

```
Remove["Global`*"]
```

Vektoren

```
r0 = 1; (* Vergrösserungsfaktor *)
schr[t_] := r0 {Cos[t], Sin[t], t};
v[u_] := Evaluate[D[schr[t], t] /. t → u];
vn[u_] := Evaluate[v[u] / Norm[v[u]]];
a[t_] := r0 { Cos[t], Sin[t], 0};
an[u_] := Evaluate[a[u] / Norm[a[u]]];
b[u_] := Evaluate[Cross[a[u], v[u]]];
bn[u_] := Evaluate[b[u] / Norm[b[u]]];
c[u_] := Evaluate[D[a[t], t] /. t → u];
cn[u_] := Evaluate[c[u] / Norm[c[u]]];
```

Austesten mit Beispielen

```
schr[Pi / 2]
```

$\left\{0, 1, \frac{\pi}{2}\right\}$

```
vn[Pi / 2]
```

$\left\{-\frac{1}{\sqrt{2}}, 0, \frac{1}{\sqrt{2}}\right\}$

```
an[Pi / 2]
```

$\{0, 1, 0\}$

```
bn[Pi / 2]
```

$\left\{\frac{1}{\sqrt{2}}, 0, \frac{1}{\sqrt{2}}\right\}$

```
cn[Pi / 2]
```

$\{-1, 0, 0\}$

Körper

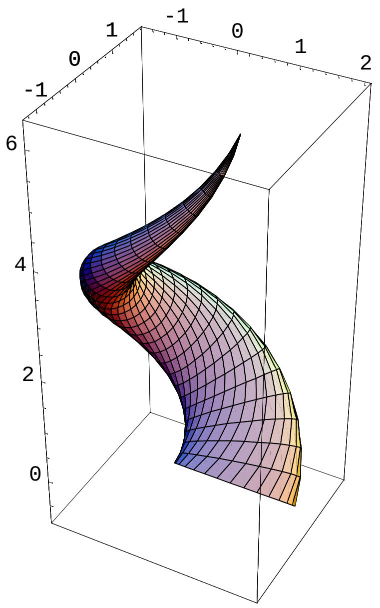
```
r[t_, rr_] := rr r0 (1 - t / (2 Pi)); r[t, 1]
```

$1 - \frac{t}{2\pi}$

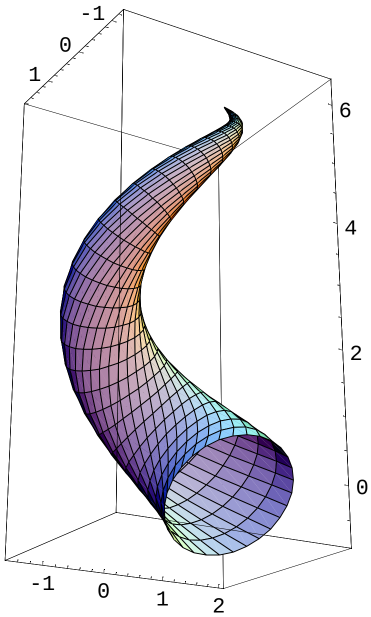
```
k1[u_, φ_, rr_] := r[u, rr] (an[u] Cos[φ] + bn[u] Sin[φ]);
k2[u_, φ_, rr_] := r[u, rr] (an[u] Cos[φ] + cn[u] Sin[φ]);
f1[u_, φ_, rr_] := schr[u] + k1[u, φ, rr];
f2[u_, φ_, rr_] := schr[u] + k2[u, φ, rr];
f3[u_, φ_, rr_] := {0, 0, u} + k2[u, φ, rr];
```

a Plots

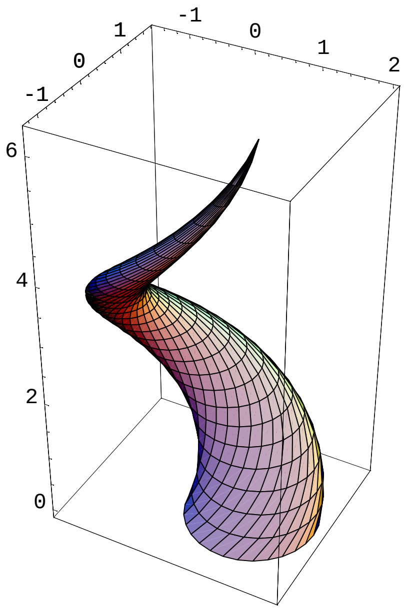
```
p1 = ParametricPlot3D[f1[u, φ, 1], {u, 0, 2 Pi}, {φ, 0, 2 Pi}];
```



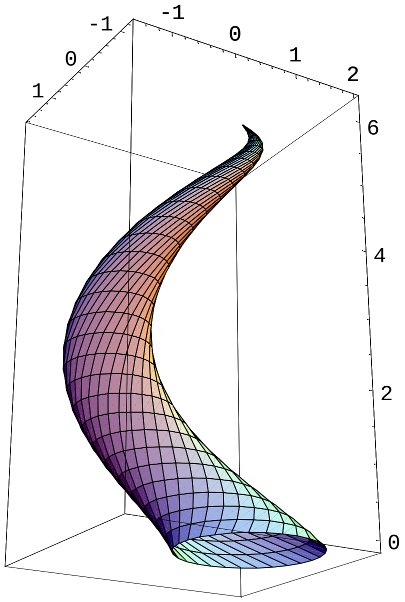
```
p11 = ParametricPlot3D[f1[u, φ, 1], {u, 0, 2 Pi},
  {φ, 0, 2 Pi}, ViewPoint -> {-1.499, -2.428, -1.154}];
```



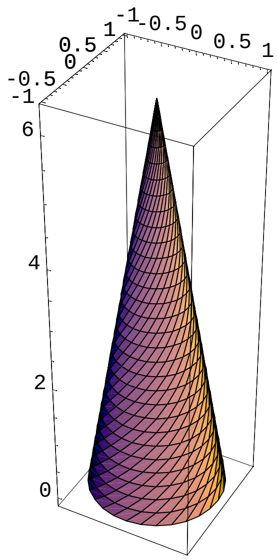

```
p2 = ParametricPlot3D[f2[u, φ, 1], {u, 0, 2 Pi}, {φ, 0, 2 Pi}];
```



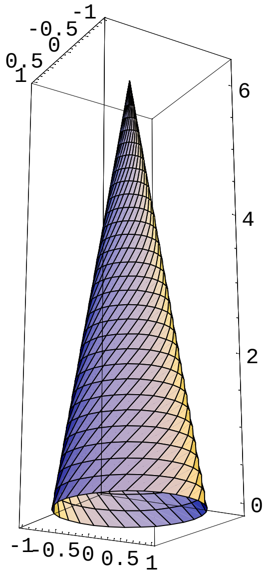
```
p21 = ParametricPlot3D[f2[u, φ, 1], {u, 0, 2 Pi},
   {φ, 0, 2 Pi}, ViewPoint -> {-1.499, -2.428, -1.154}];
```




```
p3 = ParametricPlot3D[f3[u, φ, 1], {u, 0, 2 Pi}, {φ, 0, 2 Pi}];
```



```
p31 = ParametricPlot3D[f3[u, φ, 1], {u, 0, 2 Pi},
   {φ, 0, 2 Pi}, ViewPoint -> {-1.499, -2.428, -1.154}];
```



b Volumen

```
xf1[u_, φ_, rr_] := f1[u, φ, rr][[1]];
yf1[u_, φ_, rr_] := f1[u, φ, rr][[2]];
zf1[u_, φ_, rr_] := f1[u, φ, rr][[3]];
xf2[u_, φ_, rr_] := f2[u, φ, rr][[1]];
yf2[u_, φ_, rr_] := f2[u, φ, rr][[2]];
zf2[u_, φ_, rr_] := f2[u, φ, rr][[3]];
jac1[u_, φ_, rr_] :=
  {{D[xf1[u, φ, rr], u], D[yf1[u, φ, rr], u], D[zf1[u, φ, rr], u]},
   {D[xf1[u, φ, rr], φ], D[yf1[u, φ, rr], φ], D[zf1[u, φ, rr], φ]},
   {D[xf1[u, φ, rr], rr], D[yf1[u, φ, rr], rr], D[zf1[u, φ, rr], rr]}};
jac2[u_, φ_, rr_] :=
  {{D[xf2[u, φ, rr], u], D[yf2[u, φ, rr], u], D[zf2[u, φ, rr], u]},
   {D[xf2[u, φ, rr], φ], D[yf2[u, φ, rr], φ], D[zf2[u, φ, rr], φ]},
   {D[xf2[u, φ, rr], rr], D[yf2[u, φ, rr], rr], D[zf2[u, φ, rr], rr]}};
```

```
V1v[u1_, φ1_, rr1_] := Evaluate[Det[jac1[u, φ, rr] /. {u → u1, φ → φ1, rr -> rr1}]];
V1 = NIntegrate[V1v[u1, φ1, rr1], {u1, 0, 2 Pi}, {φ1, 0, 2 Pi}, {rr1, 0, 1}] // Abs
```

```
9.30515
```

```
V2v[u1_, φ1_, rr1_] := Evaluate[Det[jac2[u, φ, rr] /. {u → u1, φ → φ1, rr -> rr1}]];
V2 = NIntegrate[V2v[u1, φ1, rr1], {u1, 0, 2 Pi}, {φ1, 0, 2 Pi}, {rr1, 0, 1}] // Abs
```

```
6.57974
```

```
V3 = 1^2 Pi 2 Pi / 3 // N
```

```
6.57974
```

```
V1 / V3
```

1.41421

```
V2 / V3
```

1.

I / 2

```
Remove["Global`*"]
```

a

```
LaplaceTransform[Cos [2 t] + Cosh [3 t], t, s]
```

$$\frac{s}{-9+s^2}+\frac{s}{4+s^2}$$

```
% // Together
```

$$\frac{-5\,s+2\,s^3}{(-9+s^2)\,(4+s^2)}$$

```
% // ExpandAll // Together
```

$$\frac{-5\,s+2\,s^3}{-36-5\,s^2+s^4}$$

```
% // Apart
```

$$\frac{1}{2\,(-3+s)}+\frac{1}{2\,(3+s)}+\frac{s}{4+s^2}$$

b

```
LaplaceTransform[E^(t - 8) E^(-2 t + 3), t, s]
```

$$\frac{1}{e^5\,(1+s)}$$

c

```
LaplaceTransform[E^(-t) (Cos[t] - 2), t, s]
```

$$-\frac{2}{1+s}+\frac{1+s}{1+(1+s)^2}$$

```
% // Together
```

$$\frac{-3-2\,s-s^2}{(1+s)\,(2+2\,s+s^2)}$$

```
% // ExpandAll // Together
```

$$\frac{-3-2\,s-s^2}{2+4\,s+3\,s^2+s^3}$$

```
% // Apart
```

$$-\frac{2}{1+s}+\frac{1+s}{2+2\,s+s^2}$$

d

```
LaplaceTransform[(-t)^3 + DiracDelta[t], t, s]
```

$$1-\frac{6}{s^4}$$

```
% // Together
```

$$\frac{-6+s^4}{s^4}$$

e

```
InverseLaplaceTransform[4 s / (2 s^2 - 1), s, t]
```

$$e^{-\frac{t}{\sqrt{2}}}\left(1+e^{\sqrt{2}\,t}\right)$$

```
% // Expand
```

$$e^{-\frac{t}{\sqrt{2}}}+e^{-\frac{t}{\sqrt{2}}+\sqrt{2}\,t}$$

```
% // Simplify
```

$$e^{-\frac{t}{\sqrt{2}}}+e^{\frac{t}{\sqrt{2}}}$$

Das ist ein Cosinus hyperbolicus. Test:

$$\left(e^{-\frac{t}{\sqrt{2}}}+e^{\frac{t}{\sqrt{2}}}\ \text{/. t → 10.}\right) == (\text{2 Cosh[t / Sqrt[2]] /. t → 10.})$$

```
True
```

$$\text{Table}\left[\left(e^{-\frac{t}{\sqrt{2}}}+e^{\frac{t}{\sqrt{2}}}\ \text{/. t → u // N}\right) == (\text{2 Cosh[t / Sqrt[2]] /. t → u // N}),\ \{u, 1, 10\}\right]$$

```
{True, True, True, True, True, True, True, True, True, True}
```

f

```
InverseLaplaceTransform[s / (s^2 - 1), s, t]
```

$$\frac{1}{2}\,e^{-t}\,\left(1+e^{2\,t}\right)$$

% // Expand

$\frac{e^{-t}}{2} + \frac{e^{t}}{2}$

% // Simplify

$\frac{1}{2} e^{-t} (1 + e^{2t})$

Das ist ein Cosinus hyperbolicus. Test:

(Cosh[10] // N) == $\left(\frac{e^{-t}}{2} + \frac{e^{t}}{2}\right.$ /. t -> 10$\left.\right)$ // N

True

Table[(Cosh[u] // N) == $\left(\frac{e^{-t}}{2} + \frac{e^{t}}{2}\right.$ /. t → u$\left.\right)$ // N, {u, 1, 10}]

{True, True, True, True, True, True, True, True, True, True}

g

InverseLaplaceTransform[1 + 2 / s - 2 / s^2, s, t]

2 - 2 t + DiracDelta[t]

I / 3

Remove["Global`*"]

a

DSolve[y '[t] == -y[t] + DiracDelta[t] + a Sin [t], y, t]

{{y → Function[{t}, e^{-t} C[1] + e^{-t} $\left(-\frac{1}{2} a e^{t}\right.$ (Cos[t] - Sin[t]) + UnitStep[t]$\left.\right)$]}}

DSolve[{y '[t] == -y[t] + DiracDelta[t] + a Sin [t], y[1] == 1}, y, t]

{{y → Function[{t},
$-\frac{1}{2} e^{-t}$ (2 - 2 e - a e Cos[1] + a e^{t} Cos[t] + a e Sin[1] - a e^{t} Sin[t] - 2 UnitStep[t])]}}

y3a[t_, a_] := Evaluate[
$-\frac{1}{2} e^{-t}$ (2 - 2 e - a e Cos[1] + a e^{t} Cos[t] + a e Sin[1] - a e^{t} Sin[t] - 2 UnitStep[t])];
(y3a[t, a] /. {t → u, UnitStep[t] → 1}) // Simplify

$\frac{1}{2} e^{-u}$ (-a e^{u} Cos[u] + e (2 + a Cos[1] - a Sin[1]) + a e^{u} Sin[u])

```
y1[u_] := ((y3a[t, 1] /. t → u) // Simplify); y1[t] /. UnitStep[t] → 1
```

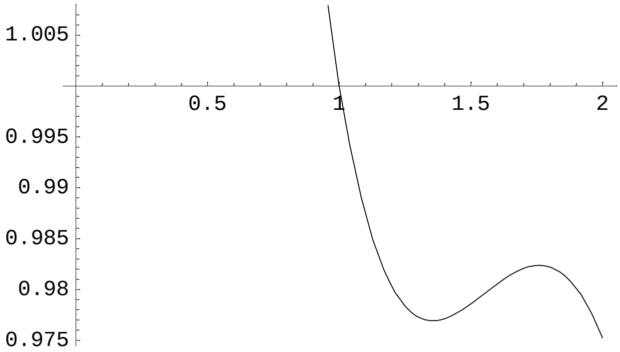
$\frac{1}{2} e^{-t} (2 e + e \operatorname{Cos}[1] - e^t \operatorname{Cos}[t] - e \operatorname{Sin}[1] + e^t \operatorname{Sin}[t])$

```
y1[t] /. UnitStep[t] → 1 // Expand
```

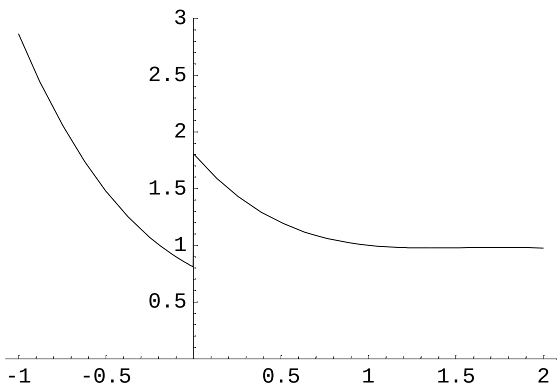
$e^{1-t} + \frac{1}{2} e^{1-t} \operatorname{Cos}[1] - \frac{\operatorname{Cos}[t]}{2} - \frac{1}{2} e^{1-t} \operatorname{Sin}[1] + \frac{\operatorname{Sin}[t]}{2}$

b

```
Plot[y1[u], {u, 0, 2}];
```




```
Plot[y1[u], {u, -1, 2}, PlotRange → {0, 3}];
```




```
y1[1 / 25] // Simplify
```

$\frac{1}{2} \left(-\operatorname{Cos}\left[\frac{1}{25}\right] + \operatorname{Sin}\left[\frac{1}{25}\right] + e^{24/25} (2 + \operatorname{Cos}[1] - \operatorname{Sin}[1])\right)$

```
y1[0.5]
```

1.20137

```
y1[2]
```

$\frac{2 + \operatorname{Cos}[1] - \operatorname{Sin}[1] + e (-\operatorname{Cos}[2] + \operatorname{Sin}[2])}{2 e}$

```
y1[2] // N
```

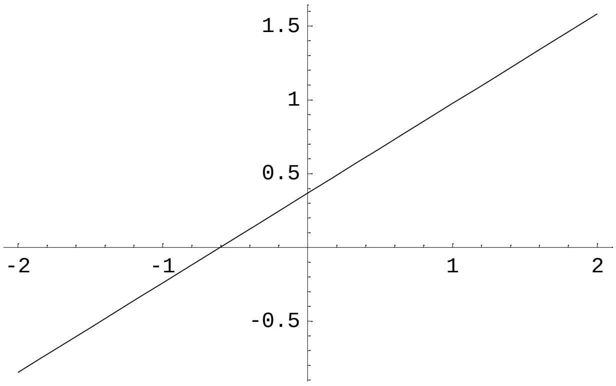
0.975205

c

```
s[aa_] := (y3a[t, a] /. {t → 2, a → aa}) // Simplify;
s[aa]
```

$$\frac{2 + aa\,(\text{Cos}[1] - \text{Sin}[1] + e\,(-\text{Cos}[2] + \text{Sin}[2]))}{2\,e}$$

```
Plot[s[aa], {aa, -2, 2}];
```



I / 4

```
Remove["Global`*"]
```

```
DSolve[y''[t] - y'[t] - 2 y[t] == 1 / 2 Cosh[t], y, t] // Flatten
```

$$\left\{y \to \text{Function}\left[\{t\}, -\frac{1}{72} e^{-t} (2 + 9 e^{2t} + 6 t) + e^{-t} C[1] + e^{2t} C[2]\right]\right\}$$

```
DSolve[{y''[t] - y'[t] - 2 y[t] == 1 / 2 Cosh[t], y[0] == 1, y'[0] == -1}, y, t] // Flatten
```

$$\left\{y \to \text{Function}\left[\{t\}, \frac{1}{72} e^{-t} (73 - 9 e^{2t} + 8 e^{3t} - 6 t)\right]\right\}$$

$$\frac{1}{72} e^{-t} (73 - 9 e^{2t} + 8 e^{3t} - 6 t) \text{ // ExpandAll}$$

$$\frac{73 e^{-t}}{72} - \frac{e^{t}}{8} + \frac{e^{2t}}{9} - \frac{e^{-t} t}{12}$$

```
LaplaceTransform[y''[t] - y'[t] - 2 y[t], t, s] == LaplaceTransform[1 / 2 Cosh[t], t, s]
```

$$-2\,\text{LaplaceTransform}[y[t], t, s] - s\,\text{LaplaceTransform}[y[t], t, s] + s^2\,\text{LaplaceTransform}[y[t], t, s] + y[0] - s\,y[0] - y'[0] == \frac{s}{2\,(-1 + s^2)}$$

I / 5

```
Remove["Global`*"]
```

```
DSolve[{y'[t] + y[t] - z'[t] - z[t] == 0,
        y'[t] + y[t] + z'[t] + z[t] == E^(-t),
        y[0] == 1, z[0] == 0}, {y[t], z[t]}, t]
```

$\left\{\left\{y[t] \to \frac{1}{2} e^{-t} (2+t),\ z[t] \to \frac{e^{-t}\, t}{2}\right\}\right\}$

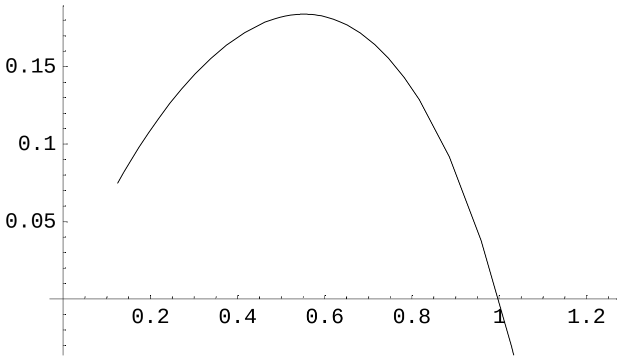
```
v[t_] := {1/2 E^(-t) (2 + t), E^(-t) t/2};
v[t]
```

$\left\{\frac{1}{2} e^{-t} (2+t),\ \frac{e^{-t}\, t}{2}\right\}$

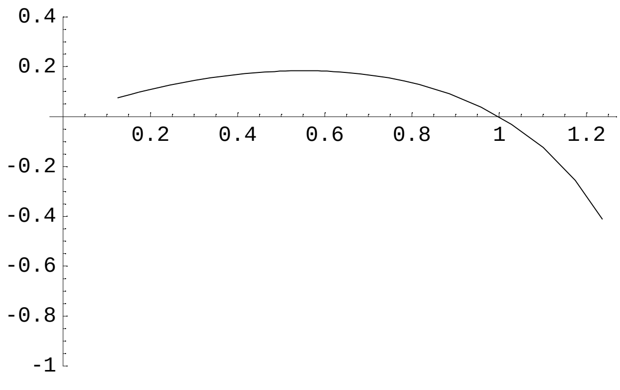
```
% // Expand
```

$\left\{e^{-t} + \frac{e^{-t}\, t}{2},\ \frac{e^{-t}\, t}{2}\right\}$

```
ParametricPlot[v[t], {t, -0.5, 3}];
```




```
ParametricPlot[v[t], {t, -0.5, 3}, PlotRange → {-1, 0.4}];
```




```
v[2] // N
```

{0.270671, 0.135335}

I / 6

```
Remove["Global`*"]
```

a

```
DSolve[{y'[t] == y[t] E^(-t) + E^(-2 t),
        y[0] == 0}, y, t]
```

{{y → Function[{t}, e^{-t} (-1 + e^{t})]}}

```
yExakt[t_] := e^-t (e^t - 1)
```

```
yExakt[t] // Expand
```

1 - e^{-t}

b

```
Δt = 0.5;
yEu[0] = 0;
yEu[i_] := Δt (yEu[i - 1] E^(-i Δt) + E^(-2 i Δt)) + yEu[i - 1];
Table[{i Δt, yEu[i]}, {i, 0, 4}] // TableForm
```

0	0
0.5	0.18394
1.	0.285441
1.5	0.34218
2.	0.374492

```
yEuInerpol[E1 .75] = 1 / 2 (yEu[3] + yEu[4])
```

0.358336

```
yExakt[1.75] // N
```

0.826226

I / 7

```
Remove["Global`*"]
```

a

```
DSolve[{y''[t] - 3 y'[t] + 2 y[t] ==  1 + a t,
        y[0] == 0}, y, t]
```

{{y → Function[{t}, $\frac{1}{4}$ (2 + 3 a - 2 e^{t} - 3 a e^{t} + 2 a t - 4 e^{t} C[2] + 4 e^{2t} C[2])]}}

y[a_, t_, C2_] := $\frac{1}{4}$ (2 + 3 a - 2 e^{t} - 3 a e^{t} + 2 a t - 4 e^{t} C2 + 4 e^{2t} C2)

```
y[a, t, C2] // Expand
```

$$\frac{1}{2}+\frac{3\,a}{4}-\frac{e^{t}}{2}-\frac{3\,a\,e^{t}}{4}-C2\,e^{t}+C2\,e^{2\,t}+\frac{a\,t}{2}$$

b 3 Variablen oder Parameter: t, a, C2

a

```
DSolve[{y''[t] - 3 y'[t] + 2 y[t] == 1 + a t,
    y[0] == 0, y'[0] == c2}, y, t]
```

$$\left\{\left\{y\to \text{Function}\left[\{t\},\ \frac{1}{4}\left(2+3\,a-4\,e^{t}-4\,a\,e^{t}-4\,c2\,e^{t}+2\,e^{2\,t}+a\,e^{2\,t}+4\,c2\,e^{2\,t}+2\,a\,t\right)\right]\right\}\right\}$$

```
y[a_, t_, C2_] := 1/4 (2 + 3 a - 4 e^t - 4 a e^t - 4 c2 e^t + 2 e^(2 t) + a e^(2 t) + 4 c2 e^(2 t) + 2 a t)
```

```
y[a, t, C2] // Expand
```

$$\frac{1}{2}+\frac{3\,a}{4}-e^{t}-a\,e^{t}-c2\,e^{t}+\frac{e^{2\,t}}{2}+\frac{1}{4}\,a\,e^{2\,t}+c2\,e^{2\,t}+\frac{a\,t}{2}$$

I / 8

```
Remove["Global`*"]
```

a

```
y'[x_] == - y[x] / Sqrt[a^2 - y[x]^2]
```

$$y'[x\_] == -\frac{y[x]}{\sqrt{a^2-y[x]^2}}$$

b Bei (b) fehlt x. (c) löst das Problem.

---

2. Teil

II / 1

```
Remove["Global`*"]
```

a

```
pCalamAus = 0.05;  (* 5000 von 100 000 *);  AnzKeinFunkCalam = 5000;
pCalamEin = 1 - pCalamAus;  (* 95 000 von 100 000 *); AnzFunkCalam = 95 000;
pTerror = 0.001;    (* 100 von 100 000 *); AnzTerror = 100;
pNichtTerror = 1 - 0.001;  (* 99 900 von 100 000 *) ; AnzKeinTerror = 99900;
total = 100000;
```

```
pAusfall = pCalamAus * pTerror + pCalamEin * pTerror + pCalamAus * pNichtTerror
```

```
0.05095
```

```
pNichtAusfall = pCalamEin * pNichtTerror
```

```
0.94905
```

```
pTerror = pCalamAus * pTerror + pCalamEin * pTerror
```

```
0.001
```

```
AnzTerrorUndKeinAusfallFunk = AnzKeinFunkCalam * AnzTerror / total
```

```
5
```

```
AnzKeinFunk = AnzKeinFunkCalam + AnzTerror - AnzTerrorUndKeinAusfallFunk
```

```
5095
```

```
(* Chance dass ein Fulugzeug ohne Funkverbindung ein terroristisches ist *)
pTerrorWennKeinFunk = AnzTerror / AnzKeinFunk  // N
```

```
0.0196271
```

```
(* Ca 2 % sind Terrorflüge wenn der Funk ausfällt *)
```

```
gegen = 1 - pTerrorWennKeinFunk
```

```
0.980373
```

b

Bei einem Abschuss würde man mit der kleinen Wahrscheinlichkeit von 0.0196 100 Menschen retten und dafür 10 vernichten. Bei einem nichtabschuss würde man mit einer grossen Wahrscheinlichkeit von 0.98 jetzt 110 Menschen retten.

Bei einem Nichtabschuss sterben 110 Menschen mit einer Wahrscheinlichkeit von ca. 0.02.

II / 2

a

```
Remove["Global`*"]
```

```
total = 128;  auto = 89; velo = total - auto
```

```
39
```

```
mitKinder = 62; ohneKinder = total - mitKinder
```

```
66
```

```
autoMitKinder = auto * mitKinder / total // N
```

```
43.1094
```

```
autoOhnetKinder = auto - autoMitKinder // N
```

```
45.8906
```

```
veloMitKinder = velo * mitKinder / total // N
```

```
18.8906
```

```
veloOhneKinder = velo * ohneKinder / total // N
```

```
20.1094
```

```
nichtUrlaubBedAuto = autoOhnetKinder / auto
```

```
0.515625
```

b

```
Remove["Global`*"]
```

```
plaetzt = 7!
```

```
5040
```

```
selbstsich = 3; nut = 1; gewoehnl = 7 - selbstsich - nut
```

```
3
```

```
(* Die selbstsichernden und die
  gewähnlichen Muttern sind unter sich vertauschbar*)
anzVerteilungen = 7! / (3! 3!)
```

```
140
```

```
anzRichtige = 1 * 3! * 3!
```

```
36
```

```
chance = anzRichtige / anzVerteilungen // N
```

```
0.257143
```

c1

```
Remove["Global`*"]
```

```
anzPers = 14;  auswahl1 = 5;  auswahl2 = 4;  auswahl3 = 3;
anzAuswahl4 = Binomial[anzPers, auswahl1]
```

```
2002
```

```
anzAuswahl4Verteil1 = Binomial[anzPers, auswahl2] 4
```

```
4004
```

```
anzAuswahl4Verteil3 = Binomial[anzPers, auswahl3] 3
```

```
1092
```

```
total1 = anzAuswahl4 + anzAuswahl4Verteil1 + anzAuswahl4Verteil3
```

```
7098
```

```
(* Wenn alle Boni gleich *)
```

c2 Variante: Alle Boni verschieden

```
total2 = anzAuswahl4 5 ! + anzAuswahl4Verteil1 5 ! / 2 ! + anzAuswahl4Verteil3 3 ! / (2 * 2 !)
```

```
482118
```

II / 3

```
Remove["Global`*"]
```

a

```
p = 3 / 10;  X == anzPumpQualitaetOK; q = 1 - p;
pXgleich[k_, n_] := Binomial[n, k] p^k q^(n - k);
pXkleinerGleich[k_, n_] := Sum[pXgleich[j, n], {j, 0, k}];
pXgroesserGleich[k_, n_] := 1 - pXkleinerGleich[k - 1, n];
```

```
n = 28; k = 6;
```

```
pXgleich[k, n] // N  (* Alle k Pumpen erfüllen die Qualitätsanforerung *)
```

```
0.107381
```

```
(* Kontrolle *)    pXkleinerGleich[n, n] // N
```

```
1.
```

b

```
ErwX = n p // N
(* Soviele Pumpen von n im Mittel erfüllen die Qualitätsanforerung  *)
```

```
8.4
```

```
StdX = Sqrt[n p q] // N
```

2.42487

II / 4

```
Remove["Global`*"]
```

a

```
t = Table[k!, {k, 1, 12}]
```

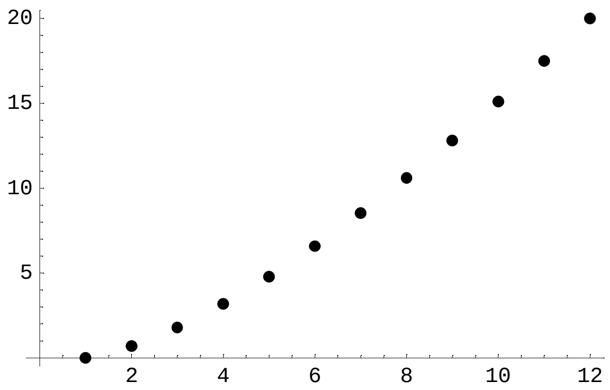
{1, 2, 6, 24, 120, 720, 5040, 40320, 362880, 3628800, 39916800, 479001600}

```
f0[k_] := Log[k!];
```

```
points = Table[{k, f0[k]}, {k, 1, 12}] // N
```

{{1., 0.}, {2., 0.693147}, {3., 1.79176}, {4., 3.17805},
{5., 4.78749}, {6., 6.57925}, {7., 8.52516}, {8., 10.6046},
{9., 12.8018}, {10., 15.1044}, {11., 17.5023}, {12., 19.9872}}

```
p1 = ListPlot[points, PlotStyle → PointSize[0.02]];
```



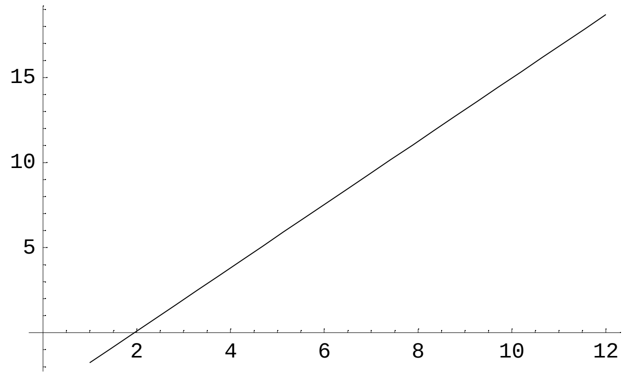
Punkte liegen nicht auf einer Geraden.

```
Fit[points, {1, x}, x]
```

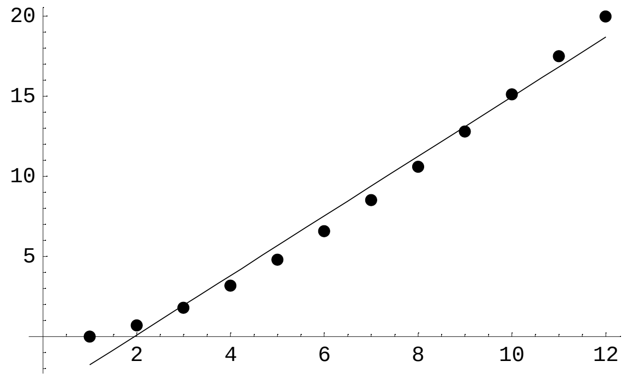
−3.62448 + 1.8596 x

```
f1[x_] := -3.6244843644409572` + 1.8596031085477305` x
```

```
p2 = Plot[f1[x], {x, 1, 12}];
```




```
Show[p1, p2];
```



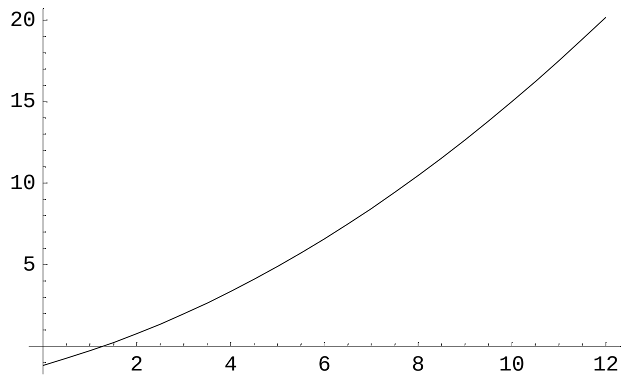
b

```
Fit[points, {1, x, x^2}, x]
```

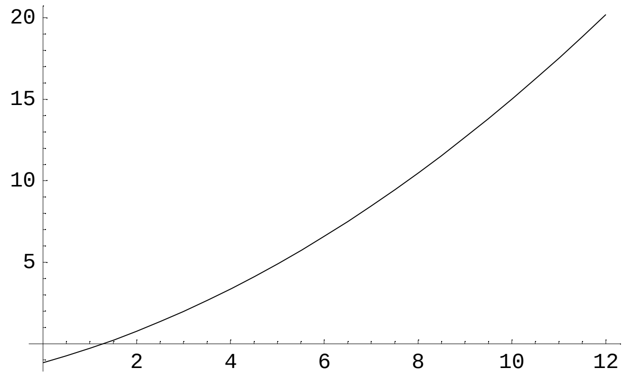
$-1.16694 + 0.806369\,x + 0.081018\,x^2$

```
f2[x_] := -1.167 + 0.8067 x + 0.08107 x^2
```

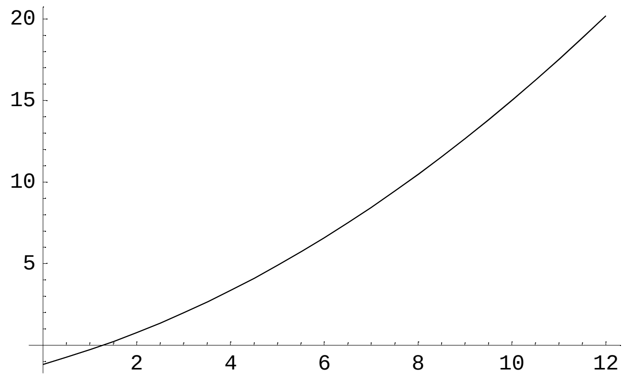
```
p3 = Plot[
   -1.1669375620976368` + 0.8063687646863081` x + 0.08101802645087866` x^2, {x, 0, 12}];
```



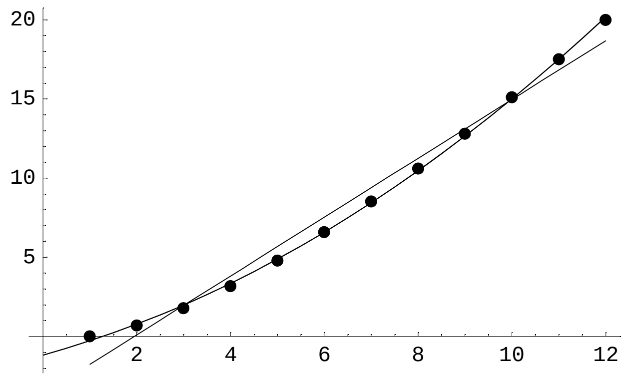
```
p31 = Plot[f2[x], {x, 0, 12}];
```




```
Show[p31, p3];
```




```
Show[p1, p31, p2, p3];
```



Eine Parabel passt schon besser..

c

```
s1 = Sum[(f0[k] - f1[k])^2, {k, 1, 12}]
```

9.01598

```
s2 = Sum[(f0[k] - f2[k])^2, {k, 1, 12}]
```

0.255776

```
s2 ≤ s1 / 2
```

```
True
```

```
(* Vergleich *)   Sum[(f0[k] - f2[k]) ^2, {k, 1, 100}]
```

4.8865×10^6

II / 5

```
pPunktUntenS = 1 / 2;
pLinieVonPunktFortsetzbar = (3 ! - 1) / 3 !  // N
```

```
0.833333
```

```
pNiveau1Niveau2s = pPunktUntenS * pLinieVonPunktFortsetzbar // N
```

```
0.416667
```

```
pNiveau1Niveau4s = pPunktUntenS * pLinieVonPunktFortsetzbar^3 // N
```

```
0.289352
```

II / 6

```
Remove["Global`*"];
```

```
<< Statistics`StatisticsPlots`;
<< Statistics`DescriptiveStatistics`;
```

a

```
M1 = {44.0, 50.5, 51.4, 48.9, 52.3, 55.4, 54.5, 57.3, 58.4, 63.3, 65.9, 66.6};
M2 = {44., 47.5, 47.1, 52.2, 49.9, 50.6, 52.5, 58.3, 58.6, 59.1, 61.8, 64.3};
```

```
{Mean[M1], Mean[M2]}
```

```
{55.7083, 53.825}
```

```
{Median[M1], Median[M2]}
```

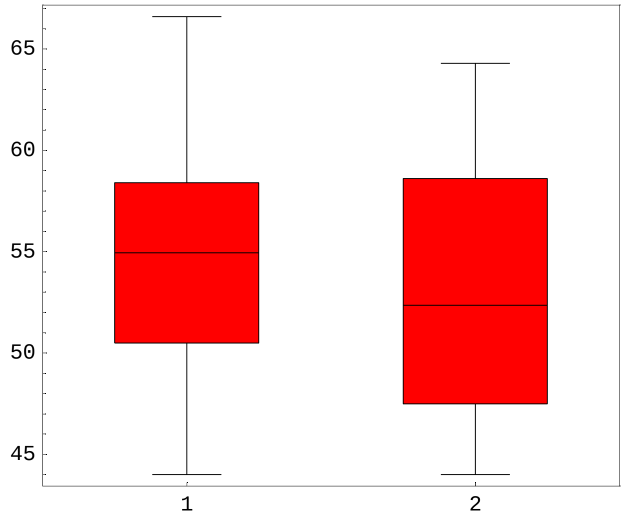
```
{54.95, 52.35}
```

```
{StandardDeviation[M1], StandardDeviation[M2]}
```

```
{6.95576, 6.43811}
```

b

```
BoxWhiskerPlot[Transpose[{M1, M2}]];
```

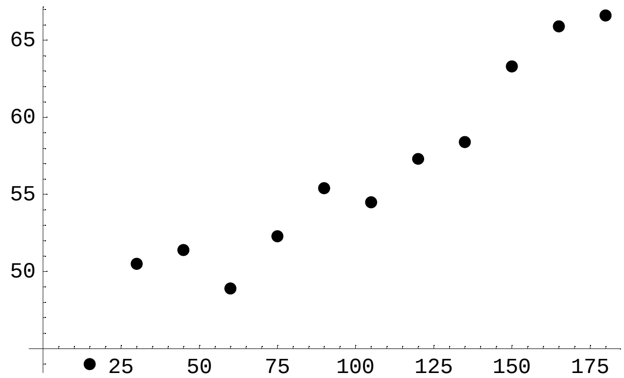


c1

```
points1 = Table[{k 15, M1[[k]]}, {k, 1, Length[M1]}]
 (* k: Alle 15 Minuten, Start 15 *)
```

```
{{15, 44.}, {30, 50.5}, {45, 51.4}, {60, 48.9}, {75, 52.3}, {90, 55.4},
 {105, 54.5}, {120, 57.3}, {135, 58.4}, {150, 63.3}, {165, 65.9}, {180, 66.6}}
```

```
p1 = ListPlot[points1, PlotStyle → PointSize[0.02]];
```

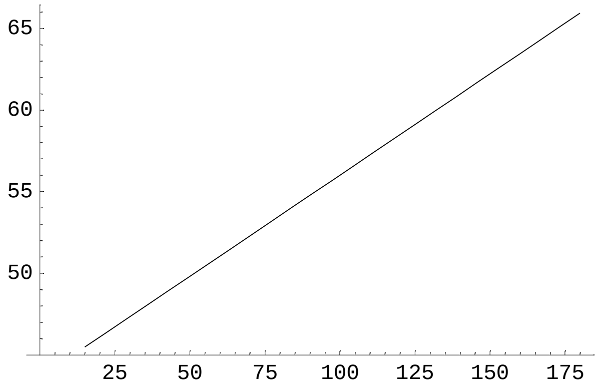



```
Fit[points1, {1, x}, x] // Expand
```

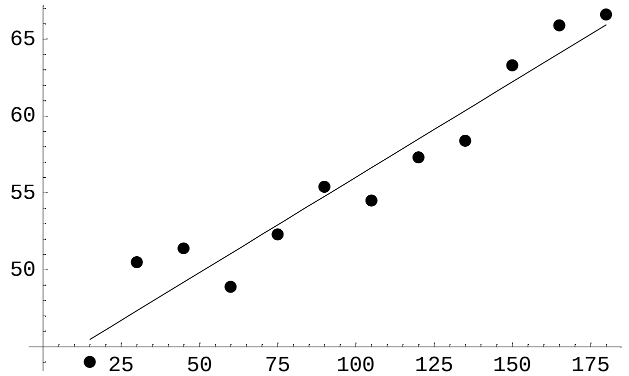
```
43.6152 + 0.124033 x
```

```
f1[x_] := 43.615151515151496` + 0.1240326340326341` x
```

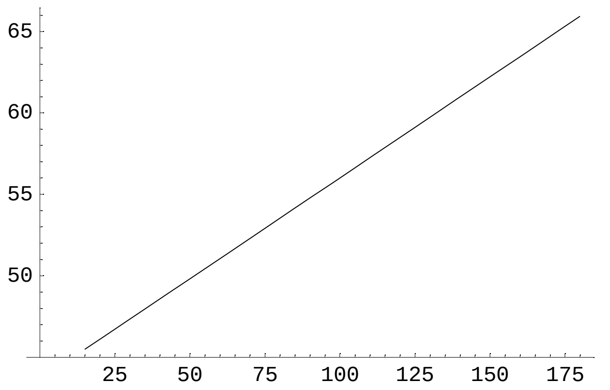
```
p2 = Plot[f1[x], {x, 15, 180}];
```




```
s1 = Show[p1, p2];
```




```
p2 = Plot[f1[x], {x, 15, 180}];
```

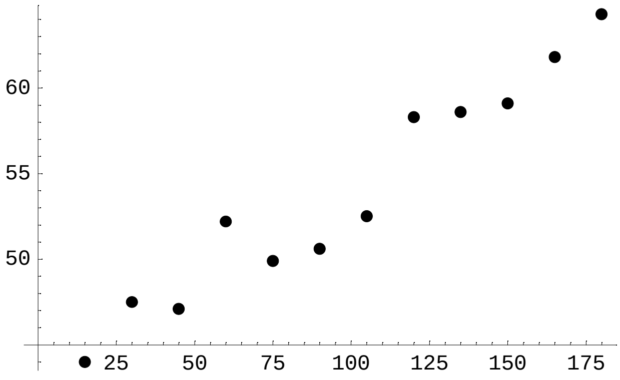


c2

```
points2 = Table[{k 15, M2[[k]]}, {k, 1, Length[M1]}]
  (* k: Alle 15 Minuten, Start 15 *)
```

```
{{15, 44.}, {30, 47.5}, {45, 47.1}, {60, 52.2}, {75, 49.9}, {90, 50.6},
 {105, 52.5}, {120, 58.3}, {135, 58.6}, {150, 59.1}, {165, 61.8}, {180, 64.3}}
```

```
p12 = ListPlot[points2, PlotStyle → PointSize[0.02]];
```

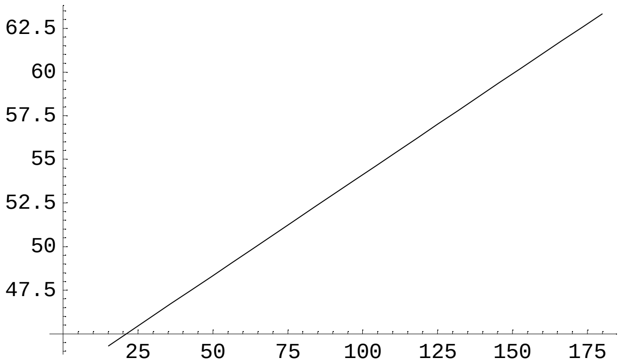



```
Fit[points2, {1, x}, x] // Expand
```

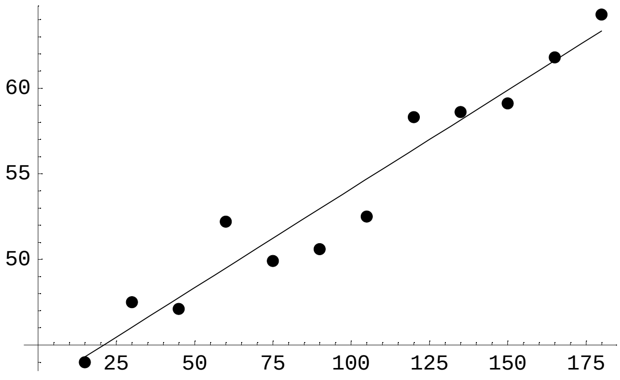
42.5727 + 0.115408 x

```
f12[x_] := 42.572727272727256` + 0.11540792540792548` x
```

```
p21 = Plot[f12[x], {x, 15, 180}];
```

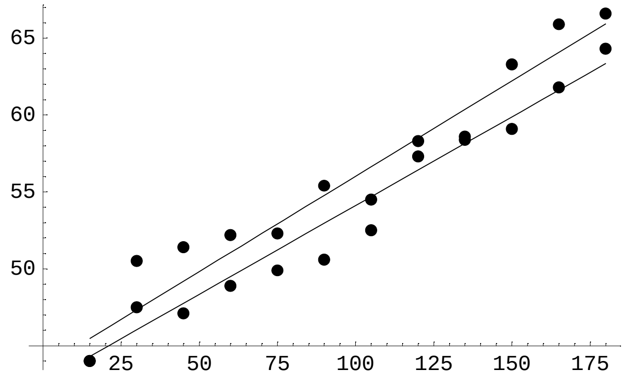



```
s2 = Show[p12, p21];
```



d

```
Show[s1, s2];
```



Komisch scheinen die Teperaturrückgänge zwischendurch. Die Erwärmung findet allerdings mit der Zeit statt. Die Teperaturrückgänge könnten die Folge von Messungenauigkeiten sein.

Work

Teile

```
t1 = Table[Floor[10 (44 + Log[k !] + 6 Random[])] / 10, {k, 1, 12}] // N

t1fix = {44.0, 50.5, 51.4, 48.9, 52.3, 55.4, 54.5, 57.3, 58.4, 63.3, 65.9, 66.6}

t2 = Table[Floor[10 (44 + Log[k !] + 6 Random[] ^3)] / 10, {k, 1, 12}] // N

t2fix = {44., 47.5, 47.1, 52.2, 49.9, 50.6, 52.5, 58.3, 58.6, 59.1, 61.8, 64.3}
```

Hilfen

```
a = 0.8 Pi; p1 = ParametricPlot3D[{Cos[t], Sin[t], t},
  {t, 0, 2 Pi}, ViewPoint -> {2.783, 0.517, 1.162}];
p2 = ParametricPlot3D[{t Cos[a], t Sin[a], a}, {t, 0, 1.3},
   ViewPoint -> {2.783, 0.517, 1.162}];
p3 = ParametricPlot3D[{0, 0, t}, {t, 0, 2 Pi}, ViewPoint -> {2.783, 0.517, 1.162}];
Show[p1, p2];
```