Aufgabe 1

In [35]:

```
t,k=var('t,k')
x=function('x')(t)
deq=diff(x,t)==-k*x
s=desolve(deq,[x,t])
s
```

Out[35]:

```
_C*e^(-k*t)
```

In [36]:

```
x0=var('x0')
s1=desolve(deq,[x,t],[0,x0])
s1
```

Out[36]:

```
x0*e^(-k*t)
```

In [37]:

```
sol(t,k,x0)=desolve(deq,[x,t],[0,x0])
sol
```

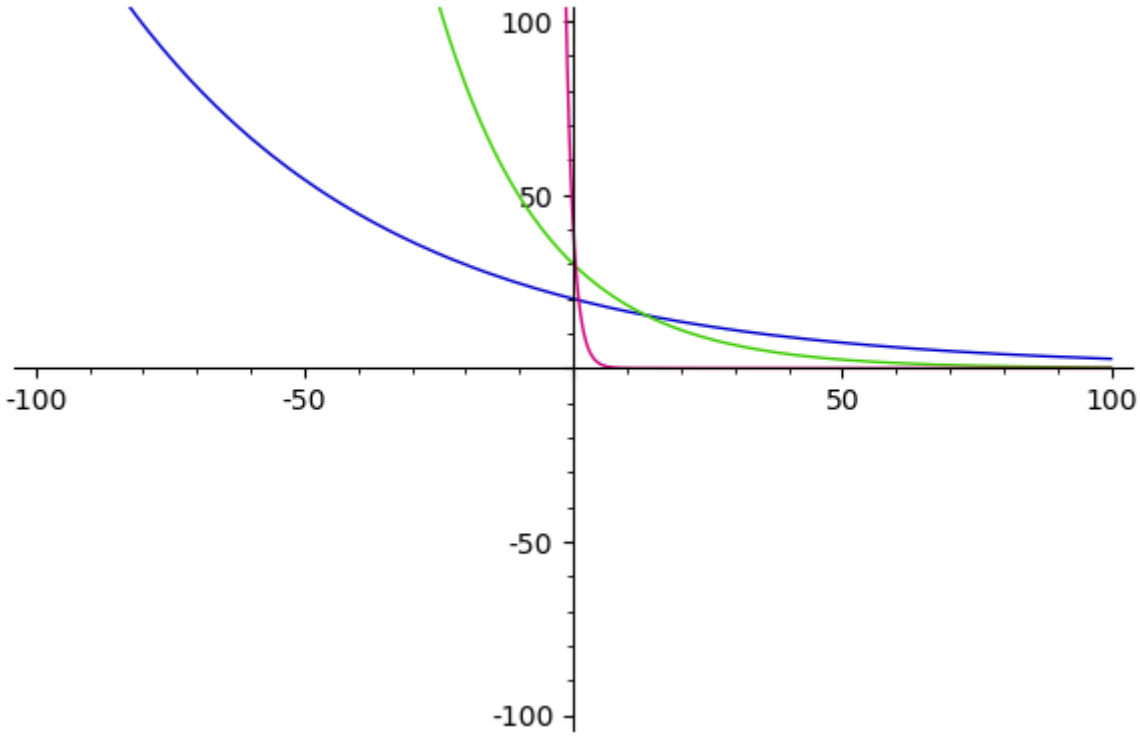
Out[37]:

```
(t, k, x0) |--> x0*e^(-k*t)
```

In [43]:

```
plot([sol(t,0.02,20),sol(t,0.05,30),sol(t,0.7,40)],t,-100,100,ymin=-100,ymax=100)
```

Out[43]:



In [44]:

```
T12=var('T12')
eq=sol(T12,k,x0)==x0/2
s2=solve(eq,k)
s2
```

Out[44]:

```
[k == log(2)/T12]
```

In [45]:

```
kk(T12)=s2[0].rhs()
kk
```

Out[45]:

```
T12 |--> log(2)/T12
```

In [46]:

```
kk(5730)
```

Out[46]:

```
1/5730*log(2)
```

In [47]:

```
numerical_approx(kk(5730))
```

Out[47]:

```
0.000120968094338559
```

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

```
Aufgabe 2
```

In [1]:

```
t,k,Tm,T0=var('t,k,Tm,T0')
T=function('T')(t)
deq=diff(T,t)==-k*(T-Tm)
s=desolve(deq,[T,t])
s
```

Out[1]:

```
(Tm*e^(k*t) + _C)*e^(-k*t)
```

In [2]:

```
s=desolve(deq,[T,t],[0,T0])
s
```

Out[2]:

```
(Tm*e^(k*t) + T0 - Tm)*e^(-k*t)
```

In [3]:

```
sol(t,k,T0,Tm)=desolve(deq,[T,t],[0,T0])
sol
```

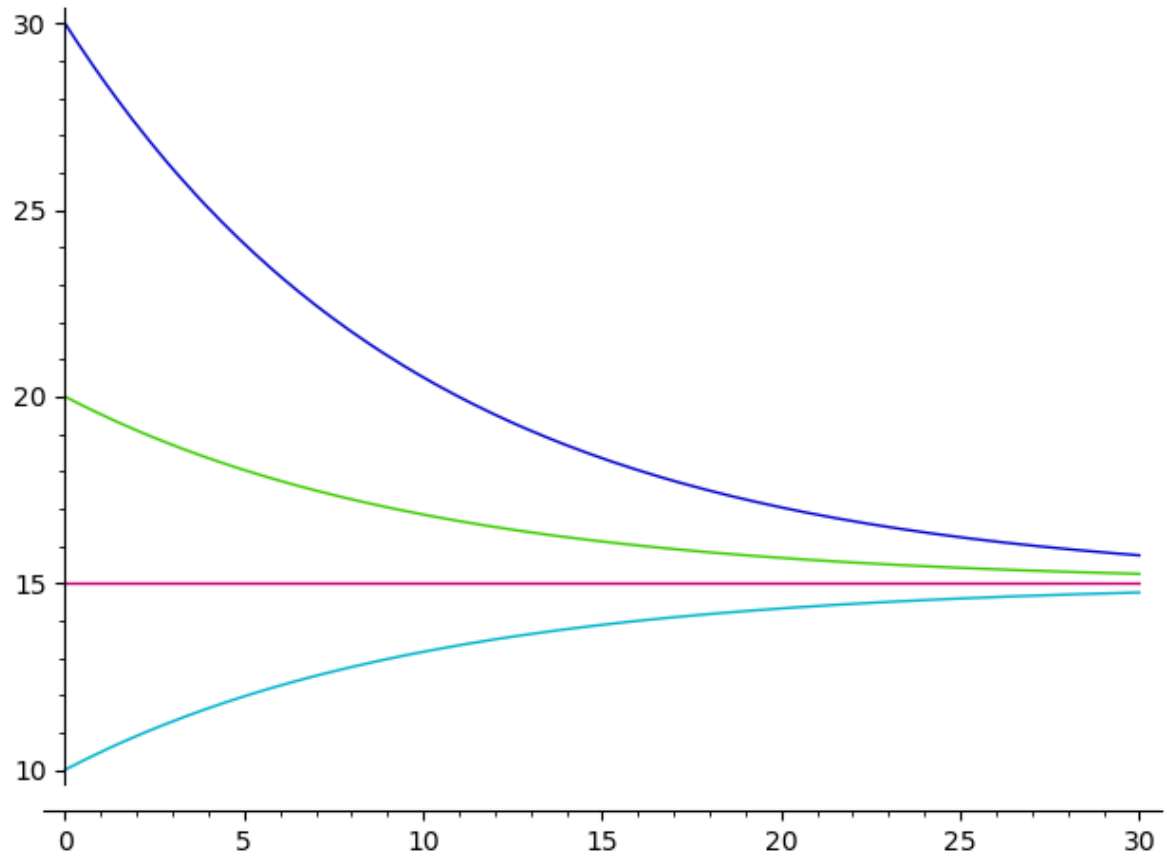
Out[3]:

```
(t, k, T0, Tm) |--> (Tm*e^(k*t) + T0 - Tm)*e^(-k*t)
```

In [4]:

```
plot([sol(t,0.1,30,15),sol(t,0.1,20,15),sol(t,0.1,15,15),sol(t,0.1,10,15)],t,0,30)
```

Out[4]:



In [6]:

```
eq1=sol(1,k,34.22,21)==34.11
s1=solve(eq1,k)
s1
```

Out[6]:

```
[k == log(1322/1311)]
```

In [7]:

```
k1=s1[0].rhs()
k1
```

Out[7]:

```
log(1322/1311)
```

In [8]:

```
Td=var('Td')
assume(Td,'real')
assume(k,'real')
eq2=sol(Td,k1,36,21)==34.22
s2=solve(eq2,Td)
s2
```

Out[8]:

```
[1322^Td == 750/661*1311^Td]
```

In [9]:

```
find_root(eq2,0,20)
```

Out[9]:

```
15.118043520273046
```

```
Aufgabe 3
```

In [31]:

```
t,r,x0,r0=var('t,r,x0,r0')
x=function('x')(t)
deqM=diff(x,t)==r*x
sM(t,x0,r)=desolve(deqM,[x,t],[0,x0])
sM
```

Out[31]:

```
(t, x0, r) |--> x0*e^(r*t)
```

In [32]:

```
solM(t,x0,r)=sM
solM
```

Out[32]:

```
(t, x0, r) |--> x0*e^(r*t)
```

In [ ]:

```

```

In [ ]:

```
```

In [ ]:

```
```

In [ ]:

```
```

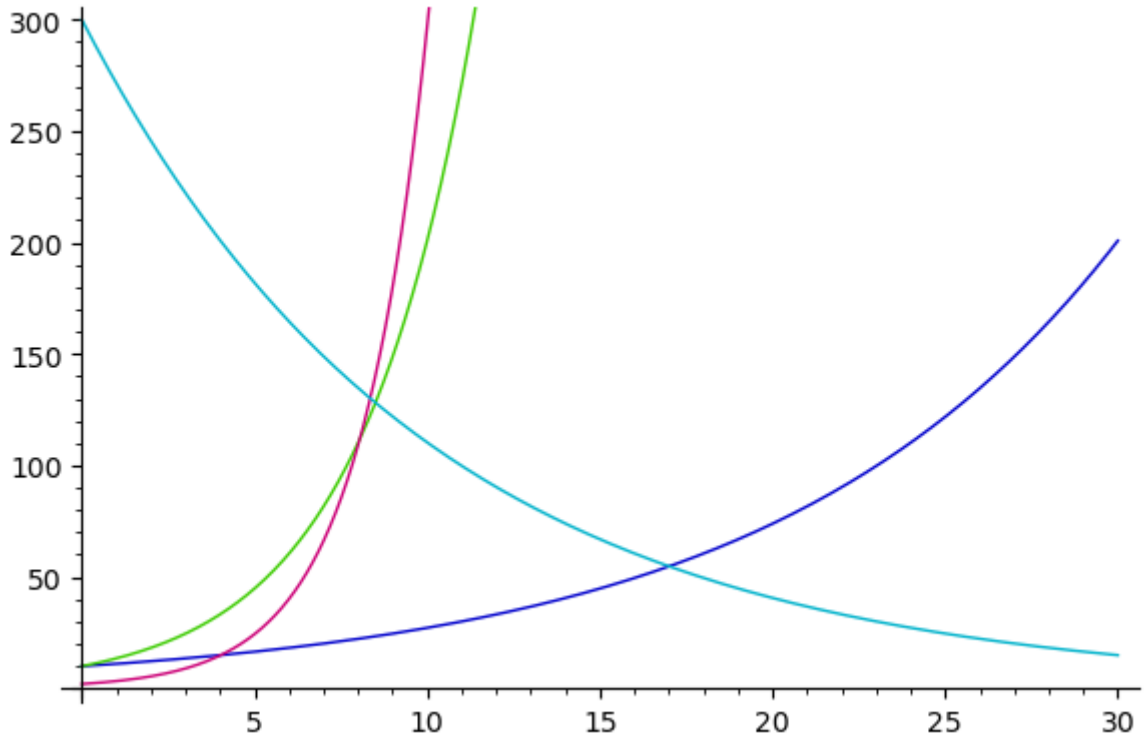
In [ ]:

```
```

In [33]:

```
plot([solM(t,10,0.1),solM(t,10,0.3),solM(t,2,0.5),solM(t,300,-0.1)],t,0,30,ymin=0,yr
```

Out[33]:



In [47]:

```
eq=solM(10,9.6,r)==12.9
s2=solve(eq,r)
s2
```

Out[47]:

```
[r == log(1/8*43^(1/10)*sqrt(2)*(sqrt(5) + I*sqrt(-2*sqrt(5) + 10) +
1)), r == log(1/8*43^(1/10)*sqrt(2)*(sqrt(5) + I*sqrt(2*sqrt(5) + 10)
- 1)), r == log(-1/8*43^(1/10)*sqrt(2)*(sqrt(5) - I*sqrt(2*sqrt(5) + 1
0) - 1)), r == log(-1/8*43^(1/10)*sqrt(2)*(sqrt(5) - I*sqrt(-2*sqrt(5)
+ 10) + 1)), r == log(-1/2*43^(1/10)*sqrt(2)), r == -4/5*I*pi + log(1/
2*43^(1/10)*sqrt(2)), r == -3/5*I*pi + log(1/2*43^(1/10)*sqrt(2)), r =
= -2/5*I*pi + log(1/2*43^(1/10)*sqrt(2)), r == -1/5*I*pi + log(1/2*43^
(1/10)*sqrt(2)), r == log(1/2*43^(1/10)*sqrt(2))]
```

In [48]:

```
numerical_approx(s2[9].rhs())
```

Out[48]:

```
0.0295464212893835
```

In [ ]:

```

```