```
> restart
> with(Optimization):
```

Vyroba maleinanhydrid

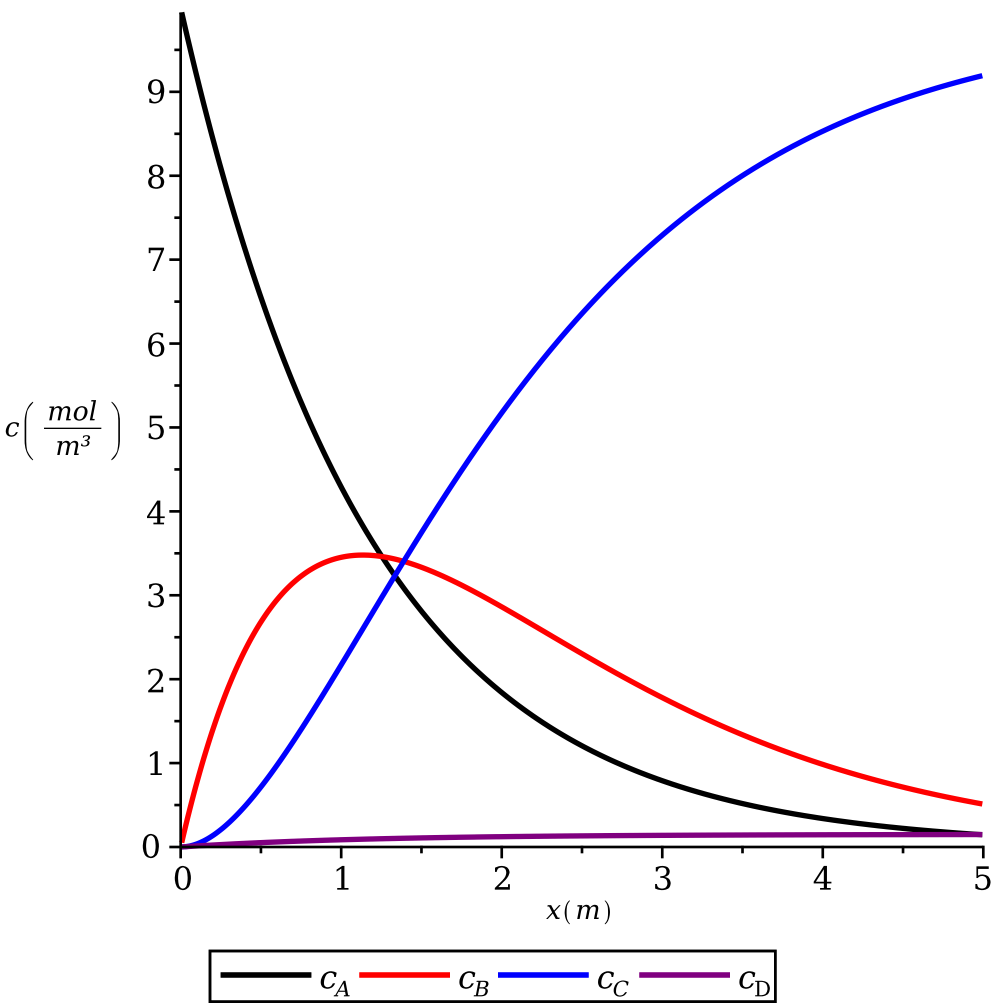
```
> odes :=
  v*diff(cA(x), x) = -k1*cA(x) - k3*cA(x),
  v*diff(cB(x), x) = k1*cA(x) - k2*cB(x),
  v*diff(cC(x), x) = k2*cB(x),
  v*diff(cD(x), x) = k3*cA(x)
  : # definuju diffky
```

Izotermni reaktor

a)

```
> v:= 0.6:
> k1 := 0.5:
> k2 := 0.55:
> k3 := 7.65 * 10**(-3): # definuju konstanty
> ics := cA(0) = 10, cB(0) = 0, cC(0) = 0, cD(0) = 0: #
  definuju pocatecni podminky
> reseni := dsolve([odes, ics], [cA(x), cB(x), cC(x), cD(x)]):
  # reseni (fuj)

> plot([seq(rhs(reseni[i]), i=1..numelems(reseni))], x=0..5,
  color=["black", "red", "blue", "purple"], thickness=2,
  legend=[c[A], c[B], c[C], c[D]], labels = [x(m), c(mol/m³)])
```



b) Optimalni delka reaktoru bude pro maximum fce c_B(x)

```
> cProdukt := x-> rhs(reseni[2]); # ulozim si konc.
  maleinanhydridu do promenne
```

$$cProdukt := x \mapsto rhs(reseni_2) \quad (1.1.1)$$

```
> delkaReaktoru := evalf(solve(diff(cProdukt(x),x) = 0)); # v
  metrech
```

$$delkaReaktoru := 1.135197797 \quad (1.1.2)$$

Neizotermni Reaktor

```
> k1 := T -> 4.3 * 10^5 * exp(-12660 / T);
  k2 := T -> 7 * 10^6 * exp(-15000 / T);
  k3 := T -> 2.6 * 10^3 * exp(-10800 / T);
```

$$k1 := T \mapsto 4.3 \cdot 100000 \cdot \mathrm{e}^{-\frac{12660}{T}}$$

$$k2 := T \mapsto 7000000 \cdot \mathrm{e}^{-\frac{15000}{T}}$$

$$k3 := T \mapsto 2.6 \cdot 1000 \cdot \mathrm{e}^{-\frac{10800}{T}} \quad (1.2.1)$$

```
> odes :=
  v*diff(cA(x), x) = -k1(T(x))*cA(x) - k3(T(x))*cA(x),
  v*diff(cB(x), x) = k1(T(x))*cA(x) - k2(T(x))*cB(x),
  v*diff(cC(x), x) = k2(T(x))*cB(x),
  v*diff(cD(x), x) = k3(T(x))*cA(x),
  diff(T(x), x) = -k1(T(x))*cA(x)*H1 - k2(T(x))*cB(x)*H2 - k3
  (T(x))*H3: # redefinuju diffky
```

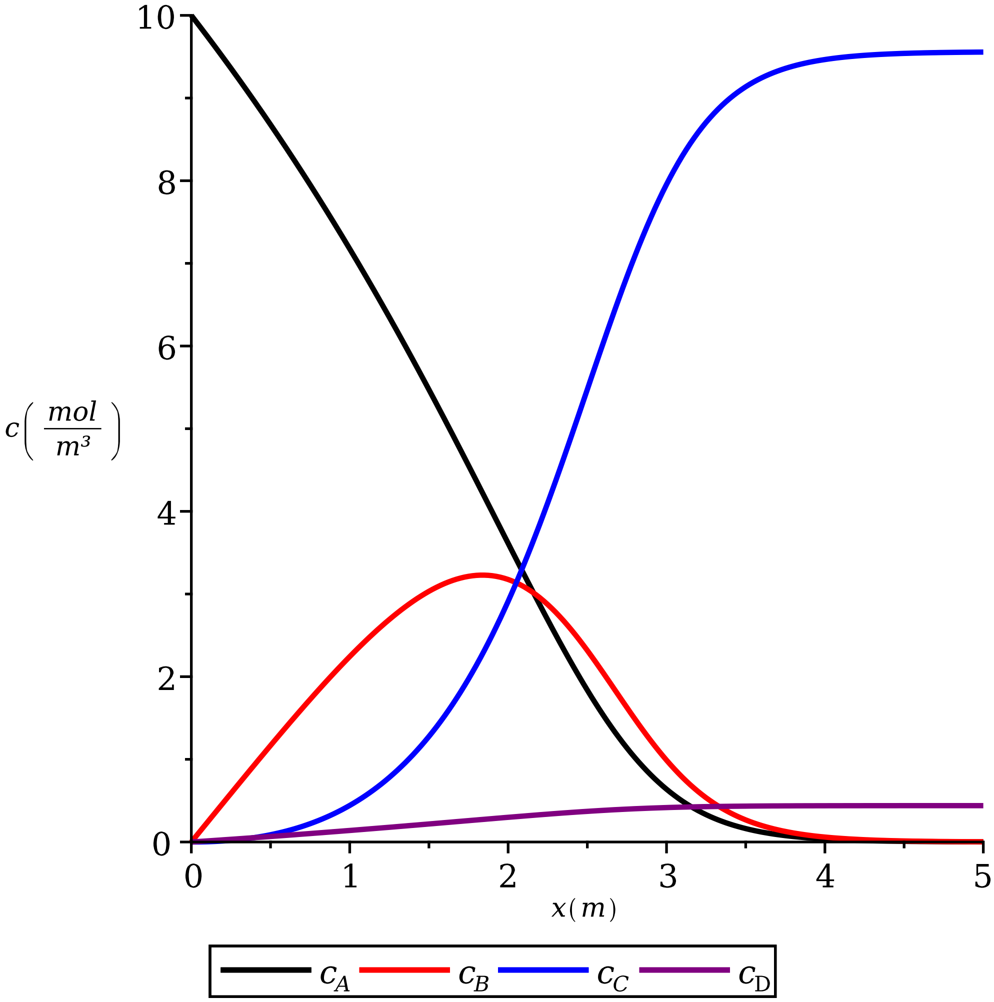
```
> H1 := -20:
> H2 := -10:
> H3 := -15: # definuju konstanty
```

```
> ics := cA(0) = 10, cB(0) = 0, cC(0) = 0, cD(0) = 0, T(0) =
  848: # definuju pocatecni podminky
```

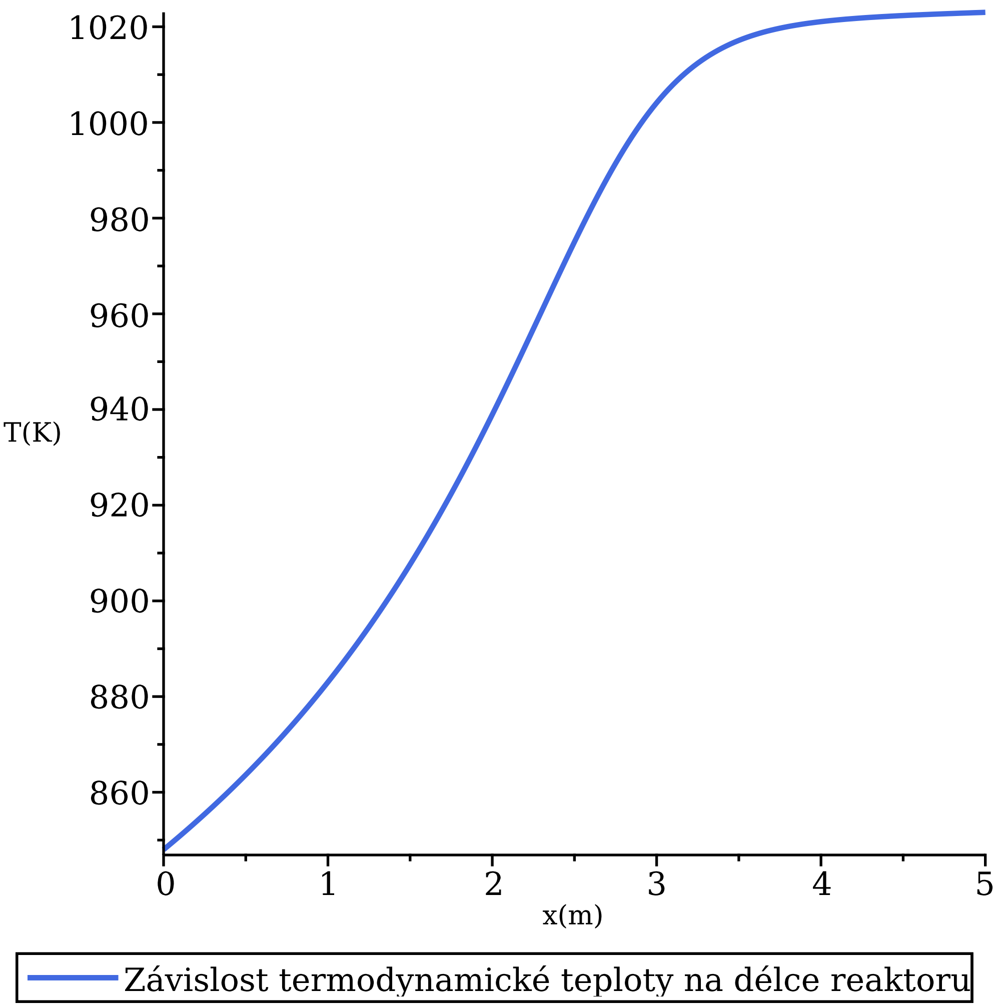
```
> reseni := dsolve([odes, ics], [cA(x), cB(x), cC(x), cD(x), T
  (x)], numeric, method = rkf45, relerr = 1.0e-8, abserr=
  1.0e-8); # reseni (fuj)
                    reseni := proc(x_rkf45) ... end proc                    (1.2.2)
```

c) Graf. reseni neizotermniho reaktoru

```
> plots[odeplot](reseni,[[x, cA(x)], [x, cB(x)], [x, cC(x)],
  [x, cD(x)]], x=0..5, labels = [x(m), c(mol/m³)], color=
  ["black", "red", "blue", "purple"], thickness=2, legend=[c
  [A], c[B], c[C], c[D]])
```



```
> plots[odeplot](reseni, [x, T(x)], x=0..5, color="RoyalBlue",
  thickness=2, labels=["x(m)", "T(K)"], legend=["Závislost
  termodynamické teploty na délce reaktoru"])
```



d) Optimalni delka reaktoru bude pro maximum fce c_B(x)

```
> cProdukt := x-> rhs(reseni(x)[3])
```

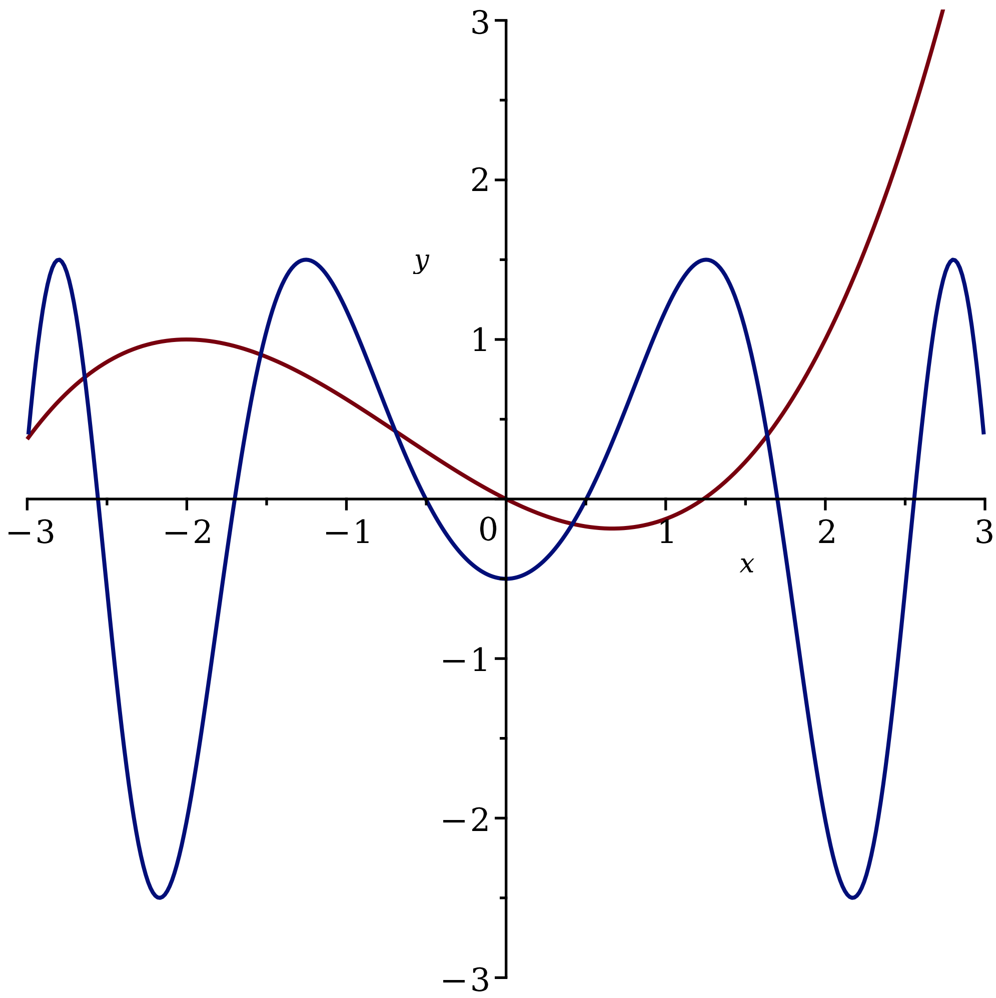
$$cProdukt := x \mapsto rhs(reseni(x)_3) \tag{1.2.3}$$

```
> delkaReaktoru:= Maximize(cProdukt, 0..5)[2]; # v metrech
```

$$delkaReaktoru := \left[\ 1.83850681382794\ \right] \tag{1.2.4}$$

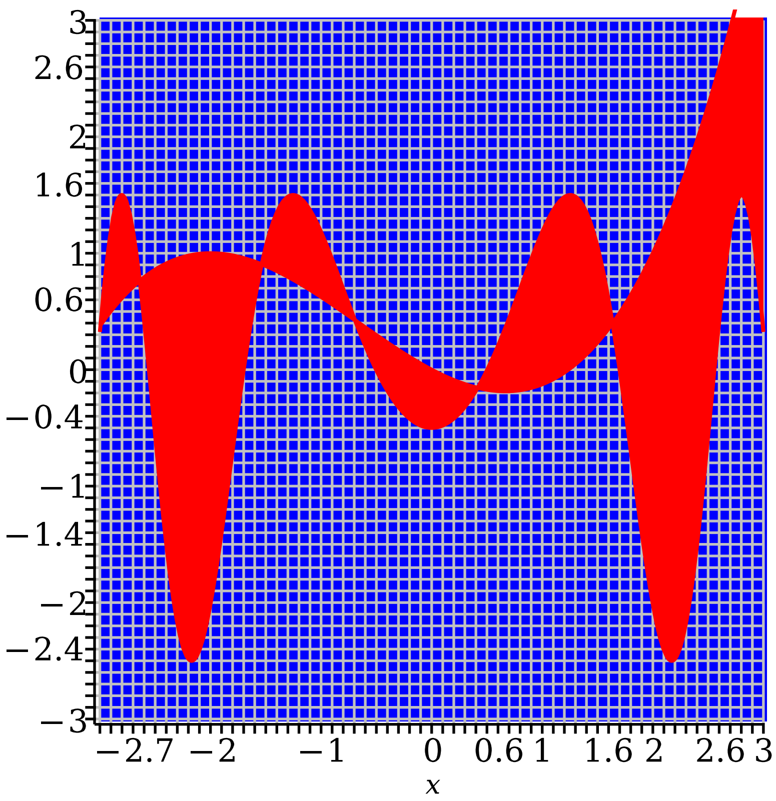
Podlahova mozaika na ustav matematiky

```
> f := x-> 1/8 * x**3 + 1/4 * x**2 - 1/2 * x:
> g := x-> 2*sin(x**2) - 1/2:
> with(plots):
> plot([f(x), g(x)], x=-3..3, y=-3..3)
```



a)

```
> mozaika := shadebetween(f(x), g(x), x = -3..3, color=red,
  background=blue, transparency=0.1,view=[-3..3, -3..3],axes=
  frame, axis = [gridlines=[60, color=grey]])
```



b)

```
> cervene := evalf(int(abs(f(x) - g(x)), x=-3..3))
                    cervene := 7.833191231                              (2.1)
```

```
> cerveneDlazdicky := ceil(cervene/0.01 * 1.1)
                    cerveneDlazdicky := 862                             (2.2)
```

```
> modreDlazdicky := ceil((36- cervene)/0.01 *1.1)
                    modreDlazdicky := 3099                              (2.3)
```

c)

```
isInside := proc(x::float, y::float)
    local i, x1, x2, inRange, f_val, g_val; # Nadefinuj promenne, aby maple neprndal
    inRange := false;
    if x >= -3.0 and x <= 3.0 then
            inRange := true;
            f_val := f(x);
            g_val := g(x);
            if (y >= min(f_val, g_val)) and (y <= max(f_val, g_val)) then #ZKONTROLUJE JESTLI JE V ROZMEZI NEBO NE
                return true; # je cervena
            else
                return false; #je modra
            end if;
        end if;
    return false;# je mimo
end proc:
```

```
> isInside(2.0, -0.7)
                         "Je cervena"
                             true                                       (2.4)
```

```
> isInside(-1.63, 2.0)
                         "Je modra"
                            false                                       (2.5)
```

```
> isInside(-1.0, 1.0)
                                  "Je cervena"
                                     true                                  (2.6)
```

d)

```
cDlazdic := 0:
mDlazdic := 0:
for i from -3.0 by 0.1 to 2.9 do
        for j from -3.0 by 0.1 to 2.9 do
                LD := isInside (evalf(i),evalf(j));
                LH := isInside (evalf(i), j+0.1);
                PD := isInside (i+0.1, evalf(j));
                PH := isInside (i+0.1, j+0.1);
                if LD and LH and PD and PH then # vsechny cervene
                        cDlazdic := cDlazdic + 1;

                elif not LD and not LH and not PD and not PH then # vsechny modre
                        mDlazdic := mDlazdic + 1;
                else # rezeme
                        cDlazdic := cDlazdic + 1;
                        mDlazdic := mDlazdic + 1;
                fi
        od
od
```

```
> cDlazdic
                                      952                                  (2.7)
> mDlazdic
                                     3017                                  (2.8)
```