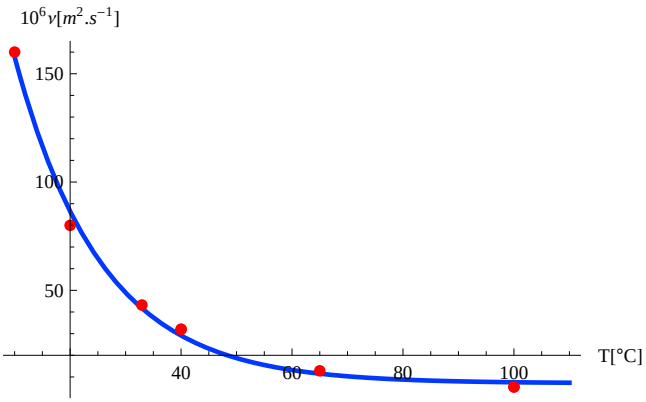
In[1]:=
```
Quiet@Remove["Global`*"];
SetDirectory[NotebookDirectory[]];
$HistoryLength = 3;
Off[FindRoot::lstol];
```

In[5]:=
```
roOlej = 847;
roVoda = 997;
cm = 0.01;
mm = 0.1 cm;
```

In[9]:=
```
datvisc = {{100, 5.4}, {100.01, 5.4 - 0.01}, {65, 10.876 * 10^-3 / roOlej * 10^6},
    {40, 32}, {40.01, 31.99}, {32.94, 36.612 * 10^-3 / roOlej * 10^6}, {20, 80}, {10, 160}};
(*mm^2/s*)
pl1 = ListPlot[datvisc,
    AxesLabel → {"T[°C]", "10^6 ν[m^2.s^-1]"}, PlotStyle → {Hue[0], PointSize[0.02]}];
```

In[11]:=
```
ClearAll[nahr, T, α];
v := α# &;
par := Union[Cases[#, α_, {0, ∞}]] &;
model = v[1] + v[2] * Exp[1 - v[3] * T];
nahr[T_] = model /. FindFit[datvisc, model, par[model], T, Method → NMinimize];
pl2 = Plot[nahr[T], {T, 10, 110}, AxesLabel → {"T[°C]", "10^6 ν[m^2.s^-1]"},
    PlotStyle → {Hue[0.63], Thickness[0.008]}, PlotRange → All];
Show[pl2, pl1, PlotRange → All]
nyOlej[Tolej_] := 10^-6 * nahr[Tolej];
cpOlej = 1988;
cpVoda = 4178;
TinVoda = 14.5;
```

Out[17]=



In[22]:=
```
(*mereni cislo 5*)
TinOlej = 59;
ToutOlej = 34.5;
msteckouVoda = 6.33;
msteckouOlej = 1.218;
respars = Solve[
    {cpOlej * msteckouOlej * (TinOlej - ToutOlej) == cpVoda * msteckouVoda * (ToutV - TinVoda),
     P == cpVoda * msteckouVoda * (ToutVoda - TinVoda)}, {ToutV, P}][[1]];
{ToutVoda, vykon} = {ToutV, P} /. respars
datNyVoda = {{0, 1.787}, {5, 1.519}, {10, 1.307}, {20, 1.004}, {30, 0.801}, {40, 0.658},
   {50, 0.553}, {60, 0.475}, {70, 0.413}, {80, 0.365}, {90, 0.326}, {100, 0.29}};
ListPlot[%];
nyVoda = 10^-6 * Interpolation[datNyVoda][#] &;
dataPrVoda = {{0.01, 13.67}, {10, 9.47}, {20, 7.01}, {30, 5.43},
   {40, 4.34}, {50, 3.56}, {60, 2.99}, {70, 2.56}, {80, 2.23}, {90, 1.96}};
ListPlot[%];
PrVoda = Interpolation[dataPrVoda];
dataLambdaVoda =
  {{0, 0.561}, {20, 0.5984}, {40, 0.631}, {60, 0.654}, {80, 0.67}, {100, 0.679}};
ListPlot[%];
lambdaVoda = Interpolation[dataLambdaVoda];
lambdaOlej = 0.13141 &;
PrOlej[T_] := nyOlej[T] / (lambdaOlej[T] / (cpOlej*roOlej));

nu[gz_] := Which[0 ≤ gz < 667, 4.364 + 0.263 * gz^0.506 * Exp[-41. / gz],
   667 ≤ gz < 2 * 10^4, 1.302 * gz^0.333 - 0.5, gz ≥ 2 * 10^4, 1.302 * gz^0.333 - 1];
Plot[nu[gz], {gz, 666, 680}];
```

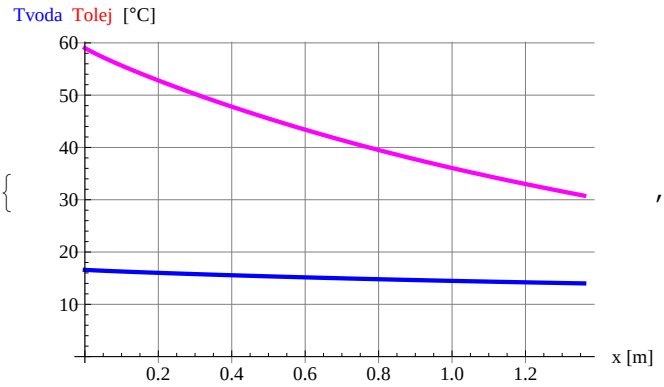
Out[27]= {16.7431, 59 323.9}

In[41]:=
```
ClearAll[vydej];
ΔxVstup = 50 mm;
dchar = 0.32 cm;
vydej[S0_, TinVoda_, d0_] :=
  Module[{Dchar = dchar, vyska, m0, nk, prurez, rychlostOlej, rychlostVoda,
    ReVoda, ReOlej, gz, alfaOlej, alfaVoda, nKanalu, ξ, Tplech, kacko, Tdeska,
    αOlej, αVoda, TdefOlej, TdefVoda, k, rce, res, Tvd, Tv0, Tvvystup, tv0, pom,
    Tvoda, Tolej, ksi, plb, vykony, TstrV, TstrO, ReV, ReO, PrV, PrO, pomNu},
   m0 = S0 / d0;
```

```
vyska = d0;

prurez = Dchar * m0;

rychlostVoda = msteckouVoda / (roVoda * prurez);
rychlostOlej = msteckouOlej / (roOlej * prurez);

ReVoda[T_] := (Dchar * rychlostVoda) / nyVoda[T];
ReOlej[T_] := (Dchar * rychlostOlej) / nyOlej[T];
gz[re_, pr_, x_] := (re * pr * Dchar) / x;
alfaOlej[T_, x_] := (lambdaOlej[T] / Dchar) * nu[gz[ReOlej[T], PrOlej[T], Abs[x] + ΔxVstup]];
alfaVoda[T_, x_] :=
 (lambdaVoda[T] / Dchar) * nu[gz[ReVoda[T], PrVoda[T], Abs[d0 - x] + ΔxVstup]];

ξ = alfaOlej[0.5 (62 + 39), 0.5 * (d0 + ΔxVstup)] / alfaVoda[TinVoda + 2, 0.5 * (d0 + ΔxVstup)];

Tplech[Tolej_, Tvoda_] =
 (Tdeska /. Simplify[Solve[αOlej * (Tolej - Tdeska) == αVoda * (Tdeska - Tvoda), Tdeska][[
       1]] /. αOlej → ksi * αVoda]) /. ksi → ξ;
kacko[α1_, α2_] := (α1 * α2) / (α1 + α2);
TdefOlej = Simplify[0.5 * (To[x] + Tplech[To[x], Tv[x]])];
TdefVoda = Simplify[0.5 * (Tv[x] + Tplech[To[x], Tv[x]])];

k[x_] = Module[{α1, α2}, α1 = alfaOlej[TdefOlej, x] * (nahr[TdefOlej] / nahr[Tplech[To[x], Tv[x]]])^0.14;
  α2 = alfaVoda[TdefVoda, x]; kacko[α1, α2]];

rce[ToutVoda_] := {-cpVoda * msteckouVoda * Tv'[x] == k[x] * m0 * (To[x] - Tv[x]),
  cpOlej * msteckouOlej * To'[x] == -k[x] * m0 * (To[x] - Tv[x]),
  To[0] == TinOlej, Tv[0] == ToutVoda};
res[ToutVoda_] := NDSolve[rce[ToutVoda], {Tv, To}, {x, 0, d0}][[1]];
```

```
Tvd[Tv0_?NumberQ] := Tv[d0] /. res[Tv0];
  Tv0[tvd_] := tv0 /. FindRoot[Tvd[tv0] == tvd, {tv0, 19}];
  Tvvystup = Tv0[TinVoda];
  pom = res[Tvvystup];

  plb = Plot[Evaluate[{Tv[x], To[x]} /. pom], {x, 0, d0},
    AxesOrigin → {0, 0}, PlotStyle → {{Thick, Blue}, {Thick, Magenta}},
    AxesLabel → {"x [m]", "Tvoda  Tolej  [°C]"}, GridLines → Automatic];
  vykony = {cpOlej * msteckouOlej * (To[0] - To[d0]),
     cpVoda * msteckouVoda * (Tv[0] - Tv[d0])} /. pom;
  {TstrV, TstrO} = Evaluate[{Tv[0.5 d0], To[0.5 d0]} /. pom];
  {ReV, ReO, PrV, PrO} =
   {ReVoda[TstrV], ReOlej[TstrO], PrVoda[TstrV], PrOlej[TstrO]};
  {plb, vykony, ξ, {TstrV, TstrO}, {ReV, ReO, PrV, PrO}, (ReV * PrV)/(ReO * PrO),
    pomNu = (nu@gz[ReV, PrV, 0.5 * (d0 + ΔxVstup)])/(nu@gz[ReO, PrO, 0.5 * (d0 + ΔxVstup)]), (pomNu * (lambdaVoda[TstrV])/(lambdaOlej[TstrO]))^-1}
  ];
S0 = 17.68;
d0 = 1360 mm;
pp = vydej[S0, 14, d0]
```

Out[47]=




```
{, {68 360.6, 68 360.6}, 0.21846,
 {15.0085, 41.7829}, {429.109, 4.13721, 8.07386, 342.598}, 2.44431, 1.01765, 0.219116}
```

In[48]:=
```
Print["odchylka vypocet - mereni= ", 100 (Mean[pp[[2]]] - P /. respars)/(P /. respars), " %"]
```

```
odchylka vypocet - mereni= 15.2329 %
```