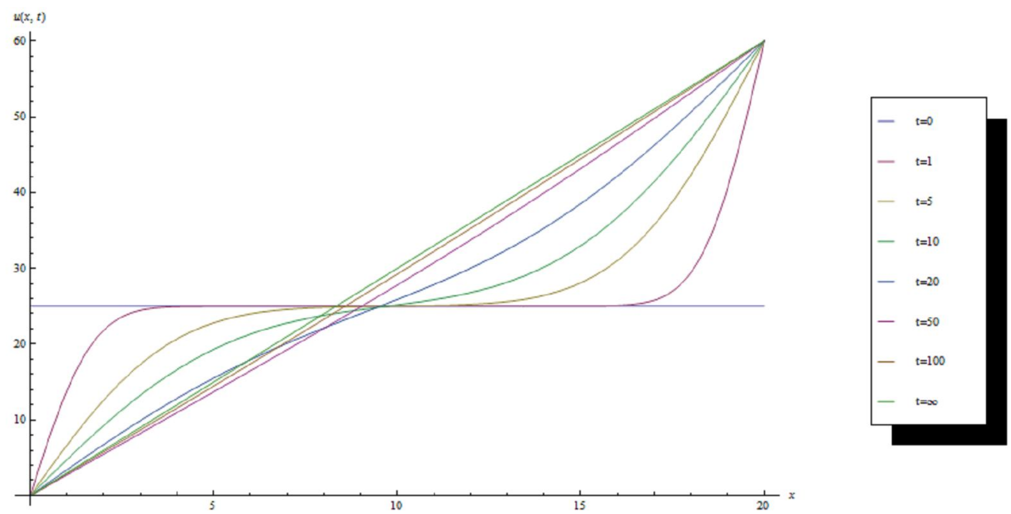
```
ClearAll["Global`*"];
Needs["PlotLegends`"];

(* Problem 10.6.9 in Boyce & DiPrima, Elementary Differential Equations and Boundary Value Problems, 8th Ed.

  We would like to plot the temperature distribution as stated below. Note that w, as defined,
is indeed the nth partial sum of the transient temperature distribution. The computer cannot handle an infinite sum (yet),
so we have to resort to the finite partial sum.

  Nevertheless, this is not so bad in view of the rapid decay of the exponential terms. So what we can and will do is to take n sufficiently
 large until the partial sum does not change noticeably with any additional terms. *)

f[x_] := 25; (* Initial temperature distribution *)
v[x_] := 3 x; (* Steady-state temperature distribution *)
w[x_, t_, n_] := Sum[(10 (5 + 7 (-1)^k))/(k π) Exp[(-0.86 π^2 k^2 t)/400] Sin[(k π x)/20], {k, 1, n}]; (* Transient temperature distribution *)
u[x_, t_, n_] := v[x] + w[x, t, n]; (* Overall temperature distribution *)

(* Plot the temperature distribution for several values of t,
where t=0 and t=∞ correspond to the initial and steady-state temperature distributions respectively. We take 1000 terms in the partial sums. *)
Plot[{f[x], u[x, 1, 1000], u[x, 5, 1000], u[x, 10, 1000], u[x, 20, 1000], u[x, 50, 1000], u[x, 100, 1000], v[x]}, {x, 0, 20},
 PlotLegend → {"t=0", "t=1", "t=5", "t=10", "t=20", "t=50", "t=100", "t=∞"}, LegendPosition → {1.1, -0.4}, AxesLabel → {x, u[x, t]}]
```




```
(* Plot the temperature distribution for several values of x for 0≤t≤200. We take 1000 terms in the partial sums. *)
Plot[{u[5, t, 1000], u[10, t, 1000], u[15, t, 1000]}, {t, 0, 200}, PlotLegend → {"x=5", "x=10", "x=15"}, LegendPosition → {1.1, -0.4}, AxesLabel → {t, u[x, t]}]
```