Literature solutions to Unsteady State Heat Transfer to a Sphere

Heisler charts (Geankoplis; see also Wikipedia)
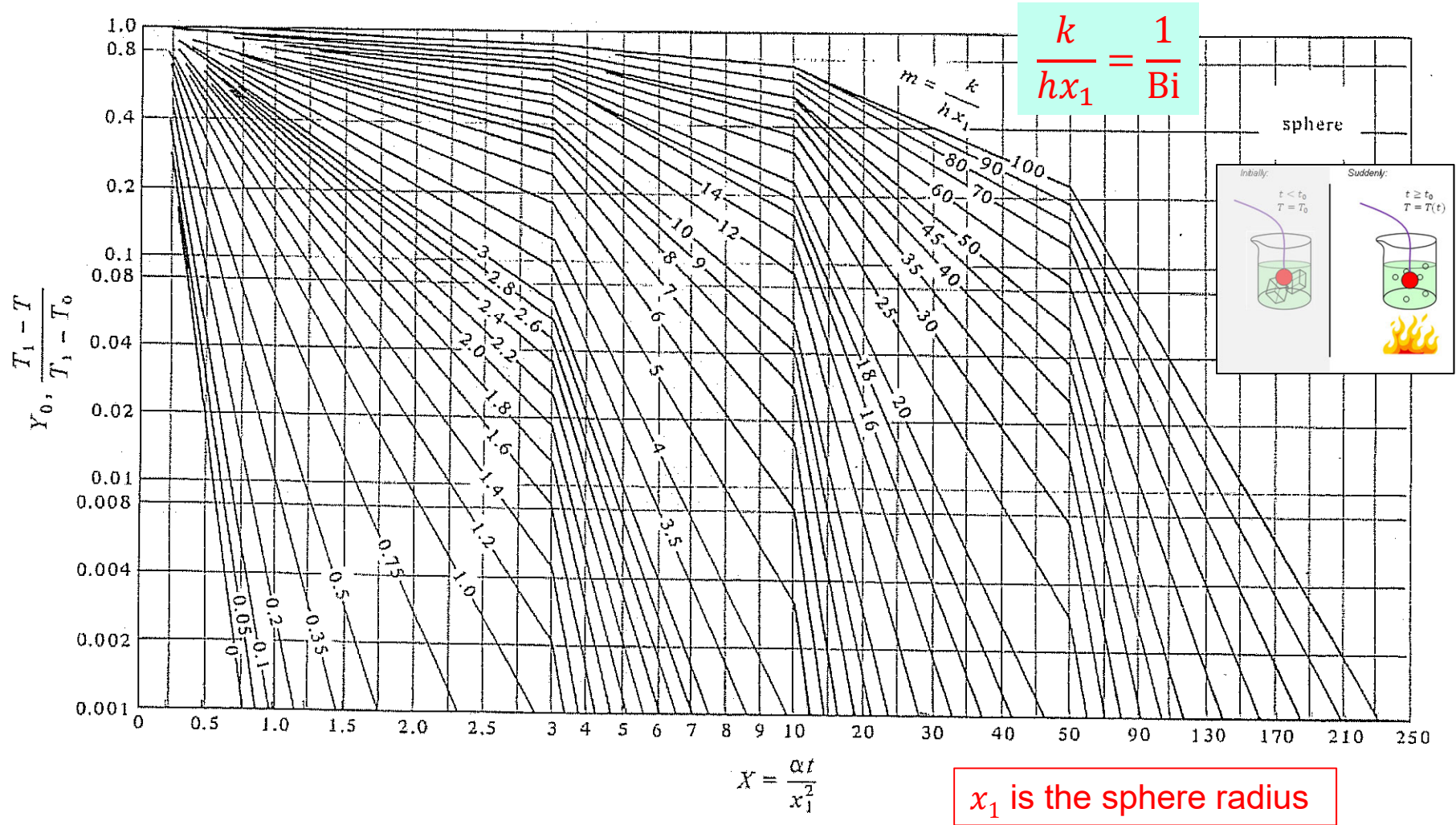

$$m = \frac{k}{h x_1}$$

$$\frac{k}{h x_1} = \frac{1}{Bi}$$

sphere

Initially: $t < t_0$, $T = T_0$ Suddenly: $t \geq t_0$, $T = T(t)$

$$X = \frac{\alpha t}{x_1^2}$$

$$Y_0, \frac{T_1 - T}{T_1 - T_0}$$

x_1 is the sphere radius

FIGURE 5.3-10. *Chart for determining the temperature at the center of a sphere for unsteady-state heat conduction.* [From H. P. Heisler, Trans. A.S.M.E., **69**, 227 (1947). With permission.]

From Geankpolis, 4th ed., page 374; see also Welty, Rorrer, Foster, 6th ed., p717, and Wikipedia.

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Heisler charts (Geankoplis; see also Wikipedia)

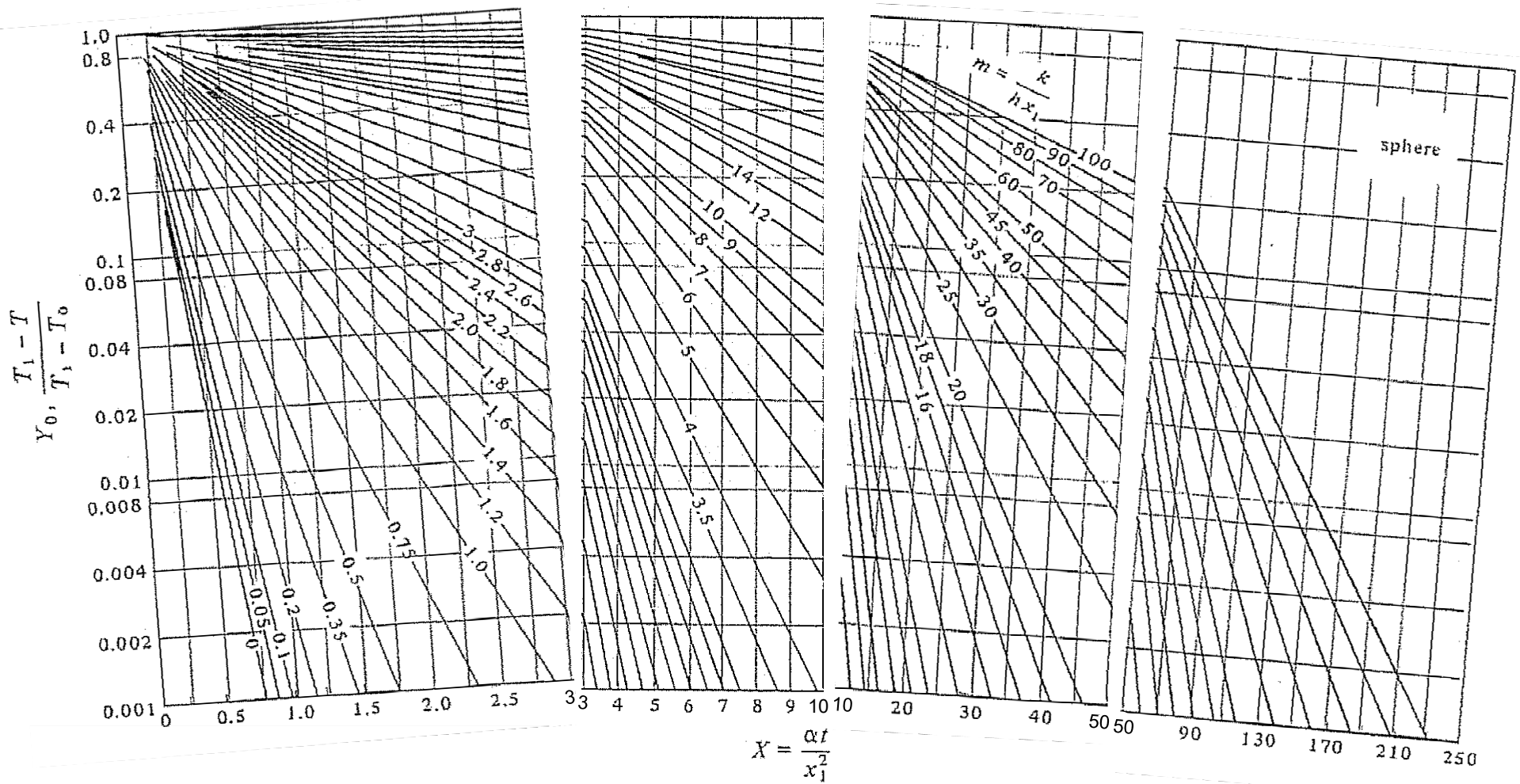Note also: think of it as 4 separate graphs

FIGURE 5.3-10. *Chart for determining the temperature at the center of a sphere for unsteady-state heat conduction. [From H. P. Heisler, Trans. A.S.M.E., 69, 227 (1947). With permission.]*

Axis label: $Y_0, \dfrac{T_1 - T}{T_1 - T_0}$

$X = \dfrac{\alpha t}{x_1^2}$

$m = \dfrac{k}{h x_1}$

sphere

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From Geankpolis, 4th edition, page 374