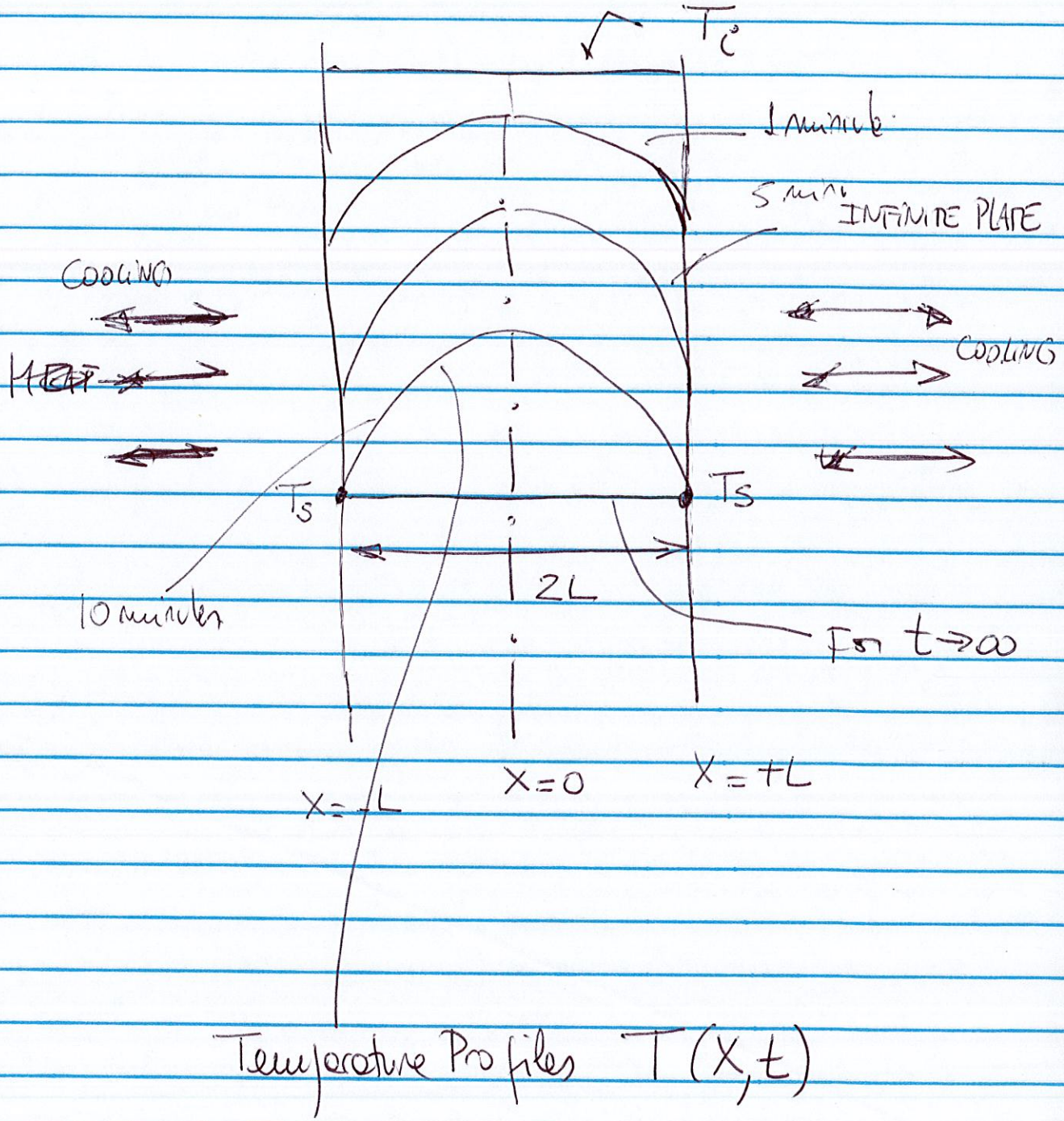
NOTES CLASS 2-6-18

UNSTEADY STATE HEAT TRANSFER PROBLEMS



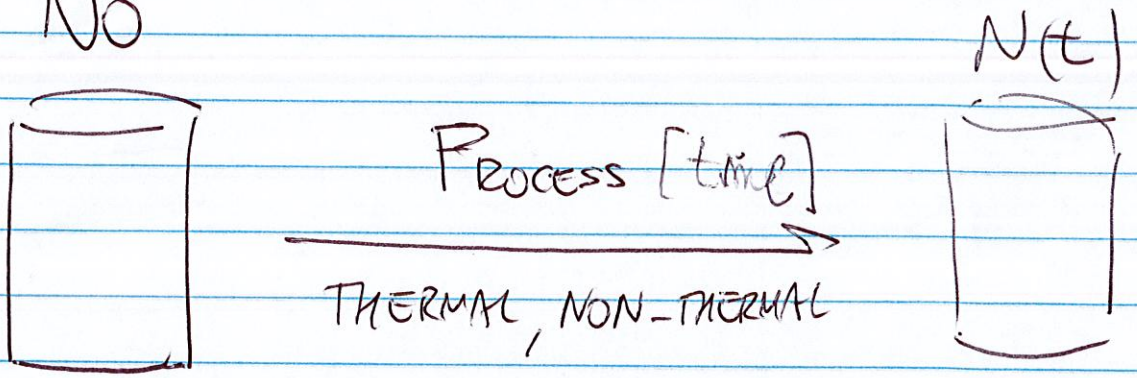
Temperature Profiles $T(X,t)$

(2)

$$S(t) = \log \frac{N(t)}{N_0}$$

$N(t)$: Number of microorganisms at time t

N_0: Initial number of microorganisms.

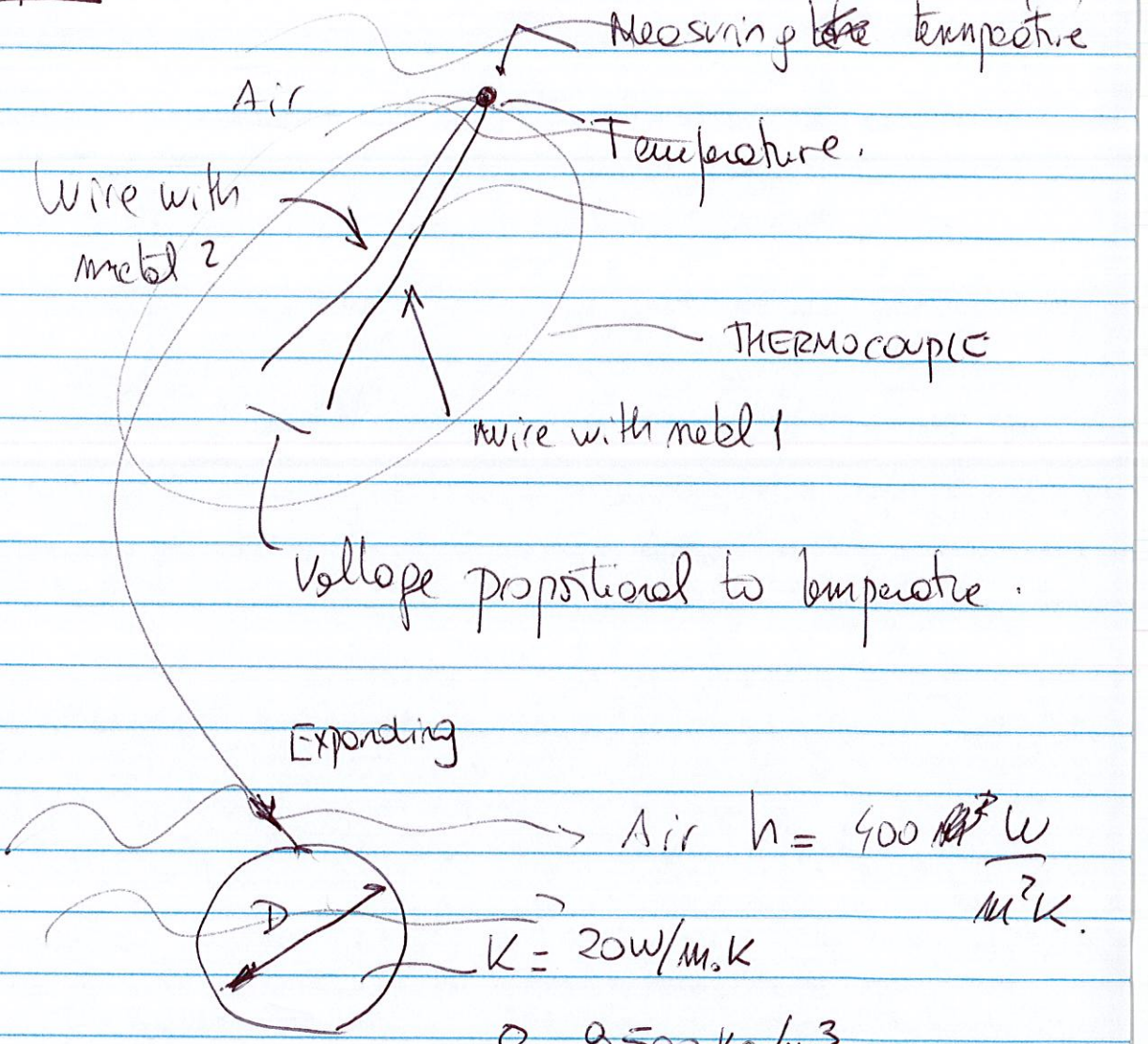


$$S(t) = \log \frac{N(t)}{N_0} = -12$$

$$\frac{N(t)}{N_0} = 10^{-12}$$

1 Probability out of 10^{12} to get a product contaminated

EXAMPLE 1


Measuring temperature
Air
Temperature.
wire with metal 2
THERMOCOUPLE
wire with metal 1
Voltage proportional to temperature.
Exposing
Air h = 400 W/m²K.
D
K = 20 W/m.K
ρ = 8500 kg/m³
c = 0.4 KJ/kg K.
t_const = 1 sec (time constant ?)

D ?

(4)

$$\frac{T(x,t) - T_i}{T_s - T_i} = 1 - \operatorname{erf}\left(\frac{x}{2\sqrt{\alpha t}}\right)$$

$$\alpha = \frac{K}{\rho C}$$

$$\frac{x}{2\sqrt{\alpha t}} = \phi$$

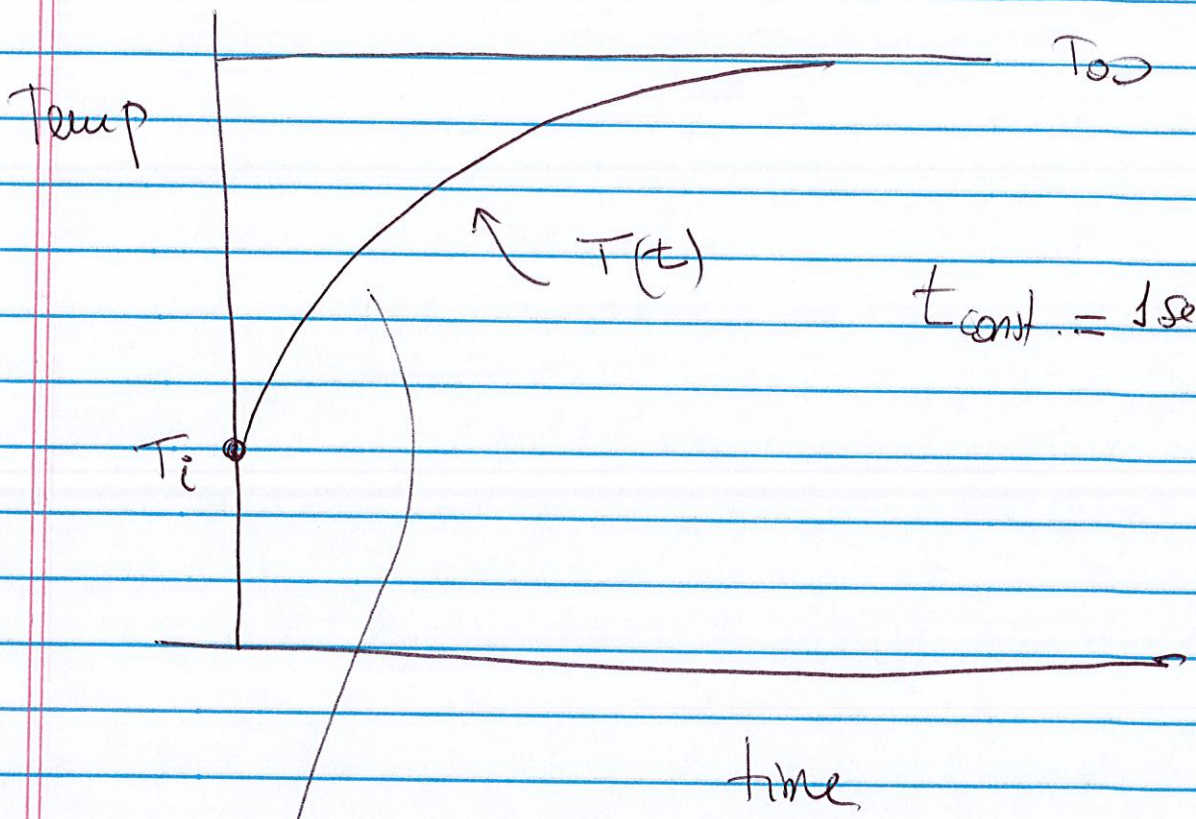
$$\phi = 2 \qquad \operatorname{erf}(2) = 0{,}9953$$

$$\frac{T(x,t) - T_i}{T_s - T_i} = 1 - 0{,}9953 \approx 0$$

$$T(x,t) \longrightarrow T_i$$

$$\frac{x}{2\sqrt{\alpha t}} \geq 2 \qquad T(x,t) \longrightarrow T_i$$

$$\boxed{x \geq 4\sqrt{\alpha t}} \qquad T(x,t) \longrightarrow T_i$$



$t_{const.} = 1\,sec.$

LUMPED PARAMETER.

$$\frac{T - T_\infty}{T_i - T_\infty} = \exp\left[-\frac{UA}{mC}\,t\right]$$

if $t = t_{const}$

if $Bi < 0.2$

$$-\frac{UA}{mC}\,t = -\frac{t}{\frac{mC}{UA}} = -\frac{t}{t_{const.}}$$

$$t_{constant} = 1\,sec = \frac{mC}{UA}$$

if $t = t_c$

$$\frac{T - T_\infty}{T_i - T_\infty} = e^{-\frac{t}{t_c}} = e^{-1} = 0.338$$