Wärme - Ü 0 ⇐ Null

①

A2) $T(x,t) = \frac{\gamma}{\sqrt{t}} e^{-\frac{x^2}{Dt\alpha}} + T_0$

einsetzen in $\frac{\partial^2}{\partial x^2} T = \frac{1}{D}\frac{\partial T}{\partial t}$

$\curvearrowright \frac{\gamma}{\sqrt{t}}\left(\frac{\partial}{\partial x}\left(-\frac{2x}{Dt\alpha} e^{-\frac{x^2}{Dt\alpha}}\right)\right) = \frac{\gamma}{D}\left\{\frac{1}{\sqrt{t}}\cdot\frac{x^2}{t^2 \cdot D\alpha} e^{-\frac{x^2}{Dt\alpha}} + e^{-\frac{x^2}{Dt\alpha}} \cdot t^{-3/2}\right\}$

$\uparrow -\frac{1}{2} \cdot \ldots !$

$\Rightarrow \frac{\gamma}{\sqrt{t}}\left\{-\frac{2}{Dt\alpha} e^{\cdots} + \frac{4x^2}{D^2t^2\alpha^2} e^{\cdots}\right\} = \text{—"—}$

$\Leftrightarrow -\frac{2}{Dt\alpha} + \frac{4x^2}{D^2t^2\alpha^2} = \frac{x^2}{D^2t^2\alpha} - \frac{1}{2Dt}$ ok

$\alpha \overset{!}{=} 1$

$\Rightarrow$ $\curvearrowright$

[Aufgabenstellung komisch]

... Also Annahme:

$$T(x,t) = \frac{\gamma}{\sqrt{t}} e^{-\frac{x^2}{\alpha D t}}$$

$\Rightarrow$ Ⓐ: $\frac{1}{D}\frac{\partial T}{\partial t} = \frac{\gamma}{D}\left\{-\frac{1}{2t^{-\frac{3}{2}}} e^{\cdots} + \frac{x^2}{\alpha D t^2} e^{\cdots}\right\}$

$\Rightarrow$ Ⓑ $\frac{\partial}{\partial x}\left\{\frac{\partial T}{\partial x}\right\} = \frac{\gamma}{\sqrt{t}}\frac{\partial}{\partial x}\left\{-\frac{2x}{\alpha D t} e^{\cdots}\right\} = \ldots$

$\ldots = \frac{\gamma}{\sqrt{t}}\left\{-\frac{2}{\alpha D t} e^{\cdots} + \frac{4}{\alpha^2 D^2 t^2}\right\} \leadsto$

Ⓐ = Ⓑ ✓ für $\alpha = 4$ egal

A1) Mittlere Stoßrate

△ Geschwindigkeit: [$T \approx 293\ K$, $m_{He_2} \approx 1{,}3 \cdot 10^{-26}\ kg$]

$\rightarrow E_{kin} = \frac{3}{2} k_B T = \frac{1}{2} m \bar{v}^2$

$\Rightarrow \bar{v} = \sqrt{\frac{3 k_B T}{m}} \approx 562\ m/s \cdot \sqrt{3}$

△ freie Weglänge:

Dichte s [$\rightarrow$ Atomabstand $a = \sqrt[3]{\frac{1}{s}}$ ... unwichtig]

He-Atom hat Radius r $\rightarrow$ Stoßfläche / Wirkungsquerschnitt $\sigma = 2 \cdot \pi r^2$

[$s = 2{,}7 \cdot 10^{25}$ pro m^3, $r \approx 10^{-10}\ m$]

freie Wl $= \frac{1}{s\sigma}$

$\approx 5{,}9 \cdot 10^{-7}\ m$

$\Rightarrow \Delta t = \frac{\Delta s}{\bar{v}} \approx 1{,}0 \cdot 10^{-9}\ s$