TBM 6A, 15.3.13

1

$$N(t) = N_0 e^{\lambda t}$$

$$N(T_n) = N_0 e^{\lambda \cdot T_n} = n \cdot N_0$$

$$\Rightarrow \quad e^{\lambda T_n} = n \quad / \ln$$

$$\underline{\underline{\lambda \cdot T_n = \ln(n)}}$$

2

a) pro 10 dB verzehnfachung

$\hookrightarrow \quad 10 \cdot 10 \cdot 2 = \underline{\underline{200}}$

Rechnung: $70 = 10 \cdot \log(I_1/I_0)$

$$10^7 = I_1/I_0$$

$$90 = 10 \cdot \log(I_2/I_0)$$

$$10^9 = I_2/I_0$$

$$I_2 = 100 \cdot I_1$$

$\hookrightarrow \quad 2 \cdot 100 = \underline{\underline{200 \text{ Sänger}}}$

b) $70\,dB \Rightarrow I_1/I_0 = 10^7$

$78.13\,dB \Rightarrow I_2/I_0 = 10^{7.813}$

$$\frac{10^{7.813}}{10^7} = 10^{0.813} \cong 6.5$$

I_2 ist 6.5-mal grösse als I_1

$\hookrightarrow \quad 6.5 \cdot 2\,\text{Sänger} = \underline{\underline{13 \text{ Sänger}}}$

(3) $f(x) = 10^x$

$$\left.\begin{aligned} 100 &= 10^2 \\ 1000 &= 10^3 \end{aligned}\right\} \text{ schwarze Striche}$$

1. Strich: $10^{2+\frac{1}{3}} = 100 \cdot 10^{1/3}$

$$= \sqrt[3]{10} \cdot 100 = \underline{\underline{215.44}}$$

2. Strich: $10^{2+2/3} = \sqrt[3]{10^2} \cdot 100 = \underline{\underline{464.16}}$

(4) $T_{1/2} = 24'110\ a$; $\lambda = -\frac{\ln 2}{24'110}$

$A = 10'000\ Bq$

$$A = N \cdot \lambda$$

A in Zeit. pro Jahr!

$$10'000 \cdot 365 \cdot 24 \cdot 3600 = N \cdot \lambda$$

$$\Longrightarrow \quad N = \frac{10'000 \cdot 365 \cdot 24 \cdot 3600}{\lambda}$$

$$m = \frac{N}{N_A} \cdot 239 = \underline{\underline{4.355\,\mu g}}$$

5

$$\lambda = -\frac{\ln 2}{T_{1/2}} = -\frac{\ln 2}{5'736}$$

$$N_0 = 3 \cdot 10^{-8}\,\%$$

$$N(t) = 6.427 \cdot 10^{-9}\,\%$$

$$6.427 \cdot 10^{-9}\,\% = 3 \cdot 10^{-8}\,\%\, e^{\lambda t}$$

$$\frac{6.427 \cdot 10^{-9}\,\%}{3 \cdot 10^{-8}\,\%} = e^{\lambda t}$$

$$\frac{0.6427}{3} = e^{\lambda t}$$

$$\frac{\ln\left(\frac{0.6427}{3}\right)}{\lambda} = t \approx 12'749.666$$

$$\underline{\underline{t \approx 12'750 \text{ Jahre}}}$$

(6) 1063 d : 217

1'200 d : 397

Nehme 1063 Tage als $t = 0$ resp. t_0

↳ $N_0 = 217$ Kaninchen

1063 → 1200 : 137 Tage

$$N(t = 137) = 397 = 217 \cdot e^{\lambda \cdot 137}$$

$$\frac{1}{137} \cdot \ln\left(\frac{397}{217}\right) = \lambda \doteq 0.004409 / \text{Tag}$$

Aussetzung war vor − 1063 Tagen

$$N \text{ zu Beginn} = 217 \cdot e^{\lambda \cdot (-1063)}$$

$$\cong \underline{\underline{2 \text{ Kaninchen}}}$$

$$T_2 = \frac{\ln(2)}{\lambda} = \underline{\underline{157.21 \text{ Tage}}}$$

5P.

7 $T(t) = 1460 \cdot e^{\lambda t} + 20$

$$T(t=3) = 1460 \cdot e^{\lambda \cdot 3} + 20 = 700^{\circ}$$

$$1460\, e^{3\lambda} = 680$$

$$e^{3\lambda} = \frac{680}{1460} = \frac{68}{146} = \frac{34}{73}$$

$$\lambda = \frac{1}{3} \cdot \ln\left(\frac{34}{73}\right)$$

$$\cong -0.255\ \cancel{\text{m}}/\text{min} \cdot {}^{\circ}\text{C}$$

$$T(t) = 1460\, e^{\lambda t} + 20 = 100$$

$$1460\, e^{\lambda t} = 80$$

$$e^{\lambda t} = \frac{8}{146} = \frac{4}{73}$$

$$\lambda \cdot t = \ln\left(\frac{4}{73}\right)$$

$$t = \frac{\ln\left(\frac{4}{73}\right)}{\lambda}$$

$$\cong 11.4\ \text{min}$$