Thermo
HW 1
Uladzimir Karachewski

① $dy/dt = -\lambda y$

$\rightarrow \frac{dy}{y} = -\lambda dt$

$\rightarrow \int \frac{dy}{y} = \int -\lambda dt$

$= \ln(y) = -\lambda t + c$

$\rightarrow y = Ae^{-\lambda t}$

$y(0) = Ae^{0} = A = y_0$

$\therefore A = y_0$

& $y(t) = y_0 e^{-\lambda t}$

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(2) $f(x) = a\ln\left(\frac{e^{bx}}{e^{cx}+1}\right)$

$= abx\cancel{\ln(e)} - a\ln(e^{cx}+1)$

$\rightarrow \frac{d}{dx} f(x) = ab - a\frac{\frac{d}{dx}(e^{cx}+1)}{e^{cx}+1}$

$= ab - \frac{ace^{cx}}{e^{cx}+1}$

$\therefore \quad = ab - \frac{ace^{cx}}{e^{cx}+1}$

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1.9 Volume of 1 mole @ room temp (≈ 300)
@ 1 atm
$\llcorner$ $1.013 \times 10^5\, Pa$

$PV = nRT$

$\rightarrow V = nRT/V$

$$= \frac{(1\,mo\cancel{l})(8.31\,\overset{\cancel{Pa}\cdot m^3}{\cancel{J}}/\cancel{mol\cdot K})(300\,\cancel{K})}{1.013 \cdot 10^5\,\cancel{Pa}}$$

$= 0.0246\, m^3$

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1.10 Estimate number of air molecules in an average sized room.

$$pV = NkT$$

$$\rightarrow N = \frac{pV}{kT}$$

$T = 300K$
$p = 1atm = 1.013 \times 10^5$ pa
$k = 1.38 \cdot 10^{-23}$ J/K
$V = 2m \cdot 2m \cdot 3m = 12m^3$

$$\therefore N = \frac{1.013 \cdot 10^5 \cancel{Pa} \cdot 12 \cancel{m^3}}{1.38 \cdot 10^{-23} \cancel{J/K} \cdot 300 \cancel{K}}$$

$$= 2.936 \cdot 10^{26} \text{ Molecules}$$

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Plot a curve for the hyperbolic tangent between -4 and 4.

My x values were defined as every number from -4 increasing in increments of 0.1 until 4 is reached. I utilized python and used a library implementation of hyperbolic tangent to generate the y values based on the x values. A plotting library was then used to generate the graphic:

```
import numpy as np;
import matplotlib.pyplot as plt;

x = np.arange(-4, 4, 0.1);
y = np.tanh(x);

plt.scatter(x, y)
plt.show()
```