UMWELTCHEMIE I

Theoretische Grundlagen der Umweltchemie II

WS 2003/04

Lösung zu Übung 6

Aufgabe 1

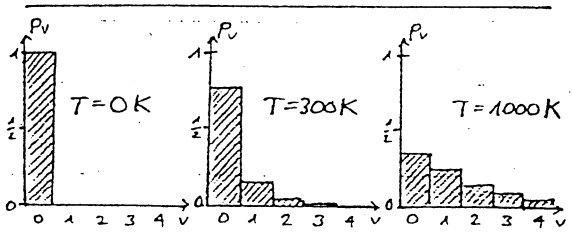
1.1 $$Z = \sum_{v=0}^{\infty} e^{-hc\tilde{\nu}(v+\frac{1}{2})/kT} = e^{-\frac{1}{2}hc\tilde{\nu}/kT} \sum_{v=0}^{\infty} \left(e^{-hc\tilde{\nu}/kT}\right)^v$$

$$= \frac{e^{-\frac{1}{2}hc\tilde{\nu}/kT}}{1 - e^{-hc\tilde{\nu}/kT}}$$

1.2 $$p_v = \frac{1}{Z} e^{-hc\tilde{\nu}(v+\frac{1}{2})/kT} = (1-q)\,q^v$$

mit $q := e^{-hc\tilde{\nu}/kT}$

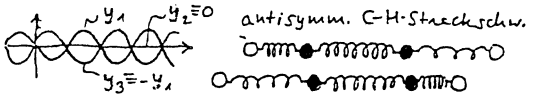
T/K	0	300	1000
p_0	1	0,788	0,372
p_1	0	0,167	0,234
p_2	0	0,035	0,147
p_3	0	0,008	0,092
p_4	0	0,002	0,058



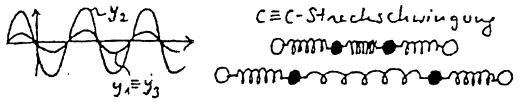
Aufgabe 2

2.1

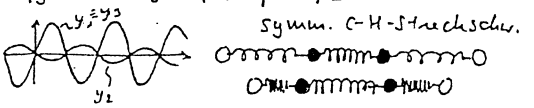
- $q_1 = a\cos(\omega_1 t + \varphi)$, $q_2 \equiv q_3 \equiv 0$



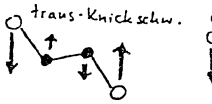
- $q_2 = a\cos(\omega_2 t + \varphi)$, $q_1 \equiv q_3 \equiv 0$



- $q_3 = a\cos(\omega_3 t + \varphi)$, $q_1 \equiv q_2 \equiv 0$



2.2 Anzahl Normalschw. 12-5 = 7 ⇒ es fehlen 4:



je zweimal in 2 Raumrichtungen

Aufgabe 3

$$\omega_1 = 2\pi c \tilde{\nu}_1 = 2{,}55 \cdot 10^{14}\,s^{-1} = \sqrt{\frac{f}{m}}$$

$$\Rightarrow f = m\omega_1^2 = 1730\ N\,m^{-1}$$

m: Masse O-Atom