

FREIE UNIVERSITÄT BERLIN

Fachbereich Physik

Übungen zur Vorlesung

‘‘Einführung in die Physik der Atome und Moleküle I’’ (SoSe 2007)

- Prof. Karsten Heyne -

Aufgabenblatt 10 vom 27.06.2007

Abgabe bei Dr. Stefan Weber, webers@physik.fu-berlin.de

vor Freitag 07.07.2007, 12.00 h.

Aufgabe 10—1 (3 Punkte)

- (a) Calculate for carbon dioxide the rotation constants B and B' , using the data in the script (Sec.12.4.1;p.182ff.).
- (b) Calculate from B and B' the distance R_{CO} for CO_2 , both in the levels $v = 0$ and $v = 1$
- (c) Calculate the expected isotope shift of $^{13}CO_2$ relative to $^{12}CO_2$, and compare this to the ratio $\frac{\nu_{^{12}CO_2}}{\nu_{^{13}CO_2}} = \frac{2349cm^{-1}}{2282cm^{-1}} = 0.97$

Aufgabe 10—2 (3 Punkte)

Give all term symbols $^{2S+1}L_J$ for the two-electron configuration $(nd)(n'd)$ and $(nd)^2$. Give for each term the degeneracy.

Aufgabe 10—3 (1 Punkt)

Explain why the lowest state of the phosphor atom (P) is $^4S_{\frac{3}{2}}$.

Aufgabe 10—4 (2 Punkte)

Show that for a non-rigid rotor the position of the minimum of the effective potential (see equation (12.90) in the script) is to good approximation:

$$R_1 = R_0 + \frac{\hbar^2 K(K+1)}{2\mu\alpha^2 R_0^3 D_e}$$

Aufgabe 10—5 (1 Punkt)

In equation (12.101) the ratio of the population of level K and 0 is given. Derive an expression for how the value K of the level with the highest population, changes as a function of temperature.