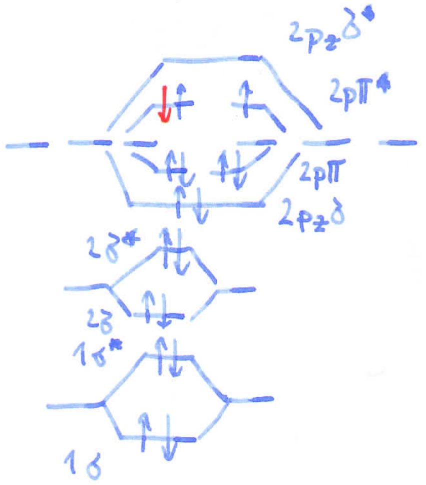
Ali se molekula stabilizira ali destabilizira pri sprejemu ali oddaji e^-?

$\boxed{O_2}$



$b = \frac{10-6}{2} = 2$

sprejem e^- : O_2^- superoksidni ion

$\Downarrow$

$b = \frac{10-7}{2} = 1{,}5$ – neugodno, če sprejme e^-

oddaja e^- : O_2^+

$\Downarrow$

$b = \frac{10-5}{2} = 2{,}5$ – ugodno

oddaja $2e^-$: O_2^{2+}

$\Downarrow$

$b = \frac{10-4}{2} = 3$ – ugodno

sprejem $2e^-$: O_2^{2-} – peroksidni ion

$\Downarrow$

$b = \frac{10-8}{2} = 1$ – neugodno, če sprejme $2e^-$

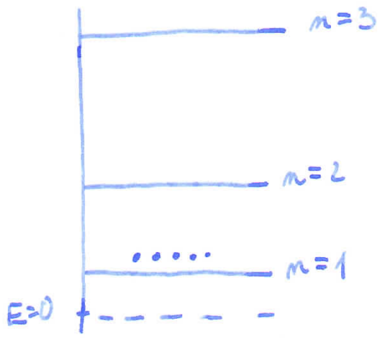
za O_2 je bolj UGODNO, če odda(ja) e^-

Imamo ~~v~~ pot. jamo dolžine 10 Å. V 1D pot. jamo spravimo 5 nevtralnih pionov π^0 (spin 1 in $E_0 = 135$ MeV). Kakšna je osnovna energija tega sistema?

$\boxed{E_0 = mc^2}$ ~ izračun mase

$$\boxed{E = \frac{n^2 h^2}{8ma^2}}$$

$$m = \frac{E_0}{c^2} = \frac{135 \cdot 10^6\ eV \cdot 1{,}6 \cdot 10^{-19}\ As/eV}{(3 \cdot 10^8)^2\ m^2/s^2} = \underline{2{,}4 \cdot 10^{-28}\ kg}$$



BOZONI – spin 1 } n. pioni ~ več jih gre na isti nivo

FERMIONI – spin $\frac{1}{2}$ } elektroni ...

KVARKI – spin $\frac{1}{3}$

$$E_{\text{SKUPNA ENERGIJA}} = 5 \cdot E_{1\ \text{nev. pion}} =$$

$$= 5 \cdot \frac{n^2 h^2}{8ma^2} =$$

$$= 5 \cdot \frac{1 \cdot (6{,}62 \cdot 10^{-34}\ Js)^2}{8 \cdot 2{,}4 \cdot 10^{-28}\ kg \cdot (10 \cdot 10^{-10}\ m)^2} =$$

$$= 5 \cdot 2{,}28 \cdot 10^{-22}\ J =$$

$$= \underline{1{,}14 \cdot 10^{-21}\ J}$$

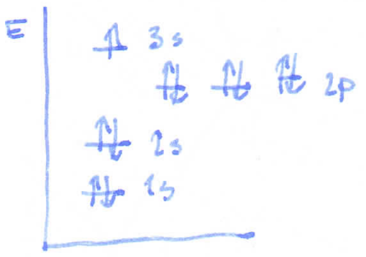
Ion. E Na je 5,11 eV, Ion. E v vzbujenem stanju 3,02 eV. Kakšna je valovna dolžina fotona, ki ga Na absorbira pri prehodu iz osnovnega na vzbujeno stanje. Kakšna je naravna širina te črte; razpadni čas določi kot da se obnaša kot harmonski oscilator?

$E_i = 5{,}11\ eV$

$E_{vi} = 3{,}02\ eV$

$E_{3s} = -5{,}11\ eV$

$E_p = -3{,}02\ eV$



$$\Delta E = E_p - E_{3s} = -5{,}11\ eV - (-3{,}02\ eV) = \underline{2{,}09\ eV}$$

$$\Delta E = h\nu$$

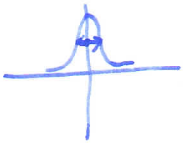
$$\nu = \frac{\Delta E}{h} = \frac{2{,}09\ eV \cdot 1{,}6 \cdot 10^{-19}\ J/eV}{6{,}62 \cdot 10^{-34}\ Js} = 5{,}05 \cdot 10^{14}\ s^{-1}$$

$$\lambda = \frac{c}{\nu} = \frac{3 \cdot 10^8\ m/s}{5{,}05 \cdot 10^{14}\ s^{-1}} = \cancel{5{,}84 \cdot 10} = \underline{593\ nm}$$

$\Delta E \cdot t \geq \hbar$

$\Downarrow$

$\Delta E = 2{,}09\,eV$



$$\frac{1}{\Gamma} = \frac{\omega_{gu}^3 \, p_{e\,gu}^2}{3\pi\varepsilon_0 c_0^3 \hbar}$$

$$\omega = \frac{E}{\hbar}$$ ~ imamo podano

1 — $\psi_1 = N_1 \cdot x e^{-ax^2}$

0 — $\psi_0 = N_0 e^{-ax^2}$

$$p = -e_0 \int_{-\infty}^{\infty} \psi_n x \psi_m \, dx$$

$$\langle \psi_0 | \psi_0 \rangle = 1$$

$$\int_{-\infty}^{\infty} \psi_0 \psi_0 \, dx = \int_{-\infty}^{\infty} (N_0 e^{-ax^2})^2 dx =$$

$$= N_0^2 \int_{-\infty}^{\infty} (e^{-ax^2})^2 dx = N_0^2 \int_{-\infty}^{\infty} e^{-2ax^2} dx =$$

$$= 2N_0^2 \int_0^{\infty} e^{-2ax^2} dx = \underline{2N_0^2 \left(\frac{\sqrt{\pi}}{2\sqrt{2a}}\right) = 1}$$

$$N_0^2 = \frac{1}{2\left(\frac{\sqrt{\pi}}{2\sqrt{2a}}\right)} \qquad N_0 = \sqrt{\frac{\sqrt{2a}}{\sqrt{\pi}}} =$$

$$\underline{\underline{N_0 = \sqrt[4]{\frac{2a}{\pi}}}}$$

$$\langle \psi_1 | \psi_1 \rangle = 1$$

$$\int_{-\infty}^{\infty} \psi_1 \psi_1 \, dx = \int_{-\infty}^{\infty} (N_1 x e^{-ax^2})^2 dx = N_1^2 \int_{-\infty}^{\infty} x^2 e^{-2ax^2} dx =$$

$$= 2N_1^2 \int_0^{\infty} x^2 e^{-2ax^2} dx = \cancel{2} N_1^2 \left(\frac{\sqrt{\pi}}{2\cancel{4}(2a)^{\frac{3}{2}}}\right) = 1$$

$$N_1^2 \cdot \frac{\sqrt{\pi}}{2(2a)^{\frac{3}{2}}} = 1$$

$$\underline{\underline{N_1 = \frac{\sqrt{2}\,(2a)^{\frac{3}{4}}}{\sqrt[4]{\pi}}}}$$

$$p = -e_0 \int_{-\infty}^{\infty} \Psi_0 \, x \, \Psi_1 \, dx = -e_0 \int_{-\infty}^{\infty} \sqrt[4]{\frac{2a}{\pi}} \cdot e^{-ax^2} x \cdot \frac{\sqrt{2}(2a)^{\frac{3}{4}}}{\sqrt[4]{\pi}} x \, e^{-ax^2} dx =$$

$$= -e_0 \sqrt[4]{\frac{2a}{\pi} \cdot \frac{4 \cdot (2a)^3}{\pi}} \int_{-\infty}^{\infty} e^{-2ax^2} x^2 dx =$$

$$= -e_0 \sqrt[4]{\frac{(2a)^4 4}{\pi^2}} \; 2 \int_0^{\infty} e^{-2ax^2} x^2 dx =$$

$$= -e_0 \cancel{2}a \sqrt[4]{\frac{4}{\pi^2}} \cancel{2} \left(\frac{\sqrt{\pi}}{\cancel{4}(2a)^{\frac{3}{2}}} \right) = -e_0 \cdot a \sqrt[4]{\frac{4}{\cancel{\pi^2}}} \cdot \frac{\cancel{\sqrt{\pi}}}{(2a)^{\frac{3}{2}}} = \frac{-e_0}{2\sqrt{a}}$$

$$\boxed{p = -\frac{e_0}{2\sqrt{a}}} \qquad \boxed{\omega = \frac{E}{\hbar}} \qquad \omega = \frac{2{,}09 \cdot 1{,}6 \cdot 10^{-19} \, J/eV}{1{,}055 \cdot 10^{-34} \, Js} = 3{,}17 \cdot 10^{15} \, s^{-1}$$

$$p = \frac{-e_0}{2\sqrt{a}} \qquad \text{har. osc.: } \hbar\omega = \Delta E$$

$$a = \frac{m\omega}{2\hbar} = \frac{9{,}1 \cdot 10^{-31} kg \cdot 3{,}17 \cdot 10^{15} s^{-1}}{2 \cdot 1{,}055 \cdot 10^{-34} Js} = 1{,}37 \cdot 10^{19} \, m^{-2}$$

$$p = \frac{-1{,}6 \cdot 10^{-19} As \; m}{2 \cdot \sqrt{1{,}37 \cdot 10^{19}}} = -2{,}16 \cdot 10^{-29} \, As\,m$$

$$J = \frac{3\pi \varepsilon_0 c_0^3 \hbar}{\omega_{gu}^3 \, p_{egu}^2} = \frac{3\pi \cdot 8{,}85 \cdot 10^{-12} \cdot (3 \cdot 10^8 m/s)^3 \cdot 1{,}055 \cdot 10^{-34} Js}{(3{,}17 \cdot 10^{15}/s)^3 \, (-2{,}16 \cdot 10^{-29} As\,m)^2} =$$

$$= 1{,}6 \cdot 10^{-8} \, s$$

$$\delta E \cdot J = \hbar$$

$$\delta E = \frac{\hbar}{J} = \frac{1{,}055 \cdot 10^{-34} \cancel{Js} \; eV}{1{,}6 \cdot 10^{-8} \cancel{s} \cdot 1{,}6 \cdot 10^{-19} \cancel{J}} = \boxed{4{,}1 \cdot 10^{-8} \, eV}$$