

# HW #1

1.  $\Gamma$  f  $l=1$  and  $l=3$

States  ${}^1G, {}^3G, {}^1F, {}^3F, {}^1D, {}^3D$

$$9 + 27 + 7 + 21 + 5 + 15 = 84 = 14 \times 6 \text{ arrangements}$$

$$2. \Delta E(\Gamma) = \epsilon_{\pi}^* - \epsilon_{\pi} - J_{\pi, \pi}^*$$

$$4 = 12 - J \Rightarrow J = 8 \text{ eV}$$

$$\Delta E(S) = 12 - J_{\pi, \pi}^* + 2K_{\pi, \pi}^*$$

$$8 = 12 - 8 + 2K \Rightarrow K = 2 \text{ eV}$$

$$3. \psi = \left(\frac{\alpha}{\pi}\right)^{1/2} e^{-\alpha x_1^2/2} e^{-\alpha x_2^2/2}$$

$$E^{(1)} = \frac{\alpha}{\pi} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} e^{-\alpha x_1^2} e^{-\alpha x_2^2} \delta(x_2 - x_1) dx_1 dx_2 = \frac{\alpha}{\pi} \int_{-\infty}^{\infty} e^{-2\alpha x_1^2} dx_1$$

$$= \frac{\sqrt{2\alpha}}{\sqrt{2\pi}}$$

$$E_1 = E_2 = \frac{\hbar\omega}{2} + \sqrt{\frac{\alpha}{2\pi}}$$