$$N_3/N_2 = e^{-(E_3-E_2)/kT} \ \dots \ \mathbf{2}$$

$$E_H(n) \sim -\frac{13.61\ eV}{n^2} \ \dots \ \mathbf{1}$$

$$E_3 - E_2 = 13.61 \times \left(\frac{1}{4} - \frac{1}{9}\right) \sim 1.89\ eV \dots \ \mathbf{3}$$

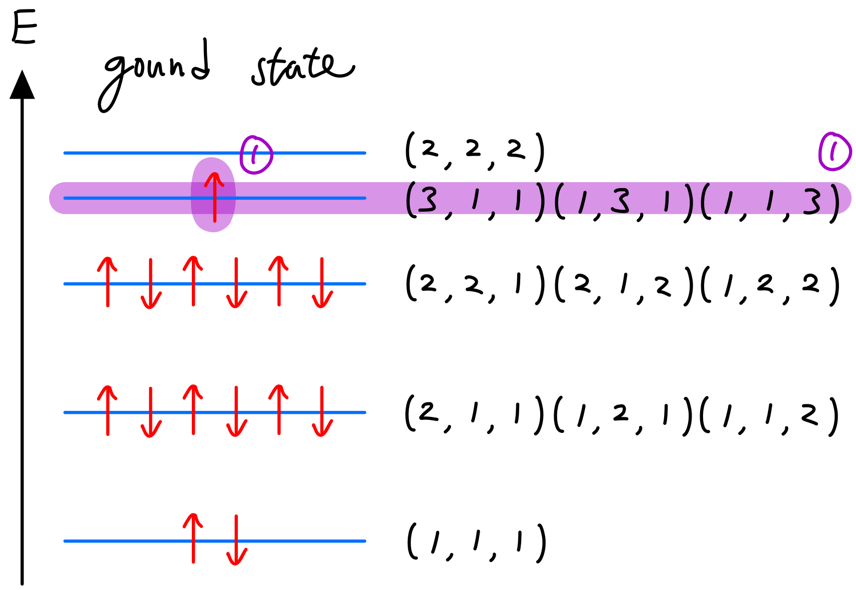
$$kT = \left(8.62 \times 10^{-5}\,\frac{eV}{K}\right) \times (30000K) \sim 2.59\ eV \dots \ \mathbf{2}$$

$$N_3/N_2 = e^{-(E_3-E_2)/kT} = e^{-1.89/2.59} \sim 0.48 \ \dots \ \mathbf{2}$$

Q.2 Fifteen electrons are confined to a 3D infinity potential well with widths $L_x = L_y = L_z = L$. Assume that the electrons do not electrically interact with one another, so they follow Pauli principle. What are the ground state and first excited state of this system? To simplify complicated calculations, we define $\frac{h^2}{8m_e L^2} = \alpha$. Please use α to express your answer! (10 points)

$$E_{(n_x, n_y, n_z)} = \frac{h^2}{8 m_e L^2}(n_x^2 + n_y^2 + n_z^2) \quad \textcircled{3}$$

$$\frac{h^2}{8 m_e L^2} \equiv \alpha$$



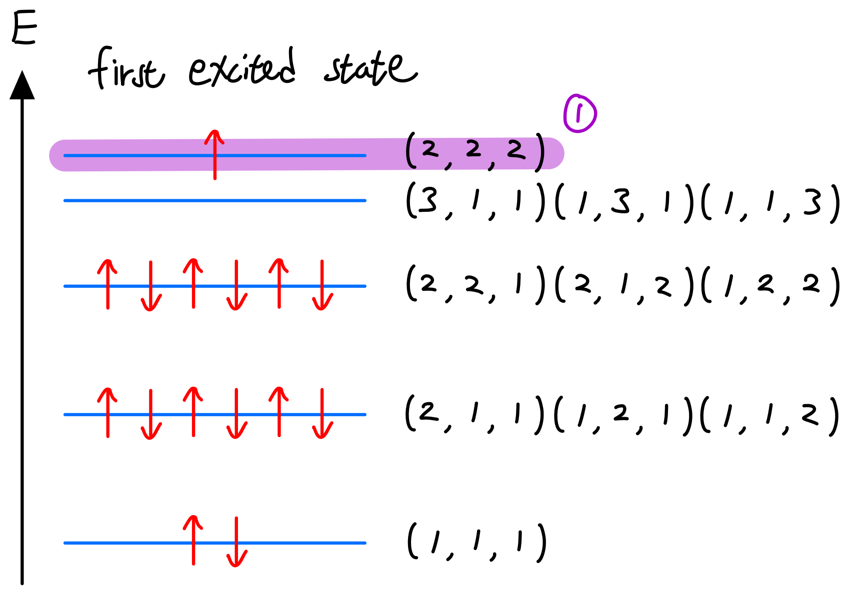
$E_{222} = (2^2+2^2+2^2)\,\alpha = 12\alpha$ ↑ $+\alpha$

$E_{311} = (3^2+1^2+1^2)\,\alpha = 11\alpha$ ↑ $+2\alpha$

$E_{221} = (2^2+2^2+1^2)\,\alpha = 9\alpha$ ↑ $+3\alpha$

$E_{211} = (2^2+1^2+1^2)\,\alpha = 6\alpha$ ↑ $+3\alpha$

$E_{111} = (1^2+1^2+1^2)\,\alpha = 3\alpha$



$E_{\text{ground state}} = 2 \times E_{111} + 6 \times E_{211} + 6 \times E_{221} + 1 \times E_{311} = 107\,\alpha$ ②

$E_{\text{1st ecited state}} = 2 \times E_{111} + 6 \times E_{211} + 6 \times E_{221} + 1 \times E_{222} = 108\,\alpha$ ②