Okayama University
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Exercises for Advanced Physics 1, 2019 term 3

# Exercise Set 2

(Due date: Tuesday, October 22, 2019)

**Exercise 3** (**Magnetite**) (5 points)

Please explain in your own words why magnetite is an insulator (Around 100 words).

**Exercise 4** (**Spinors**) (5 points)

The three Pauli spin matrices

$$\sigma_x = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \quad \sigma_y = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix} \quad \sigma_z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}. \tag{1}$$

are joined in a vector of matrices $\vec{\sigma} = (\sigma_x, \sigma_y, \sigma_z)$. Take the definition of the spin angular momentum operator $\vec{S} = \frac{\hbar}{2}\vec{\sigma}$ and prove the following commutation relations

$$\left[S_i, S_j\right] = i\epsilon_{ijk}S_k \tag{2}$$