Basic Physical Chemistry I

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Q33
Summarize the principle of Mössbauer spectrometry.
2×2 Matrices I, σ_x, σ_y, σ_z is defined as

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

These are Pauli Matrices. Prove that arbitrary 2×2 matrix can be described by the linear combination of Pauli Matrices and unit Matrix I.

Q34
For arbitrary three dimension vectors $\vec{a}$, $\vec{b}$, prove the following relation using Pauli Matrices. Here, $\vec{\sigma} = (\sigma_1, \sigma_2, \sigma_3)$ is satisfied.

$$(\vec{\sigma}, \vec{a})(\vec{\sigma}, \vec{b}) = (\vec{a}, \vec{b})I + i(\vec{\sigma}, \vec{a}\times\vec{b})$$

Q35
Derive the spin-orbit coupling term from Biot-Savert law.

Q36
Derive the spin-orbit coupling term from Dirac equation.

Q37
Explain why atomic radii in Au and Ag is almost the same.

Q38
Summarize the principle of x-ray magnetic circular dichroism (XMCD).

Q39
Explain the principles of bi-polar transistor and field-effect transistor.

Q40
Explain about your research if relates to spectroscopy.