For some other atoms and molecules, the size and the deformed magnetic field is of the order 3 x 10^{-9} e\cdot g. For the atom B, the effect is where the atom becomes important, since it to be rather lower.

\[ B = 3 \times 10^{-9} e\cdot g. \]

Thus, the magnetic field is a factor of 10^7 - 10^8 \text{ cm}^2 / \text{mole}.

Part (b) The V x B term is of the order of \( B(\mu / \kappa) \), so it is of the order of the Bohr radius, \( \alpha \). Therefore, it is comparable to the term in the form in which \( \frac{\Delta E_{B}}{\Delta E_{A}} = \frac{B}{\mu / \kappa} \).

Part (c) The half 

The two effects become comparable when \( \frac{\Delta E_{B}}{\Delta E_{A}} \approx \frac{1}{\mu / \kappa} \).

\[ \frac{\Delta E_{B}}{\Delta E_{A}} = \frac{1}{\mu / \kappa} \]

When \( \mu / \kappa = 2 \), the ratio is about 2. When \( \mu / \kappa = 1 \), the ratio is about 10. This ratio is about 1. When \( \mu / \kappa = \frac{1}{2} \), the ratio is about 20. These may be interpreted as the second-order ground state splitting to the first excited state.

The first-order Zeeman effect for these levels is

\[ \frac{\Delta E_{B}}{\Delta E_{A}} = \frac{n\Delta E_{B}}{\Delta E_{A}} = (n) \]
Now let us look at the $m = 2$, $l = 0$ separate:

\[
\frac{1}{\sqrt{\Omega}} + \frac{1}{\sqrt{\Omega}} + \frac{1}{\sqrt{\Omega}} \frac{\partial H}{\partial \phi} = \frac{\partial H}{\partial \phi}
\]

so that

\[
2 = \phi^4 \quad \frac{\partial \phi}{\partial \phi} = \phi^4
\]

In spherical-tensor notation.

The problem is simplified if you exploit the remaining axial symmetry. Write

\[
\nabla \frac{\partial H}{\partial \phi} = \frac{\partial H}{\partial \phi}
\]

Problem 7.11 The van der Waals effect

\[
\begin{align*}
\mathbf{v} & = \mathbf{v} \\
\mathbf{u} & = \mathbf{u}
\end{align*}
\]

When $l = 0$, there is no $f$ state, and the second term is absent.

\[
\left[ \left( \frac{\nabla \phi}{\nabla \phi} - \frac{\partial}{\partial \phi} \right) \frac{I + \frac{1}{2}}{\frac{1}{2} + w + 1} + \left( \frac{\nabla \phi}{\nabla \phi} - \frac{\partial}{\partial \phi} \right) \frac{I + \frac{1}{2}}{\frac{1}{2} + w + 1} \right] \frac{\partial H}{\partial \phi}
\]

We know the matrix elements in the $|m\Phi\rangle$ basis, where $|m\Phi\rangle$ is diagonal. So in the $|m\Phi\rangle$ basis.

\[
\langle \frac{\nabla \phi}{\nabla \phi} + \frac{1}{2} | m \Phi \rangle \langle \frac{\nabla \phi}{\nabla \phi} + \frac{1}{2} | m \Phi \rangle = \delta
\]

Part (d) We want to compute the first order perturbed energy:

\[
\begin{align*}
\text{Using}\ 	ext{values}\ \frac{\partial H}{\partial \phi} & = \mathbf{v}
\end{align*}
\]

so the structure splitting

\[
\begin{align*}
\text{are still comparable to the}\ 	ext{splitting}\ \text{in the strong field limit, labeled the states by m,}\ m'\text{.}\ 	ext{The energies in the field along the}\ z\text{-axis}
\end{align*}
\]

Part (c) In the strong field limit, label the states by $m, m'$. The energies in the field along the $z$-axis
The error is of order \( m/M \), as expected.

\[
\left( \frac{\mathcal{F}}{u^2} + 1 \right) \frac{u}{\mathcal{E}} \mathcal{E} = \mathcal{E}^m \quad \frac{\mathcal{F}}{\mathcal{E}} = \frac{\mathcal{E}}{\mathcal{E}} = \mathcal{E}^m
\]

Part (c) Now compare with the exact solution from problem 37. That is

\[
\frac{\mathcal{F}}{\mathcal{E}} = \frac{\mathcal{E}}{\mathcal{E}} = \mathcal{E}^m
\]

where

\[
\left( \frac{\mathcal{F}}{\mathcal{E}} + u \right) \frac{\mathcal{E}}{\mathcal{E}} + \left( \frac{\mathcal{F}}{\mathcal{E}} + u \right) \left( \mathcal{E}^m \right) = \mathcal{E}^m
\]

harmonic oscillator with frequency \( \omega_m \). When \( \omega_m = \omega \) and the energy is the constant term plus the allowed energies of a

\[
\left( \mathcal{F} - \frac{\mathcal{F}}{\mathcal{E}} \right) \frac{\mathcal{E}}{\mathcal{E}} + \left( \frac{\mathcal{F}}{\mathcal{E}} + u \right) \mathcal{E}^m = \mathcal{E}^m
\]

Part (d) Now use \( \mathcal{E}^m \) as the effective potential for the nuclear motion. The Hamiltonian is

\[
\frac{\mathcal{F}}{\mathcal{E}} + \frac{\mathcal{F}}{\mathcal{E}} + \frac{\mathcal{E}}{\mathcal{E}} = \mathcal{E}^m
\]

with

\[
\left( \frac{\mathcal{F}}{\mathcal{E}} + u \right) \mathcal{E}^m + \left( \frac{\mathcal{F}}{\mathcal{E}} + u \right) \left( \mathcal{E}^m \right) = \mathcal{E}^m
\]

zero of the energy. Suddenly the electron energies are

\[
\mathcal{E} = \mathcal{E} \quad \text{and} \quad \mathcal{E} = \mathcal{E}
\]

where

\[
\left( \frac{\mathcal{F}}{\mathcal{E}} - \mathcal{E} \right) \frac{\mathcal{E}}{\mathcal{E}} + \left( \mathcal{E} \right) \mathcal{E}^m = \left[ \left( \mathcal{F} + \mathcal{E} - \mathcal{E} \right) + \left( \mathcal{F} - \mathcal{E} - \mathcal{E} \right) \right] \frac{\mathcal{E}}{\mathcal{E}} = \mathcal{E}^m
\]

\[
\frac{\mathcal{F}}{\mathcal{E}} = \frac{\mathcal{E}}{\mathcal{E}} = \mathcal{E}^m
\]

Our estimate of course does not contradict the exact second order answer.

\[
\mathcal{E} \mathcal{E} = \mathcal{E} \mathcal{E} = \mathcal{E}^m
\]

So the variational method does better than that. It is still above the lower bound from equation (7.29).

\[
\mathcal{E} \mathcal{E} \mathcal{E} = \mathcal{E} \mathcal{E} \mathcal{E} < \mathcal{E}^m
\]

In problem 7.9, with these terms in the perturbation series we would

\[
\mathcal{E} \mathcal{E} \mathcal{E} \mathcal{E} > \mathcal{E}^m
\]

Since the variational estimate of the exact state energy is always an upper bound.

Quantum Mechanics