PH 451/551 **Winter 2026**

Worksheet # 14

(Monday, February 16, 2026)

Name

Questions (5 pts):

As we showed, the hyperfine perturbation is represented (in the uncoupled basis) by the following matrix:

$$H'_{hf} \doteq \frac{A}{4}\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 2 & 0 \\ 0 & 2 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

(a) Diagonalize the matrix to find the energy corrections to the ground state of the H-atom due to hyperfine interactions.

(b) Find the eigenstates corresponding to each correction.

(c) Sketch the energy level diagram showing the effect of the hyperfine interaction. Indicate the states.