Homework # 2; due Thursday, Feb. 14

Reading: Lecture notes on group theory and, if you like, Chapter 5 of Atkins and Friedman's *Molecular Quantum Mechanics*; Chapters 1,3 of Kittel's *Introduction to Solid State Physics*.

7. Find all the *symmetry operations* and *symmetry elements* of a planar Star of David (Magen David) shown in the figure.

8. Using the decision flowchart given in Chapter 5 of Atkins and Friedman (and reproduced in class notes), find the proper point group for the NV center in diamond.

9. Consider a model system (as used in Ch. 3 of Kittel) of an oscillator with one charge (+e) fixed, and the other (-e) connected to the first one with a spring with a spring constant C. What is the electric polarizability of this system ($\alpha \equiv \boldsymbol{P}/\boldsymbol{E}$), where $\boldsymbol{P}$ is the induced dipole moment, and $\boldsymbol{E}$ is the electric field applied along the line defined by the two charges. How is α related to the van der Waals interaction?

10. A naive model of a solid is a bunch of masses (the atoms) connected by springs. What is the order of magnitude of the *spring constant* C in a typical solid? Please present a "generic" estimate of this quantity that would show how this approximate value follows just from the fact that a crystal consists of atoms bound together by some sort of chemical bonds.

11. Based on the "toy model" of the van deer Waals interaction, estimate at what distance between two atoms, the force of Van deer Waals attraction becomes equal to the weight of one of the atoms. What would you say is the accuracy of such an estimate?