Background for i-clicker questions

Without quantum mechanics, magnetism could not be understood. It serves to explain diamagnetism, paramagnetism, and ferromagnetism.

Ferromagnetism relates to certain materials (such as iron) which form permanent magnets, or are attracted to magnets.

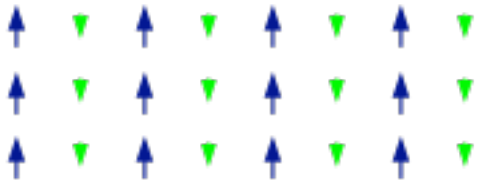
They are explained by the quantum numbers m_l (orbitals) and m_s (spin), and the Pauli exclusion principle.

Only atoms with partially filled orbitals (i.e., unpaired spins) can have a net magnetic moment, so magnetism only occurs in materials with partially filled orbitals. Hund's rule, places the first electrons in orbital shells with the same spin, thereby increasing the total dipole moment.

These unpaired electrons tend to align in parallel to an external magnetic field, an effect called paramagnetism. Ferromagnetism involves an additional phenomenon. The dipoles tend to align spontaneously, giving rise to a spontaneous magnetization, even when there is no applied magnetic field.

Ferromagnetism (including ferrimagnetism) is the strongest type of magnetism; it is the only type that creates forces strong enough to be felt, and is responsible for the common phenomena encountered in everyday life. The two other types of magnetism, paramagnetism and diamagnetism are so weak that they can only be detected by sensitive instruments in a laboratory.

A **ferrimagnetic** material is one in which the magnetic moments of the atoms are opposed and the opposing moments are unequal, therefore a spontaneous magnetization remains.



This happens when the sublattices consist of different materials or ions (such as Fe^{2+} and Fe^{3+}).

Neodymium-iron-boron magnets are important components in the electric motors of hybrid vehicles. Each Toyota Prius requires ~1 kilogram of neodymium, and electric generators for wind turbines require ~ 180 kg of neodymium per megawatt .

Name(s): _____

"i-clicker" questions

(You will have ~ 5 min of in-class time to provide answers to the following questions.)

Write the electron configuration of neodymium: *(Can abbreviate using the Noble gas configuration.)*

Draw the electron diagram for the neodymium atom: *(Can abbreviate using the Noble gas configuration.)*

Using the electron diagram of neodymium atom explain its relationship to the magnetic properties.

Toyota projects sales of 2 million units of the Prius, and wind energy companies plan to generate at least 1,000 megawatts in the Altamont pass near Livermore. How many kilograms of neodymium in total do both applications require? (Show your calculations.)