Review for Final Exam

Big Science

Increasing sophistication of science requires larger scale research projects. Industrialization of society allows large scale projects to be built (and paid for). Science for gov't projects begins in a big way in WWI and II in arms races. Best example: The Manhattan Project to build the atomic bomb. Harnessed huge resources for one goal. Uses fission of uranium or plutonium to trigger chain reaction and explosion. Explosions are easy, controlling them is hard. After the war the Manhattan Project evolves into the National Labs that still do cutting edge, federally funded research today.

Who Funds Science?

Ancient societies had gov't funded projects, but theoretical work (ancient Greece) was not funded. A few gov't science positions were available, like court mathematician. Universities taught old science, but did not fund research until 1800's. Some scientists taught, and paid for research with own money. Organizations like Royal Society made science legit in eyes of gov't, but had no funding. Private industry funds science, beginning with chemistry. University/Industry feedback.

Quantum Mechanics

The crisis between the rational cause-and-effect nature of classical physics (e.g. Newton, Faraday & Maxwell) and the probabilistic, dual nature of the new quantum mechanics.

Wien, Rayleigh and the failure of Maxwell's wave equations: the ultraviolet catastrophe. This was solved by Planck by assuming that rays of light were quantized bundles of energy.

The nature of the atom: protons, neutrons and electrons. Einstein and the explanation of the photoelectric effect through quantized rays of light called photons. Wave – particle duality: light is both a particle and a wave, simultaneously.

Rutherford's model of the atom and the problem with electron energies. Bohr's model of the atom, atomic energy levels and quantized spectra.

Quantum numbers: energy level, angular momentum, magnetic moment, spin – and the periodic table. The Pauli exclusion principle.

Quantum Mechanics (continued)

Heisenberg and matrix math vs. de Broglie and Schroedinger's wave math. The probabilistic nature of particles using Schroedinger's wave Equations. The Heisenberg uncertainty principle.

Determinism vs. randomness.

Schroedinger's cat.