Final Exam – Learning goals since Exam 3

Students will be able to

Draw the structure of electromagnetic waves showing the electric and magnetic field

Use the electromagnetic spectrum to identify types of EM waves with higher energy photons or lower energy photons and show how wavelength relates to photon energy.

Calculate the energy of a single photon of a given wavelength or frequency of EM wave.

Identify which model of EM waves is useful in a particular situation: photon model, wave model, ray model.

Describe how a microwave oven heats food

Apply the idea that hotter objects emit higher frequency EM waves.

Use the ideas of intensity vs energy of individual photons to explain phenomena.

Explain the photoelectric effect and be able to predict what will happen if various factors are changed such as the wavelength of incoming light, the intensity of the incoming light or the metal that the light shines on.

Calculate the maximum kinetic energy of photons emitted in the photo electric effect.

Calculate the deBroglie wavelength of any particle based on its momentum.

Explain *why* electrons have distinct energy levels.

Calculate the energy of photons that will be absorbed or emitted by a given molecule.

Identify an inertial reference frame

Explain how following Maxwell's law that the speed of light is always constant brings us to time dilation. Moving clocks run slower.

Explain how moving clocks run slower brings us to the idea of length contraction. Be able to identify in a situation what length will contract.

Explain the twin paradox using *special relativity* and why it's not actually a paradox using *general relativity.*

The implications of general and special relativity on GPS (Global positioning system)

Identify how many protons and neutrons are in an atom when given the atomic weight and atomic number.

Identify four different types of radiation (alpha, beta, gamma and neutrons) and their various characteristics.

The difference between fusion and fission.

Describe how binding energy tells us about the amount of energy given off in a nuclear reaction.

Describe what the famous equation $E=mc^2$ tells us.