

Physics 10164 - Exam 5D

Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work even if you get the right answer. Clearly indicate your answer with a circle or a box and remember to include correct units and significant figures.

1. (25 points) Carbon-14 has a half-life of 5700 years and mass of approximately 14 amu. A sample of wood contains 13 milligrams of Carbon-14.

a) What is the activity of this sample, in Curies?

b) How many years will it take for the activity to fall to 1.3% of its initial level?

2. (25 pts) An electron in a Hydrogen atom is in energy level $n = 3$.

a) What wavelength of light must be absorbed by the electron to move up to the $n = 5$ energy level?

b) From the $n = 5$ energy level, what is the longest possible wavelength of light that the electron can emit while transitioning to another energy level within the atom?

3. (25 pts) A spaceship travels from Earth to Jupiter at a constant velocity. According to clocks on board the spaceship, the trip takes 32 minutes. According to observers on the Earth, however, the trip takes 56 minutes.

- a) How fast is the ship traveling, as measured in Earth's reference frame? Answer as a fraction of c .
- b) What is the distance between Earth and Jupiter, as measured in Earth's reference frame?
- c) According to passengers on the ship, what is the distance that they have travelled?

4. (25 pts) An example of "clean" fusion would be the reaction involving Hydrogen and Boron. Suppose we fuse a proton with Boron-11 (11.009306 amu) to produce 3 Helium nuclei (4.002602 amu each).

a) How much energy (MeV) is liberated in this reaction?

b) How many kg of Boron-11 would be needed in order to satisfy the needs of the TCU campus for one year, which requires about 2.5 billion kW-hr of energy?