

Homework #5: Uncertainty and Conservation Laws

1. Ford, E3.1 (p. 67)
2. ${}_{92}\text{U}^{232}$ undergoes radioactive decay as it emits an alpha particle with a kinetic energy = 5.414 MeV.
 - a) What is the baryon (B) number and Z number of uranium-232? Why does it get those numbers?
 - b) Using the various conservation laws, determine the Z number and B number of the daughter nuclide. (Make sure you use conservation laws!)
 - c) Draw an energy vs. Z diagram of this decay process.
3. You are a store manager for a Target megastore. You get an average number of 12735 customers coming into your store on a typical day. Advertising salespeople are always calling you, claiming that their techniques will increase the number of people coming into your store. One in particular claims that she can increase your number of customers in a single day. How many customers would have to come in that day before you could even start to believe it wasn't just a random fluke?
4. Invent a conservation law for money. Show how your law applies to the four steps I outlined in class. That is, what is your system? What is the interaction you are considering? Does money change form? What do you need to consider when calculating whether or not money is conserved? (Note that I mean "money", not "wealth" or "value".)
5. You have measured five angles to $\pm 1^\circ$. These angles are 5° , 12° , 68° , 124° , and 180° . How would you write the sine of these angles, with uncertainty? Hint: Pay close attention to units here. $\sin(\theta)$ is unitless, so you don't want your uncertainty in sine to have a unit! Use radians for your uncertainty; that has no units.
6. In the 1996 action film *Eraser*, Arnold Schwarzenegger is portrayed as firing two rifles, one in each hand. These rifles are claimed in the narrative to be rail guns that can fire bullets at speeds close to the speed of light. Ignoring relativity theory, if Arnold were to fire a 10^0 g paper clip at a speed close to the speed of light, what would happen to him? (Assume Arnold has a mass of 10^2 kg. Give your answer to zero sig figs. If you were to account for relativistic effects, the answer would be much larger!)
7. a) You measure the length of a table to be 2.45 ± 0.06 m and the width to be 0.87 ± 0.02 m. What is the area of the table in square centimeters?

b) You measure the length of three (presumed identical) tables set end to end to be 5.96 ± 0.03 m. How long is one table?

c) You measure the diameter of a cylinder to be 1.3 ± 0.2 cm and the length to be 5.2 ± 0.6 cm. You measure the mass to be 4.56 ± 0.01 g. What is the average density of the cylinder?

d) You measure the length of a table to be 1.98 ± 0.03 m. How long would three of these tables placed end to end be?

Due: Wednesday, September 30, 10:00 am