Tareas 1 – Topicos de la Fisica Moderna

1. Determine the mass (in kg) of the following atoms: (a) ^4He, (b) ^{12}C, (c) ^{208}Pb.

2. Use the density of graphite, $\rho = 2 \times 10^3 \, \mathrm{kg/m^3}$, to make an estimate of the size of a carbon atom.

3. The density of air at room temperature and atmospheric pressure is about $1.2 \, \mathrm{kg/m^3}$. Estimate the number of molecules in one cubic meter of air.

4. Make an estimate of the number of atoms in a person who has a mass of $100 \, \mathrm{kg}$.

5. Electrons are accelerated from rest through a potential difference of 10^4 V. The electrons are then directed into a magnet that has a uniform field of of 10^{-3} T. The magnetic field direction is orthogonal to the electron velocity. Calculate the radius of curvature of the electron's trajectory inside the magnet.

6. In the Millikan oil-droplet experiment, a relatively small metal plate can pull a droplet upward with a stronger force than the whole earth pulling it downwards! Do you consider this to be convincing evidence that the electric force is many, many orders of magnitude greater in strength than gravity? Can you think of other common examples that illustrate the relative strengths of electromagnetism and gravity?

7. Make an estimate of the mass density of nuclear matter.

8. Which does your physical intuition tell you is greater, the mass energy of a mosquito or the kinetic energy of a 747 jumbo jet at cruising speed? Estimate the order of magnitude of each.

9. The energy released in the explosion of one ton of TNT is about 4×10^9 J. (a) Where does this energy come from? (b) The ^{235}U nucleus may be broken apart by bombarding it with neutrons, a process called *nuclear fission*. In the fission process, an energy of about $200 \, \mathrm{MeV}$ is released. Where does this energy come from? (c) What mass of the ^{235}U is needed to produce the equivalent of one megaton of TNT by the fission process?

10. When an atom of carbon combines with a molecule of oxygen to produce CO_2, an energy of $11.4 \, \mathrm{eV}$ is released. (a) How much energy is released in the burning of $1 \, \mathrm{kg}$ of carbon? (b) How much matter is converted to energy?

11. Four protons are combined into an alpha particle by a series of nuclear *fusion* reaction that occur in the sun. The energy released in this process $(4p \rightarrow \alpha)$ is about $25 \, \mathrm{MeV}$. If the solar luminosity is dominated by proton fusion, at what rate are protons "burned" in the sun?

12. According to our current understanding of the universe, matter is composed of six quarks with similar properties and six leptons with similar properties. Do you believe that this is an indication that quarks and leptons might have structure? Explain!

13. Do you think that there could be a fifth fundamental force that has not yet been observed? Explain.

14. Lea y comenta la publicación "Determination of the Avagadro Constant...", PRL 106 030801.