Nuclear Chemistry Assignment

- Why isn't the sum of the masses of all nucleons (protons and neutrons) in one nucleus equal to the mass of the actual nucleus?

A small amount of mass is converted into energy and lost from the system when the nucleons assemble into a stable nucleus. The amount of mass that is converted into energy corresponds to the gain in stability that the nucleus achieves by loss of this amount of energy as high energy electromagnetic radiation. (binding energy)

- What are the names of the two forces at work within an atomic nucleus? Which force provides the net force of attraction? How do the two differ in their abilities to act over a distance?

The two forces in an atomic nucleus are the electrostatic force of repulsion among the protons in the nucleus and the so called strong nuclear force that operates to bind the nucleons together in spite of the repulsive forces. The strong force provides the net force of attraction. The strong force decreases more rapidly as a function of distance than does the electrostatic force.

- What are the three kinds of radiation that have been observed from naturally occurring radionuclides?

Naturally occurring radionuclides emit alpha particles, beta particles and gamma radiation.

- Give the composition of each of the following: a) Alpha particle; b) beta particle and c) positron particle

a) alpha particle is composed of a helium nucleus (2p & 2n) and has a +2 charge
b) beta particle is composed of an electron (neutron changes into a proton by emitting an electron
c) positron particle are particles with a +1 charge and have the same mass as the electron

- Complete these nuclear equations:
  - $^{211}Pb \rightarrow$ beta particle + ? — ^{211}Bi
  - ^{177}Ta + electron $\rightarrow$? — ^{177}Hf + energy
  - $^{220}Rn \rightarrow$ alpha particle + ? — ^{216}Po
  - $^{19}Ne \rightarrow$ positron particle + ? — ^{19}F
  - $^{245}Cm \rightarrow$ alpha particle + ? — ^{241}Pu
  - $^{140}Ba \rightarrow$ beta particle + ? — ^{140}La
  - $^{58}Cu \rightarrow$ postitron + ? — ^{58}Ni
  - ^{68}Ge + electron $\rightarrow$? — ^{68}Ga + energy

- Write a balanced nuclear equation for each of these changes.
  - Alpha emission from plutonium-242 — $^{242}Pu \rightarrow {}^{4}He + {}^{238}U$
  - Beta emission from magnesium-28 — $^{28}Mg \rightarrow {}^{0}e + {}^{28}Al$
  - Positron emission from silicon-26 — $^{26}Si \rightarrow {}^{0}e + {}^{26}Al$
  - Electron capture by argon-37 — $^{37}Ar + {}^{0}e \rightarrow {}^{37}Cl$ + energy
  - Electron capture by iron-55 — $^{55}Fe + {}^{0}e \rightarrow {}^{55}Mn$ + energy
  - Beta emission by potassium-42 — $^{42}K \rightarrow {}^{0}e + {}^{42}Ca$
  - Positron emission by ruthenium-93 — $^{93}Ru \rightarrow {}^{0}e + {}^{93}Tc$
  - Alpha emission by californium-251 — $^{251}Cf \rightarrow {}^{4}He + {}^{247}Cm$
  - Beta emission from aluminum-30 — $^{30}Al \rightarrow {}^{0}e + {}^{30}Si$
  - Alpha emission from einsteinium-252 — $^{252}Es \rightarrow {}^{4}He + {}^{248}Bk$
  - Electron capture by molybdenum-93 — $^{93}Mo + {}^{0}e \rightarrow {}^{93}Nb$ + energy
  - Positron emission by phosphorus-28 — $^{28}P \rightarrow {}^{0}e + {}^{28}Si$
  - Positron emission by carbon-10 — $^{10}C \rightarrow {}^{0}e + {}^{10}B$
  - Alpha emission by curium-243 — $^{243}Cm \rightarrow {}^{4}He + {}^{239}Pu$
  - Electron capture by vanadium-49 — $^{49}V + {}^{0}e \rightarrow {}^{49}Ti$ + energy
  - Beta emission by oxygen-20 — $^{20}O \rightarrow {}^{0}e + {}^{20}F$

- Write the balanced nuclear equation that would give each of these products:
  - Fermium-257 by alpha emission — $^{261}No \rightarrow {}^{4}He + {}^{257}Fm$
  - Bismuth-211 by beta emission — $^{211}Pb \rightarrow {}^{0}e + {}^{211}Bi$
  - Neodymium-141 by positron emission — $^{141}Pm \rightarrow {}^{0}e + {}^{141}Nb$
  - Tantalum-179 by electron capture — $^{179}W + {}^{0}e \rightarrow {}^{179}Ta$ + energy
  - Rubidium-80 formed by electron capture — $^{80}Sr + {}^{0}e \rightarrow {}^{80}Rb$ + energy
  - Antimony-121 formed by beta emission — $^{121}Sn \rightarrow {}^{0}e + {}^{121}Sb$
  - Chromium-50 formed by positron emission — $^{50}Mn \rightarrow {}^{0}e + {}^{50}Cr$
  - Californium-253 formed by alpha emission — $^{257}Fm \rightarrow {}^{4}He + {}^{253}Cf$