For the following, write the radioactive decay equation:

1. Tritium ($^{3}_{1}H$) is a radioactive isotope of hydrogen and decays by beta decay. Write down the equation for the reaction and name the products of the decay.

2. Nitrogen ($^{14}_{7}N$) is produced in the beta decay of a radioactive isotope. Write down the reaction and name the particles in the reaction.

3. Plutonium ($^{239}_{94}Pu$) decays by alpha decay. Write down the reaction and name the element produced in the decay.

4. Name the two missing particles in the reaction: $^{22}_{11}Na \rightarrow ^{22}_{10}Ne + ? + ?$

#5 The "size" of the atom in Rutherford's model is about 1.0 x 10^{-10} m. (a) Determine the attractive electrical force between and electron and a proton separated by this distance. (b) Determine (in eV) the electrical potential energy of the atom

#6 In a Rutherford scattering experiment, an alpha particle (charge = +2e) heads directly toward a gold nucleus (charge = +79e). The alpha particle has KE of 5.0 MeV when very far ($r \rightarrow \infty$) from the nucleus. Assuming the gold nucleus to be fixed in space, determine the distance of closest approach. (Hint: use conservation of energy with PE = kqQ/r).

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#7 Compare the nuclear radii of the following nuclides, (assuming $R = R_o A^{1/3}$): $^{2}_{1}H, ^{60}_{27}Co, ^{197}_{79}Au, ^{239}_{94}Pb$

#8 An alpha particle (Z = 2, mass = 6.64 x 10^{-27} kg) approaches to within 1.00 x 10^{-14} m of a carbon nucleus (Z = 6). What are (a) the maximum Coulomb force on the alpha particle, (b) the acceleration of the alpha particle at this point, and (c) the potential energy of the alpha particle at this point?

#9 Singly ionized carbon is accelerated through 1 000 V and passes into a mass spectrometer to determine the isotopes present. The magnetic field strength in the spectrometer is 0.200 T. (a) Determine the orbit radii for the C-12 and C-13 isotopes as they pass through the field. (b) Show that the ratio of the radii may be written in the form $\frac{r_1}{r_2} = \sqrt{\frac{m_1}{m_2}}$ and verify that your radii in part (a) agree with this.

#10 The half-life of an isotope of phosphorus is 14 days. If a sample contains 3.0×10^{16} such nuclei, determine its activity.

#11 A radioactive sample contains 3.5 μg of pure C-11, which has a half-life of 20.4 min. (a) How many moles of C-11 is present initially? (b) Determine the number of nuclei present initially. What is the activity of the sample (c) initially and (d) after 8.00 hr?

#12 Many smoke detectors use small quantities of he isotope Am-241 in their operation. The half-life of Am-241 is 432 yr. How long will it take for the activity of this material to decrease to 1.00×10^{-3} if the original activity?

#13 Complete the following radioactive decay formulas:

$$^{212}_{83}Bi \rightarrow \quad Tl + {}^{4}_{2}He$$

$$^{95}_{36}Kr \rightarrow \quad Rb + e^{-} + \bar{\nu}$$

$$Nd \rightarrow {}^{140}_{58}Ce + {}^{4}_{2}He$$

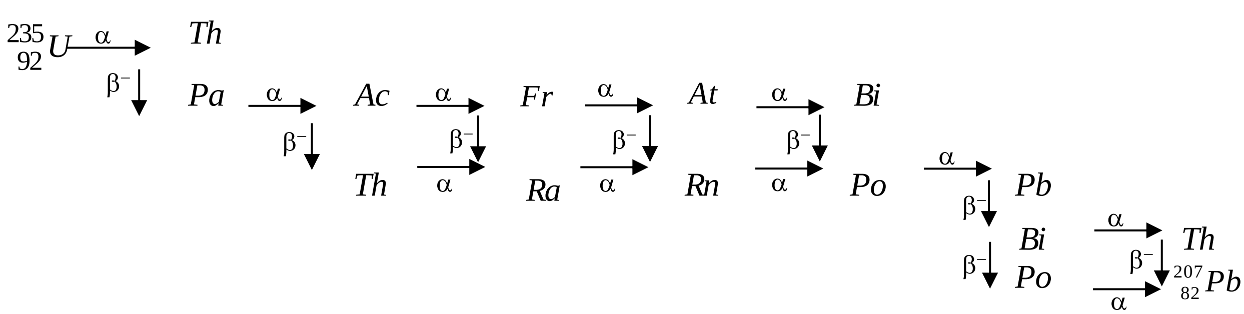
#14 Complete the following radioactive decay formulas:

(a) $Ca \rightarrow e^{+} + {}^{40}_{19}K + \nu$

(b) $^{94}_{44}Ru \rightarrow {}^{4}_{2}He + \quad Mo$

(c) $^{144}_{60}Nd \rightarrow \qquad + {}^{140}_{58}Ce$

#15 The reaction chain shows the steps by which U-235 decays into Pb-82. Enter the correct values for each nuclide.



#16 A wooden artifact is found in an ancient tomb. Its C-14 activity is measured to be 60.0% of that in a fresh sample of wood from the same region. Assuming the same amount of C-14 was initially present in the wood from which the artifact was made, determine the age of the artifact. (The half-life for C-14 is 5730 yr.)