PROBLEM 1 – 10 points

[5 points] (a) You have equal numbers of two radioactive nuclei to start with. The A nuclei have a half-life of 4 days, while the half-life of the B nuclei is unknown. After waiting for 12 days, you find that there are twice as many B nuclei remaining as there are A nuclei. What is the half-life of the B nuclei?

[5 points] (b) Uranium-235 has a half-life of about 700 million years. The Earth today has approximately $1/32^{nd}$ of the Uranium-235 that it had when the Earth was formed. Use this information to approximate the age of the Earth.

PROBLEM 2 – 10 points

Note: you will find a periodic table to be helpful for this problem.

[2 points] (a) Americium-241, which is used in many smoke detectors, is radioactive, decaying via alpha decay. Complete the alpha decay equation below to show what americium-241 decays into.

$$^{241}_{95}\text{Am} \rightarrow \underline{\hspace{1cm}} + \underline{\hspace{1cm}}$$

[2 points] (b) Oxygen-15 decays via beta-plus decay, which means it gives off a positron and an electron neutrino. Because of this, oxygen-15 is often used in positron emission tomography studies. Complete the decay equation below to show what oxygen-15 decays into.

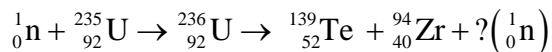$$^{15}_{8}\text{O} \rightarrow \underline{\hspace{1cm}} + {}^{0}_{1}e^{+} + \nu_{e}$$

[2 points] (c) Scandium-46 decays via beta-minus decay, which means it gives off an electron and an electron antineutrino. Complete the decay equation below to show what scandium-46 decays into.

$$^{46}_{21}\text{Sc} \rightarrow \underline{\hspace{1cm}} + {}^{0}_{-1}e^{-} + \bar{\nu}_{e}$$
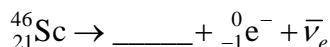
[2 points] (d) Nickel-60 is an emitter of gamma rays. Complete the decay equation below to show what an excited nickel-60 nucleus decays into.

$$^{60}_{28}\text{Ni}^{*} \rightarrow \underline{\hspace{1cm}} + \gamma$$
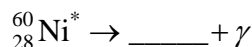
[2 points] (e) How many neutrons are produced in the following fission reaction for a uranium-235 atom that combines with a neutron?

$$^{1}_{0}n + {}^{235}_{92}\text{U} \rightarrow {}^{236}_{92}\text{U} \rightarrow {}^{139}_{52}\text{Te} + {}^{94}_{40}\text{Zr} + ?\left({}^{1}_{0}n\right)$$

_____ neutrons are produced.