Chapter 10 Reading Questions 2018 Name Key

*See page numbers on some questions as we skip around the book a bit. Your notes and power point online will help as well.

1. Isotopes of elements differ in the ratio of neutrons to protons. This ratio is related to the stability of the nucleus.

2. What is the Golden Ratio of neutrons to protons in less massive elements? What is the ratio of neutrons to protons in heavier elements?
   less massive 1:1 — Ex: He, N, O
   more massive 3:2 — Ex: Fe, Ni, Cu, Zn

3. With regards to the forces holding a nucleus together, why does a nucleus become unstable (radioactive)? P. 309
   A nucleus becomes unstable when the strong nuclear force can no longer overcome the repulsive electric force among protons.

4. Radioactivity is the process in which a(n) unstable nucleus emits charged particles and energy. P. 292

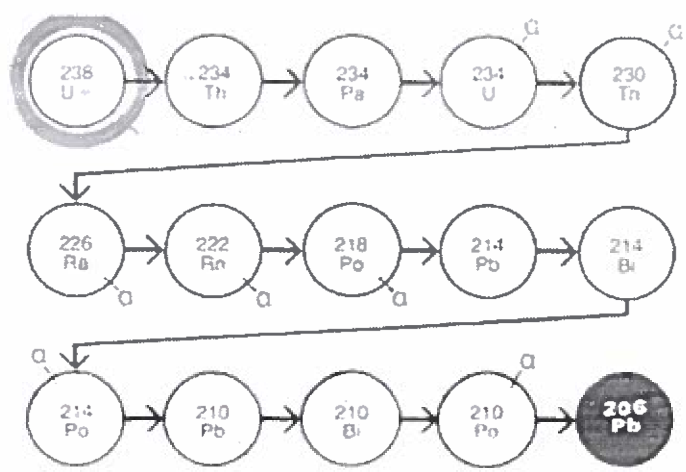
5. Create a graphic organizer for the three types of radiation discussed in the book. Be sure to include how each affects the nucleus (mass and atomic number). P. 293-296

	ALPHA	BETA		GAMMA
symbol	α, ${}^{4}_{2}He$	${}^{0}_{-1}\beta$	${}^{0}_{+1}\beta$	${}^{0}_{0}\gamma$
charge	+2	−1	+1	0
mass	4	0	0	0
effects nucleus	at # −2 mass # −4 amu	$n^0 \rightarrow p^+$ at # +1 mass # same	$p^+ \rightarrow n^0$ at # −1 mass # same	doesn't affect nucleus

6. The most penetrating form of radiation are gamma rays. They are a form of radiation called electromagnetic waves, and they carry energy. P. 296

7. As atoms decay, they are changed from one element to another through a process called transmutation. The following picture shows this process. Looking at the picture below, Uranium-238 decays (eventually) into Lead-206. Why does Lead-206 (Pb-206) no longer decay? Remember, emitting alpha particles and beta particles changes the element but in different ways.

   Pb-206 is stable



Showing how uranium (U^{238}) decays to lead (Pb^{206}) and points where helium (α) is given off.

α – at # – 2, mass # – 4 amu

β plus – at # – 1, mass # same; $p^+ \rightarrow n^0 + {}^{0}_{+1}\beta$

β minus – at # + 1, mass # same; $n^0 \rightarrow p^+ + {}^{0}_{-1}\beta$

Radioactive Decay Practice

γ – at # same, mass # same

Complete the chart below. You may use your periodic table.

Element		New Element		Equation Symbol	Greek Symbol And Label
${}^{241}_{95}Am$	→	${}^{237}_{93}Np$	+	${}^{4}_{2}\alpha$	Alpha Decay α
${}^{131}_{53}I$	→	${}^{131}_{54}Xe$	+	${}^{0}_{-1}\beta$	Beta Decay β minus
${}^{99}_{43}Tc$	→	${}^{99}_{43}Tc$	+	${}^{0}_{0}\gamma$	γ Gamma Decay
${}^{174}_{77}Ir$	→	${}^{170}_{75}Re$	+	${}^{4}_{2}He$	α Alpha Decay
${}^{199}_{78}Pt$	→	${}^{199}_{79}Np$	+	${}^{0}_{-1}\beta$	Beta Decay β minus
${}^{235}_{92}U$	→	${}^{231}_{90}Th$	+	${}^{4}_{2}He$	Alpha Decay α
${}^{231}_{91}Pa$	→	${}^{227}_{89}Ac$	+	${}^{4}_{2}He + {}^{0}_{0}\gamma$	Alpha & Gamma α & γ
${}^{211}_{82}Pb$	→	${}^{211}_{83}Bi$	+	${}^{0}_{-1}\beta$	Beta Decay β minus

**Before we take a look at a geoscience application of decay, let's take a look at nuclear reactions.

7. Compare and contrast fission and fusion. P. 309-315

FISSION	BOTH	FUSION
produces radioactive particles takes little E, prod less E than fusion doesn't occur normally in nature lg nucleus → 2 sm nuclei nuclear reactor atomic bomb chain reaction	release ↑ E! (more than in chem rxns) sm amount of mass lost $E=mc^2$	2 sm nuclei → 1 lg nucleus Sun (& other ☆) Hydrogen Bomb needs ↑ temp & density & E to occur releases 3-4 x the E of a fission rxn

8. Describe the relationship between mass and energy. P. 310

$E=mc^2$

E = energy

m = mass

c = speed of light (3.00×10^8 m/s)

Section 2 Half-Life, pg. 298-301

1. What is a half-life? Are all half-lives the same? What are the ranges of time your book gives you?
P. 299 ½ life - amount of time it takes for ½ the nuclei in a sample to decay
some are less than a thousandth of a sec & some are billions of yrs

2. How are nuclear decay rates different from chemical reaction rates? P. 299
nuclear decay rates are constant, while chem rxn rates can vary (based on conc, temp, S.A., catalyst, etc.)

3. What is radioactive dating? Why do scientists use it? P. 300
- dating of materials based on known ½ lives
- compare amount of parent isotope to daughter isotope
- # ½ lives calculated - mult. # ½ lives by 1 ½ life of that material
- scientists use it to determine how old rocks, fossils are

Half-Life Practice Problems:

1. What percentage of a radioactive (parent) element will be left after:

a. 1 half-life 50% b. 2 half-lives 25% c. 3 half-lives 12.5%

2. How many half-lives have passed for each of the following samples:
   a. 50% of the original radioactive material remains 1
   b. 25% of the original radioactive sample remains 2
   c. 12.5% of the original radioactive sample remains 3

3. If a rock sample originally contained 12 g of Uranium-235, how much will be left after:

a. 1 half-life 6.0g b. 2 half-lives 3.0g c. 3 half-lives 1.5g

4. Uranium-235 has a half-life of 700 million years. How much of the 12 g sample of Uranium-235 will be left after :

a. 700 million years 6.0g b. 1400 million years 3.0g

5. Carbon-14 is a radioactive element that decays into Nitrogen-14. The half-life of Carbon-14 is 5730 years. What percentage of Carbon-14 and Nitrogen-14 will be left in a dinosaur bone after:

5730 years: % of Carbon-14 50% + % of Nitrogen-14 50% = 100%

11,460 years: % of Carbon-14 25% + % of Nitrogen-14 75% = 100%

17,190 years: % of Carbon-14 12.5% + % of Nitrogen-14 87.5% = 100%

6. If the dinosaur bone in question 5 originally had 16 grams of Carbon-14 in it how much of each type of element should be left after:

1 ½ life **5730 years:** Grams of Carbon-14 8.0g Grams of Nitrogen-14 8.0g

2 ½ lives **11,460 years:** Grams of Carbon-14 4.0g Grams of Nitrogen-14 12.0g

3 ½ lives **17,190 years:** Grams of Carbon-14 2.0g Grams of Nitrogen-14 14.0g

7. More dinosaur bones are found and examined. If they contain the following percentages of Carbon-14 and Nitrogen-14 how old are each of the bones?

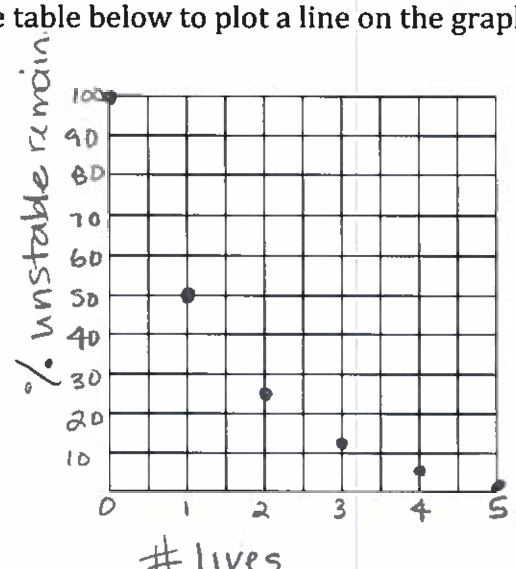
Bone #1: 50% Carbon-14 and 50% Nitrogen-14 5,730 years old

Bone #2: 25% Carbon-14 and 75% Nitrogen-14 11,460 years old

Bone #3: 12.5 % Carbon-14 and 87.5% Nitrogen-14 17,190 years old

8. Scientists have recently discovered a new type of radioactive element. They have measured its half-life and know it takes 10,000 years to decay. Use their data in the table below to plot a line on the graph below.

x Number of Half Lives	y % of Unstable Atom Remaining
0	100
1	50
2	25
3	12.5
4	6.25
5	3.125



9. A fossil bone has 25% of this new radioactive element remaining. How many half-lives have passed?

2 ½ lives

10. If the half-life of this new element is 10,000 years, how old is the fossil bone in question 9?

20,000 yrs