

Homework 4 CHEM 130

Homework 4: Show All Work 1.

Complete the following table.

Name	Charge	Mass	Greek Symbol	Equation Symbol	Identity
ALPHA					
BETA					
GAMMA					

When an atom undergoes radioactive decay the product nucleus is often unstable and undergoes further decay. This occurs until a stable nucleus is produced. (There is no way for a student to know how an atom will decay. We will always tell you the mode of decay for equations.)

2. Write the nuclear equations for the following radioactive decay series. Use the periodic table in your book.

- uranium-235 emits an alpha
- thorium-231 emits a beta and a gamma
- protactinium-231 emits an alpha and a gamma
- actinium-227 emits a beta
- Th-227 emits an alpha and a gamma
- Ra-223 emits an alpha
- Rn-219 emits an alpha
- Po-215 emits an alpha and a gamma

3. What is a *radioactive isotope*?

4. What is radioactive decay?

5. What is *half-life*?

6. If we start with 400 atoms of a radioactive substance, how many would remain after one half-life? _____ after two half-lives? _____ after three half-lives? _____ after four half-lives? _____

7. If we start with 48 atoms of a radioactive substance, how many would remain after one half-life? _____ after two half-lives? _____ after three half-lives? _____ after four half-lives? _____

8. If we start with 16 grams of a radioactive substance, how much will remain after three half-lives? _____

9. If we start with 120 atoms of a radioactive substance, how many will remain after three half-lives? _____

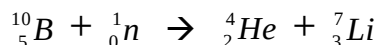
10. Which type of nuclear radiation (beta particles, gamma rays, or alpha particles) can be blocked by...

a) a piece of paper _____

b) a sheet of aluminum _____

b) a piece of lead _____

11. Example: Boron-10 is bombarded with a neutron yielding an alpha and another product.



12. Write nuclear equations for the following bombardment reactions.

a. Platinum-196 is bombarded by a deuteron (H-2), producing platinum-197 and a proton.

b. Nitrogen-14 is bombarded by a neutron, producing carbon-14 and a proton.

c. Plutonium-239 plus an alpha yields three neutrons and a transuranium element.

d. Uranium-238 plus a neutron yields a beta and another product.

13. Which of the human senses can detect radiation?

14. What are the **two** properties of radiation that allow us to detect it?

15. What element collects on the ions on photographic film?

16. To balance a nuclear reaction, the mass number on both sides of the equation must be equal but the atomic number can be different.

A. True B. False

17. What is a Curie (Ci)

18. What is a rad?

19. What is a rem and how do you calculate it?

20. What is the LD₅₀ for radiation in humans?

21. What would a whole body exposure of 100 rem at one time do to a person?

22. Why are short half-life radioisotopes used in medical applications?

The Roentgen Equivalent Man, or REM, is the unit used most frequently to measure radiation exposure/effect on humans. This unit takes into account not only the amount of radiation you are exposed to but also how sensitive your body is to a particular type of radiation. Fill in the following blanks with suitable values. You may need to look up some information on the internet. When you finish, add the quantities to estimate your annual radiation dose.

SOURCE OF RADIATION	QTY PER YEAR
1. Location of your community a. Cosmic radiation (radiation emitted by stars across the universe. Much of this is deflected by the earth's atmosphere and ionosphere.) sea level (U.S. Average). Find your dose value based on your community's elevation sea level: 26 mrem 4000-5000 ft 47 mrem 0-1000 ft 28 mrem 5000-6000 ft 52 mrem 1000-2000 ft 31 mrem 6000-7000 ft 66 mrem 2000-3000 ft 35 mrem 7000-8000 ft 79 mrem 3000-4000 ft 41 mrem 8000-9000 ft 96 mrem	35 mrem
2. Terrestrial Radiation (from the ground) If you live in a state bordering the Gulf or Atlantic coasts 16 mrem If you live in AZ, CO, NM, or UT 63 mrem If you live anywhere else in the US 30 mrem	____ mrem
3. House construction material. (Building materials contain a very small percent of radioisotopes.) If your house is stone, adobe, brick or concrete 7 mrem	____ mrem
4. Power Plants If you live within 50 miles of a nuclear power plant 0.009 mrem If you live within 50 miles of a coal-fired power plant 0.03 mrem	____ mrem
5. Food, water, and air. From food (C-14 and K-40) and water (Rn dissolved in water) 40 mrem From air (Rn) 200 mrem	____ mrem
6. How you live Weapons test fallout 1 mrem Travel by jet aircraft (per hour in air) 0.5 mrem If you have porcelain crowns or false teeth 0.07 mrem If you wear a luminous wristwatch 0.06 mrem If you go through airport security (each time) 0.002 mrem If you watch TV 1 mrem If you use a video display (computer screen) 1 mrem If you live in a dwelling with a smoke detector 0.008 mrem If you use a gas camping lantern with an old mantle 0.2 mrem If you wear a Pu powered pacemaker 100 mrem	____ mrem ____ mrem ____ mrem ____ mrem ____ mrem ____ mrem ____ mrem ____ mrem ____ mrem ____ mrem
7. Medical and dental X rays (dose per procedure) X-ray Extremity (arm, hand, foot, or leg) 1 mrem Dental 1 mrem Chest 6 mrem Pelvis/hip 65 mrem Skull/neck 20 mrem Barium enema 405 mrem Upper GI 245 mrem CT scan (head and body) 110 mrem Nuclear medicine (e.g. thyroid scan) 14 mrem	____ mrem ____ mrem ____ mrem ____ mrem ____ mrem ____ mrem ____ mrem ____ mrem ____ mrem
Total	____ mrem

After calculating your annual radiation dose, answer these questions:

23. How does your yearly radiation dose compare with the US limit of 500 mrem?

24. Compare your value compare to the average background radiation of 360-mrem

25. Why is it useful to monitor how many X-rays you receive annually?

26. When choosing a place to live, what factors might decrease you annual ionizing dose?

27. What are some lifestyle changes that could reduce a person's exposure to ionizing radiation?

28. Would you want to make those changes? Explain.