Key

INTRODUCTION TO NUCLEAR CHEMISTRY

Use your knowledge of chemistry and the resource provided by your teacher to complete the following.

Diagnosing Appendicitis

1. Define radioactivity

   the emission of tiny, invisible particles by the nuclei of certain atoms.

2. Explain how nuclear medicine can be used to diagnose appendicitis.

   Antibodies are labeled with radioactive isotopes, which migrate to infection site. An X-ray will reveal where these have accumulated & therefore, the infection source.

3. Identify at least two other diseases/conditions that can be diagnosed used radioactivity.

   cancer, thyroid disease, abnormal kidney & bladder function, and heart disease

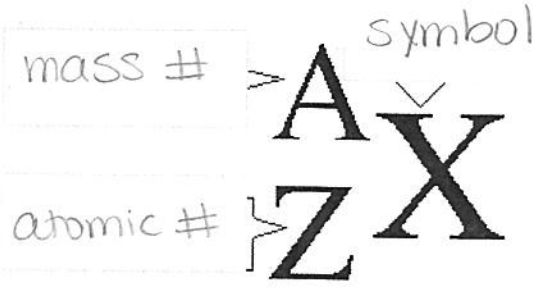
Discovery of Radioactivity

4. Identify the two main scientists credited with discovering radioactivity. Summarize the work of each scientist.

   - Antoine-Henri Becquerel - discovered radioactivity by showing that phosphorescent crystals exposed x-ray film
   - Marie Curie - discovered the radioactive elements polonium & radium

Types of Radioactivity

5. Label the generic representation of an element in isotopic notation.



6. Identify the number of protons, neutrons and electrons in each of the following isotopes.

   a. $^{21}_{10}Ne$ p = 10 n = 11 e = 10

   b. $^{24}_{12}Mg$ p = 12 n = 12 e = 12

   c. $^{63}_{29}Cu$ p = 29 n = 34 e = 29

   d. $^{239}_{94}Pu$ p = 94 n = 145 e = 94

Actinides are radioactive.

What is the difference between mass # & atomic mass?

p+n of one atom

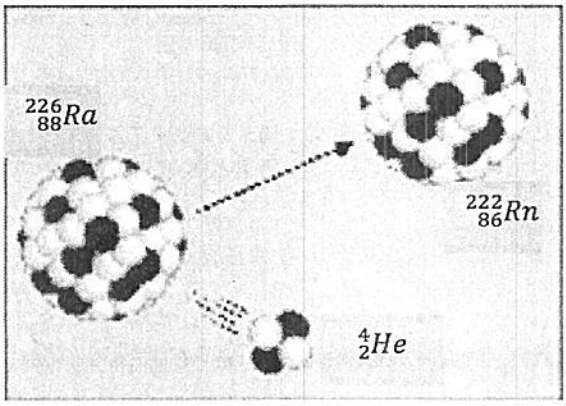
weighted average mass of isotopes all of that element

Why are p & e same for each example? They are neutral

Utilize the information in the provided resource and the models below to answer the following questions.

Alpha Decay

Elements with very large and unstable nuclei tend to undergo alpha decay because the emission of an alpha particle quickly reduces the size of the nucleus.



Parent Nuclide = Ra-226 Daughter Nuclide = Rn-222

Nuclear Equation: $^{226}_{88}Ra \rightarrow {}^{222}_{86}Rn + {}^{4}_{2}He$

7. Define **parent nuclide**

   the original atoms

8. Define **daughter nuclide**

   the products of the nuclear decay

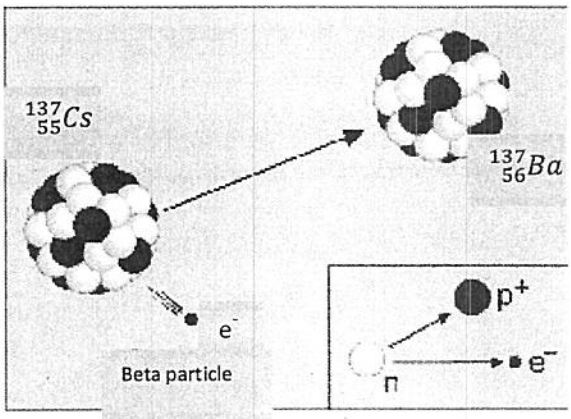
9. Write the symbol used to represent an alpha particle. $^{4}_{2}He$

10. How did the atomic number change when an alpha particle was emitted? decreases by 2

11. How did the mass number change when an alpha particle was emitted? decreases by 2

Beta Decay

Elements with a high neutron to proton ratio will undergo beta decay in which a neutron is converted into a proton and a beta particle (similar to an electron) is emitted from the nucleus.



Parent Nuclide = Cs-137 Daughter Nuclide = Ba-137

Nuclear Equation: $^{137}_{55}Cs \rightarrow {}^{137}_{56}Ba + {}^{0}_{-1}e$

12. Write the symbol used to represent a beta particle.

    $^{0}_{-1}e$

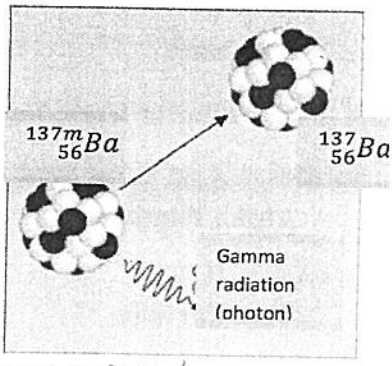
13. Which subatomic particle breaks down to create a beta particle?

    a neutron

14. How did the atomic number change when a beta particle was emitted? increases by 1

15. How did the mass number change when a beta particle was emitted? stays the same

Gamma Radiation



16. What is gamma radiation?

high-energy photons

17. How is gamma radiation different from alpha and beta decay?

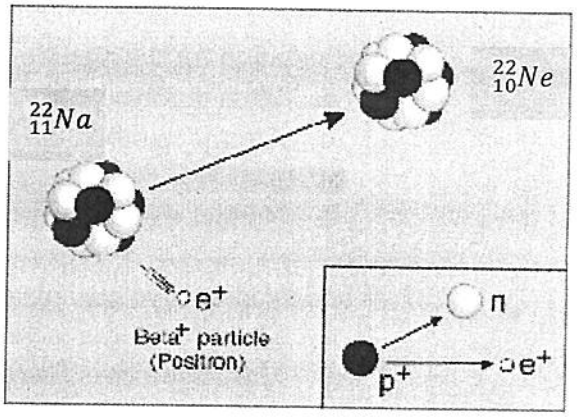
It is not matter, but electromagnetic radiation; no charge + no mass

18. When are gamma rays emitted?

in conjunction w/ other types of radiation

Positron Emission

Elements with a low neutron to proton ratio will undergo positron decay in which a proton is converted into a neutron and a positron (similar to an electron but with a positive charge) is emitted from the nucleus.



Parent Nuclide = Na-22 Daughter Nuclide = Ne-10

Nuclear Equation: $^{22}_{11}Na \rightarrow {}^{22}_{10}Ne + {}^{0}_{+1}e$

19. Write the symbol used to represent a positron.

$^{0}_{+1}e$

20. Which subatomic particle breaks down to create a positron?

a proton

21. How did the atomic number change when a positron was emitted? decreases by 1

22. How did the mass number change when a positron was emitted? stays the same

23. Define **ionizing power**.

the ability of radiation to ionize molecules and atoms

24. Define **penetrating power.**

the ability to penetrate (go through) matter.

25. Write a relationship between ionizing and penetrating power. (inverse)

The higher the ionizing power, the lower the penetrating power.

(X) Go over this!

Summary For HW you read about these types of radioactive decay

Type of Radiation	Symbol	Mass	Charge	Penetrating Power	Ionizing Power
Alpha Particle	$^{4}_{2}He$ or $^{4}_{2}\alpha$	4	+2	low	high
Beta Particle	$^{0}_{-1}e$ or $^{0}_{-1}\beta$	0	−1	mod.	mod.
Gamma Radiation	$^{0}_{0}\gamma$	0	0	high.	low
Positron	$^{0}_{+1}e$ or $^{0}_{+1}\beta$	0	+1	mod.	mod.

on Table O of Ref Table

Practice Multiple Choice

(X) 30 over!

26. The notation for the nuclide $^{137}_{55}Cs$ gives information about
    a. Mass number only
    b. Atomic number, only
    c. Both mass number and atomic number
    d. Neither mass number nor atomic number

27. When a radioactive nucleus emits a beta particle, the atom's — atomic # ↑ by 1, mass # stays the same
    a. Mass number is increased by 1
    b. Mass number is decreased by 1
    c. Atomic number is increased by 1
    d. Atomic number is decreased by 1

28. Which particle has the greatest mass?
    a. An alpha particle $^{4}_{2}He$
    b. A beta particle
    c. An electron
    d. A neutron

29. Which radioactive emanations have a charge of 2+?
    a. Alpha particles $^{4}_{2}He$
    b. Beta particles
    c. Gamma rays
    d. Neutron

30. In the following equation, which particle is represented by the letter X?
    $^{14}_{6}C \rightarrow {}^{14}_{7}N + X$ $^{0}_{-1}e$
    a. An alpha particle
    b. A beta particle
    c. A neutron
    d. A proton