**Atomic notation/Nuclear Decay/Half-life**

**Atomic notation and average atomic mass**

* 1. Fill in the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Symbol | Protons | Electrons | Neutrons | Mass Number | Atomic Number |
| 174Yb |  |  |  |  |  |
|  | 59 |  |  | 141 |  |
|  |  |  | 60 |  | 44 |
| 24Mg |  |  |  |  |  |

* 1. What is the average atomic mass of silicon if 92.21 % of its atoms have mass 27.97 amu, 4.70% have mass 28.976 1amu, and 3.09 % have mass 29.974 amu?

**Types of Radiation**

* 1. Complete the table below to compare the properties of alpha, beta, positron, and gamma radiation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | Alpha |  | Positron |  |
| **Greek letter** |  | β- |  | γ |
| **Symbol** |  |  |  |  |
| **Composition** |  |  | anti-electron |  |
| **Charge** |  |  |  | 0 |
| **Stopped by** | paper, skin, clothing |  |  |  |

**Nuclear Decay Reactions**

In problems 4 – 7, fill in the missing particle for each nuclear decay reaction. Then, match each equation to the appropriate type of nuclear decay.

\_\_\_\_\_ 4. 

1. alpha emission
2. beta emission
3. electron capture
4. positron emission

\_\_\_\_\_ 5. 

\_\_\_\_\_ 6. 

\_\_\_\_\_ 7. 

In problems 8 and 9, write a balanced equation for each nuclear decay reaction.

|  |  |
| --- | --- |
| 1. Decay of radium-223 by alpha (α) emission.
 | 1. Decay of iodine-126 by positron (β+) emission.
 |
|  |  |

1. How are the atomic number and mass number of a nuclide affected by positron emission?
2. How are the atomic number and mass number of a nuclide affected by the emission of gamma radiation?

**Half life**

1. Fluorine-21 has a half life of approximately 5 seconds. What fraction of the original nuclei would remain after 1 minute?

1. The half-life of chromium-51 is 28 days. If the sample contained 510 grams, how much chromium would remain after 56 days? How much would remain after 1 year? How much was present 168 days ago?

1. If 20.0 g of a radioactive isotope are present at 1:00 PM and 5.0 g remain at 2:00 PM, what is the half life of the isotope?

**Atomic notation/Nuclear Decay/Half-life Key**

1. Fill in the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Symbol | Protons | Electrons | Neutrons | Mass Number | Atomic Number |
| 174Yb | **70** | **70** | **104** | **174** | **70** |
| **141Pr** | 59 | **59** | **82** | 141 | **59** |
| **104Ru** | **44** | **44** | 60 | **104** | 44 |
| 24Mg | **12** | **12** | **12** | **24** | **12** |

1. What is the average atomic mass of silicon if 92.21 % of its atoms have mass 27.97 amu, 4.70% have mass 28.976 amu, and 3.09 % have mass 29.974 amu?

**Mass (amu) % Abundance**

Si - 27.97 x 92.21/100 = 25.79

Si - 28.976 x 4.70/100 = 1.362

Si - 29.974 x 3.09/100 = + .9262

 28.08 u

**Types of Radiation**

1. Complete the table below to compare the properties of alpha, beta, positron, and gamma radiation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | Alpha | Beta | Positron | Gamma |
| **Greek letter** | α | β- | β+ | γ |
| **Symbol** |  |  |  | N/A |
| **Composition** | 2p+, 2n0 | electron | anti-electron | EM wave |
| **Charge** | 2+ | 1- | 1+ | 0 |
| **Stopped by** | paper, skin, clothing | wood, glass | wood, glass | thick concrete or lead |

**Nuclear Decay Reactions**

In problems 4 – 7, fill in the missing particle for each nuclear decay reaction. Then, match each equation to the appropriate type of nuclear decay.

 **B**  4. 

1. alpha emission
2. beta emission
3. electron capture
4. positron emission

 **D**  5. 

 **A**  6. 

 **C** 7. 

In problems 8 and 9, write a balanced equation for each nuclear decay reaction.

|  |  |
| --- | --- |
| 1. Decay of radium-223 by alpha (α) emission.
 | 1. Decay of iodine-126 by positron (β+) emission.
 |
|  |  |

1. How are the atomic number and mass number of a nuclide affected by positron emission?

**Atomic number decreases by one. Mass number stays the same.**

1. How are the atomic number and mass number of a nuclide affected by the emission of gamma radiation?

**Both atomic number and mass number stay the same since gamma radiation has no mass or charge.**

1. Fluorine-21 has a half life of approximately 5 seconds. What fraction of the original nuclei would remain after 1 minute?

*The answer is solved by creating the fraction . Where n = the*

*number of half lives. If each half life is 5 seconds, then in one minute*

*(60 seconds) there are 12 half lives.*

$$60 sec×\frac{1 half life}{5 sec}=12 half lives$$

*Therefore the answer is:*



1. The half-life of chromium-51 is 28 days. If the sample contained 510 grams, how much chromium would remain after 56 days? How much would remain after 1 year? How much was present 168 days ago?

 *In this problem, the fraction will be multiplied by the initial amount. In*

*the first problem each half life is 28 days, therefore in 56 days two half lives occur.*

$$56 days×\frac{1 half life}{28 days}=2 half lives$$

*This means that n=2. The solution is as follows:*

 **

 *The second is solved the same way except that there are 13 half lives*

*over one year.*

$$365 days×\frac{1 half life}{28 days}=13 half lives$$

*This means n=13. The solution is as follows:*

 

*The third is solved by recognizing there must be more of the sample 168 days ago then there is now. 168 days represents*

$$168 days×\frac{1 half life}{28 days}=6 half lives$$

*6 half lives so n=6. The solution is:*



1. If 20.0 g of a radioactive isotope are present at 1:00 PM and 5.0 g remain at 2:00 PM, what is the half life of the isotope?

 *In this problem, you must figure out how many half lives have occurred.*

*After one half life 20.0g becomes 10.0g. After a second half life, 10.0g becomes 5.0g. This means that during the question, two half lives have occurred. Since this happened over the course of 1 hour, then each half life must be equal to:*

 *30 minutes.*

|  |  |  |  |
| --- | --- | --- | --- |
| *Amount* | *20.0 g* | *10.0 g* | *5.0 g* |
| *Half life* | *0* | *1* | *2* |

*Time of decay from 20.0 g to 5.0 g is 60 minutes*

$$\frac{60 minutes}{2 half lives}=\frac{30 minutes}{1 half lives} $$