**Isotopes and Atomic Mass**

**Learning Goal 13**: I can calculate the average atomic mass of an atom when given the percent composition and masses of the atom’s isotopes.

* **Ask your teacher for the card set titled “Isotope Card Set”.**

**Part 1: Isotopes**

 **Open the envelope titled “Isotope Card Set”**.

 This card set contains ten cards illustrating the subatomic particles in

 various atoms.

 The subatomic particles on each card are illustrated as shown below:

 **Atom Card Key**

**Nucleus**

**Neutron (White)**

**Proton (Red)**

**Electron (Black)**

* **Sort the cards into four groups based on the identity of the atom.**
* Recall that the number of protons in an atom is different for each

 type of atom. The number of protons is equal to the atomic

 number which tells you the identity of the atom.

* + Have your teacher check your card sort.
* **Record the number of protons, neutrons, and electrons in each atom in the tables below.**
* Write the atom symbol for each atom as follows:

 ##X

**Element Symbol**

**(# of Protons = Atomic #)**

 **# of Protons**

**# of Protons + # of Neutrons**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Card** **Letter** | **# of****Protons** | **# of****Neutrons** | **# of****Electrons** | **Atom****Symbol** |
|   |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

 **Group 1 Group 2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Card** **Letter** | **# of****Protons** | **# of****Neutrons** | **# of****Electrons** | **Atom****Symbol** |
|   |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Card** **Letter** | **# of****Protons** | **# of****Neutrons** | **# of****Electrons** | **Atom****Symbol** |
|   |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

 **Group 3 Group 4**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Card** **Letter** | **# of****Protons** | **# of****Neutrons** | **# of****Electrons** | **Atom****Symbol** |
|   |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

* + What two things are different between the atoms in each group?

 **Isotopes** are atoms of the same element (same

**Vocabulary!**

number of protons), with different numbers

of neutrons and different mass numbers.

**Part 2: Percent Abundance**

* **Determine the percentage of boys and girls in your class.**
* Count the total number of students in your class.

 # of Students =

* Count the number of boys and girls in your class.

 # of Boys = # of Girls =

* + Calculate the percentage of boys in your class:

 **% of Boys = # of Boys x 100**

 **# of Students**

%

 % of Boys = x 100 =

* + Calculate the percentage of girls in your class:

 **% of Girls = # of Girls x 100**

 **# of Students**

%

 % of Girls = x 100 =

 **Percentage** is equal to:

**Vocabulary!**

 amount of each part x 100

 amount of the total

* **Ask your teacher for a bag of “Isotope Poker Chips”.**

Each isotope chip has the atom symbol for one of the isotopes of

 boron (B) written on it.

* Sort the chips into two groups of boron isotopes.

* **Determine the percentage of 105B isotope chips and 115B isotope chips**

 **in your sample .**

* Count the total number of isotope chips in your sample.

 # of Isotope Chips =

* Count the number of 105B isotope chips and 115B isotope chips in

 your sample.

 # of 105B Chips = # of 115B Chips =

* + Calculate the percentage of 105B isotope chips in your sample.
	+ Calculate the percentage of 115B isotope chips in your sample.

 The **percent abundance** of an isotope is

**Vocabulary!**

 another name for the percentage of the

 isotope.

**Part 3: Atomic Mass**

* **Determine the origin of the Atomic Mass Numbers shown in the**

 **periodic table.**

* The isotopes for the element Nickel (Ni) are shown below.

 The percent abundance and actual mass of each isotope are also

 listed.

 The periodic table block for the element nickel is shown to the

 right of the isotope information.

 **Isotope % abundance Mass (amu)**

28

Ni

**58.693**

Nickel

 5828Ni 68.08% 57.9353

 6028Ni 26.22% 59.9308

 6128Ni 1.14% 60.9311

 6228Ni 3.63% 61.9283

 6428Ni 0.93% 63.9280

|  |
| --- |
|   |
|   |

 The **average** of a group of numbers is equal to:

**Vocabulary!**

 sum of the numbers

 number of numbers

* Calculate the average mass of the nickel isotopes listed in the

 table above.

* Is the average mass of nickel equal to the number that is shown

 in the periodic table?

* Look again at the isotope data and periodic table square for nickel.

 **Isotope % abundance Mass (amu)**

28

Ni

**58.693**

Nickel

 5828Ni 68.08% 57.9353

 6028Ni 26.22% 59.9308

 6128Ni 1.14% 60.9311

 6228Ni 3.63% 61.9283

 6428Ni 0.93% 63.9280

 The **weighted average**  of a group of numbers is

 equal to:

 (1st number)(percentage) + (2nd number)(percentage) + …

 100

**Vocabulary!**

 The higher the percentage of the number, the more

 influence its value has in the final answer.

 **\*\*When using this formula, do not convert the percentages**

 **to decimals!**

* Calculate the average weighted mass of nickel.

 (57.9353)(68.08) + (59.9308)(26.22) + (60.9311)(1.14) + (61.9283)(3.63) + (63.9280)(0.93)

 100

=

 **\*\*The unit for atomic mass is the atomic mass unit (amu)**

* Is the average weighted mass of nickel equal to the number that

 is shown in the periodic table?

 The **atomic mass** number in the periodic table is

**Vocabulary!**

 the **average weighted mass** of all of the isotopes

 of an element.

* **Ask your teacher for a set of “Isotope Task Cards” and get out the**

 **“Task Card Answer Sheet”.**

* Answer each of the questions on the Isotope Task Cards. **Record**

 **your answers on your “Task Card Answer Sheet”.**

 **Isotopes and Average Mass**

 **Study Sheet – Page 1**

 **Vocabulary**

 **Isotope**: atoms of the same element (same number

 of protons), with different numbers of neutrons and

 different mass numbers

 **Mass Number:** the mass of a particular isotope

 **Percentage**: amount of each part x 100

amount of the total

 **Percent Abundance:** the percentage of an isotope

 **Average:** the sum of a list of numbers

the number of numbers

 **Weighted Average:**

(1st number)(percentage) + (2nd number)(percentage) + …

 100

 **Average Weighted Mass:**

 (1st mass #)(% abundance) + (2nd mass #)(% abundance) + …

 100

 **Atomic Mass:** the average weighted mass of all of an

element’s isotopes - this is the decimal number in the

 periodic table

 **Isotopes and Average Mass**

 **Study Sheet – Page 2**

 **Isotopes**



 **Different #’s of Neutrons**

 **Different Mass #’s**

 **Same #’s of Protons**

 **6 Neutrons 7 Neutrons 8 Neutrons**

 **126C 136C 146C**

 **Average Weighted Mass = Atomic Mass Number**

|  |  |  |
| --- | --- | --- |
| **Isotope** | **Mass Number****(amu)** | **Percent****Abundance** |
| Oxygen-16 | 15.995 | 99.759% |
| Oxygen-17 | 16.995 | 0.037% |
| Oxygen-18 | 17.999 | 0.204% |

 **Average Weighted Mass =**

**8**

**O**

**15.999**

**Oxygen**

**(15.995)(99.759) + (16.999)(0.037) + (17.999)(0.204)**

 100

 = **15.999 amu**

 **Task Card Answer Sheet**

**Isotope Task Card Answers**

**Card Color\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

