Alchemy Unit Subatomic Heavyweights gpb video: Chem Std: 1a, 3b, 11c
I&E Std: 1d,1g

38

ChemCatalyst:

Look at the pictures:
Q: What is the difference btwn the 2 atoms?
Q: What is the atomic # of each?
Q: What is the mass #?
Q: Are they both Li?

Notes:

- What are the parts of the atom?

Protons	neutrons	electrons
in nucleus	in nucleus	outside nucleus
(+) charge	no charge	(-) charge
contributes to atom's mass	contributes to atom's mass	nearly massless
*Give atom's identity!	Does not determine atom's identity (atom's can have different # of neutrons)	Does not determine atom's identity (can be lost or gained)

- What is an isotope?
  - isotope: atom of an element with different # of neutrons
  - why the atomic mass is NOT a whole # on the P.T.
    --the decimal # is an average mass of all isotopes
    i.e.: Carbon has 3 isotopes: Carbon-12, Carbon-13, and Carbon-14. Most atoms of the element carbon are Carbon-12, which is why the avg is closest to 12 (12.01)

- How do I calculate the # of neutrons in an isotope?
  - #1) Round atomic mass (decimal #) down to the nearest whole number, then subtract the atomic # (# of protons)
    #2) Round atomic mass up to the nearest whole number, then subtract the atomic #
    ex: Li = 6.94

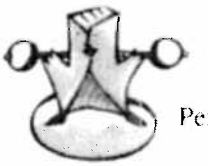
6	7
- 3	- 3
3	4

Li has isotopes with 3 neutrons and 4 neutrons (the 4 neutron isotope is more abundant because 6.94 is closer to 7.

Student Worksheet

39

Subatomic Heavyweights

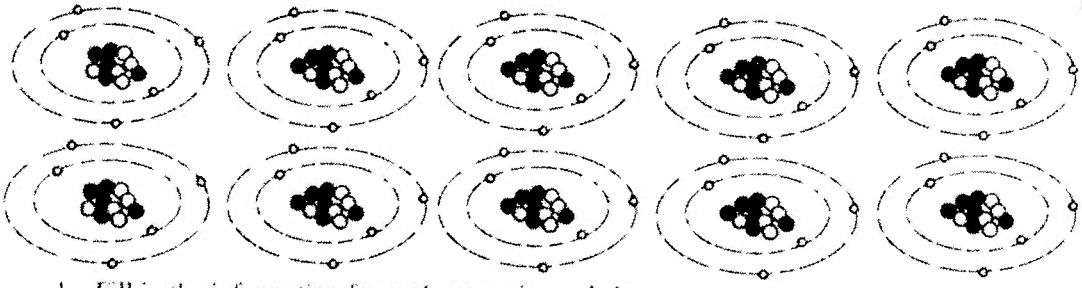


Name: _____

Period: _____ Date: _____

Purpose: In this lesson you will investigate isotopes and how they affect atomic mass. For the purposes of our calculations today a proton weighs 1.0 amu (atomic mass units) and a neutron weighs 1.0 amu (atomic mass units).

Complete the following:
Let's say you were able to isolate ten atoms of the element boron. Below is a drawing representing the structures of the different boron atoms you would find. (Please note that the size of the nucleus has been hugely exaggerated in these drawings so that you can count the protons and neutrons.)



1. Fill in the information for each atom pictured above:

boron atom	1	2	3	4	5	6	7	8	9	10
# protons										
# neutrons										
# electrons										

2. How many different isotopes of boron are pictured above? Explain what they are.

3. How many of each type of isotope is present in the sample of ten atoms?

4. What is the atomic mass of each type of isotope? ~~How did you arrive at your answer?~~

5. How would you figure out the average atomic mass of the ten atoms?
   a) Complete that calculation and show your work here.

   b) How does your answer compare to the atomic mass of boron listed in the periodic table?

6. Imagine you were able to examine 100 atoms of boron.

a) What isotopes would you expect to find?

b) How many atoms of each isotope would you expect to find?

c) Express your answers in percentages.

7. Fill in the following table. Look carefully at the atomic mass in order to estimate the number of neutrons in each case.

Element	Chemical Symbol	Atomic Number	Atomic Mass	# of protons	# of electrons	# of neutrons
Boron	B					5 or 6
Chlorine				17		
Lithium			6.94			
Vanadium	V	23				
Nitrogen					7	
Magnesium						
Argon	Ar		39.9			18, 20, or 22

8. How many isotopes does argon have? _____

9. Which isotope of argon is most commonly found? _____ Explain your reasoning.

10. If you somehow managed to have a single atom of lithium isolated, how many neutrons will it *probably* have in its nucleus? Explain.

Making Sense:
Explain why the atomic masses listed in the periodic table are not usually whole numbers.

If you finish early…
The element copper, Cu, has two naturally occurring isotopes. 69% of all copper consists of atoms with 34 neutrons, 31% of all samples consist of samples with 36 neutrons. Calculate the average atomic mass of copper atoms.

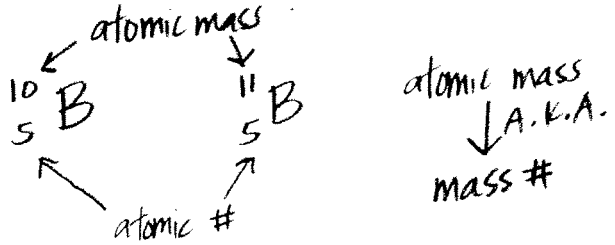
Alchemy Unit Subatomic Heavyweights gpb video: Chem Std: 1a, 3b, 11c
I&E Std: 1d,1g

(40)

Making Sense Notes:

- What symbols are used to represent isotopes?

- Isotopes have the same # of protons and different # of neutrons, so their masses are different
  -ex: "Skinny" Boron (Boron-10) and "Fat" Boron (Boron-11)



- What is the average atomic mass?

- the decimal # for each element on the P.T.
- the weighted average of masses of isotopes in a sample of the element
- the most common isotope of an element has a mass close to the average mass on the P.T.
  --ex: B = 10.811 ← closer to 11 than 10, so Boron-11 is more abundant/common

Check-In:

Q: Predict the isotopes of C. Which is more abundant?