Answers

JHS Chemistry Department
pHet simulation activity

Basics of Atomic Structure:

Objectives: Students will be able to

- Make models that show neutral atoms, ions & isotopes
- Use given information about subatomic particles to
- Identify an element and its position on the periodic table
- Create and Draw models of atoms
- Predict how adding or subtracting a proton, neutron, or electron will change the element, charge or mass of their atom or ion.
- Define all vocabulary
- Use a periodic symbol to determine the number of protons, neutrons, and electrons in an atom or ion.
- Draw the symbol for the element as you would see on the periodic table.

Define:

Atom ~ _____

Ion ~ charged atom due to loss or gain of e^-

Isotope ~ same atoms w/ same at# but diff atomic mass due to diff # of n°

Valence electrons ~ the e^- in the outermost energy level

Kernel~ all the p^+, n^o & NON VALENCE e^-

Principal Energy Level~ _____

FIND THE LINK FOR THIS ACTIVITY AT TANDTHEJHAWKS > CHEMISTRY RESOURCES > ATOMIC STRUCTURE PHET BUILDING AN ATOM SIMULATION. CLICK THE LINK FOR BUILD AN ATOM THEN CLICK RUN NOW. CLICK THE GREEN PLUS SIGN NEXT TO SYMBOL, MASS NUMBER, AND NET CHARGE SO THAT ALL BOXES ARE MAXIMIZED.

MODELING ATOMS*:** Using ***Build an Atom simulation, investigate the sub atomic particles to find…

a. What are the 3 basic subatomic particles in an atom?

proton neutron electron

b. The ***NUCLEONS*** are the sub atomic particles in the center of an atom. Which sub atomic particles go in the center of the atom? Identify the charge of each particle in the center of the atom?

Subatomic particle	*charge*	*mass*
neutron	0	1amu
proton	+	1amu

c. What is the center of the atom called? nucleus

d. Create 2 different atoms (at least 1 stable and 1 unstable) – Complete the table below and include a drawing of each ***nucleus***.

	What subatomic particles are in the nucleus?	Draw your nucleus	Is it stable or unstable?	What Element is it?
1		Answers will vary!!		
2				

Create a statement that describes when a nucleas begins to become unstable based on the protons and neutrons in the nucleus. the larger the difference between #p+ & #of n° the more unstable the nucleus is

Everything around us is made up of different elements. The air has the elements Oxygen and Nitrogen. Plants and people have lots of Carbon. Helium is found in balloons. Hydrogen and Oxygen are the elements found in water. Elements are composed of all the same Atoms and all have the same # protons. The subatomic particles in all atoms are protons which have a + charge, neutrons which have a 0 charge & electrons which have a − charge.

- Play until you discover a rule for what determines the identifying factor of the **element** you build. What did you find determines the element? # of p+ ⇒ the atomic # on PT
- Test your idea by identifying the element for the 3 cases. What information is most important to use to determine the element. # of p+

example	Atom has…	What Element is it?
1	# of protons: 6 # of neutrons: 6 # of electrons: 6	Carbon
2	# of protons: 7 # of neutrons: 6 # of electrons: 7	Nitrogen
3	# of protons: 9 # of neutrons: 10 # of electrons: 9	Flourine

Each atom has varying number of subatomic particles. The electrons that are located in the outermost principal energy Level are the **VALENCE ELECTRONS**. These are the electrons most frequently involved in the bonding process with other atoms. The subatomic particles that are included in the **KERNEL** of the atom ~ these subatomic particles include the protons, all the neutrons and all NON VALENCE electrons in the atom

Use the online pHet model program to create the following atoms

Element (find in element box on PT)	*Atomic #*	*Atomic mass*	*# p^+*	*# e^-*	*# n^0*	*Subatomic particles present in the kernel of the atom*	*# of Valence electrons*
Neon 2-8	10	20	10	10	20-10 = 10	P^+ = 10 n^0 = 10 e^- = 2	8
Carbon 2-4	6	12	6	6	12-6 = 6	P^+ = 6 n^0 = 6 e^- = 2	4
Lithium 2-1	3	7	3	3	7-3 = 4	P^+ = 3 n^0 = 4 e^- = 2	1
Nitrogen 2-5	7	14	7	7	14-7 = 7	P^+ = 7 n^0 = 7 e^- = 2	5
Boron 2-3	5	11	5	5	11-5 = 6	P^+ = 5 n^0 = 6 e^- = 2	3

Modeling Atoms mini activity

Each team needs to obtain the following items:

- A copy of the Generalized Atomic Modeling Diagram
- 10 green chips (neutrons)
- 10 red chips (protons)
- 10 blue chips (electrons)
- Periodic Table of Element
- One green pencil, one red pencil, and one blue pencil

Example: Place one proton (+) chip in the center of the atomic modeling diagram and one electron (-) chip in the yellow ring around the nucleus region that is labeled K (1st Principal energy level) shell. This model represents hydrogen, the simplest of all the elements and the only one that has NO neutrons in the nucleus under normal circumstances. The electrical charge of the electron and proton cancel each other out so that the atom is electrically neutral, or has a zero electrical charge.

Special Note: When the first energy level contains two electrons, it is full and can hold no more. Therefore, any subsequent electrons must be placed in the second energy level.

1st Principal energy level: may hold up to **2** electrons and no more

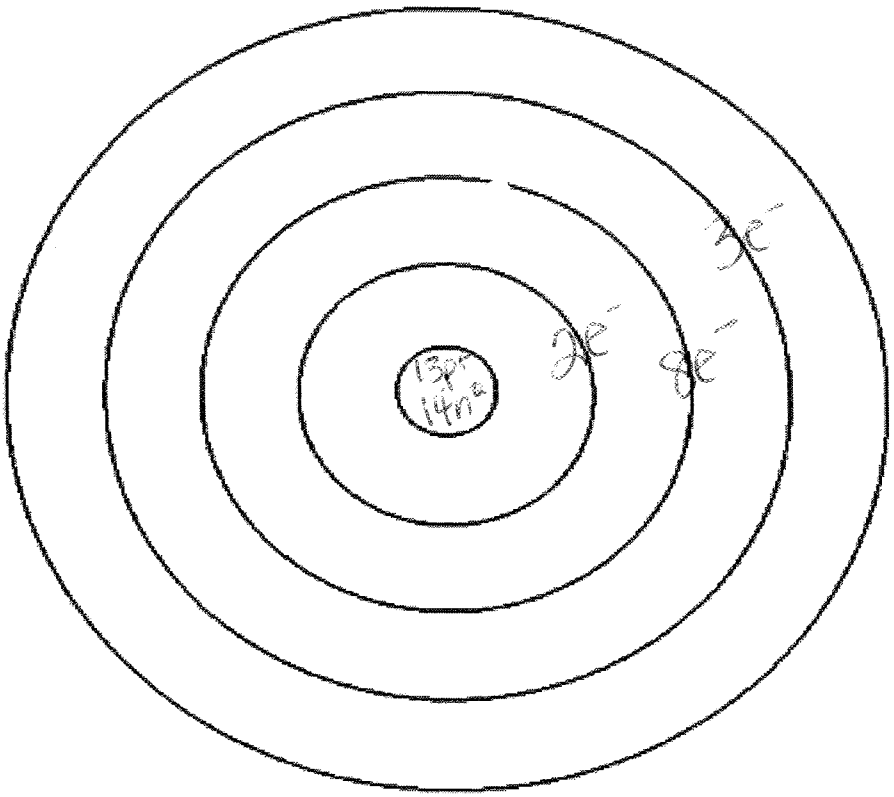
2nd Principal energy level: may hold up to **8** electrons and no more

3rd Principal energy level: may hold up to **18** electrons and no more

Using the example above create a model for each of the elements below and draw a correct model of each atom using the

Legend: Blue circle for an electron (-); Red circle for a proton (+); Green circle for a neutron (no charge)

Element name: Aluminum



Element Symbol: Al

Mass number 27

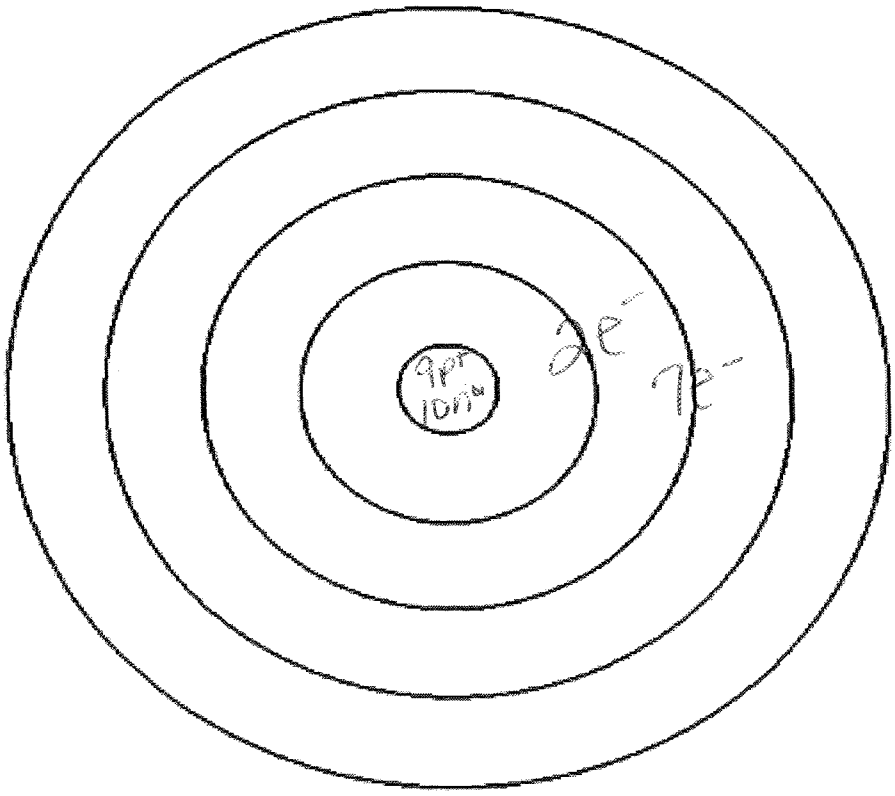
Atomic Number 13

Overall Charge 0

Valence e- 3e⁻

Nuclear Charge +13

Element name: Flourine



Element Symbol: F

Mass number 19

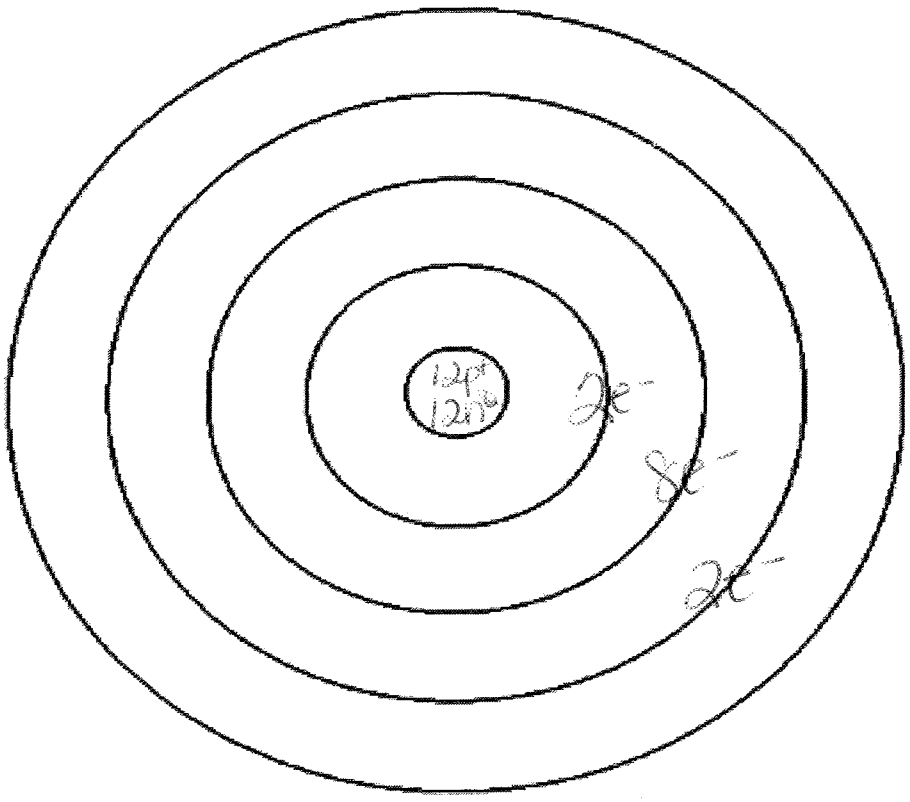
Atomic Number 9

Overall Charge 0

Valence e- 7e⁻

Nuclear Charge +9

Element name: Magnesium



Element Symbol: Mg

Mass number 24

Atomic Number 12

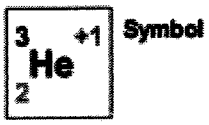
Overall Charge 0

Valence e- 2e⁻

Nuclear Charge +12

Critical Thinking Questions

1. What does the tool called **Symbol** tell you about what parts are in an atom or ion?



At #, At mass, Symbol for element + charge if it becomes an ion

2. What rules can you use to tell how many protons, neutrons and electrons make up an atom

p⁺ = atomic #; # of e⁻ = # of p⁺; Atomic mass - atomic # = n°

3. What is the significance of the atomic number (Z) in each atomic symbol on the periodic table?

(Z) = # of p⁺ + identifies element, elements listed in order of atomic #

4. What do all nickel (Ni) atoms have in common?

all have same # of p⁺ & same atomic #

5. Where is most of the mass of an atom located? Explain.

nucleus ⇒ p⁺ & n° each are 1 amu e⁻ only 1/1800 of an amu

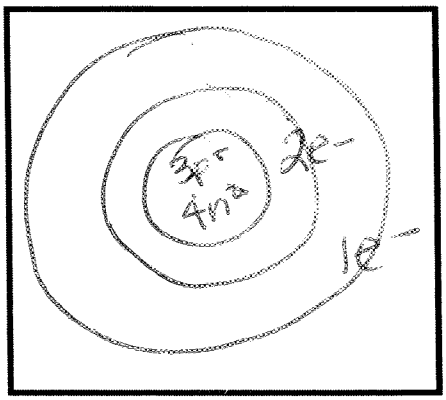
Rutherford model of atom

6. You build an atom that has the following components:

3 protons (P) Li 4 neutrons (N) 3 electrons (E)

a) Draw a picture of how you would build your atom in the box

b) Circle which element this atom is on this periodic table below:



H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe

c) The mass of this atom is:

a. 3 mass units
b. 4 mass units
c. 6 mass units
d. 7 mass units

Explain what ideas you used to choose an answer:

p+ + n° = atomic mass

7. How is the mass number (A) determined from the structure of the atom? (A) = p+ + n°

Practice Regents Questions!

8. Compared to the charge and mass of a proton, an electron has

1) the same charge and a smaller mass
2) the same charge and the same mass
3) an opposite charge and a smaller mass
4) an opposite charge and the same mass

9. A proton has approximately the same mass as

1) a neutron
2) an alpha particle
3) a beta particle
4) an electron

10. What is the mass number of an atom which contains 28 protons, 28 electrons, and 34 neutrons?

34 n°
28 p+
62

1) 28
2) 56
3) 62
4) 90

11. Which subatomic particle has no charge?

1) alpha particle
2) beta particle
3) neutron
4) electron

12. Which statement is true about the charges assigned to an electron and a proton?

1. Both an electron and a proton are positive.
3. An electron is negative and a proton is positive.
2. An electron is positive and a proton is negative.
4. Both an electron and a proton are negative.

13. What is the total charge of the nucleus of a carbon atom?

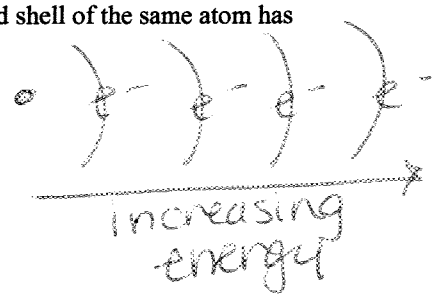
1. -6
3. +6
2. 0
4. +12

14. Which two particles each have a mass approximately equal to one atomic mass unit?

1. electron and neutron
3. proton and electron
2. electron and positron
4. proton and neutron

15. Compared to an electron in the first electron shell of an atom, an electron in the third shell of the same atom has

1. less mass
3. more mass
2. less energy
4. more energy

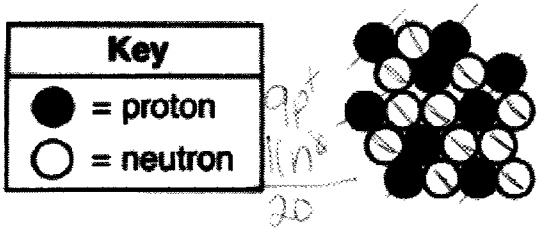


16. What is the total number of electrons in an atom of potassium?

1. 18
3. 20
2. 19
4. 39

17. The accompanying diagram represents the nucleus of an atom.

What are the atomic number and mass number of this atom?



1. The atomic number is 9 and the mass number is 19.
3. The atomic number is 11 and the mass number is 19.
2. The atomic number is 9 and the mass number is 20.
4. The atomic number is 11 and the mass number is 20.

PART 2 ~ *MODELING IONS:* RESET ALL! Use the pHet ***Build an Atom simulation*** activity.

- Play until you discover some good rules about determining the **charge** of your atom or ion.
  - What is a rule for making:
    1) A neutral atom which has no charge. # p+ = # e−
    2) A positive ion which has positive charge? # p+ > # e− (atom lost e−)
    3) A negative ion which has negative charge? # p+ < # e− (atom gain e−)

4) How did you decide if the atom had a positive, negative, or neutral (0) charge.
(+) # p+ vs # e− (−)

Use the table below to identify four examples of ions (include at least 2 with a positive charge, and 2 with a negative charge) that show your rules **for charge**. Show mathematical work and include a drawing of your atom.
(All of your examples should have a stable nucleus.)

	Subatomic particles in your ions	Nuclear Charge	Overall charge	Ion symbol	Cation (positive ion) OR Anion (negative ion)
1	# of protons: # of neutrons: # of electrons:	+(# p+)	+	?+	cation
2	# of protons: # of neutrons: # of electrons:	+(# p+)	+	?+	cation
3	# of protons: # of neutrons: # of electrons:	+(# p+)	−	?−	anion
4	# of protons: # of neutrons: # of electrons:	+(# p+)	−	?−	anion

Use the online pHet model program to create the following ions

Element	*Atomic #*	*Atomic mass*	*# p^+*	*# e^-*	*# n^0*	*Valence electrons*
Li^{+1}	3	7	3	2e−	4	
N^{-3}	7	14	7	10e−	7	
B^{+3}	5	11	5		6	

5) What do you notice about the number of electrons present in the valence shell of each newly created ion?

the new valence shell is full

) What happens to the nuclear charge when you change an atom to an ion?

a) increase b) decrease (c) remain the same

7) What happens to the number of protons when you change an atom to an ion?

a) increase b) decrease (c) remain the same

8) What happens to the number of neutrons when you change an atom to an ion?

a) increase b) decrease (c) remain the same

changing e- won't change the nucleus!

9) When changing an atom to an ion the number of e- change which will change the charge of the atom.

Design challenges: Try these!

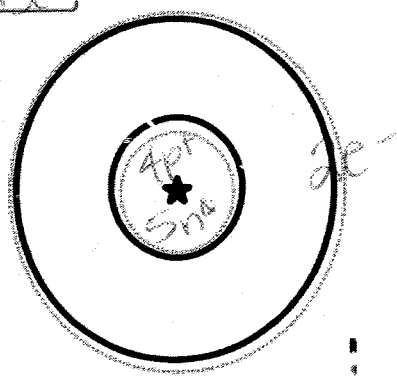
Design a ***positive ion*** with a charge of +2

include a drawing: Be^{+2}

Number of protons 4

Number of neutrons 5

Number of electrons 2



What element is your ion? Beryllium

What mass is your ion? 9amu

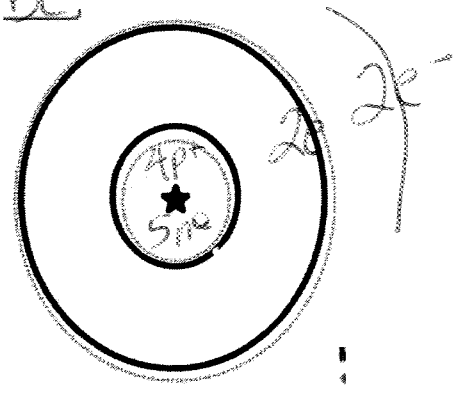
Design neutral, stable ***atom*** with a mass of 9

include a drawing: Be

Number of protons 4

Number of neutrons 5

Number of electrons 4

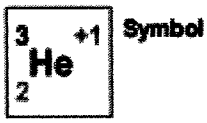


What element is your atom? Beryllium

What is the charge of you atom? 9amu

Critical Thinking questions

6. What does the tool called **Symbol** tell you about what parts are in an atom or ion?



At#, At mass, ion charge, Symbol

7. In terms of the numbers of protons, neutrons, and electrons: Why does the notation C^- have a negative sign in the upper right hand corner?

gained 1 e-

8. What feature distinguishes a neutral atom from an ion?

the charge + an unequal # of p^+ vs e^-

9. Provide an expression for calculating the charge on an ion.

charge = #P/T/(ion) diff between # p^+ & e^-

10. Define the following terms:

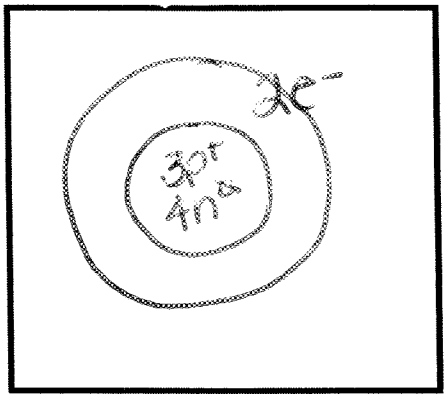
- Ion : Charged atom
- Cation: (+) Charged ion
- Anion : (−) charged ion

11. You build an atom that has the following components: Li +1

3 protons (P) 4 neutrons (N) 2 electrons (E)

a) Draw a picture of how you would build your atom in the box

b) Circle which element this atom is on this periodic table below:



H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe

c) The mass of this atom is:

e. 3 mass units
f. 4 mass units
g. 6 mass units
h. 7 mass units

Explain what ideas you used to choose an answer:

$p^+ + n^\circ$

d) The charge is equal to:

a. 0, this is a neutral atom
b. -3
c. -1
d. +1
e. +3

Explain what ideas you used to choose an answer: $3p^+ + 2e^- = +1$

12. How is Mg atom different from Mg^{+2} (be specific)? Mg atom $12e^-$, $Mg^{+2} = 10e^-$

How are they the same (be specific) ? Same at #, Same at mass

13. How is Br atom different from Br^{-1} (be specific)? $Br^\circ = 35e^-$ $Br^{-1} = 36e^-$

How are they the same (be specific) Same at #, same at mass

Practice Regents Questions! (79-3)

14. How many electrons are contained in an Au^{3+} ion?

1. 76
2. 79
3. 82
4. 197

15. Note: This question may require the use of the *Reference Tables for Physical Setting/Chemistry*. Which symbol represents a particle with a total of 10 electrons?

1. N - 7e⁻
2. N^{3+} - 4e⁻
3. Al - 13e⁻
4. Al^{3+} - 10e⁻

** PLAY GAME mode on the pHet simulation**

FIND THE LINK FOR THIS ACTIVITY AT TANDTHEJHAWKS > CHEMISTRY RESOURCES > ATOMIC STRUCTURE PHET ISOTOPES AND ATOMIC MASS SIMULATION. CLICK THE LINK FOR ATOMIC MASS SIMULATION THEN CLICK RUN NOW. CLICK THE GREEN PLUS SIGN NEXT TO SYMBOL AND ABUNDANCE IN NATURE SO THAT ALL BOXES ARE MAXIMIZED.

PART 3 ~ *MODELING ISOTOPES:*

- ***Play until you discover some good rules about the <u>mass</u> of your atom or ion.***

1. What is a rule for determining the mass of an atom or ion?

p⁺ + n°

2. What particles determine the mass number? p+ n°

3. Why is mass number always a whole number? # of p⁺ + n°

4. One isotope of carbon (C) has exactly the same mass number and atomic mass since it was used as the definition of the atomic mass unit (amu). Which isotope is it and what is its atomic mass?

C-12

Since the mass of the atomic mass unit is defined using Carbon atoms The amu is 1/12 the mass of a carbon atom.

2. What is the approximate mass of one proton? 1 amu

3. What is the approximate mass of one neutron? 1 amu

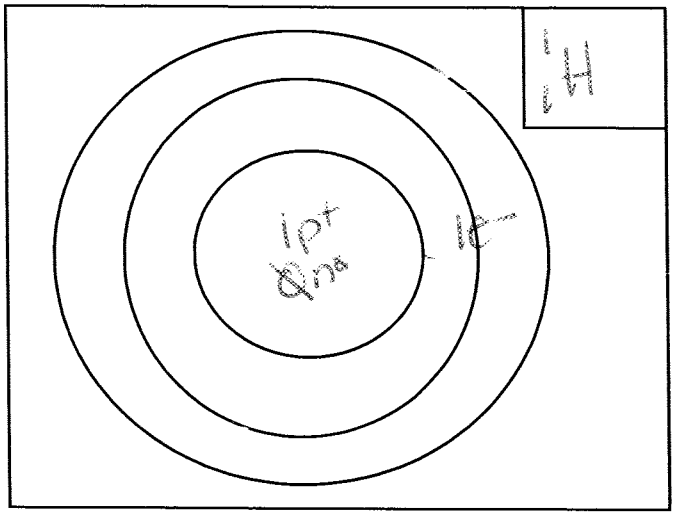
4. Look at 3 or 4 other atoms using the simulation. Do any of them have a whole number for atomic mass?

no all avg masses

Using the simulation to complete the following: Use the legend Blue circle for an electron (-); Red circle for a proton (+); Green circle for a neutron (no charge) for the entire activity

Click on the element Hydrogen in the periodic table. Draw your diagram in the box below.

- In the upper right corner of the box, write the isotope symbol found in the symbol box.



p^+ 1 # e^- 1 # n^0 0

Mass number 1

Atomic mass _____

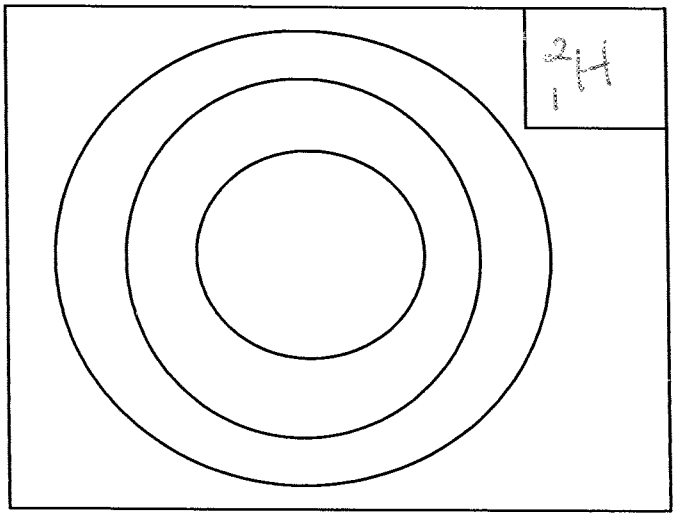
Atomic Number 1

Nuclear charge +1

Overall Charge 0

Drag one additional neutron towards the center.

- Draw your diagram in the box below.
- In the upper right corner of the box, write the isotope symbol found in the symbol box



p^+ 1 # e^- 1 # n^0 1

Mass number 2

Atomic Number 1

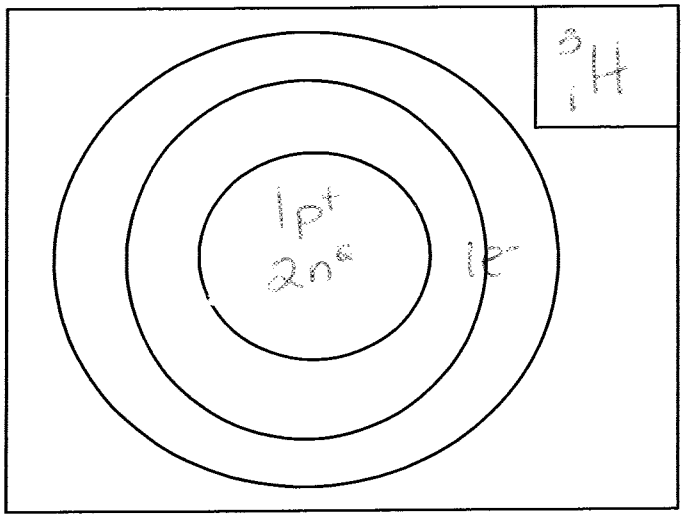
Atomic Number _____

Nuclear charge +1

Overall Charge 0

Drag one additional neutron towards the center.

- Draw your diagram in the box below.
- In the upper right corner of the box, write the isotope symbol found in the symbol box



p^+ 1 # e^- 1 # n^0 2

Mass number 3

Atomic Number _____

Atomic Number 1

Nuclear charge +1

Overall Charge 0

5. As neutrons are added, comment on the stability of the isotope.

more n^0 added becomes more unstable

6. How does the stability of an isotope relate to its abundance in nature?

more unstable less abundance in nature

Why might this be the case?

unstable (radioactive) less likely to exist

Complete the following table from the models you created. This information will be important later.

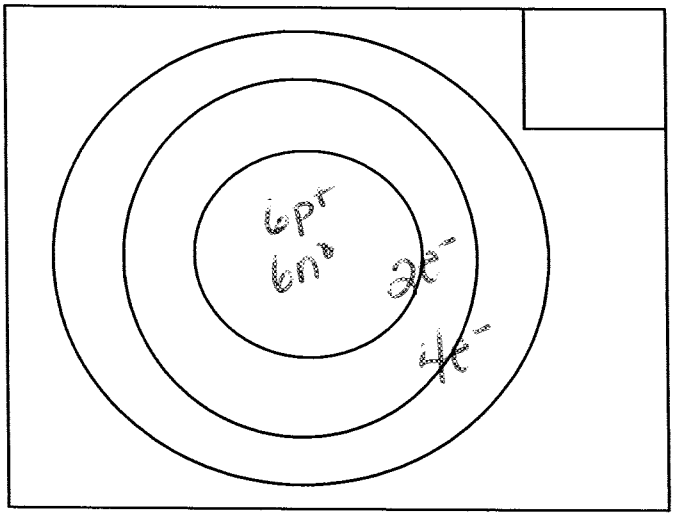
Isotope	Symbol	Abundance in Nature	Mass Number	Atomic Mass (amu)
Hydrogen -1 ***Protium***	$^{1}_{1}H$	99.99%	1	1.00783
Hydrogen -2 ***Deuterium***	$^{2}_{1}H$	.0115%	2	2.01355
Hydrogen -3 ***Tritium***	$^{3}_{1}H$	____	3	____

6. In the isotope Symbol H-3 ; What does the 3 represent? mass #

Continue using the "Make an Isotope tab" and Lets Try Carbon!

Click on Carbon

- Draw your diagram in the box below.
- In the upper right corner of the box, write the isotope symbol found in the symbol box



p^+ 6 # e^- 6 # n^0 6

Mass number 12

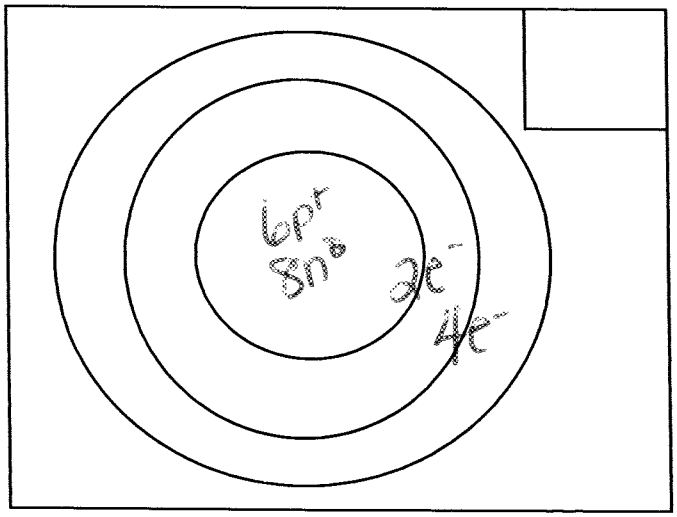
Atomic Number 6

Nuclear charge +6

Overall Charge 0

Drag two additional neutron to the center of the atom.

- Draw your diagram in the box below.
- In the upper right corner of the box, write the isotope symbol found in the symbol box



p^+ 6 # e^- 6 # n^0 8

Mass number 14

Atomic Number 6

Nuclear charge +6

Overall Charge 0

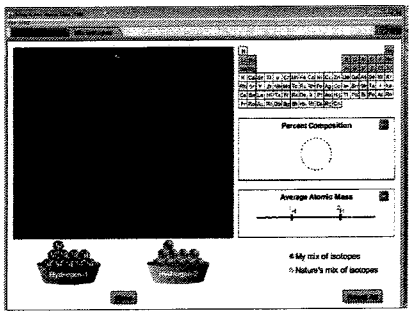
Valence e- 4e-

7. Which of the carbon isotopes has an unstable nucleus? C-14

atomic mass

NOW ….select the Mix Isotopes tab and make sure your screen looks like this before proceeding.

- Play with the "Mix Isotopes" tab for a few minutes, then answer the following questions.



8. What are the factors that affect the average atomic mass of a mixture of isotopes?
% abundance, mass of each isotope that exists

- Drag hydrogen isotopes (purple and green atoms) into the black box. Notice how the percent composition and average atomic mass data changes. As you add more atoms to the box, record at least three different observations. You may add as many of each isotope (color) as you like.
  - % abundance
  - avg mass
  - isotope mass

The **average atomic mass** for hydrogen is listed as 1.007 amu on the periodic table. Predict the combination of purple and green atoms required to achieve this mass. Check your prediction by clicking on "Nature's mix of isotopes".

greater amount (almost all) of H-1 few H-2 & H-3

9. Define the term **average atomic mass** using your own words.

avg mass of all naturally occuring isotopes & % abundance of each.

10. Beryllium (Be) and Fluorine (F) have only one stable isotope. Use the pHet simulation and the periodic table to complete the following table:

Element	Mass of 1 atom	Average mass of 2 atoms (sim)	Average mass of 3 atoms (sim)	Atomic mass (periodic table)
Beryllium (Be)	9.01218 amu	9.012	9.012	9.0
Fluorine (F)	18.99840 amu	18.99	18.99	18.9

11. Why are all the values in each row of the table above the same?

only 1 isotope of each element exists

NOW... Reset All!

In order to discover the relationship between percent composition and average atomic mass, it is helpful to be more systematic when choosing the number of atoms in the simulation. Complete the following table by adding purple and green atoms to the black box. In order to add larger amounts, Click "More" and use the slider bar or numerically enter data.

# of atoms Hydrogen-1 Purple	# of atoms Hydrogen-2 Green	% Hydrogen-1 Purple	% Hydrogen-2 Green	Average Atomic Mass (amu)
1	1	50%	50%	1.51
5	5	50%	50%	1.51
5	10	33.3%	66.7%	1.678
10	5	66.7%	33.3%	1.343
1	10	9.1%	90.9%	1.9226
10	1	90.9%	9.1%	1.0993
20	1	95.2%	4.8%	1.0557
50	1	98%	2.0%	1.02756

12. Look at the table you completed in above as well as the information gathered from the activity. What conclusions can you draw between abundance in nature, percent composition, and average atomic mass?

greater abundance = greater % comp = closest to that avg atomic mass.

13. Carbon has an average atomic mass of 12.011 amu (as given on the periodic table). Which isotope of carbon do you think is most abundant: carbon-12 or carbon-13? Explain your answer. Check your response by using the pHet simulation to select carbon and clicking on "Nature's mix of isotopes".

Carbon-12 since avg isotope mass closest to 12 there are more of that isotope

14. Lithium has only two stable isotopes. Use the pHet simulation to determine the following:
    a. Atomic mass of lithium-6 = 6.01512 amu
    b. Atomic mass of lithium-7 = 7.01600 amu
    c. Average atomic mass of a sample containing ***three*** lithium-6 atoms and ***two*** lithium-7 atoms.
    6.41548 amu
    d. Is the average atomic mass you just determined closer to the mass of lithium-6 or lithium-7? Explain
    Closer to Li-6 b/c it is a greater % (abundance)

15. Describe a method to calculate the average atomic mass of the sample in the previous question using only the atomic masses of lithium-6 and lithium-7 without using the simulation.
    (atomic mass x % abundance) + (atomic mass x % abundance)...

16. Test your method by creating a few sample mixtures of isotopes with the pHet simulation and see if your method correctly predicts the average atomic mass of that sample from only the atomic masses of the isotopes and the quantity of each isotope. Use the table below to track your progress.

Element	**Atomic mass and quantity of *each* isotope**	**Average atomic mass of sample (calculate yourself)**	**Average atomic mass of sample (from simulation)**

answers will vary!

NATURES MIX OF ISOTOPES

17. Using the pHet simulation, examine "Nature's mix of isotopes" for several different elements. If you assumed 100 total atoms in a sample, how could you relate the % values shown in the sim into a number you could use for your calculation of average atomic mass?

100 atoms = 100% of atoms So # of atoms = % abundance

18. Calculate the atomic mass of each of the following elements using your method from above. Test your answer using the Nature's mix of isotopes and the periodic table. Keep going until you can get two in a row right.

	Isotope 1		Isotope 2		Isotope 3			Check answer with sim	
Element	**Mass (amu)**	**%age**	**Mass (amu)**	**%age**	**Mass (amu)**	**%age**	**Calculated average atomic mass (amu)**	**Yes**	**No**
Hydrogen	1.007 (1.0067)	99.98	2.01410 (.0002215)	0.011	-	-	1.007	✓	
Silicon	27.97 (25.79)	92.22	28.9764 (1.3575)	4.685	29.97377 (.92678)	3.092	28.074	✓	
Nitrogen	14.00 (13.948)	99.63	15.0001 (.0546)	0.364	-	-	14.002	✓	
Argon	35.96 (.1208)	0.336	37.9627 (.0239)	0.063	39.96238 (39.8025)	99.60	39.95	✓	

Critical Thinking Questions:

19. Where is most of the mass of an atom located? Explain.

nucleus, p^+ & n^0 each 1 amu (e^- = 1/1800 amu)

20. What structural feature is different in isotopes of a particular element?

atomic mass / # of n^0

21. How is the mass number (A) determined from the structure of the atom? # of p^+ + # of n^0

22. Use the percent abundances listed below to calculate the weighted atomic mass for magnesium.
Mg-24 79% Mg-25 10% Mg-26 11%

$24 \times (.79) + 25 \times (.10) + 26 \times (.11) =$

23. Titanium has five common isotopes:

^{46}Ti (8.00%), mass= 45.953 amu
^{47}Ti (7.80%), mass= 46.952 amu
^{48}Ti (73.40%), mass= 47.947 amu
^{49}Ti (5.50%), mass= 48.948 amu
^{50}Ti (5.30%), mass = 49.945 amu

Calculate the average atomic mass of titanium.

4

24. The atomic mass of boron is 10.81 amu. Boron has two isotopes: Boron-10 has a mass of 10.01 amu. Boron-11 has a mass of 11.01 amu. What is the percentage of each isotope in boron? (check your answer using the pHet simulation)

10.01

25. A certain sample of rubidium has just two isotopes, ^{85}Rb (mass = 84.911amu) and ^{87}Rb (mass = 86.909amu). The atomic mass of this sample is 86.231 amu. What are the percentages of the isotopes in this sample?

84.911 = 85 x (.x)

86.231 =

26. **Using all of your rules**, figure out what changes for each of these item changes to an atom or ion. Test your ideas with the simulation.

Make the change:	**What changes also? Element name, charge, mass?**
Add a proton	change atom
Remove a neutron	change mass
Remove an electron	change charge ⇒ (+)
Add an electron	change charge ⇒ (−)

27. You start with your atom: 3 protons,4 neutrons,3 electrons. You want to change your atom's properties.
Mark YES if a change will work, and mark NO if it will not work.

a) If you want to **change the type of element** your atom is, you can either:

	(circle)
Add a proton	(Yes) or No
Add a neutron	Yes or (No)
Add an electron	Yes or (No)

Explain the ideas you used to choose your answer p+ identify element

b) If you want to **change the charge** of your atom, you can either:

	(circle)
Add a proton	Yes or (No)
Add a neutron	Yes or (No)
Add an electron	(Yes) or No

28. Define isotope. (Use online or textbook resources)
Same element different at mass (diff # of n°)

29. How many protons are found in ^{12}C? ^{13}C? $^{13}C^-$?
6 6 6

30. How many neutrons are found in ^{12}C? ^{14}C? $^{14}C^-$?
6 8 8

31. How many electrons are found in ^{12}C? ^{14}C? $^{14}C^-$?
12 12 13

32. Determine the number of protons, neutrons, and electrons in one $^{1}H^+$ ion.

p^+ 1 n^0 0 e^- 0

Practice Regents Questions!

33. In comparison to an atom of $^{19}_{9}F$ in the ground state, an atom of $^{12}_{6}C$ in the ground state has
    1. three fewer neutrons
    2. three fewer valence electrons
    3. three more neutrons
    4. three more valence electrons

34. Which two notations represent atoms that are isotopes of the same element?
    1. $^{121}_{50}Sn$ and $^{119}_{50}Sn$
    2. $^{121}_{50}Sn$ and $^{121}_{50}Sn$
    3. $^{19}_{8}O$ and $^{19}_{9}F$
    4. $^{39}_{17}Cl$ and $^{39}_{19}K$

35. Atoms of different isotopes of the same element differ in their total number of
    1. electrons
    2. neutrons
    3. protons
    4. valence electrons

36. The atomic mass of an element is the weighted average of the masses of
    1. its two most abundant isotopes
    2. its two least abundant isotopes
    3. all of its naturally occurring isotopes
    4. all of its radioactive isotopes

37. The atomic mass of an element is the weighted average of the
    1. number of protons in the isotopes of that element
    2. number of neutrons in the isotopes of that element
    3. atomic numbers of the naturally occurring isotopes of that element
    4. atomic masses of the naturally occurring isotopes of that element

38. A 100.00-gram sample of naturally occurring boron contains 19.78 grams of boron-10 (atomic mass - 10.01 atomic mass units) and 80.22 grams of boron- 11 (atomic mass = 11.01 atomic mass units). Which numerical setup can be used to determine the atomic mass of naturally occurring boron?
    1. (0.1978)(10.01) + (0.8022)(11.01)
    2. (0.8022)(10.01) + (0.1978)(11.01)
    3. [(0.1978)(10.01)]/[(0.8022)(11.01)]
    4. [(0.8022)(10.01)]/[(0.1978)(11.01)]

39. The isotopes K-37 and K-42 have the same
    1. decay mode
    2. bright-line spectrum
    3. mass number for their atoms
    4. total number of neutrons in their atoms

40. Which particles are isotopes of each other?
    (1) $^{1}_{1}X$ and $^{3}_{1}X$
    (2) $^{2}_{1}X$ and $^{3}_{2}X$
    (3) $^{2}_{1}X$ and $^{4}_{2}X$
    (4) $^{3}_{1}X$ and $^{3}_{2}X$

Drawing atoms

Element symbol: _____ # of protons: _____ # of neutrons: _____ # of electrons: _____

Nuclear charge: _____ charge of the atom or ion: _____ # of valence electron: _____ Found in the kernel: _____

○ = electrons

○ = protons

○ = neutrons