Unit 2: Atomic Structure & Nuclear Chemistry

Name:________________

Date	Classwork	Homework
Frid 2/7 (Mon 2/10)	Test Unit 1 Intro to Atomic Structure POGIL (pgs 1-4)	Atomic Structure Practice (pg 5)
Mon 2/10 (Tues 2/11)	Atomic Structure Review Notes (pg 6) Atomic Structure Practice Worksheets (pgs 7-8)	Atomic Structure Practice (pg 9)
Tues 2/11 (Wed 2/12)	Atomic Structure Activity Notes: Bohr Models (pg 10) Practice Bohr Model Worksheets (pg 11) Notes: Average Atomic Mass (pg 12)	Atomic Structure/Bohr Model/Average atomic mass practice (pg 13)
Wed 2/12 (Thur 2/13)	Quiz - Atomic Structure and Bohr Models Average Atomic Mass Worksheets (pg 14-16)	Average Atomic Mass Practice (pg 17)
Thu 2/13 (Fri 2/14)	Quiz - Average Atomic Mass Notes: Nuclear Equations (pg 18) Practice Nuclear Equations (pg 19-20)	Balancing Nuclear Reactions Practice (pg 21)
Fri 2/14 (Wed 2/19)	Fission/Fusion POGIL (pg 22-24) Fission/Fusion Notes (pg 25) Half-Life Notes (pg 26) Half life practice (pg 27)	Half-Life Practice (pg 28)
Mon 2/17	Holiday- No School	
Tues 2/18	Teacher Workday	
Wed 2/19 (Thurs 2/20)	Half-Life Practice (pg 29) Half-Life of Candium Lab	Test Review
Thurs 2/20 (Fri 2/21)	Test Unit 2: Atom and Nuclear Chemistry Color in Periodic Table	

Objectives:

1. Characterize protons, neutrons electrons by location, relative charge & relative mass
2. Use symbols: A = mass number Z = atomic number
3. Use isotopic notation.
4. Identify isotope using mass number and atomic number and relate to number of protons, neutrons and electrons.
5. Draw Bohr Models for elements.
6. Calculate average atomic mass.
7. Define: decay, bombardment, capture, half life, fission, fusion, radiation
8. Know the symbols for: alpha particle, beta particle, electron, neutron, gamma ray
9. Write nuclear equations.
10. Solve Half Life problems.
11. Compare and contrast fission and fusion.

Atoms and Their Isotopes

Why?

Atoms and isotopes are identified by the numbers of protons, neutrons and electrons that they contain. Before you can understand the properties of atoms, how atoms combine to form molecules, and the properties of molecules, you must be familiar with the number of protons, neutrons and electrons associated with atoms.

Success Criteria

- Identify the composition of atoms and their isotopes in terms of the numbers of protons, neutrons, and electrons.
- Use atomic symbols to represent different atoms and their isotopes.
- Efficient use of Periodic Table as a source of data.

Resources

- Periodic Table

Information

From the perspective of a chemist, the entire world is composed of atoms, and atoms are composed of protons, neutrons and electrons. Protons and neutrons are about 2000 times heavier than an electron. A proton has a charge of +1, a neutron has no charge and an electron has a charge of -1. The nucleus is very dense and very small compared to the entire atom.

The properties of atoms are determined by the numbers of protons, neutrons and electrons that they contain. Atoms with the same number of protons but different number of neutrons are called isotopes of an element.

The isotopic notation for an atom includes the following information: symbol of the element, the element's atomic number (Z) which specifies the number of protons in the nucleus, and the mass number (A) which indicates the number of protons plus neutrons in the nucleus. [The number of electrons in a neutral atom is equal to the number of protons in the nucleus of the atom. The mass contributed by the electrons in an atom is very small, so it is not included when calculating the mass number.]

Atomic Symbol Notation

$${}^{A}_{Z}X$$

A	Mass Number
X	Atomic Symbol
Z	Atomic Number

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Subatomic Particles

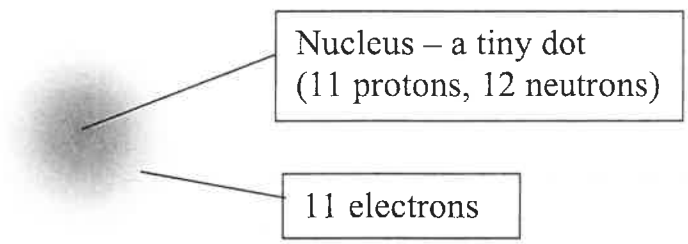
Particle	Symbol	Relative Charge	Absolute Mass	Relative Mass
electron	e^-	-1	9.109×10^{-31} kg	0
proton	p^+	+1	1.673×10^{-27} kg	1
neutron	n^0	0	1.675×10^{-27} kg	1

Model: Two Isotopes of Sodium

The diagrams below show representations of sodium isotopes. [Note: the diameter of an atom is about 10,000 times larger than the diameter of the atomic nucleus so the relative sizes of the atom and the nucleus are not accurately depicted in these diagrams.]

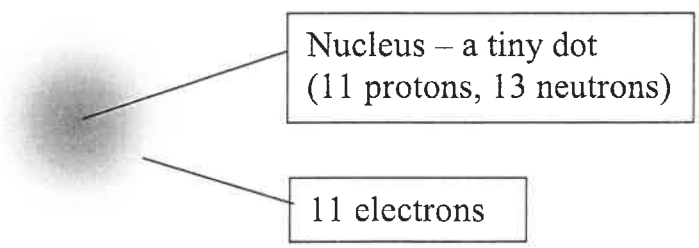
Isotope 1

$^{23}_{11}\text{Na}$



Isotope 2

$^{24}_{11}\text{Na}$



Key Questions

1. What information is provided by the atomic number, Z?

2. What information is provided by the mass number, A?

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3. What is the relationship between the number of protons and the number of electrons in an atom?

4. Because of the relationship between the number of protons and number of electrons in an atom, what is the electrical charge of an atom?

5. Where are the protons and neutrons located in an atom?

6. What do the two sodium isotopes shown in the model have in common with each other?

7. How do the two sodium isotopes shown in the model differ from each other?

8. What distinguishes an atom of one element from an atom of another element?

Exercises

1. Describe the similarities between $^{35}_{17}Cl$, and $^{37}_{17}Cl$.

2. Describe the differences between $^{35}_{17}Cl$, and $^{37}_{17}Cl$.

3. Write the atomic symbols for two isotopes of carbon, C, one with 6 neutrons and the other with 7 neutrons.

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4. Use a periodic table to fill in the missing information in the following table.

Name	Symbol	Atomic Number Z	Mass Number A	Number of Neutrons	Number of Electrons
oxygen	$^{16}_{8}O$	8	16	8	8
		7		7	
	$^{34}_{16}S$			18	
		1		1	
		1	3		
		12	24		
		12	25		
			238		92
	$^{84}_{36}Kr$		84		36

Problems

1. The radius of a Cl nucleus is 4.0 fm, and the radius of a Cl atom is 100 pm. (1 fm = 1 x 10^{-15} m; 1 pm = 1 x 10^{-12} m).How many times larger is the diameter of the Chlorine atom than the diameter of the Chlorine nucleus?

2. Identify two objects that have this same ratio of lengths.

3. How many times larger is the volume of the atom than the volume of the nucleus?

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Atomic Structure

CLASSWORK

Part I. Fill in the following table:

ISOTOPIC SYMBOL	NUMBER OF PROTONS	NUMBER OF ELECTRONS	NUMBER OF NEUTRONS	ATOM OR ION?	NET CHARGE
$^{131}I^{1-}$					
	35	36	45		
	11		12	Atom	
$^{45}Sc^{3+}$					
	84	80	125		
$^{91}Zr^{4+}$					
	27	25	32		
		55	78	atom	

Notes on Atomic Structure

Name: ______________________________ Date: ____________ Class Pd. _____

Parts of the Atom Practice

Symbol	Atomic Number	Mass Number	Number of Protons	Number of Neutrons	Number of Electrons
	10	20			
Fe				30	
	25			30	23
Au^{+1}		198			
Pb		206			
	47			61	46
	37	84			
I^{-1}		127			
	4			5	2
	86	222			86
	78			118	
Zr		91			
	28			31	
	17	34			18
Sn		118			
	9			10	10
Sr				20	
	19	40			18
Fr		223			

Name: ______________________ Date: __________

Isotopes Practice

Calculating atomic number, mass number, subatomic particles.

PART A

Given the following isotopes, determine the atomic number, the mass number, the number of protons, electrons and neutrons.

Isotope Symbol	Atomic Number	Mass Number	Protons	Electrons	Neutrons	Isotope Name
$^{131}_{53}I$						
$^{35}_{16}S$						
$^{4}_{2}He$						
$^{27}_{13}Al$						
$^{81}_{36}Kr$						
$^{81}_{37}Rb$						

PART B

Complete the following chart by writing the symbol for the isotope of the following elements. In addition, give the number of protons, electrons, mass number and atomic number and complete the element name.

Element Name	Neutrons	Protons	Electrons	Mass Number	Atomic Number	Isotope Symbol
Uranium- ____	145					
Chlorine- ____	28					
Oxygen- ____	9					
Boron- ____	6					
Beryllium- ____	5					
Hydrogen- ____	1					
Carbon- ____	8					

Adapted from MVCSP

Atomic Structure

Symbol	Atomic Number	Mass Number	Number of Protons	Number of Neutrons	Number of Electrons	Charge (oxidation number)
$^{108}Ag^{+1}$		108				+1
^{56}Fe				30	23	
$^{80}Br^{-1}$				45		-1
	79	198				+3
^{206}Pb		206				
^{19}F				10		
	37	84			37	
^{127}I		127				
$^{9}Be^{+2}$	4			5		+2
$^{16}O^{-2}$				8		-2
$^{196}Pt^{+4}$	78			118		+4
^{91}Zr		91			38	
^{59}Ni	28			31		
	17			17		-1
^{118}Sn						
$^{32}S^{-2}$				16		-2
^{58}Sr				20	36	
	19	40				0
^{223}Fr						

Bohr Model Notes

Name:
Date:

Bohr Model and Valence Electron Worksheet

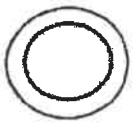
Label the missing pieces of each given element's periodic square. Give its number of protons (P), neutrons (N), and electrons (E).

Draw the Bohr digrams for each element as well. ~~Only draw Lewis structures if you think you know how – they are not required.~~

B

P = ___
N = ___
E = ___

Bohr Diagram

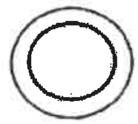


~~Lewis Structure B~~

Li

P = ___
N = ___
E = ___

Bohr Diagram

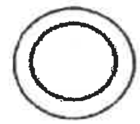


~~Lewis Structure Li~~

Ne

P = ___
N = ___
E = ___

Bohr Diagram

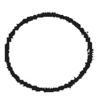


~~Lewis Structure Ne~~

He

P = ___
N = ___
E = ___

Bohr Diagram

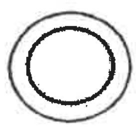


~~Lewis Structure He~~

C

P = ___
N = ___
E = ___

Bohr Diagram

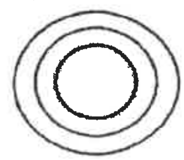


~~Lewis Structure C~~

P

P = ___
N = ___
E = ___

Bohr Diagram

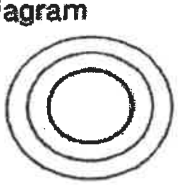


~~Lewis Structure P~~

S

P = ___
N = ___
E = ___

Bohr Diagram

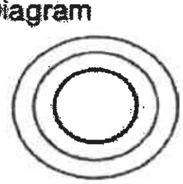


~~Lewis Structure S~~

Mg

P = ___
N = ___
E = ___

Bohr Diagram



~~Lewis Structure Mg~~

H

P = ___
N = ___
E = ___

Bohr Diagram

~~Lewis Structure H~~

Source: BetterLesson

Average Atomic Mass Notes

Isotopes Worksheet

1. Determine the number of protons, neutrons, and electrons for the following

a. ^{28}Si p_____ n_____ e_____

b. ^{131}Xe p_____ n_____ e_____

c. $^{207}Pb^{+2}$ p_____ n_____ e_____

d. $^{127}I^{-1}$ p_____ n_____ e_____

2. Silver exists as 51.84% ^{107}Ag and 48.16% ^{109}Ag. The actual mass of ^{107}Ag is 106.90509 amu and the actual mass of ^{109}Ag is 108.90476. What is the average atomic mass of silver?

3. The average atomic mass of copper is 63.55 amu. If the only two isotopes of copper have masses of 62.94 amu and 64.93 amu, what are the percentages of each?

4. Boron has only two isotopes, ^{10}B with a mass of 10.0129 and ^{11}B with a mass of 11.0093. If the average atomic mass of boron is 10.81, what are the percentages of each isotope?

Average Atomic Mass Classwork

1. Answer the following questions using the data below:

Isotope	Mass (amu)	% Abundance
1	31.972	95.0
2	32.971	0.76
3	33.967	4.22
4	35.967	0.014

a. What is the most common isotope of the unknown element?

b. Calculate the average atomic mass of the unknown element.

c. Use your periodic table to identify the unknown element.

d. What is the atomic number of this element?

e. This atom forms an ion with a charge of –2. Write the isotopic symbol for the most common isotope of this element.

2. Copper has two naturally occurring isotopes with mass numbers 63 and 65. The relative abundances and atomic masses of these isotopes are as follows: 69.2% for mass= 62.93 amu and 30.8% for mass=64.93amu. Calculate the average atomic mass for copper.

3. Samples of an unknown element X were collected and their masses were recorded. Use the information presented in the data table to answer the following questions:

Isotope	Mass(amu)	% Abundance
1	37.765	9.67
2	39.056	78.68
3	40.003	11.34
4	41.060	0.31

a. Determine the mass number for each isotope of element X.

b. What is the most common isotope of element X?

c. Calculate the average atomic mass of elements X.

d. Use your periodic table to identify element X.

e. What is the atomic number of this element?

f. This atom forms an ion with a charge of 1+. Write the isotopic symbol for the most common isotope of this element.

Average Atomic Mass CW

1. Three isotopes of argon occur in nature, Ar-36, Ar-38, Ar-40. If the relative atomic masses and abundances of each of these isotopes are as follows, calculate the average atomic mass of argon: Ar-36 (35.968 amu, 0.337%); Ar-38 (37.963 amu, 0.063%); and Ar-40 (39.962 amu, 99.600%)

2. If naturally occurring boron is 80.20% B-11 (atomic mass = 11.009 amu) and 19.80 % of some other isotopic form of boron, what must the atomic mass of this second isotope be in order to account for the 10.811 amu average atomic mass of boron?

3. An element X has three isotopes: X-26, X-28, X-29. Calculate the average atomic mass of element X if X-26 has a mass of 25.998 amu and is 20.33% abundant, X-28 has a mass of 28.003 amu and is 5.99% abundant, and X-29 has a mass of 28.986 amu and is 73.68% abundant.

   Identify Element X: ____________________

4. Oxygen has three naturally occurring isotopes: O-16 (15.995 amu; 99.762%), O-17 (16.999 amu; 0.038%), and O-18 (17.999 amu; 0.200%). Calculate the average atomic mass of oxygen.

5. Find the average atomic mass for Li if 7.5% of Li atoms are ^{6}Li with a mass of 6.015 amu and 92.5% are ^{7}Li with a mass of 7.016 amu.

6. Find the average atomic mass for Cl if 75.78% of Cl atoms are ^{35}Cl with a mass of 34.969 amu and 24.22% are ^{37}Cl with a mass of 36.966 amu.

7. Find the average atomic mass for Mg if 78.99% of Mg atoms are ^{24}Mg with a mass of 23.985 amu, 10.00% are ^{25}Mg with a mass of 24.986 amu, and 11.01% are ^{26}Mg with a mass of 25.983 amu.

8. There are 2 isotopes of copper that occur naturally; ^{63}Cu and ^{65}Cu. The ^{63}Cu atoms have a mass of 62.930 amu and the ^{65}Cu atoms have a mass of 64.928 amu. What is the percent natural abundance for each isotope?

Nuclear Equations Notes

Balancing Nuclear Equations

Name: ______________________ Period: ______________________

There are two types of nuclear reactions: Fission, where a nucleus breaks into two or more pieces, and fusion where two or more nuclei combine to form a new element. In nuclear reactions, only the nucleus is involved. Electrons are ignored. Some atomic nuclei are inherently unstable and spontaneously change or "decay". There are four types of decay:

Type	Symbol	Charge of particle	Mass(AMU)	Effect on Atomic #	Effect on Atomic Mass	Strength
Alpha	α	+2 (He nucleus)	4	decrease by 2	decrease by 4	Stopped by paper
Beta- e- emission	β- electron	-1	0	increase by 1	0	Aluminum Foil
Beta+ e- capture	β+ Positron	+1	0	decrease by 1	0	Aluminum Foil
Gamma	γ	none	none	none	none	Lead

The net result of α, β- or β+ decay is a new element. In b- decay, a neutron decays into a p+ and an e- which is then ejected. In β+ decay a p+ captures an e- and transforms into a neutron. But despite the nature of the reaction the law of conservation of matter still applies and the equations are balanced the same way. Note α particle is a helium nucleus!

Another type of reaction occurs when something impacts a nucleus. These reactions result either in the nucleus splitting (fission) or the combination of two or more nuclei to form a third, different nucleus (fusion).

Balancing Nuclear Equations: Matter must be conserved including all p+ & n°. Example:

Decay reaction (α decay) $^{219}_{86}Rn \rightarrow ^{4}_{2}He + ^{215}_{84}Po$

Fission Reaction $^{1}_{0}n + ^{235}_{92}U \rightarrow ^{92}_{36}Kr + ^{141}_{56}Ba + 3^{1}_{0}n$

Fusion Reaction: $^{35}_{17}Cl + ^{1}_{1}H \rightarrow ^{36}_{18}Ar$ another example $^{2}_{1}H + ^{3}_{1}H \rightarrow ^{4}_{2}He + n^{\circ}$

Practice

Fill in the missing symbol and name the reaction:

1. $^{3}_{1}H \rightarrow$ ______________ $+ ^{0}_{-1}e$ ______________
2. $^{232}_{92}U \rightarrow ^{228}_{90}Th +$ ______________ ______________
3. $^{144}_{58}Ce \rightarrow ^{144}_{59}\mathrm{Pr} +$ ______________ ______________
4. $^{65}_{30}Zn \rightarrow$ ______________ $+ ^{0}_{+1}e$ ______________
5. $^{40}_{19}K \rightarrow ^{40}_{18}Ar +$ ______________ ______________

6. ${}^{7}_{4}Be \rightarrow {}^{7}_{4}Be +$ ________ ____________________

7. ${}^{1}_{0}n + {}^{235}_{92}U \rightarrow$ ____________ $\rightarrow {}^{141}_{55}Cs + {}^{92}_{37}Rb +$ ____________ __________

8. ${}^{222}_{86}Rn \rightarrow$ ________ $+ {}^{4}_{2}He$ ____________________

9. ${}^{129}_{53}I \rightarrow {}^{129}_{54}Xe +$ __________ ____________________

10. ${}^{239}_{94}Pu \rightarrow$ __________ $+ {}^{4}_{2}He$ ____________________

11 ${}^{15}_{8}O \rightarrow {}^{15}_{7}N +$ __________ ____________________

12. Write a balanced nuclear equation for each decay process indicated.

a. The isotope Th-234 decays by an alpha emission.

b. The isotope Fe-59 decays by a beta emission.

c. The isotope Tc-99 decays by a gamma emission.

d. The isotope C-11 decays by a electron capture.

Balance these equations: Note ${}^{4}_{2}He$ is the only stable isotope of helium.

13. ${}^{1}_{1}H + {}^{7}_{3}Li \rightarrow$ ____________

14. ${}^{7}_{4}Be + n^{\circ} \rightarrow$ ______H + ______He

15. What is the balanced nuclear equation for the reaction of curium-246 with carbon-12 to produce nobelium-254 and four neutrons?

16. What is the balanced nuclear equation for the reaction of californium-250 with boron-10 to produce lawrencium-258 and two neutrons?

Balancing Nuclear Reactions Practice

1. $^{222}_{86}Rn$ ---------> ________ $+^{4}_{2}He$

2. ____ ---------> $^{234}_{90}Th$ + $^{4}_{2}He$

3. $^{234}_{90}Th$ ---------> $^{226}_{88}Ra$ + ______

4. $^{214}_{82}Pb$ ---------> ______ + $^{0}_{-1}e$

5. $^{234}_{92}U$ ---------> $^{234}_{93}Np$ + _______

6. Write a balanced nuclear equation for the Beta decay of:

   a. Nitrogen-16

   b. Potassium-40

7. Write a balanced nuclear equation for the Alpha decay of:

   a. Plutonium-244

   b. Strontium-90

8. Write the balanced nuclear equations for the Beta, Alpha, and Gamma decay of Radium-226.

9. How are the mass number and atomic number of the nucleus affected by the loss of the following?
   a. beta particle
   b. alpha particle
   c. gamma particle

Name: ______________________________ Date: __________

Nuclear Fission and Fusion

Learning Objectives

- Compare and contrast nuclear fission and nuclear fusion.
- Understand the conservation laws that apply to nuclear reactions.

Vocabulary

- Fission, fusion, transmutation and nuclide.

Why?

Fission and fusion are two processes that alter the nucleus of an atom. Nuclear fission provides the energy in nuclear power plants and fusion is the source of the sun's energy. The use of fission in power plants can help conserve fossil fuels. Without the energy produced by eh fusion of the hydrogen in the sun, the Earth would quickly change into a cold planet that could not support life as we know it.

Information

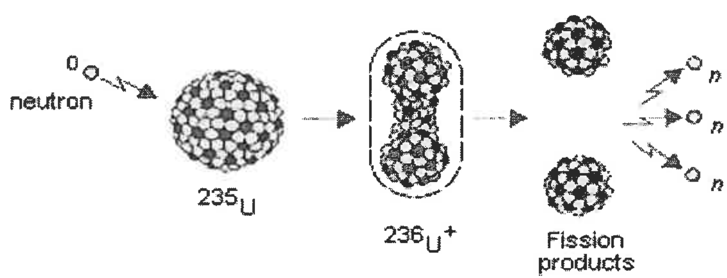
Transmutation is the transformation of the nucleus of an atom so that the atom is changed from one element into a different element. This can be accomplished through many types of reactions, including fission and fusion.

Nuclear transformations always obey two fundamental conservation laws: (1) mass number is conserved and (2) electrical charge is conserved. Energy and mass are not served, but can be inter-converted according to Einstein's equation, $E=mc^2$. The amount of binding energy released from the nucleus of an atom during fission and fusion is so tremendous that a small fraction of mass is converted to energy; this is referred to as the **mass defect.**

Model

1. Fission

The process of fission occurs when a nucleus splits into smaller pieces. Fission can be induced by a nucleus capturing slow moving neutrons, which results in the nucleus becoming very unstable.



(http://chemed.chem.purdue.edu/genchem/topicreview/bp/ch23/fission.html)

The following equations represent fission reactions, where n = neutron.

$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{141}_{56}Ba + ^{92}_{36}Kr + 3\ ^{1}_{0}n$

$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{131}_{50}Sn + ^{103}_{42}Mo + 2\ ^{1}_{0}n$

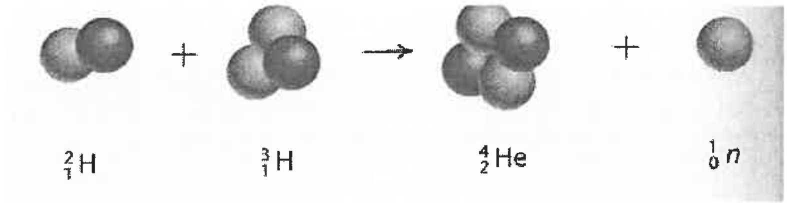
$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{137}_{52}Te + ^{97}_{40}Zr + 2\ ^{1}_{0}n$

$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{138}_{54}Xe + ^{95}_{38}Sr + 3\ ^{1}_{0}n$

$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{152}_{60}Nd + ^{81}_{32}Ge + 3\ ^{1}_{0}n$

2. Fusion

Fusion occurs when 2 nuclei join together to form a larger nucleus. Fusion is brought about by bringing together two or more small nuclei under conditions of tremendous pressure and heat.



(Phillips, Strozak, Wistrom, Glencoe Chemistry. 2002 p. 766)

The following equations represent fusion reactions, where p = proton.

$^{2}_{1}H + ^{2}_{1}H \rightarrow ^{3}_{1}H + ^{1}_{1}p$

$^{2}_{1}H + ^{3}_{1}H \rightarrow ^{4}_{2}He + ^{1}_{0}n$

$^{3}_{2}He + ^{3}_{2}He \rightarrow ^{4}_{2}He + 2\,^{1}_{1}H$

Key Questions

1. What is fission?

2. What is fusion?

3. What is the difference between deuterium, $^{2}_{1}H$ and tritium, $^{3}_{1}H$?

4. What two quantities are **conserved** in all natural nuclear transmutation?

5. The fusion equations show the production of atoms of several different elements through the combination of hydrogen nuclei. These reactions require tremendous amounts of energy and pressure in order to be successful. Why is it so difficult to get two ***nuclei*** of elements to come together? (Hint: Think about the particles contained in the nucleus of all atoms)

6. The nuclei of atom twos will repel because of the like charges. Explain, in terms of nuclear charge, why fusion is only possible for the nuclei of small elements such as hydrogen and is impossible for the nuclei of large elements, such as uranium.

Exercises

1. An equation in the model shows the fusion of two deuterium nuclei to form a nucleus of tritium. Suggest another product that might form in this reaction.

$$^{2}_{1}H + ^{2}_{1}H \rightarrow \_\_\_\_\_\_\_\_\_\_$$

2. Describe *how* to find the identity of the species X in the equation.

$$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{152}_{60}Nd + \underline{X} + 3^{1}_{0}n$$

3. What is missing in the following reaction?

$$^{235}_{92}U + ^{1}_{0}n \rightarrow \_\_\_\_\_\_\_\_ + ^{90}_{37}Rb + 2^{1}_{0}n$$

4. An atom of U-235 absorbs a neutron and produces an atom of Sb-123, four neutrons and an unknown nuclide, X. Write the decay equation to represent this reaction and identify the other nuclide, X, formed in this reaction.

5. Classifying the following equations as fission or fusion.

	Fission or Fusion?
$^{2}_{1}H + ^{2}_{1}H \rightarrow ^{3}_{1}H + ^{1}_{1}p$	
$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{141}_{56}Ba + ^{92}_{36}Kr + 3\ ^{1}_{0}n$	
$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{138}_{54}Xe + ^{95}_{38}Sr + 3\ ^{1}_{0}n$	
$^{3}_{2}He + ^{3}_{2}He \rightarrow ^{4}_{2}He + 2^{1}_{1}H$	

Fissian vs. Fusion Notes

Half-Life Notes

Honors Chemistry: Half-life. Solve the following problems.

1. The half-life of an isotope is 2.0 hours. How much of a 50.0 g sample is left after 6.0 hours? (6.25 g)

2. The half-life of an isotope is 10.0 minutes. If 25.0 grams are left after 60.0 minutes, how many grams were in the original sample? (1600 g)

3. If 200.0 g of an isotope decays to 25.0 grams in 24.0 seconds, what is the half-life of this isotope? (8.0 s)

4. The half-life of Carbon-14 is about 5730 years. If an artifact had 4.0 grams of C-14 originally, and it now has 1.0 grams of C-14, what is the approximate age of the artifact? (11,400 years)

5. The half-life of radon-222 is 3.8 days. How much of a 100.0 g sample is left after 15.2 days? (6.25 g)

6. Carbon-14 has a half-life of 5,730 years. If a sample contains 70 mg originally, how much is left after 17,190 years? (8.75 g)

7. How much of a 500.0 g sample of potassium-42 is left after 62 hours? The half-life of K-42 is 12.4 hours. (15.6 g)

8. The half-life of cobalt-60 is 5.26 years. If 50.0 g are left after 15.8 years, how many grams were in the original sample? (400 g)

9. The half-life of I-131 is 8.07 days. If 25 g are left after 40.35 days, how many grams were in the original sample? (800 g)

10. If 100.0 g of Au-198 decays to 6.25 g in 10.8 days, what is the half-life of Au-198? (2.7 days)

HALF-LIFE PROBLEMS

Name________________________________ Block ______

1. An isotope of cesium (cesium-137) has a half-life of 30 years. If 1.0 g of cesium-137 disintegrates over a period of 90 years, how many g of cesium-137 would remain?

2. Actinium-226 has a half-life of 29 hours. If 100 mg of actinium-226 disintegrates over a period of 58 hours, how many mg of actinium-226 will remain?

3. Sodium-25 was to be used in an experiment, but it took 3.0 minutes to get the sodium from the reactor to the laboratory. If 5.0 mg of sodium-25 was removed from the reactor, how many mg of sodium-25 were placed in the reaction vessel 3.0 minutes later if the half-life of sodium-25 is 60 seconds?

4. The half-life of isotope X is 2.0 years. How many years would it take for a 4.0 mg sample of X to decay and have only 0.50 mg of it remain?

5. Selenium-83 has a half-life of 25.0 minutes. How many minutes would it take for a 10.0 mg sample to decay and have only 1.25 mg of it remain?

6. The half-life of Po-218 is three minutes. How much of a 2.0 gram sample remains after 15 minutes? Suppose you wanted to buy some of this isotope, and it required half an hour for it reach you. How much should you order if you need to use 0.10 gram of this material?