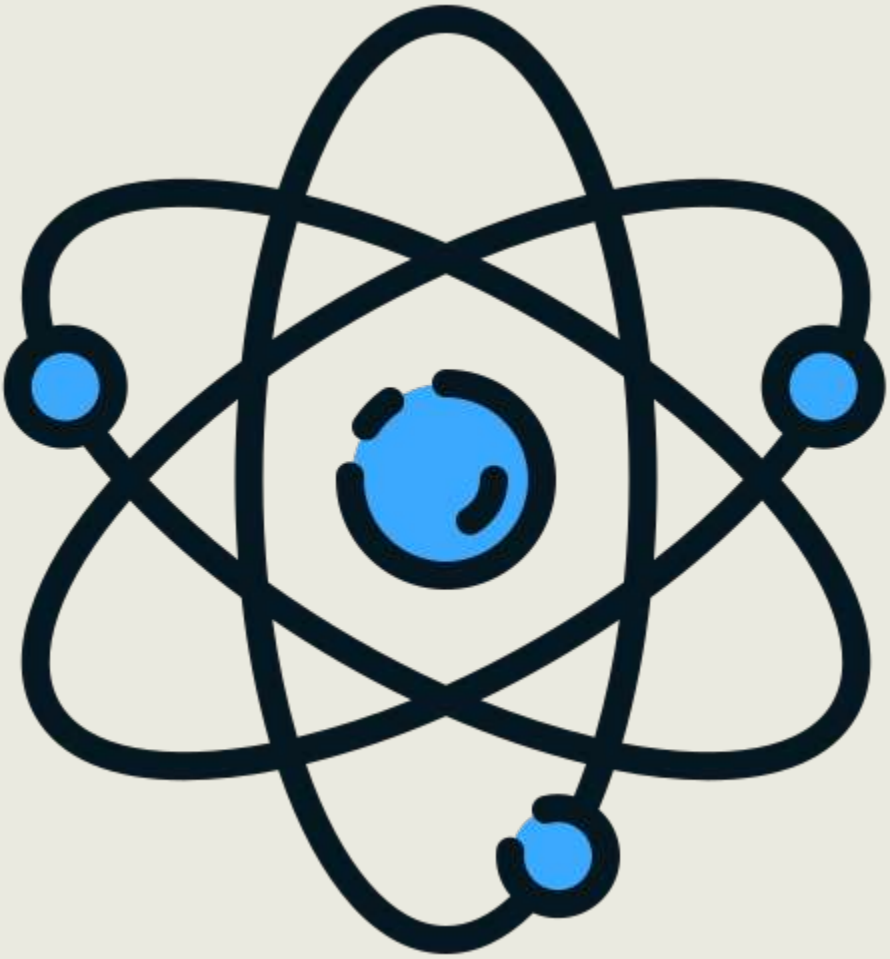
INTRO to the *atom*



Student Workbook

Table of Contents

created by Nicole Wilkinson @Etownscience

Parts of Atom

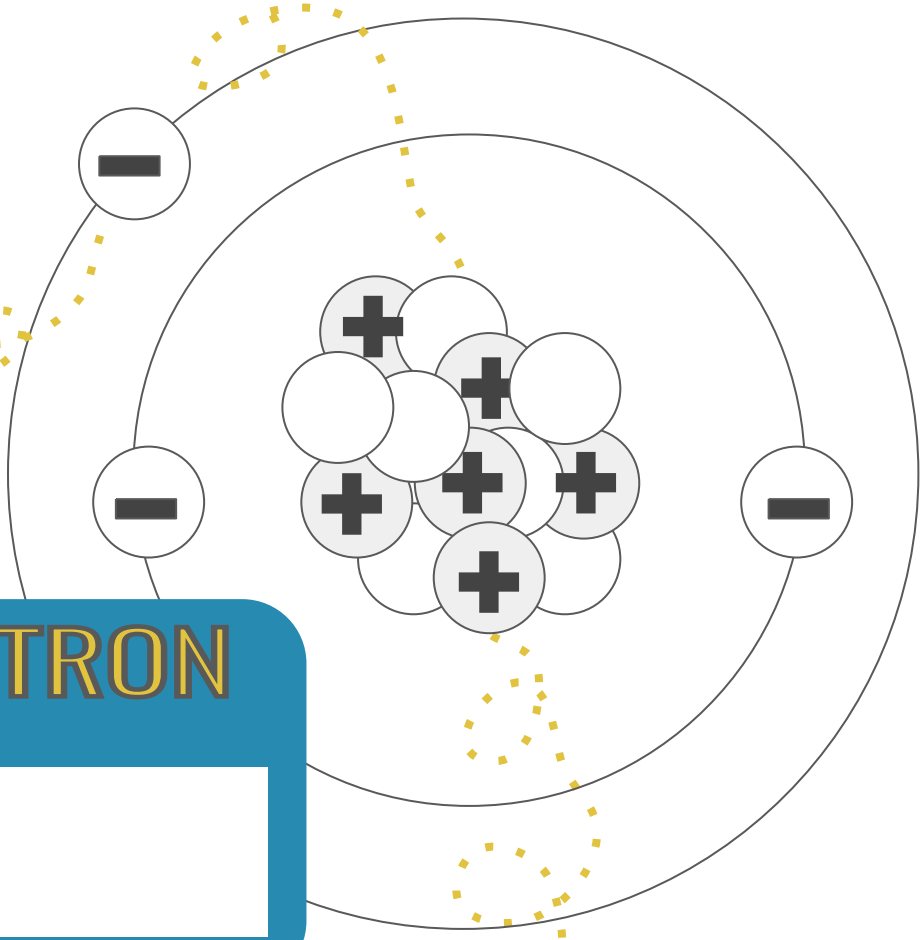
Color code the PARTS of the atom by using the FILL tool & DEFINE.

Click HERE to read about the atom.

The overall charge of an atom is **neutral.** WHY?

NEUTRON

WHAT IS THE AREA CALLED WHERE THE ELECTRONS EXIST?



ELECTRON

WHAT PARTICLES EXIST IN THE NUCLEUS?

PROTON

Important ATOM Vocabulary

Click HERE for a Quizlet of vocabulary

ATOMIC NUMBER

ATOMIC MASS

CHEMICAL SYMBOL

ELEMENT NAME

MASS NUMBER

PLEASE DROP AND DRAG THE VOCABULARY WORD AND LABEL THE DIAGRAM

ATOMIC NUMBER

ELEMENT NAME

CHEMICAL SYMBOL

ATOMIC MASS

12

Mg

Magnesium

24.305

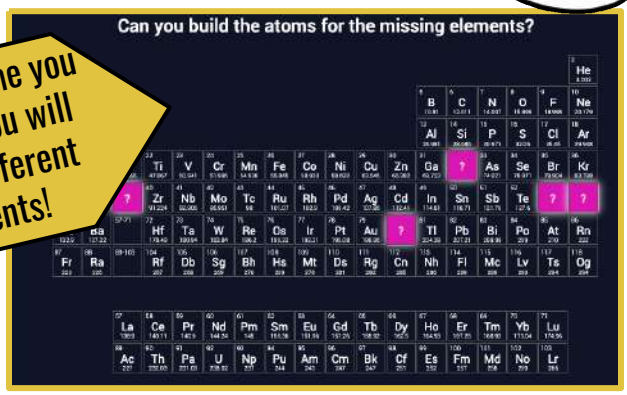
CHECK FOR UNDERSTANDING

WHAT IS THE DIFFERENCE BETWEEN ELECTROSTATIC AND NUCLEAR STRONG FORCE?

Do I Know?

- ❑ The difference between atomic mass and mass number?
- ❑ Where element and names and symbols come from?
- ❑ What's special about atomic number?

Build It!



Each time you play, you will get different elements!

WHAT PATTERN DO YOU NOTICE BETWEEN UNSTABLE ELEMENTS AND THE PARTICLES IN THEIR NUCLEUS?

- ❑ Click on the PINK box of an unknown element.
- ❑ Use the SLIDER to choose PROTONS, NEUTRONS and ELECTRONS
- ❑ Record your answers below.

EXAMPLE 1	
Element Name	
Protons	
Electrons	
Neutrons	

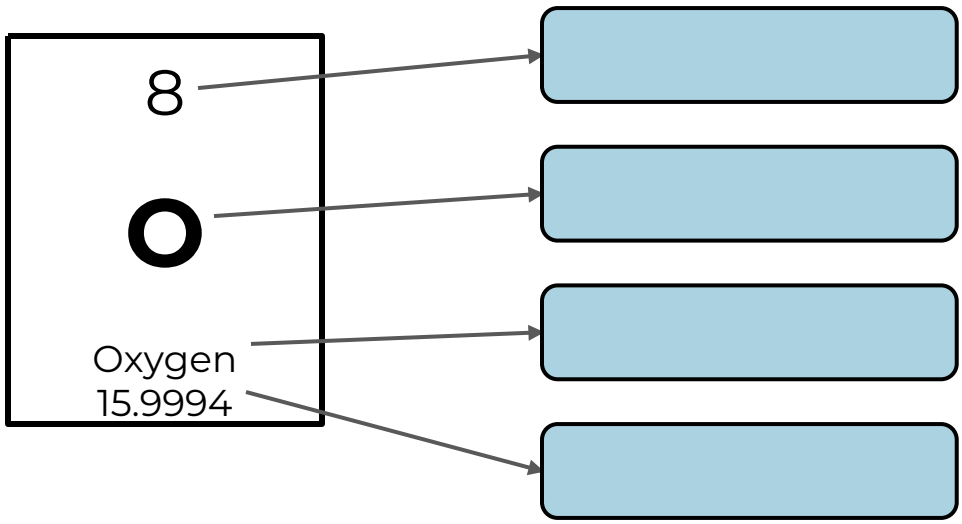
EXAMPLE 2	
Element Name	
Protons	
Electrons	
Neutrons	

EXAMPLE 3	
Element Name	
Protons	
Electrons	
Neutrons	

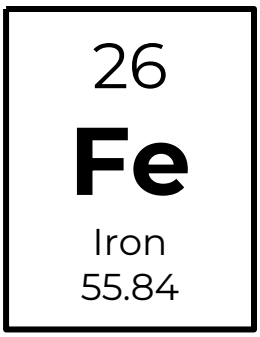
Why are some element symbols so different from their names?

Please use the following terms to fill in the boxes: *atomic mass, atomic number, element symbol and element name.*

Atomic Structure REVIEW



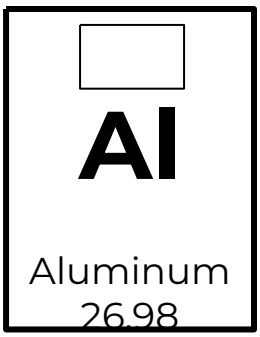
PLEASE FILL-IN THE MISSING INFORMATION



Atomic Number: _____

Protons: _____

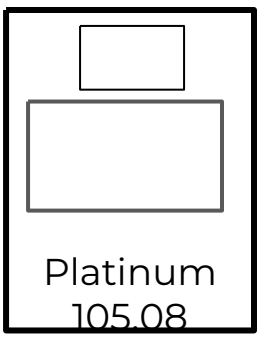
Electrons: _____



Atomic Number: _____

Protons: _____

Electrons: _____



Atomic Number: _____

Protons: _____

Electrons: _____

IMPORTANT VOCABULARY

PROTON: the positively charged particle in the nucleus

NEUTRON: the neutral particle in the nucleus; is the mass of the atom

ELECTRON: the negative particle; found in the cloud; equal the number of protons

ATOMIC NUMBER: gives the atom its identity; equals the number of protons in the nucleus

ATOMIC MASS: number at the bottom of the box on the periodic table; is the mass of the entire atom

ELEMENT SYMBOL: a 1 or 2 letter symbol representing the element name

Using your shape tools, please DRAW the nucleus of the following atoms and fill in the missing information.

4 protons
5 neutrons

Atomic Number Type HERE

Element Name Type HERE

Electrons Type HERE

DRAW NUCLEUS HERE

9 protons
10 neutrons

Atomic Number Type HERE

Element Name Type HERE

Electrons Type HERE

DRAW NUCLEUS HERE

BASED ON THE DEFINITION OF MASS NUMBER CALCULATE THE MASS NUMBER FOR EACH EXAMPLE ABOVE.

ELEMENTS to Know

Click HERE to PRACTICE

You must know both the element SYMBOL and NAME.
*spelling counts!

Elements #1-20 (H, He, Li, Be. . .)			
Iron	Fe	Nickel	Ni
Copper	Cu	Zinc	Zn
Bromine	Br	Silver	Ag
Tin	Sn	Iodine	I
Bairium	Ba	Gold	Au
Mercury	Hg	Lead	Pb
Uranium	U	Tungsten	W

PLEASE DROP AND DRAG. NOT ALL ANSWERS WILL BE USED.

Phosphorus →

Fluorine →

Tin →

Gold →

Potassium →

Bromine →

P

K

Au

Ag

F

B

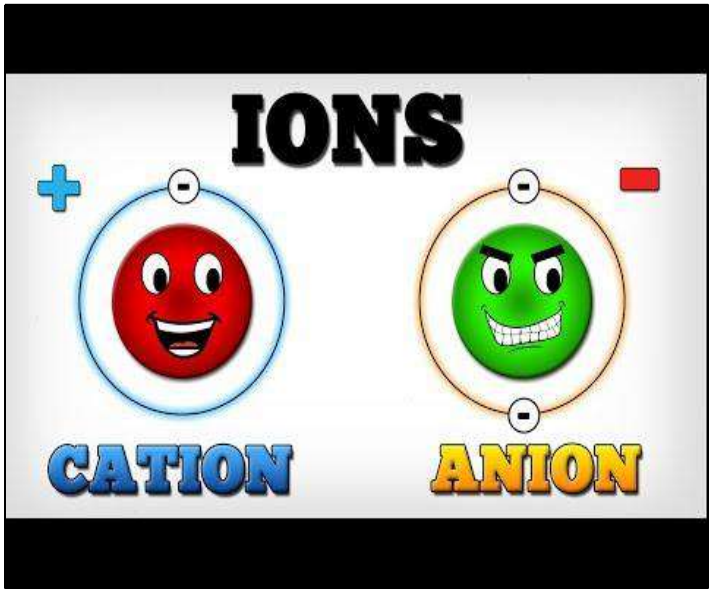
Br

Sn

Ph

Fl

CALCULATING NET CHARGE



WHAT HAPPENS WHAT AN ATOM IS NOT NEUTRAL?

Elements on the Periodic Table are neutral but they are always trying to become stable by gaining or losing electrons. When they gain or lose electrons, they will become **an ion**.

Cation +

A **CATION** IS AN ELEMENT THAT HAS MORE PROTONS THAN ELECTRONS. IT HAS MORE + CHARGES THAN - CHARGES SO CATIONS ARE **POSITIVE**.

Anion −

AN **ANION** IS AN ELEMENT THAT HAS MORE ELECTRONS THAN PROTONS. IT HAS MORE - CHARGES THAN - CHARGES SO ANIONS ARE **NEGATIVE**.

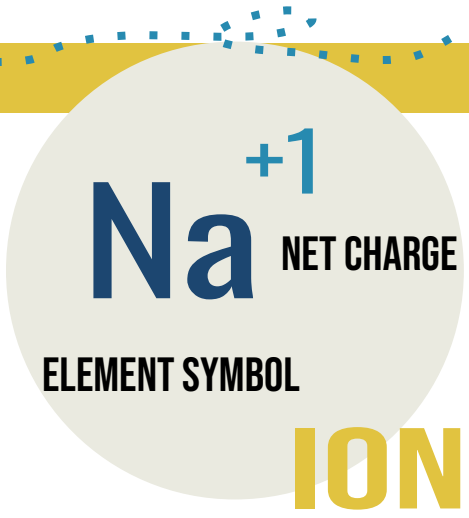
Try It!

Protons	13
Electrons	10
Element Symbol	
Net Charge	
Cation or	

Protons	15
Electrons	18
Element Symbol	
Net Charge	
Cation or	

Protons	17
Electrons	18
Element Symbol	
Net Charge	
Cation or	

Try It!



What is the name of the atom that has 5 protons?

What is the name of the atom that has 83 protons?

What is the name of the atom that has 83 protons?

Write the symbol for the ion with 74 protons and 70 electrons.

Write the symbol for the ion with 95 protons and 90 electrons.

Write the symbol for the ion with 15 protons and 18 electrons.

How many protons and electrons are present in Ni^{+2} ?

How many protons and electrons are present in Se^{-2} ?

How many protons and electrons are present in Pb^{+4} ?

How many protons and electrons are present in N^{-3} ?

Ion Practice

Complete the following table, using the periodic table as a resource.

Element Name	Ion Symbol	Number of Protons	Number of Electrons	Number of Electrons Lost or Gained
Fluorine	F^{-1}	9	10	Gained 1
		16		Gained 2
Potassium				Lost 1
	Ca^{+2}			
		35	36	
	Sr^{+2}			
	H^{+1}			
		8		Gained 2
		12		Lost 2
Aluminum			10	
		34	36	

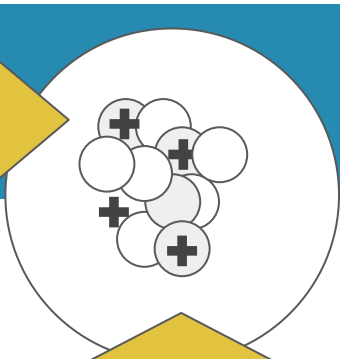
What is a ion?

What does the number to the right of the symbol mean?

Isotopes

Type HERE

neutron



protons + neutrons = mass number

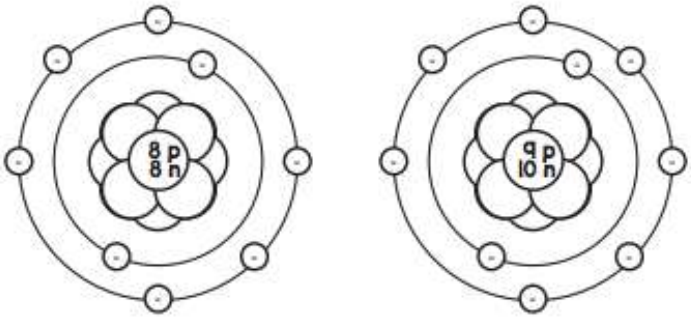
Type HERE

mass number

ISOTOPE

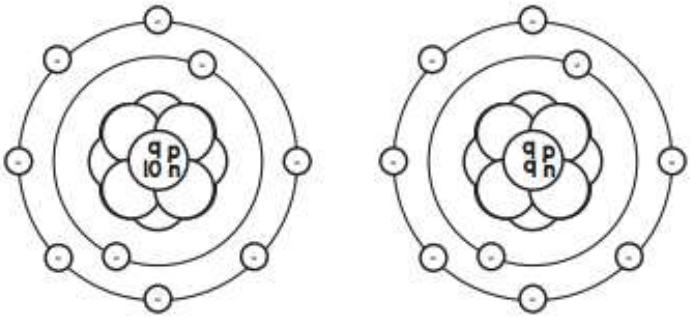
The same number of _____ but a different number of _____.

1. Circle: Different Isotopes of the same Element or Atoms of Different Elements



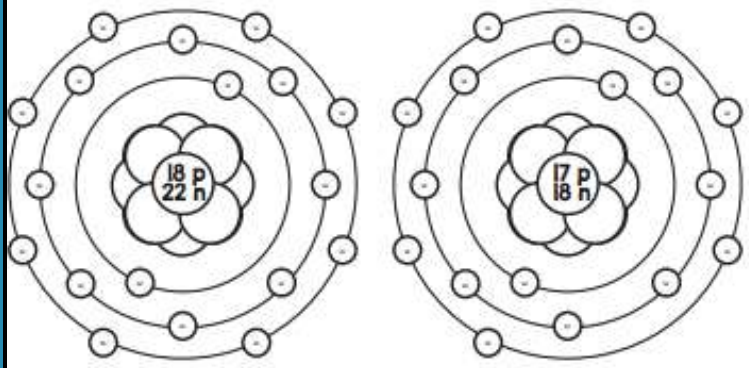
Chemical Symbols: ☐ ☐

2. Circle: Different Isotopes of the same Element or Atoms of Different Elements



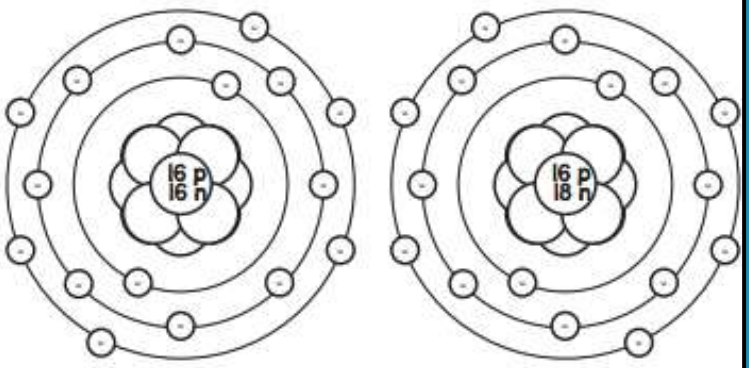
Chemical Symbols: ☐ ☐

3. Circle: Different Isotopes of the same Element or Atoms of Different Elements



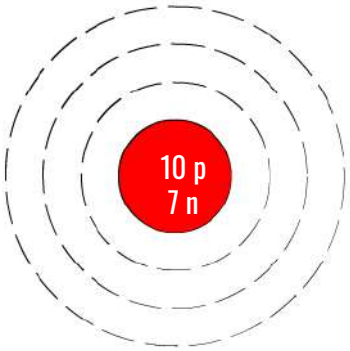
Chemical Symbols: ☐ ☐

4. Circle: Different Isotopes of the same Element or Atoms of Different Elements



Chemical Symbols: ☐ ☐

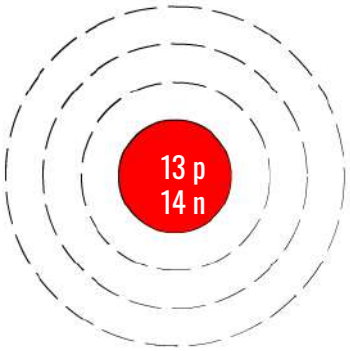
CALCULATING MASS NUMBER



Atomic Number: _____

Element Symbol: _____

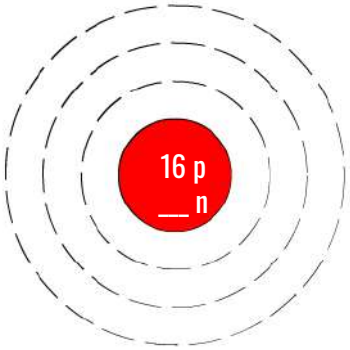
Mass Number: _____



Atomic Number: _____

Element Symbol: _____

Mass Number: _____



Atomic Number: _____

Element Symbol: _____

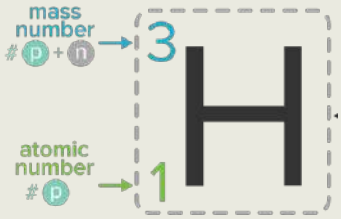
Mass Number: ____39____

Mass Number:
The TOTAL number of particles in the nucleus. (protons + neutrons)

Element Name	Symbol	Atomic #	Mass #	Protons	Neutrons	Electrons
	Cu	29	62			
Gold		79			118	
	Zr			40	51	
Lead			207			
	Na				12	11
			35	17		

Ways to Represent Isotopes

Isotope Notation



Hyphen Notation

Hydrogen-3

Mass number

$^{63}_{29}Cu$

Protons

Neutrons

Electrons

$^{78}_{36}Kr$

Protons

Neutrons

Electrons

$^{238}_{94}Pu$

Protons

Neutrons

Electrons

Ar-38

Argon-38

Protons

Neutrons

Electrons

C-16

Carbon-16

Protons

Neutrons

Electrons

Co-56

Cobalt-56

Protons

Neutrons

Electrons

ISOTOPE NOTATION	HYPHEN NOTATION	ATOMIC NUMBER	MASS NUMBER	PROTONS	NEUTRONS	ELECTRONS
				13	14	
			19	9		
		21	44			

ISOTOPE REVIEW WORKSHEET

Isotope Notation	Atomic Number	Mass Number	Protons	Electrons	Neutrons	Hyphen Notation
	53				78	
		35	16			
			2		2	
		81		36		
	37	81				

Isotope Notation	Atomic Number	Mass Number	Protons	Electrons	Neutrons	Hyphen Notation
					145	Uranium - _____
					28	Chlorine- _____
					9	Oxygen - _____
					6	Boron - _____
					5	Beryllium - _____
					1	Hydrogen- _____

Isotopes & Ions REVIEW

What is the difference between mass number and atomic number?	
What is the difference between a cation and an anion?	

$^{19}_{9}F^{-1}$ $^{11}_{5}B$ $^{11}_{5}B^{-3}$

Protons	
Neutrons	
Electrons	

$^{28}_{13}Al^{+3}$

Protons	
Neutrons	
Electrons	

$^{56}_{26}Fe$

Protons	
Neutrons	
Electrons	

$^{56}_{26}Fe^{+3}$

Protons	
Neutrons	
Electrons	

$^{40}_{20}Ca^{+2}$

Protons	
Neutrons	
Electrons	

$^{70}_{31}Ga^{+3}$

Protons	
Neutrons	
Electrons	

$^{31}_{15}P^{-3}$

Protons	
Neutrons	

Protons	
Neutrons	

Protons	
Neutrons	

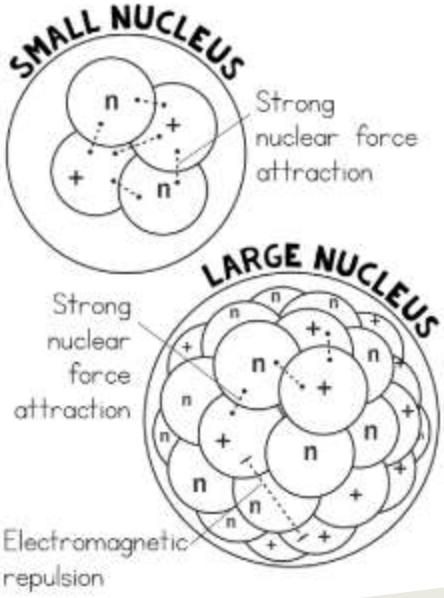
Nuclear RADIATION

ANYTHING that radiates from a nucleus is NUCLEAR RADIATION.

RADIATION

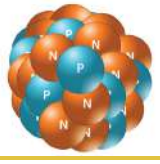
- Radioactive Atoms
- Types of Radiation

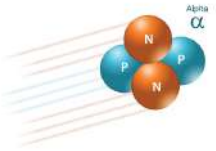
Ionizing Radiation is high energy electromagnetic radiation that causes damage to matter, particularly living tissue.



ALPHA Radiation

- Travels at a slow speed
- Has a +2 charge
- Has a high mass that allows it to interact with matter but lose energy quickly
- Stopped by skin or paper
- Dangerous if inhaled.





BETA Radiation

- Travels at a higher speed
- Has a -1 charge
- Has less mass
- Can travel through 1-2 cm of water and human skin
- Stopped by aluminum foil

Why are some atoms unstable?

- Scientists _____ know what makes an isotope _____.
- The _____ of a _____ depends on the interaction between the _____ force and the _____ strong force.
- _____ seem to have a stabilizing effect.
- All elements larger than _____ are unstable and radioactive.

GAMMA Radiation

- Highest energy wave of the electromagnetic spectrum
- Will pass through the body
- Stopped only by concrete and lead.

TRANSMUTATION: the spontaneous changing from one element to another.

Nuclear Equations

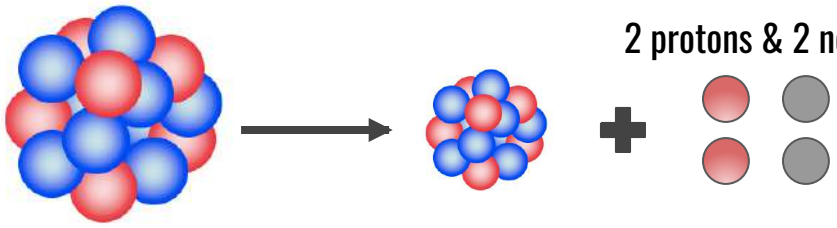
An unstable nucleus will try to balance itself by giving off protons or neutrons.

In a **stable** nucleus, the strong force is enough to hold the nucleus together.

An **unstable** nucleus has too many protons or too many neutrons.

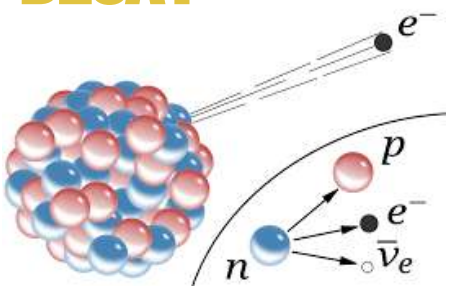
ALPHA DECAY

Mass number: subtract 4
Atomic number: subtract 2

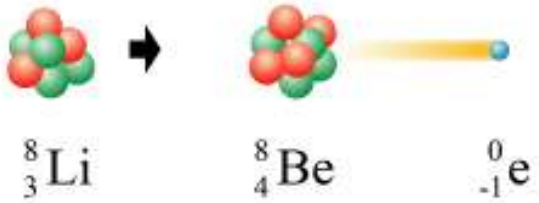


Parent → Daughter + Helium Nuclei

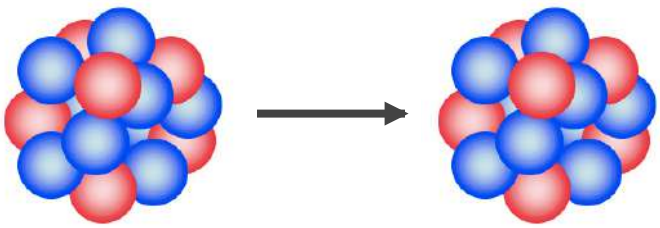
BETA DECAY



Beta decay loses a neutron which ADDS a proton and LOSES an electron. The mass number stays the same.



GAMMA DECAY



High energy atom → NO change to protons or neutrons + γ

High energy gamma wave released

Identify the following as alpha, beta or gamma decay.

1. $^{233}_{92}U \rightarrow {}^{4}_{2}He + {}^{229}_{90}Th$ _____

2. $^{99}_{43}Tc \rightarrow {}^{0}_{-1}e + {}^{99}_{44}Ru$ _____

3. $^{175}_{78}Pt \rightarrow {}^{171}_{76}Os + {}^{4}_{2}He$ _____

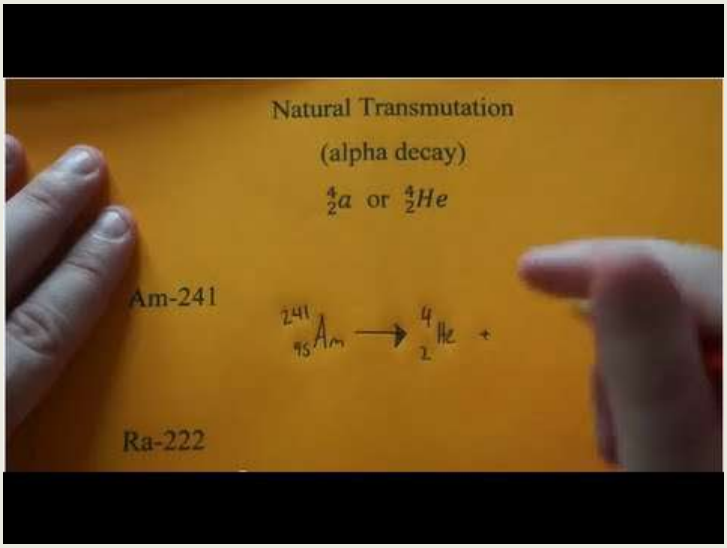
4. $^{202}_{81}Tl \rightarrow {}^{202}_{81}Tl + {}^{0}_{0}\gamma$ _____

5. $^{125}_{53}I \rightarrow {}^{0}_{0}\gamma + {}^{125}_{53}I$ _____

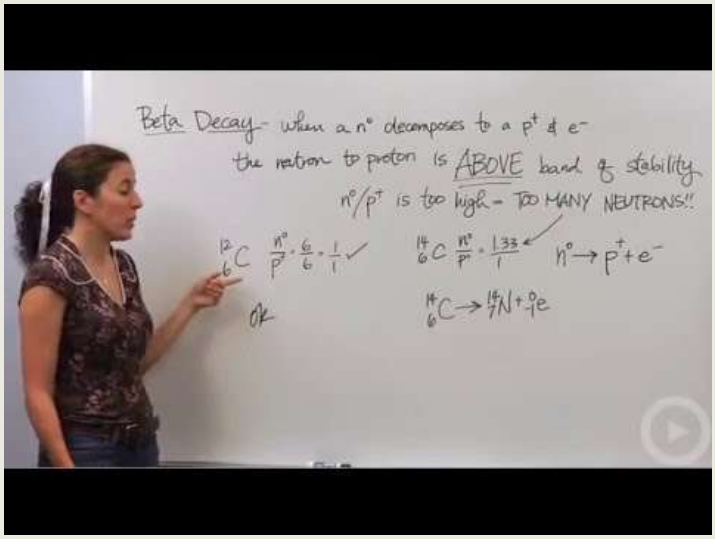
6. $^{82}_{35}Br \rightarrow {}^{82}_{36}Kr + {}^{0}_{-1}e$ _____

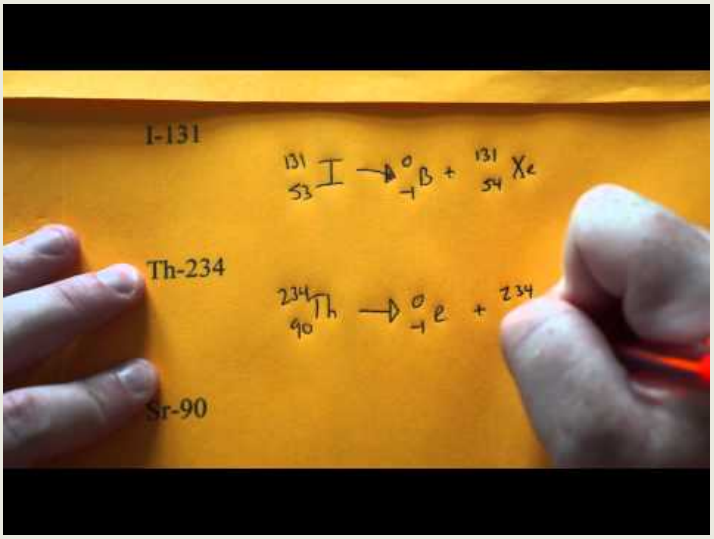
TUTORIAL VIDEOS

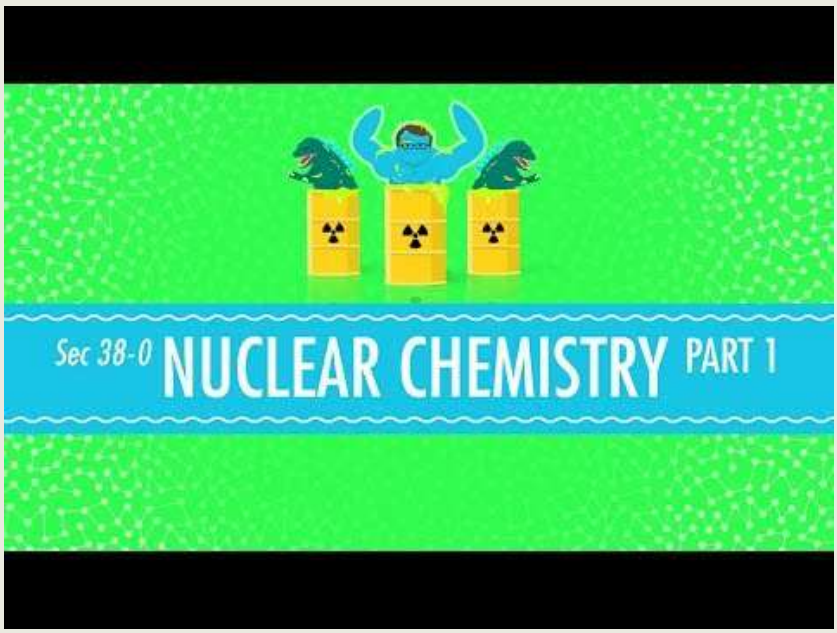
ALPHA DECAY



BETA DECAY







EXPLORING Radioactive Decay

While most atoms are stable, some are ***radioactive,*** *which means that they have a tendency to undergo spontaneous* ***nuclear decay****. The decay of radioactive atoms generally results in the emission of particles and/or energy.*

Click the PLAY button and click PAUSE as soon as you see an alpha particle form.
Draw and label the alpha particle.

Click PLAY and carefully observe what happens. Besides the alpha particle, what else is emitted from the nucleus during alpha decay?

Type HERE

Click RESET and make sure that Alpha Decay and Uranium are selected.

An alpha particle consists of two protons and two neutrons. How will the emission of an alpha particle affect the following?

The atomic number of an atom?

Type HERE

The mass number of an atom?

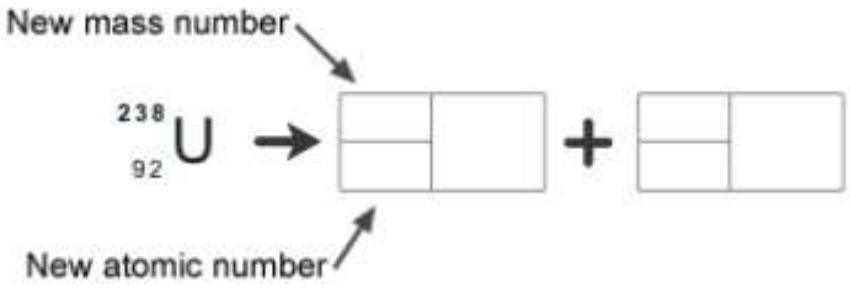
Type HERE

Turn on WRITE EQUATION. What you see is an equation that shows the original uranium atom on the left. The boxes on the right represent the daughter product (the atom produced by nuclear decay) and the alpha particle.

In the top left box, predict the MASS NUMBER and ATOMIC NUMBER of the "daughter product" of the alpha decay of uranium and type it into the boxes.

In the next set of boxes, enter the MASS NUMBER and ATOMIC NUMBER of the alpha particle, which has the same composition as the nucleus of a helium (He) atom.

Record your prediction:

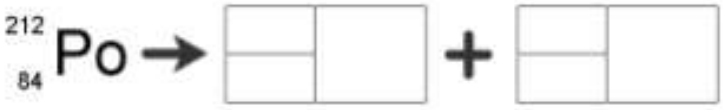


Turn on SHOW EQUATION and click PLAY.

Was your prediction correct? _____

PRACTICE:

Click RESET, turn OFF SHOW EQUATION and select Polonium. Write an equation for the alpha decay of polonium and then use the Gizmo to check your answer



What isotope remains after the alpha decay of polonium-212? Type HERE

PRACTICE:

Click RESET, turn OFF SHOW EQUATION and select Radium. Write an equation for the alpha decay of radium and then use the Gizmo to check your answer.

What dangerous gas is produced by the decay of radium-226? Type HERE

Click RESET and turn off SHOW EQUATION. Select beta decay from the "Type of Decay" menu. Check that carbon is selected.

Click PLAY and watch the animation. What happens to the decaying neutron during beta decay?

Type HERE

What is emitted from the nucleus during beta decay?

Type HERE

What is the charge of the emitted particle? Type HERE

During beta decay, a neutron is transformed into a proton and an electron (the beta particle) which is emitted. Gamma rays are often emitted during beta decay as well.

How will beta decay affect the mass number and the atomic number?

Type HERE

Turn on WRITE EQUATION. Fill in the first set of boxes with the MASS NUMBER and ATOMIC NUMBER of the "daughter product" and the next set of boxes with the MASS NUMBER and ATOMIC NUMBER of the beta particle.

$$^{14}_{6}C \rightarrow \square\square + \square\square$$

*NOTE: The atomic number of an electron is -1.

Check your answer by turning on SHOW EQUATION and clicking PLAY. What isotope is produced by the beta decay of carbon-14?

Type HERE

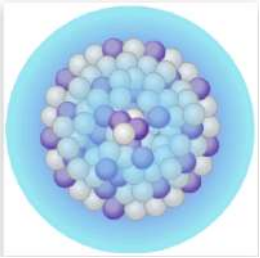
Turn OFF SHOW EQUATION. Fill in the equations for the beta decay of iodine-131 and sodium-24 in the spaces below. Use the Gizmo to check your answers.

$$^{131}_{53}I \rightarrow \square\square + \square\square$$

$$^{24}_{11}Na \rightarrow \square\square + \square\square$$

ASSESSMENT

An atom of radon gas emits an alpha particle. Radon-222 has 86 protons and 136 neutrons. What daughter will be produced from this decay?



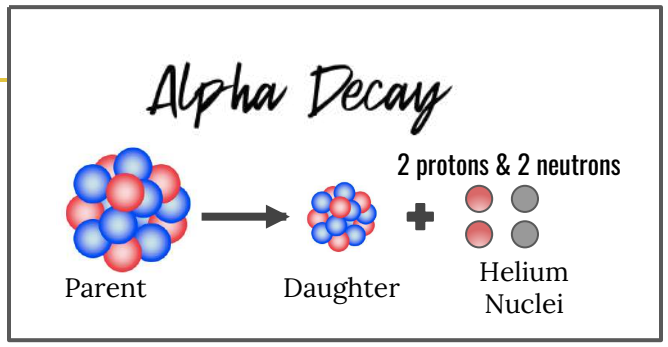
- A. Francium-222 (87 protons)
- B. Polonium-218 (84 protons)
- C. Radium-226 (88 protons)
- D. Lead-220 (82 protons)

What type of decay is illustrated by the equation below?

$$^{214}_{83}Bi \rightarrow {}^{214}_{84}Po + {}^{0}_{-1}e$$

- A. alpha decay
- B. beta decay
- C. positron emission
- D. electron capture

Complete each nuclear equation by filling in the blank space.



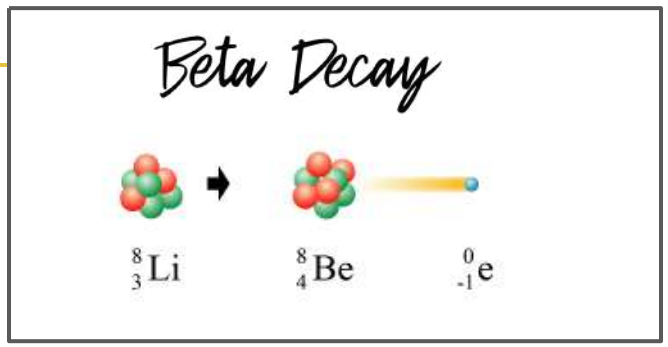
$^{214}_{84}Po \rightarrow {}^{210}_{82}Pb + \_\_\_\_\_$

$^{222}_{86}Rn \rightarrow \_\_\_\_\_ + {}^{4}_{2}He$

$^{230}_{90}Th \rightarrow {}^{226}_{88}Ra + \_\_\_\_\_$

$^{226}_{88}Ra \rightarrow \_\_\_\_\_ + {}^{4}_{2}He$

$\_\_\_\_\_ \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$



$^{214}_{82}Pb \rightarrow \_\_\_\_\_ + {}^{0}_{-1}e$

$^{239}_{93}Np \rightarrow \_\_\_\_\_ + {}^{0}_{-1}e$

$^{254}_{91}Pa \rightarrow \_\_\_\_\_ + {}^{0}_{-1}e$

$^{234}_{92}U \rightarrow \_\_\_\_\_ + {}^{0}_{-1}e$

$^{206}_{82}Pb + {}^{4}_{2}He \rightarrow \_\_\_\_\_$

NUCLEAR RADIATION REVIEW

How does the atomic number change after alpha decay?

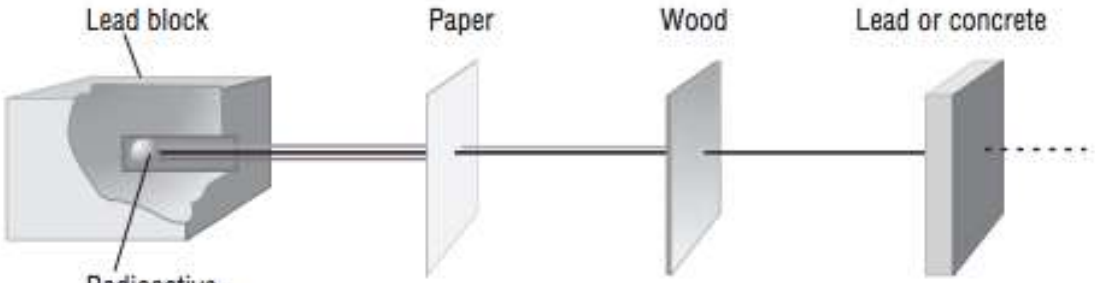
How does the mass number change after alpha decay?

When are alpha particles most dangerous for humans? Why?

What is the change in atomic number after beta decay?

Why doesn't the mass number change during beta decay?

Look at the diagram below. Indicate with an "X" in the box which type of radiation can be stopped by each material.



☐	Alpha	☐	Alpha	☐	Alpha
☐	Beta	☐	Beta	☐	Beta
☐	Gamma	☐	Gamma	☐	Gamma

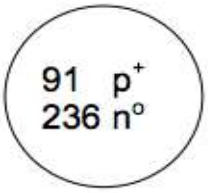
Match the description with the correct term.

A B C E

_____ Radioisotope	A. The process in which an unstable nucleus releases energy by emitting radiation.
_____ Radioactive decay	A. Isotopes that have unstable nuclei and undergo radioactive decay.
_____ Gamma Ray	A. High-energy photon with no mass or electrical charge
_____ Alpha Particle	A. Electron resulting from the breaking apart of a neutron in an atom
_____ Beta Particle	A. Helium nuclei emitted from a radioactive source.

	PROTONS	NEUTRONS	ELECTRONS
How many p+ , n, and e- are found in Nickel-66?			
How many p+ , n, and e- are found in Helium-2?			
How many p+ , n, and e- are found in Carbon-14?			
How many p+ , n, and e- are found in Uranium-235?			

Identify the isotopes whose nucleus is shown below. Write your answer in hyphen notation.



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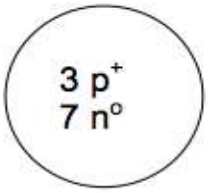

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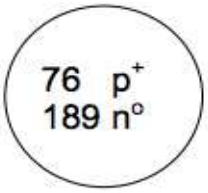

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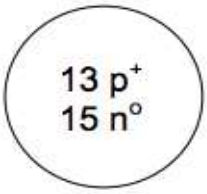

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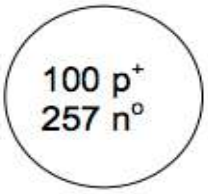

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