STUDY GUIDE - ATOMIC STRUCTURE

The current atomic theory has come about over the past 2000 years. In the beginning, **Democritus** proposed the idea that all things were made of particles too small to see. He was laughed at.

In the 1800's **John Dalton** proposed the idea of the "Atomic Theory". He had 5 theories, 3 of which are still believed today. They are:

1. All matter is composed of extremely small particles too small to see
2. In reactions, atoms separate, combine or rearrange.
3. Different atoms can combine in simple, whole number ratios (to form compounds)

Dalton believed that atoms could not be broken into smaller particles. That belief was proven false in the 1890's when **JJ Thomson** discovered the electron. His idea was that the atom had a negative charge, but he thought the electrons were just found with in atom, like plum pudding, not circling the atom. He made his discovery using a *cathode ray tube.*

In 1911 **Ernest Rutherford** shot alpha particles through a piece of gold foil. He found that some of the particles went through the gold foil, but most bounced off. He concluded that atoms had a densely packed, positively charged center – called the nucleus.

In 1913 **Neils Bohr** found that electrons are not actually *in* the nucleus, but circle it instead. He proposed the idea that electrons were found in energy levels. He believed the electrons circled the nucleus the way the planets orbit the sun. His theory has been revised since then – now electrons are believed to be found in orbitals around the nucleus, called the quantum theory.

Atomic Structure

Terms:

1. **Atomic number**: # of protons (whole number on the PT)
2. **Average Atomic Mass**: mass according to the periodic table (decimal number on the PT)
3. **Mass number**: determined by adding the #p^+ to the # n^0.
4. **Ions**: When an atom has a charge – comes from *unequal numbers of protons and electrons*. This occurs when electrons are gained or lost in a reaction
5. **Isotope**: atoms of the same element have different atomic masses due to *different numbers of neutrons*.
6. **Nuclear symbol:** Show the element's symbol, the atomic mass & the atomic number. Mass goes on the top left of the symbol, number goes on the bottom left of the symbol. $^{\text{mass\#}}_{\text{atomic number}}\text{X}$
7. **Bohr Model:** Shows number of electrons in each energy level around the nucleus.

Answer the following questions regarding the discovery of the atom & its parts.

A. Identify 3 conclusions of the gold foil experiment.
B. Which experiment discovered the electron?
C. Why was the electron discovered first?
D. Which parts of the atomic theory are still considered true today?

Know the parts of the atom

A. Which are in the nucleus?
B. Which have a mass of 1 u?
C. Which does not contribute to the mass of an atom?
D. What is the charge on each subatomic particle?
E. What is the job of each subatomic particle?
F. If an atom loses 3 electrons, what is its charge and name?
G. How are isotopes of the same element different?
H. If an atom gains an electron in a reaction, what are its charge and its name

7. Fill in the following table.

Name	Symbol	Atomic #	Mass #	# protons	# neutrons	# electrons
		29	64			
	^{41}Ca					20
				38	50	
Lithium-8		3		3		3
	$^{35}Cl^{-1}$					
Magnesium-25 (cation +2)						

9. Calculate the average atomic mass for Ne given the following isotopes & their abundance: Neon-20 = 90.92%; Neon-21 = 0.257%; Neon-22 = 8.82%

Study Guide Answer Key

Answer the following questions regarding the discovery of the atom & its parts.

A. Identify 3 conclusions of the gold foil experiment.
1-Atom was more than empty space
2-There is a dense portion in the center of the atom that contained most of its mass
3-The nucleus must be positively charged

B. Which experiment discovered the electron?
cathode ray tube experiment

C. Why was the electron discovered first?
The theory was that atoms had a negative charge, and that is what they were looking for first.

D. Which parts of the atomic theory are still considered true today?
1- All matter is composed of extremely small particles too small to see
2- In reactions, atoms separate, combine or rearrange.
3- Different atoms can combine in simple, whole number ratios (to form compounds)

Know the parts of the atom

A. Which are in the nucleus?
Protons & Neutrons

B. Which have a mass of 1 u?
Protons & Neutrons

C. Which does not contribute to the mass of an atom?
Electron

D. What is the charge on each subatomic particle?
Protons (+), Electrons (-), Neutrons (0)

E. What is the job of each subatomic particle?
Protons- identify atom
Electrons- responsible for chemical reactions
Neutrons- identifies isotopes

F. If an atom loses 3 electrons, what is its charge and name?
(3+), Cation

G. How are isotopes of the same element different?
Some are more stable than others. They have differing numbers of neutrons.

H. If an atom gains an electron in a reaction, what are its charge and its name
(1-), Anion

7. Fill in the following table.

Name	Symbol	Atomic #	Mass #	# protons	# neutrons	# electrons
Copper	Cu	29	64	29	35	29
Calcium-41	^{41}Ca	20	41	20	21	20
Strontium	Sr	38	88	38	50	38
Lithium-8	^{8}Li	3	8	3	5	3
Chlorine-35 (anion -1)	$^{35}Cl^{-1}$	17	35	17	18	17
Magnesium-25 (cation +2)	$^{25}Mg^{+2}$	12	25	12	13	12

9. Calculate the average atomic mass for Ne given the following isotopes & their abundance: Neon-20 = 90.92%; Neon-21 = 0.257%; Neon-22 = 8.82%

AAM= (20 * 0.9092) + (21 * 0.00257) + (22 * 0.0882) = 18.184 + 0.05397 + 1.9404 = 20.18