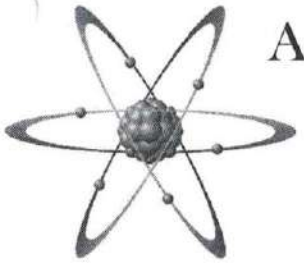
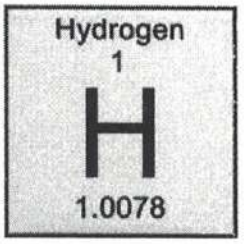
NAME Notes Key PER____ DUE DATE Monday MAIL BOX_____



ATOMS and THE PERIODIC TABLE



ATOM - smallest part of an element that can be identified as that element.

ATOMIC NUMBER - different elements have different numbers of protons. Each element has a unique atomic #. Atomic # = protons. This is always a whole number and just the protons

ATOMIC MASS - total number of the protons & Neutrons in the nucleus of an atom.

"why is atomic mass" a decimal? → Isotopes ←

Protons + neutrons = Atomic mass

ISOTOPES - Atomic # never changes for element but atomic mass can vary. Carbon has several isotopes

All have 6 protons but C_{14}, C_{13}, C_{12} different #ers of neutrons

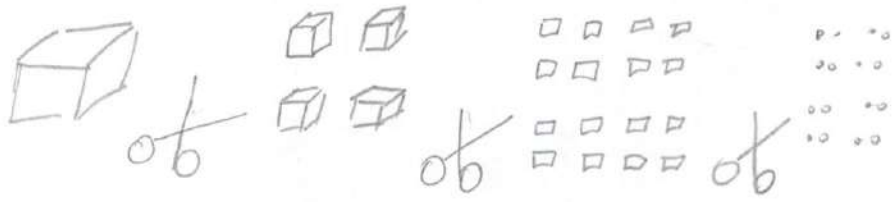
AMU - Atomic Mass Unit { proton - $p^+ = 1$; neutron - $n = 1$; electron $e^- = \emptyset$

Tuesday → Wednesday

Models

____ Greek Philosophers - Democritus 2400 yr ago

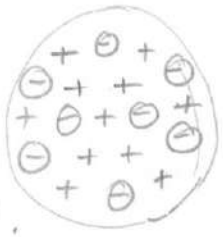
Atom - indivisible



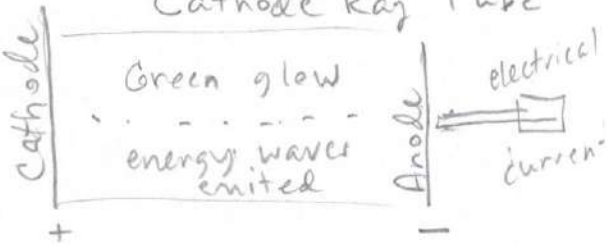
____ Thompson 1897

Plum Pudding

Positively charged material with electrons scattered evenly throughout.

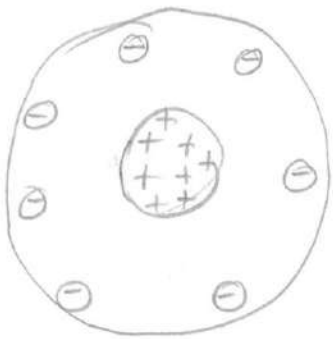


Cathode Ray Tube

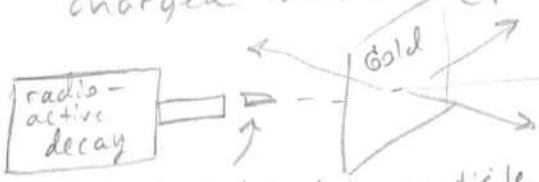


____ Rutheford 1911

Why don't electrons fall into nucleus?

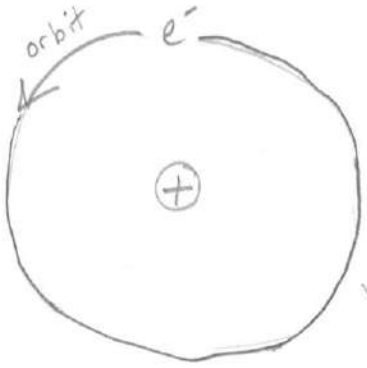


Discovered atom is mostly empty space. Discovered dense positively charged nucleus (protons)



bullet; alpha particle; (cation or helium nucleus w/out electrons)

____ Bohr Early 20th Century



Proposed energy levels with electrons moving around the nucleus in discrete orbits, (like planets around the sun)

shells or quanta

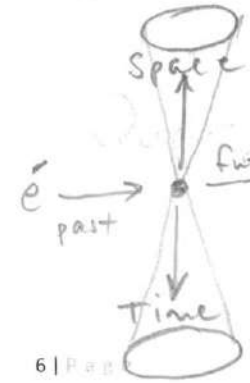
Today - the electron cloud

____ Plank and Einstein

Quantum Model

Scientists now know - The exact location cannot be predicted.

like quantity (meaning numerical value)



"Electrons are links between energy & mass"
m-B.

Monday – tuesday

Name Key per___ due date _____ mailbox_____

ATOMIC THEORY NOTES

How big is an atom?- 0.001m -> 0.1cm -> 1mm -> 10^3um -> 10^3 nm -> Visible Light Wave Length

Meter → millimeter 1/1000 → Micrometer 1/1000 → nanometer 1/1000

Dimension of an atom? Stadium analogy -

Nucleus (protons/neutrons) - golf ball size on 50 yard line ; Electrons are in the stands & parking lot

99.999% in just empty open space!

Recall positives and negatives attract. -

Protons (+) attracted to cathode Electrons (-) attracted anode Neutrons - neutral

The following are some of the leading theories for the model of an atom throughout the ages. Based on the video "History of the Atom" match the following with the appropriate theorist.

3. Rutheford 1911

1.Coined the term "Atom" to describe the smallest attainable size a piece of matter could cut be into. Atom literally mean indivisible.

5. Plank and Einstein

2.Atoms are like "**plum pudding**" meaning that particles that make them up, are randomly scattered about (perhaps explaining the dizzying array of chemical reactivity they demonstrate) He also discovered the electron. ***Plum Pudding Model***

1. Greek Philosophers

3.Conducted the Gold Foil Experiment. He proposed that electrons orbit the nucleus of atoms like planets orbit the sun. He discovers protons in the nucleus. ***Electron Orbital Model*** of the Atom

Scattering Experiment

4. Bohr Early 20th Century

4.Electron don't so much orbit but rather exist in fixed electron energy levels around the nucleus. Sometimes called the ***Cloud Model*** *of the atom.* Most closely aligned with modern Quantum Theory

2. Thompson 1897

5.Quantum Theory – Energy doesn't flow in a stream per say but rather in discrete measurable quanta (or think of quantities). Electrons are thought to have discrete distances that they range from the nucleus based an energy levels.

Chadwick ← Identified neutrons

NAME

Period

THE ATOM

THE ATOM

THE ATOM

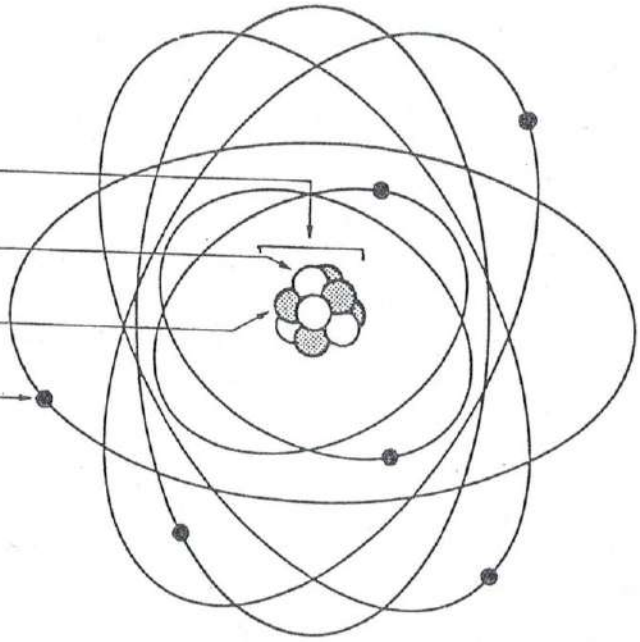
Label the parts of the atom.

Nucleus

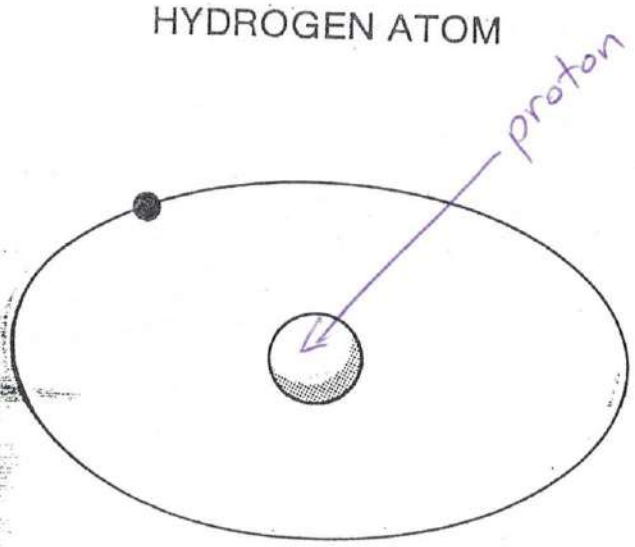
proton

neutron

electron



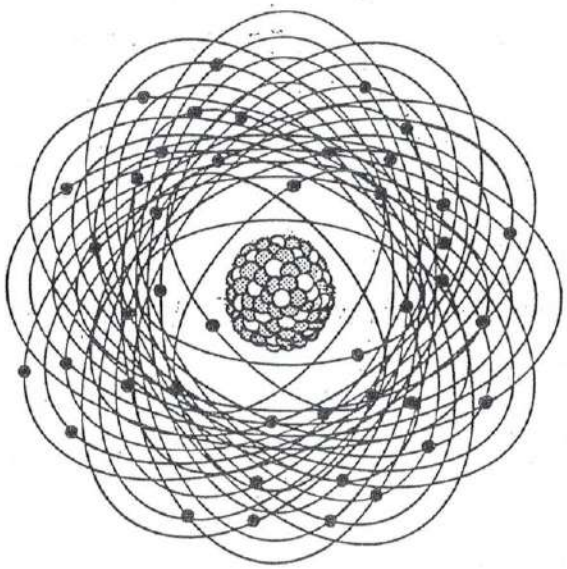
HYDROGEN ATOM



the lightest atom

1 electron

URANIUM ATOM



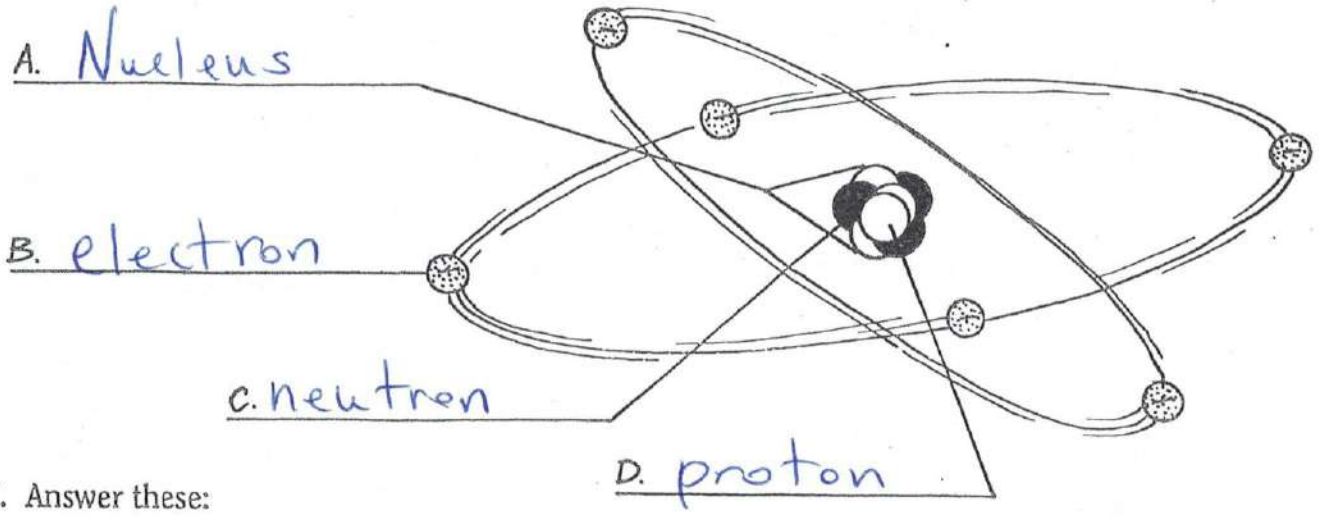
1 of the heaviest

92 electrons

ON THE INSIDE

A Greek philosopher called Democritus, who lived over 2000 years ago, taught people that all things were made of grains which could not be divided. He called these grains *atoms* because in Greek *atom* means *indivisible.* Today, *atom* is the common name for the tiny particles of matter that cannot be further divided (and still be the same substance). If you could look inside an atom, you'd find that it looks like a miniature solar system, with something in the center and other things orbiting around it.

I. Label the parts of this atom (nucleus, protons, electrons, neutrons).



II. Answer these:

neutron 1. the part of the atom that carries no electric charge

proton 2. the part of the atom that carries a positive charge

electron 3. the part of the atom that carries a negative charge

2 4. the number of electrons that can be held in the first ~~orbit~~ shell (closest to the nucleus)

8 5. the number of electrons that can be held in the second orbit

18 6. the number of electrons that can be held in the third orbit

protons & electrons 7. there are the same number of these two particles in an atom

protons 8. the atomic number is the same as the number of these particles

What you need to remember...

- Atomic Number - # of protons in an atom of that element
- The # of protons and electrons are equal
- Atomic Mass - used to find # of neutrons
  - Round to the nearest whole number
  - Subtract the Atomic Number

Protons = electrons

Protons	6
Electrons	6
Neutrons	6

12 - 6 = 6

6 — Atomic Number

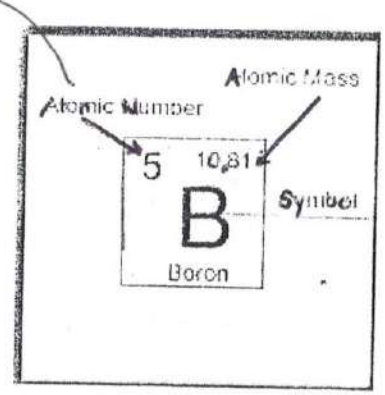
C — Symbol

Carbon — Name

12.011 — Atomic Mass

Protons	5
Electrons	5
Neutrons	6

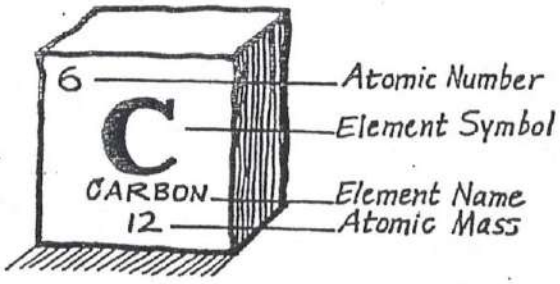
Round to nearest whole # 11 - 5 = 6



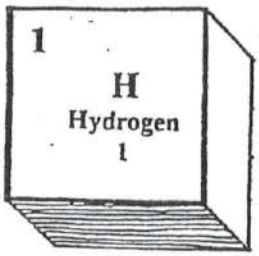
 NAME Key PERIOD

A WORLD-FAMOUS TABLE

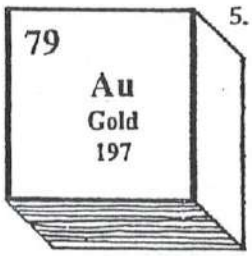
There is a table (not one for dinner) that's probably the most famous table of science. If you learn how to read it, you'll have quick access to important stuff about elements. It's called the Periodic Table (because it's written in rows, called periods). Build your skill at reading the Periodic Table by finding the missing information in the samples below.



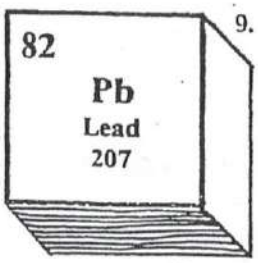
REMEMBER:
atomic mass = protons + neutrons
atomic number = # protons
protons = # electrons



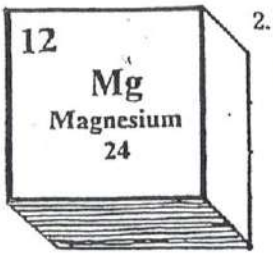
1. a. atomic number 1
   b. atomic mass 1.0079



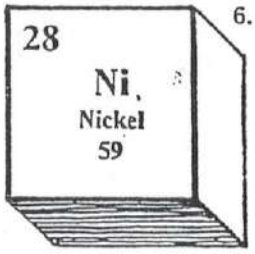
5. a. # electrons 79
   b. # protons 79
   c. atomic number 79
   d. name of element Gold



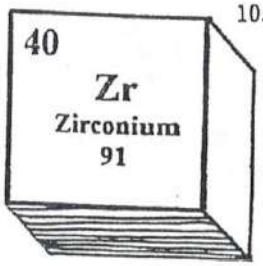
9. a. element name Lead
   b. # protons 82



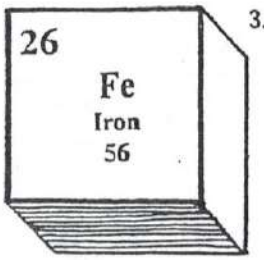
2. a. element name Magnesium
   b. atomic number 12



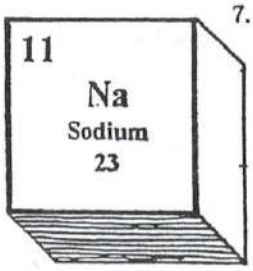
6. a. atomic mass 59
   b. element symbol Nickel



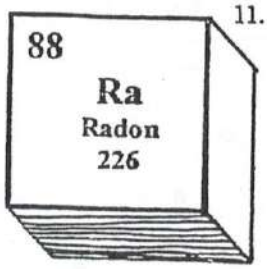
10. a. # electrons 40
    b. atomic mass 91



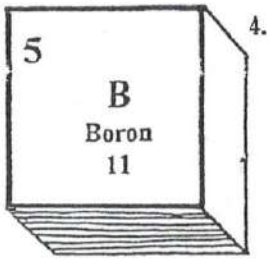
3. a. # protons 26
   b. element symbol Iron



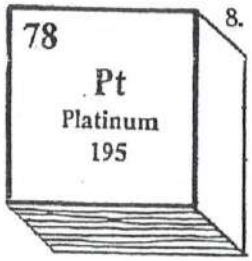
7. a. element symbol Na
   b. # neutrons 12
   c. element name Sodium



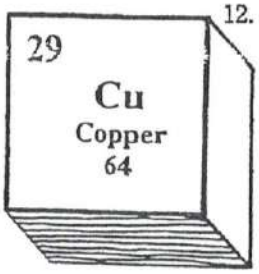
11. a. atomic numb 88
    b. # neutrons 138



4. a. atomic number 5
   b. element name Boron



8. a. atomic number 78
   b. # neutrons 117



12. a. atomic mass 64
    b. # neutro 35

Name

7

Name _____ Date _____

EVERYDAY PHYSICAL SCIENCE

Atomic Numbers of Elements

The atomic number of an element is the number of protons in an atom's center. For example, hydrogen has 1 proton, and its atomic number is 1. Use the periodic table this activity.

1. Write the chemical symbols for the elements with atomic numbers of

   5 B 10 Ne 15 P

   20 Ca 25 Mn 30 Zn

2. Write the atomic numbers for five elements whose symbols begin with the letter C.

   6 20 24

   27 29 48 55

3. What is your age? 34

   Which element has that atomic number?

   Selenium

4. Write the symbols for the elements whose atomic numbers match these descriptions:

   a. number of states in the U.S.

   Sn - Tin 50

   b. number of planets in the solar system

   F - Fluorine-9 O-Oxygen8

   c. number of moons of Earth

   H-1

   d. number of years in a decade

   Ne - 10

   e. number of centimeters in a meter

   Fm - 100 Fermium

   f. number of ounces in a pound

   16 - S - Sulfur

   g. number of quarts in a gallon

   4 - Be - Beryllium

   h. number of sides in a pentagon

   5 - B - Boron

5. Add the atomic numbers of these elemen

   U 92

   C 6

   Cl 17

   Au 79

   + Al 13

   Total 207

6. Identify the atomic numbers of these metals:

   silver 47

   gold 79

   zinc 30

   copper 29

   lead 82

   iron 26

   chromium 24

9

Name Key - Notes Class _____ Date _____

Chapter 4 Master Form

Atomic Structure

Use the information provided for each element to complete the diagrams. Draw the electrons in their proper shells, and place the correct numbers in the nucleus to indicate the number of protons and the number of neutrons.

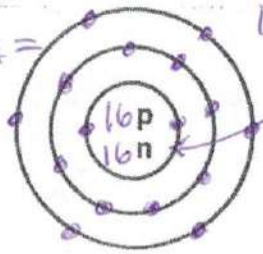
1. Sulfur: atomic number 16
atomic mass 32

32
−16
16

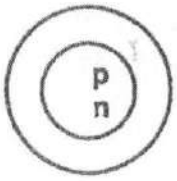
Atomic # = proton #

Atomic mass − atomic # = neutrons

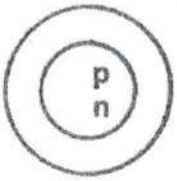
protons = electron #



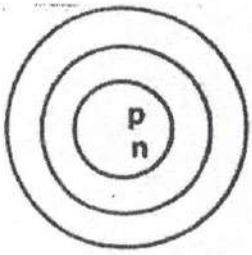
2. Beryllium: atomic number 4
atomic mass 9



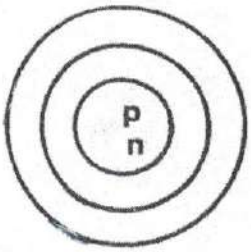
3. Nitrogen: atomic number 7
atomic mass 14



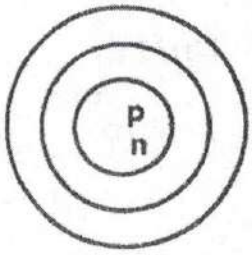
4. Sodium: atomic number 11
atomic mass 23



5. Potassium: atomic number 19
atomic mass 39



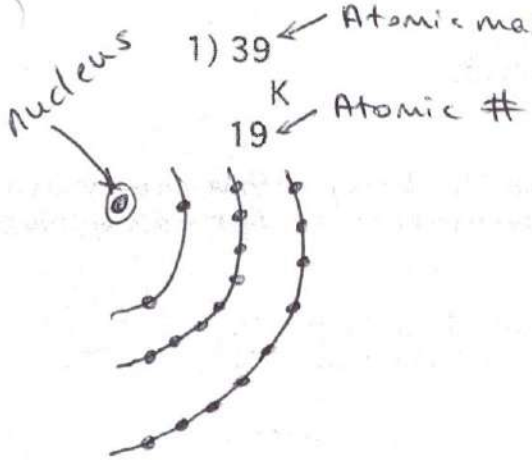
6. Argon: atomic number 18
atomic mass 40



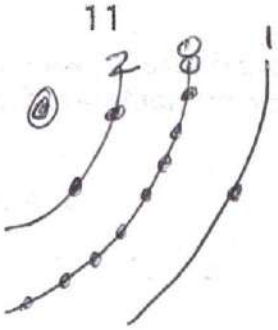
Atomic Diagrams Name Notes Key

Construct atomic diagrams for the following. Show all information.

1) 39 ← Atomic mass
K
19 ← Atomic #



2) 23
Na
11

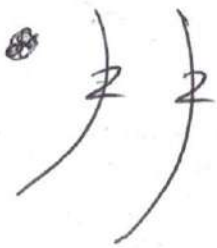


3) 7
Li
3

4) 9
Be
4

5) 14
N
7

6) 16
O
8



← Finish up by simply entering electron #

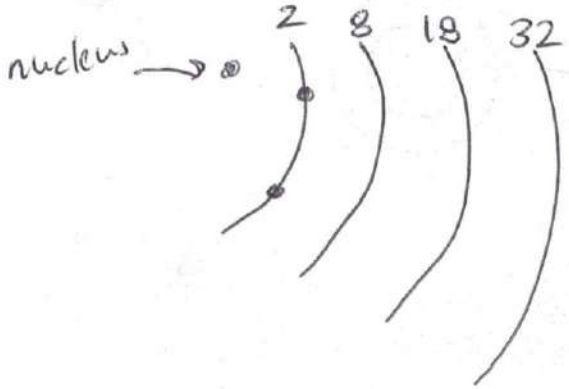
7) 28
Si
14

8) 4
He
2

9) 11
B
5

Recall - Electron Shells are filled as follows:

10) 20
Ne
10



Isotopes or Different Elements?

In each of the following statements, you are given a pair of elements and important information about each. Use this information to determine if the pair of elements are isotopes or different elements. Indicate your answer in the space provided.

1. Element D has 6 protons and 7 neutrons.
   Element F has 7 protons and 7 neutrons. — different element

2. Element J has 27 protons and 32 neutrons.
   Element L has 27 protons and 33 neutrons. — isotopes

3. Element X has 17 protons and 18 neutrons.
   Element Y has 18 protons and 17 neutrons. — different

4. Element Q has 56 protons and 81 neutrons.
   Element R has 56 protons and 82 neutrons. — isotopes

5. Element T has an atomic number of 20 and an atomic mass of 40.
   Element Z has an atomic number of 20 and an atomic mass of 41. — isotopes

6. Element W has 8 protons and 8 neutrons.
   Element V has 7 protons and 8 neutrons. — different

7. Element P has an atomic number of 92 and an atomic mass of 238.
   Element S has 92 protons and 143 neutrons. — isotopes

Name Key Period ~~Class~~

Chapter Using Science Skills: Applying conce

Check your answers

Atomic Dimensions

The table below contains information about several elements. Use this table to review the con cepts of atomic number, mass number, numbers of subatomic particles, isotopes, and charged ar uncharged atoms. In each case, enough information has been provided for you to fill in all the blanks.

Element	Symbol	Atomic Number	Mass Number	Number of Protons	Number of Neutrons	Number of Electrons
Aluminum	Al	13	27	13	14	13
Bromine	Br	35	80	35	45	35
Uranium	U	92	238	92	146	92
Helium	He	2	4	2	2	2
Helium (Isotope)	He	2	5	2	3	2
Lithium	Li	3	7	3	4	3
Tungsten	W	74	184	74	110	74
Xenon	Xe	54	131	54	79	54
Magnesium	Mg	12	24	12	12	12
Carbon	C	6	12	6	6	6
Carbon (Isotope)	C	6	14	6	8	6
Nitrogen	N	7	14	7	7	7

Typo "not 2"

(Check that these 3 columns are all equal)

Atomic Theorems 1-5

Notes — Thursday

#1 Atomic # = proton #

#2 Protons = electron count

#3 Atomic mass − atomic # = neutrons

#4 Protons + neutrons = ~~Atomic~~ mass

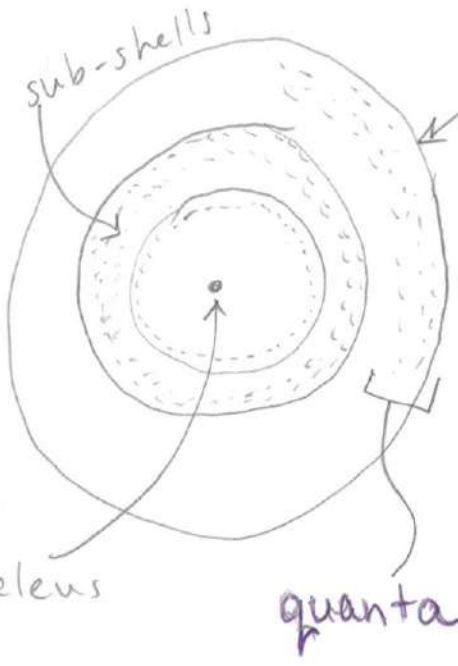
#5 Neutrons ≠ electrons

Electron Shells - electrons exist in discrete bands called "quanta" around the nucleus (# 1-6 total)

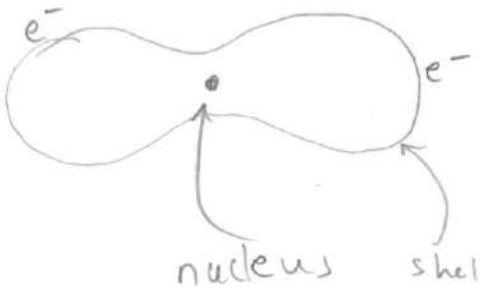
- quanta —like→ quantum theory

Sub-shells - each shell has multiple subshells labeled S, P, D, F

Shell	e^-
1	2
2	8
3	18
4	32



Sub Shell P



Check your answers 16

Subatomic Particles
Chapter 4
Physical Science

Name Key
Date _____ Period _____

	Atomic #	Symbol	Rounded Atomic Mass	P	N (mass − Proton =)	E
1.	32	Ge	73	32	41	32
2.	9	F	19	9	10	9
3.	40	Zr	91	40	51	40
4.	85	At	210	85	125	85
5.	19	K	39	19	20	19
6.	1	H	1	1	0	1
7.	38	Sr	88	38	50	38
8.	88	Ra	226	88	138	88
9.	60	Nd	144	60	84	60
10.	97	Bk	247	97	150	97
11.	81	Tl	204	81	123	81
12.	28	Ni	59	28	31	28
13.	16	S	32	16	16	16
14.	23	V	51	23	28	23
15.	101	Md	258	101	157	101
16.	57	La	139	57	82	57
17.	34	Se	79	34	45	34
18.	5	B	11	5	6	5
19.	53	I	127	53	74	53
20.	4	Be	9	4	5	4

16

Reading review

14-2 What are the parts of an atom?

Objective ▸ Name the three basic parts of an atom.

TechTerms

- **electron:** negatively charged particle
- **neutron:** neutral particle
- **nucleus:** center, or core, of an atom
- **proton:** positively charged particle

Structure of an Atom According to modern atomic theory, an atom has a center, or core, called the **nucleus.** In the nucleus are **protons** and **neutrons.** Protons are positively charged particles. Neutrons are neutral particles. Surrounding the nucleus is a cloud of very small particles called **electrons.** Electrons are negatively charged particles.

List: What are the three types of particles in an atom?

Thomson's Model The first scientist to suggest that atoms contain smaller particles was J. J. Thomson of England. In 1897, Thomson passed an electric current through a gas. He found that the gas gave off rays made of negatively charged particles. Today, these particles are known as electrons. Because atoms are neutral, Thomson reasoned that there must also be positively charged particles in an atom. Thomson hypothesized that an atom was made up of a positively charged material with electrons scattered evenly throughout.

Identify: What type of particles did Thomson discover in atoms?

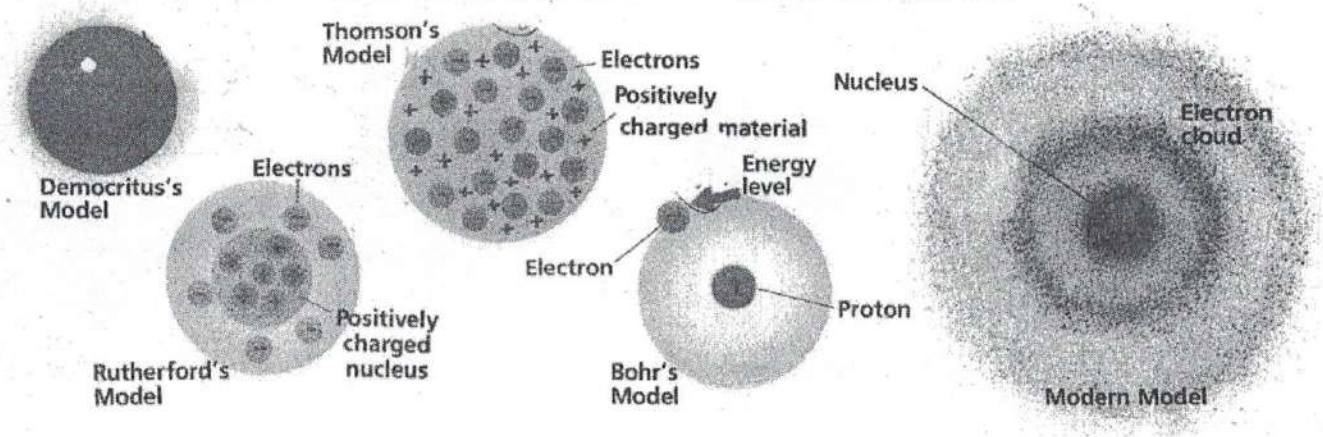
Rutherford's Model In 1908, a scientist from New Zealand named Ernest Rutherford performed an experiment to test Thomson's atomic model. Rutherford discovered that an atom is mostly empty space. He concluded that the protons are contained in a small central core. Rutherford called this core the nucleus.

Describe: What did Rutherford discover about an atom?

Bohr's Model Rutherford's model of the atom did not explain the arrangement of electrons. In 1913, the Danish scientist Neils Bohr proposed that electrons in an atom are found in energy levels. Each energy level is at a certain distance from the nucleus. Electrons in different energy levels move around the nucleus in different orbits, much as the planets move in orbits around the sun.

Scientists now know that the exact location of an electron cannot be predicted. Instead, energy levels are used to predict the place where an electron is most likely to be found outside the nucleus. This area is often called the electron cloud.

Locate: Where did Bohr say that electrons are found in an atom?



Reading review

14-4 What is atomic mass?

Objective ▸ Explain how to find the atomic mass and mass number of an atom.

TechTerms

- **atomic mass:** total mass of the protons and neutrons in an atom, measured in atomic mass units
- **mass number:** number of protons and neutrons in the nucleus of an atom

Mass of an Atom The mass of an atom is very small. Scientists cannot measure the mass of an atom in grams. In order to measure the mass of an atom, scientist have developed a special unit. This unit is called the atomic mass unit, or amu. One amu is equal to the mass of one proton. Neutrons and protons have the same mass. Therefore, one amu is also equal to the mass of one neutron. The mass of an electron is equal to 1/1836 amu. Because electrons are so small, only the masses of protons and neutrons are used to find the mass of an atom.

Infer: What is the mass, in amu, of an atom with one proton and two neutrons?

Atomic Mass Because atoms of different elements have different numbers of protons and neutrons, they also have different masses. The total mass of the protons and neutrons in an atom is called the **atomic mass.** Atomic mass is measured in atomic mass units.

Define: What is atomic mass?

Mass Number The total number of protons and neutrons in the nucleus of an atom is called the **mass number.** Each element has its own mass number. The mass number is equal to the atomic mass rounded off to the nearest whole number. You can find the number of neutrons in an atom by using this formula:

neutrons = mass number (protons + neutrons) − atomic number (protons)

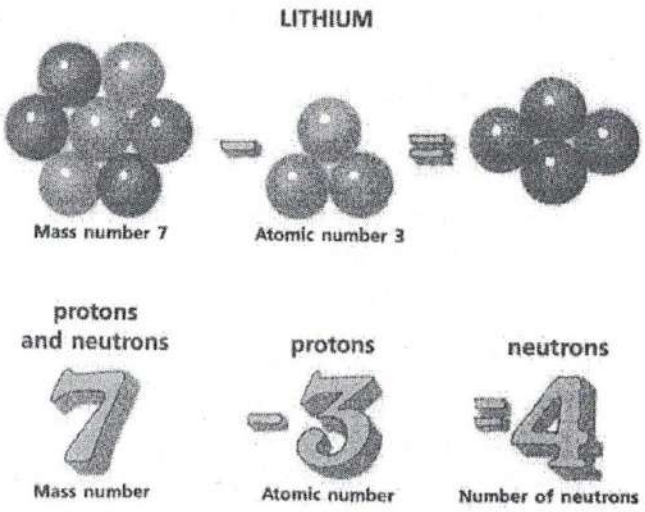


Table 1 lists the atomic numbers and mass numbers of some common elements. You can use this information to determine the number of protons, neutrons, and electrons in an atom of an element.

Table 1 Atomic Number and Mass Number

ELEMENT	SYMBOL	ATOMIC NUMBER	MASS NUMBER
Hydrogen	H	1	1
Helium	He	2	4
Carbon	C	6	12
Nitrogen	N	7	14
Oxygen	O	8	16
Sodium	Na	11	23
Aluminum	Al	13	27
Sulfur	S	16	32
Chlorine	Cl	17	35
Calcium	Ca	20	40
Iron	Fe	26	56
Copper	Cu	29	64
Silver	Ag	47	108
Gold	Au	79	197
Lead	Pb	82	207

Analyze: How many neutrons are in the nucleus of an atom of chlorine?

Reading review

14-6 How are electrons arranged in an atom?

2 8 18 32

Nucleus

electron Levels

Objective ▸ Describe how the electrons in an atom are arranged in energy levels.

TechTerm

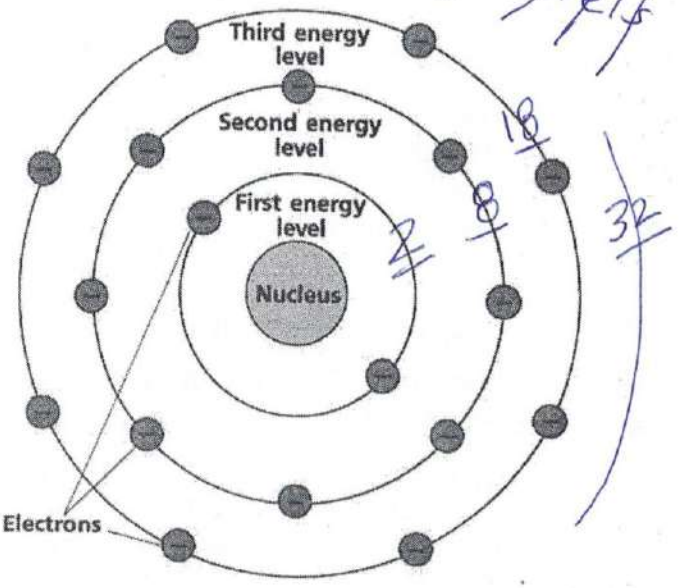
▸ **energy level:** place in an atom where an electron is most likely to be found

Electron Cloud Model For many years, scientists thought that electrons circled the nucleus of an atom in much the same way as planets orbit the sun. Scientists now know that it is not possible to predict the exact path of an electron. The area in an atom where electrons are likely to be found is often called the electron cloud. Scientists use the word "cloud" because they know that they cannot predict the exact location of electrons at any given time. The electron cloud is often compared to bees buzzing around a beehive.

Describe: What is the electron cloud?

Energy Levels In the modern atomic theory, electrons are arranged in **energy levels.** An energy level is the place in the electron cloud where an electron is most likely to be found. Each energy level is a different distance from the nucleus. The lowest, or first, energy level is closest to the nucleus. Electrons with higher energy are found in energy levels farther away from the nucleus.

Each energy level can hold only a certain number of electrons. The first energy level can hold only 2 electrons. The second energy level can hold 8 electrons. ~~Energy levels beyond the second level can hold up to 32 electrons.~~ For the first 20 elements, the electrons in an atom of an element fill up the energy levels in order, beginning with the lowest. An atom of helium has 2 electrons. These 2 electrons fill the first energy level. An atom of lithium has 3 electrons. Two of these electrons fill the first energy level. The third electron occupies the second energy level.



Predict: Where would you expect to find the 6 electrons in an atom of carbon?

Changing Energy Levels Electrons can move from one energy level to another. If an electron gains enough energy, it jumps to a higher energy level. If an electron loses enough energy, it drops back to a lower energy level.

Analyze: What causes an electron to change energy levels?