New Jersey Center for Teaching and Learning

Progressive Science Initiative

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AP Chemistry

Summer Assignment
"The Basics"

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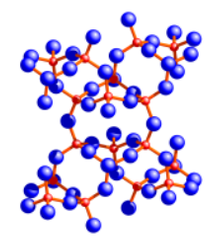
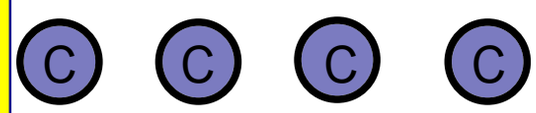
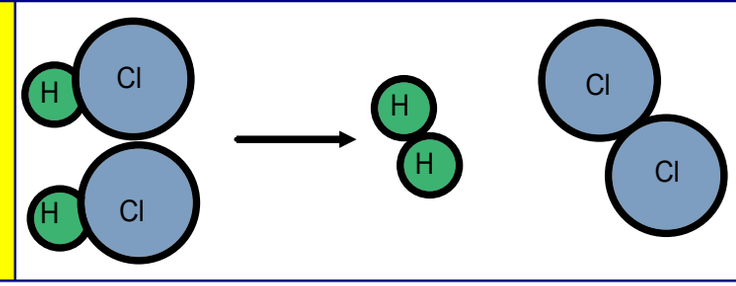
Dalton's Atomic Theory

By the late 1800's, scientists worldwide had adopted John Dalton's Atomic Theory as the best explanation for the behavior of matter.

Matter is composed of atoms, which are indivisible. Each compound consists of a set ratio of atoms.	
Atoms of same element are identical	
Atoms of different elements are different	
Atoms are not changed, created, or destroyed in a reaction, they are simply rearranged	

1 Which of the following were a part of Dalton's Atomic Theory?

A All matter is composed of atoms

B Atoms get rearranged in chemical reactions

C Atoms of the same element are identical

D A and B

E A, B, and C

Answer

2 Which of the following components of Dalton's theory was proved incorrect by the discovery of isotopes?

A All matter is composed of atoms

B Atoms are rearranged in chemical reactions

C Atoms of the same element are identical

D Both A and B

E A, B, and C

Answer

Protons, neutrons, and electrons

Atoms are composed of subatomic particles.

Protons and neutrons have similar masses (roughly 1 amu) and together constitute the mass number (A) of an atom.

# of protons + # of neutrons = mass number (A)

Protons, neutrons, and electrons

Each element consists of atoms which differ in the number of protons compared to atoms of different elements. The atomic number (Z) is equal to the number of protons in an atom.

# of protons = atomic number (Z)

Protons, neutrons, and electrons

If an atom is electrically neutral, the number of electrons and protons will be the same.

# of protons = # of electrons

(neutral atom)

Nuclide Symbols

There are two common ways the atomic mass and number are indicated for an atom.

Method 1: Provides all information

A < --- mass number

Symbol

Z < --- atomic number

119

Cs

55

or

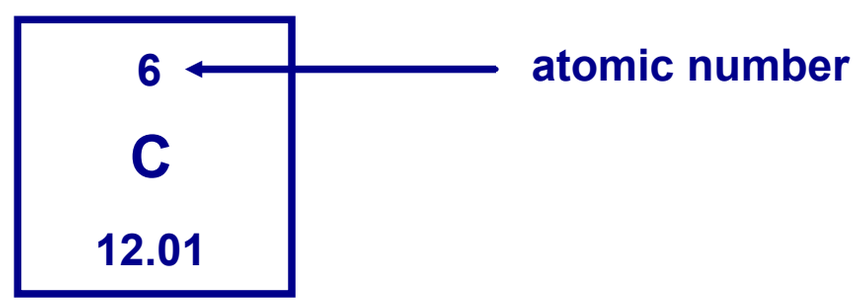
3

H

1

Method 2: Must look up atomic number on the periodic table.

Symbol - mass number Cs-199 or H-3



Nuclide Symbols & protons and neutrons

The number of protons and neutrons can be easily determined from the nuclear symbol.

Example: How many protons and neutrons are present in the following?

a) $^{220}_{88}Ra$

move for answer

b) Au - 197

move for answer

3 **Barium is used to help take X-rays of the digestive system of the human body. What is the atomic number of barium (Ba)?**

A 38

B 48

C 137

D 4

E 56

Answer

4 Which is the correct number of protons in an atom of vanadium (V)?

A 23

B 51

C 18

D 24

E 50

Answer

5 What is the mass of an element that has 10 protons and 11 neutrons?

Answer

6 How many neutrons are present in an oxygen atom with a mass of 18 amu?

Answer

7 What is the mass of an element with 18 protons, 18 electrons, and 22 neutrons?

Answer

8 How many neutrons are present in atom with a mass of 13 amu and an atomic number of 7?

Answer

9 How many neutrons are present in a neutral atom of Sr-80?

A 38

B 32

C 38

D 80

E 42

Answer

10 **How many electrons does this neutral element have?**

$^{23}_{11}Na$

Sodium Atom

Answer

11 **How many neutrons does this element have?**

$^{23}_{11}Na$

Sodium Atom

Answer

12 Which of the following has 45 neutrons?

A ^{80}Kr

B ^{80}Br

C ^{78}Se

D ^{103}Rh

Answer

Isotopes and a hole in Dalton's Theory

Dalton postulated that all atoms of a given element were identical. In the early 1900's scientists determined that certain atoms of lead were more stable than others - so there must be a difference!

The difference was in the mass of the different atoms of lead. Since the atoms were all lead they must have the same atomic number or number of protons. The difference in mass must be due to differing numbers of neutrons amongst the lead atoms!!

Atoms of the same element with differing numbers of neutrons are called <u>isotopes</u>!

Pb - 204		Pb - 206
82	protons	82
122	neutrons	124

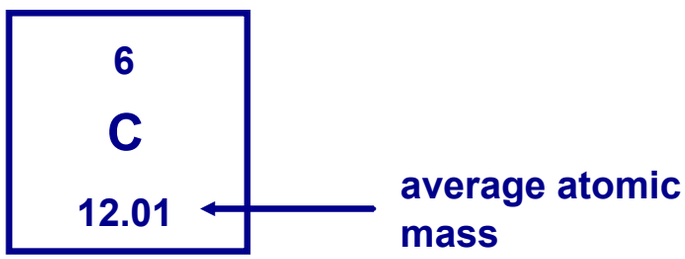
Average Atomic Mass

When one examines even the smallest sample of an element, there are hordes of atoms present. All of the stable isotopes of that element will be in the sample but not in the same abundance.

For example, in a sample of carbon atoms, roughly 99% of the atoms will be C-12 while 1% will be C-13. These percentages do not vary no matter where, when, or how the sample was taken.

Average Atomic Mass

The mass listed on the periodic table is a weighted ***average*** of the isotopes of that particular element.



**Note: The average atomic mass of carbon is much closer to 12 compared to 13. This is due to the much larger abundance of C-12.*

Calculating an Average Atomic Mass

To find the average atomic mass of an element simply find the sum of the contribution of each isotope by multiplying the mass of each isotope by it's abundance (expressed as a decimal instead of a %) and adding them all together.

Example: Neon consists of three stable isotopes: Ne-20, Ne-21, and Ne-22. If the relative abundance of these are 90.48%, 0.27%, and 9.25% respectively, what is the atomic mass of neon?

$$20(.9048) + 21(0.0027) + 22(0.0925) = 20.18 \text{ amu}$$

Calculating % Abundances from an Average Atomic Mass

If the average atomic mass is known, the % abundance of each isotope can be determined if the mass of each isotope is known.

Example: There are two stable isotopes of calcium: Ca -40 (39.96) and Ca -46 (45.95). Using the average atomic mass of calcium from the periodic table, calculate the % abundance of each isotope of calcium.

Step 1: Set the abundance of each isotope as equal to "x" and "y"
Both decimal abundances must add up to 1.

$x + y = 1$ so $y = 1-x$

Step 2: Solve for x using average atomic mass equation.

$39.96(x) + 45.95(1-x) = 40.08$ (from PT)

$-5.99x = -5.87$ --> $x = 0.98$ or 98%

98% Ca-40 and 2% Ca-46

13 Which pair of atoms constitutes a pair of isotopes of the same element?

A $^{14}_{6}X$ $^{14}_{7}X$

B $^{14}_{6}X$ $^{12}_{6}X$

C $^{17}_{9}X$ $^{17}_{8}X$

D $^{19}_{10}X$ $^{19}_{9}X$

E $^{20}_{10}X$ $^{21}_{11}X$

Answer

14 Which of the following is TRUE of isotopes of an element?

A They have the same number of protons

B The have the same number of neutrons

C They have the same mass

D They have the same atomic number

E A and D

Answer

15 An atom that is an isotope of potassium (K) must...

A Have 20 protons

B Have 19 neutrons

C Have 19 protons

D A mass of 39

E A total of 39 protons and neutrons

Answer

16 Which species is an isotope of ^{39}Cl?

A $^{40}Ar^{+}$

B $^{34}S^{2-}$

C $^{36}Cl^{-}$

D ^{80}Br

E ^{39}Ar

Answer

17 **Calculate the atomic mass of oxygen if it's abundance in nature is:**

99.76% oxygen-16,
0.04% oxygen-17, and
0.20% oxygen-18.

(liquid oxygen)

Answer

18 **Sulfur has two stable isotopes: S-32 and S-36. Using the average atomic mass on the periodic table, which of the following best approximates the natural relative abundances of these isotopes of sulfur?**

A 50% S-32 and 50% S-34
B 25% S-32 and 75% S-34
C 75% S-32 and 25% S-34
D 95% S-32 and 5% S-34
E 5% S-32 and 95% S-34

Answer

19 Copper has two stable isotopes, Cu-63 (62.93) and Cu-65 (64.93). Using your periodic table, determine the % abundance of each isotope of copper.

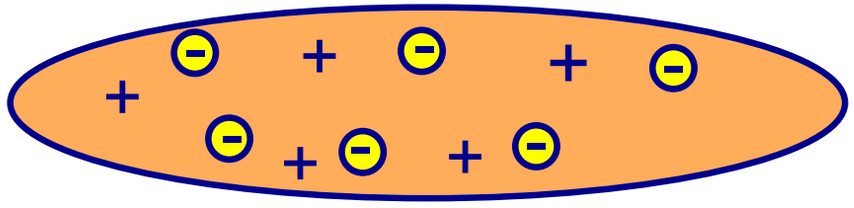
Answer

Atomic Models

The model of the atom has changed significantly over the years.

Plum Pudding Model

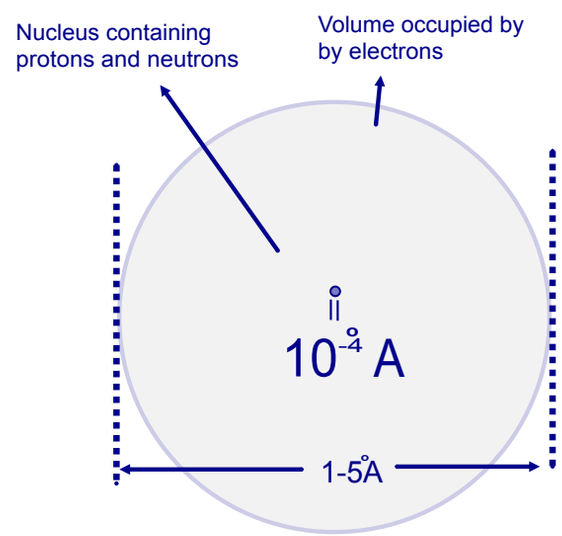
Protons and electrons are spread evenly throughout the atom



Atomic Models

Nuclear Model

Due to Rutherford's gold foil scattering experiment, it was determined the protons were clustered together in a highly dense nucleus. It was postulated that the electrons orbited this nucleus.



Interaction of Light and Matter

Scientists noticed that light interacted with matter on the subatomic scale. For example, light of the right frequency could dislodge an electron from an atom (photoelectric effect)

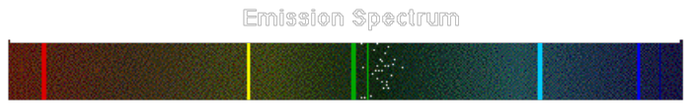
In order to understand atomic structure we must recall the basic properties of a wave - specifically waves of EM radiation.

Properties of a EM wave	Relationships between properties
Wavelength (λ)	$c = \lambda v$ and $E = hv$
Frequency (v)	$c = 3.00 \times 10^{8}$ m/s
Energy (E)	$h = 6.626 \times 10^{-34}$ J*s

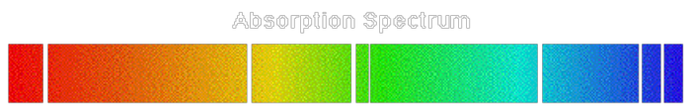
Energy and frequency are directly related while wavelength is inversely related to both.

Interaction of Light and Matter

Scientists noticed that atoms absorbed and emitted energy of only certain frequencies thereby creating absorption and emission spectra.



emission spectrum

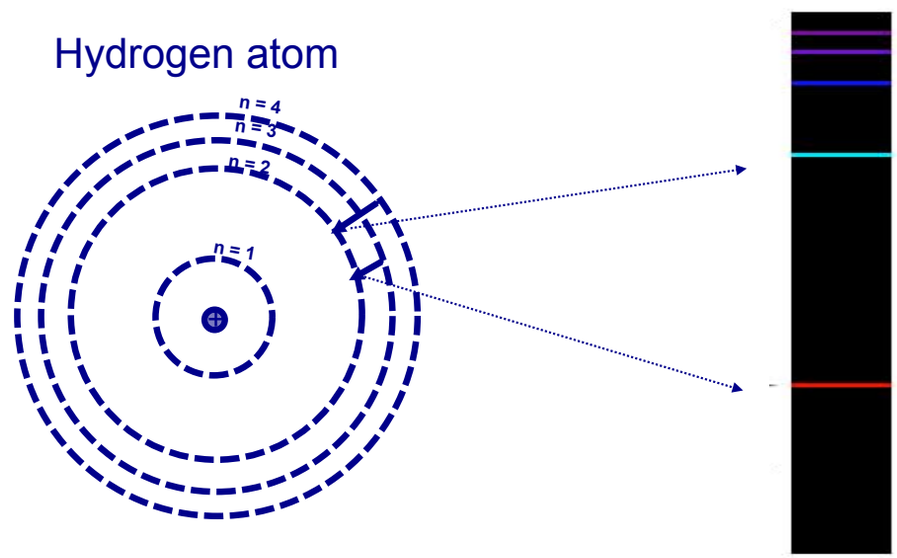


absorption spectrum

Atomic Models

Bohr Model

Neils Bohr explained these spectral lines by postulating that electrons were only able to exist in discrete orbits of differing energies around the atom.



The spectral lines were caused by electrons emitting energy as they transitioned from one specific orbit to another

Atomic Models

Quantum Model

Although successful on a number of "levels" *(haha - catch that chemistry humor?)*, the Bohr model proved insufficient as it could not explain why the electrons do not decay into the nucleus due to coulombic attractions.

de-Broglie proved these orbits could be stable but only if we pictured the electron as behaving as wave.

In 1927, electrons were shown experimentally to behave as waves, giving birth to the quantum model of the atom.

Atomic Models

Quantum Model

In the quantum model, we cannot know the exact location of an electron at any point, just a series of possible quantum states that are allowed - some of which are favored energetically for certain electrons over others.

These quantum states are described by four quantum numbers - each providing specific information.

Quantum #	Symbol	Describes	Possible Values
Principal	N	Main Energy Level	0, 1, 2 ....
Azimuthal	L	orbital (s, p, d, f)	0,1,2... (N-1)
Magnetic	ml	orbital orientation	-L <---> +L
Spin	ms	spin	+1/2 or -1/2

Atomic Models

Quantum Model

These quantum numbers serve as our basis for writing electron configurations - ie. diagraming the quantum states of electrons in an atom. This will be developed sufficiently in the course so will not be reviewed here but if you were weak on the subject - you will want to review "Models of the Atom and Periodic Table."

20 What experimental evidence prompted the rejection of the "plum pudding" model?

A The existence of spectral lines

B Atoms absorbed energy at the same frequencies it emitted them

C Electrons decayed into the nucleus over time

D Some Alpha particles were deflected when launched through metal foil

E The plum pudding model is still held today.

Answer

21 What experimental evidence, if TRUE, would not have supported the Bohr model of the atom?

A A few alpha particles were deflected when launched at metal foil

B Only specific frequencies of light were emitted by atoms

C Only certain frequencies of light were absorbed by atoms

D The discovery of the neutron

E A continous spectrum of light was emitted by atoms

Answer

22 Which of the following is TRUE regarding the properties of a wave?

A Energy and frequency are inversely related

B Wavelength and frequency are inversely related

C Energy and wavelength are directly related

D Both A and B

E Both A and C

Answer

23 What is the wavelength of light (in nm) of light with a frequency of 2.3×10^{15} 1/s?

Answer

24 What is the energy of a photon of light with a wavelength of 450 nm?

Answer

25 Which of the following quantum numbers determines the orbital an electron would be most likely found?

A Principal

B Azimuthal

C Magnetic

D Spin

Answer

26 Oxygen has it's outermost (valance) electrons in the 2nd main energy level. Which quantum number would describe the main energy level of these electrons?

A Principal

B Azimuthal

C Magnetic

D Spin

Answer

Periodic Table

Physical and Chemical Properties

Since the discovery of the first elements, attempts were made to group like elements together. Scientists used physical and chemical properties to do so.

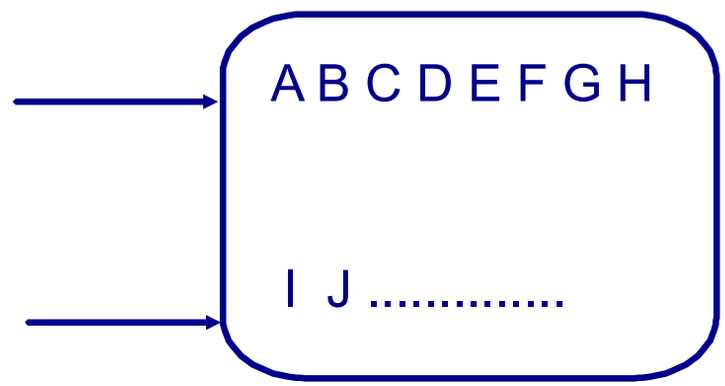
Recall the difference between physical and chemical properties:

Physical		Chemical
without substance changing	**OBSERVABLE?**	when substance changes
mass, density, BP MP, color, hardness	**EXAMPLES?**	reactivity

Evolution of Periodic Table

The first periodic tables noticed that if elements were ordered in increasing atomic mass, certain properties tended to repeat "periodically".

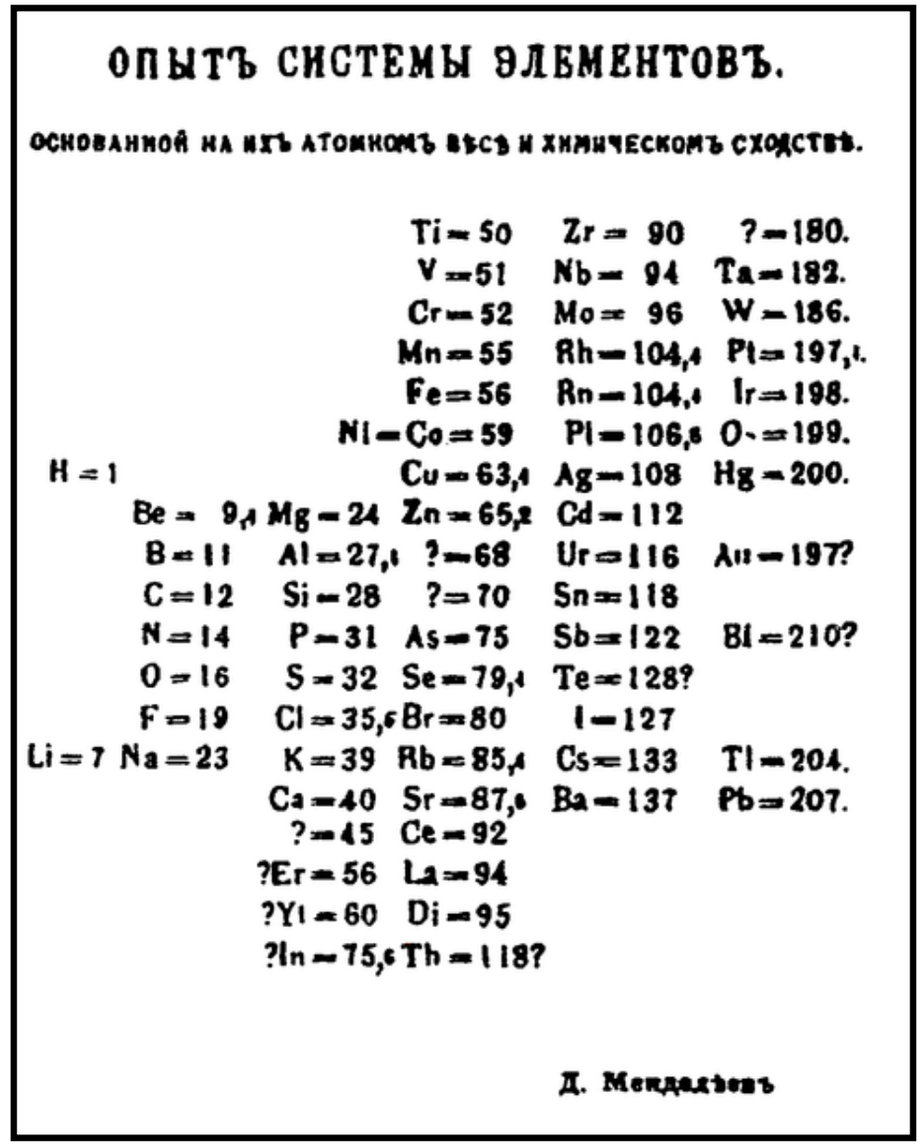
For example, what if elements A, B, C, D, E, F, G, H each had unique chemical properties and were ordered from lowest to highest mass. The next atom of higher mass, atom "I", was found to behave just like atom "A" did, and "J" just like atom "B" and so forth throughout the table.



The result is a table that groups atoms of similar properties.

Evolution of the Periodic Table

One of the first periodic tables! Notice that is flipped sideways to our periodic tables!



ОПЫТЪ СИСТЕМЫ ЭЛЕМЕНТОВЪ.

ОСНОВАННОЙ НА ИХЪ АТОМНОМЪ ВѢСѢ И ХИМИЧЕСКОМЪ СХОДСТВѢ.

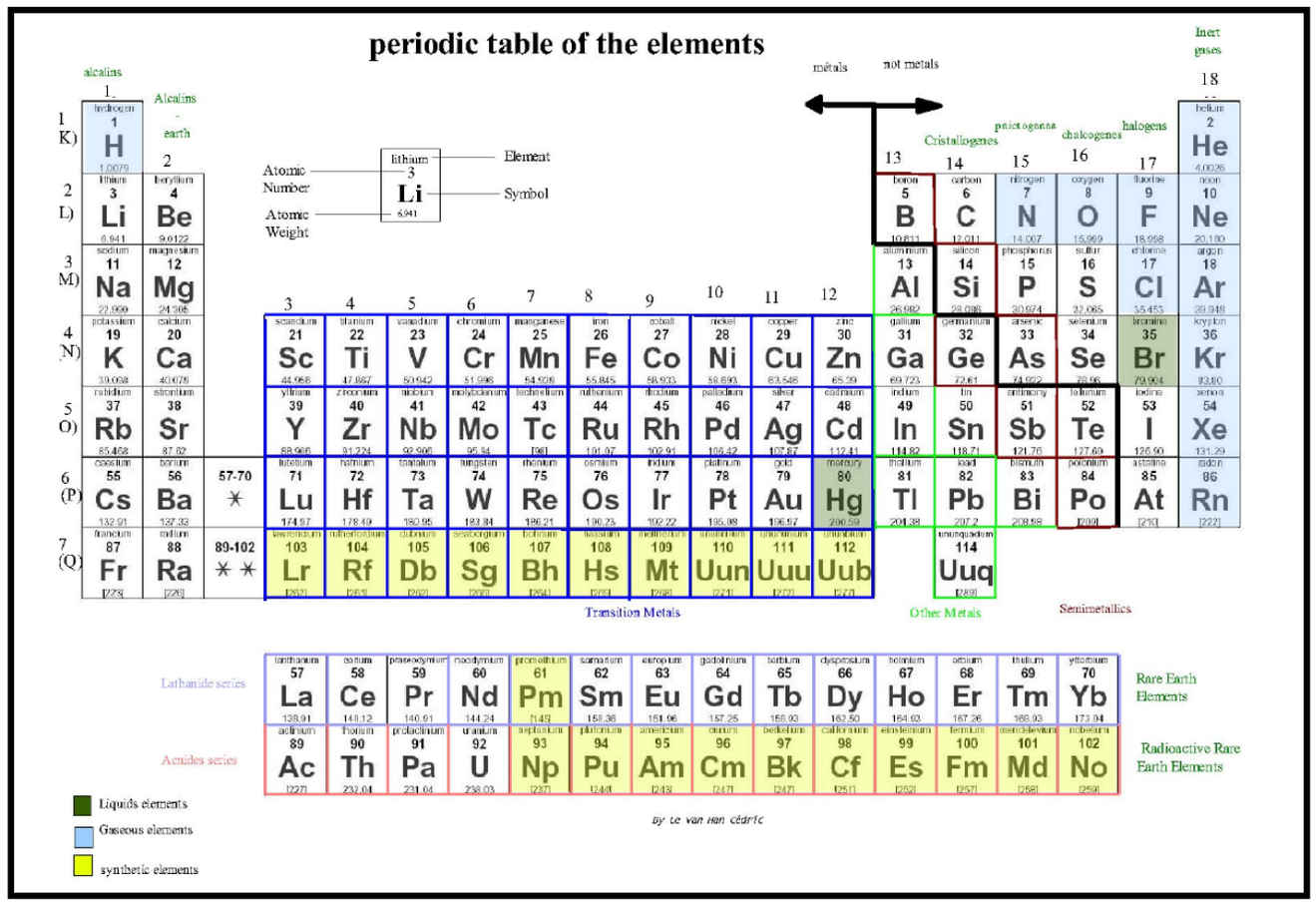
			Ti=50	Zr=90	?=180.
			V=51	Nb=94	Ta=182.
			Cr=52	Mo=96	W=186.
			Mn=55	Rh=104,4	Pt=197,4.
			Fe=56	Rn=104,4	Ir=198.
			Ni=Co=59	Pl=106,6	Os=199.
H=1			Cu=63,4	Ag=108	Hg=200.
	Be=9,4	Mg=24	Zn=65,2	Cd=112	
	B=11	Al=27,4	?=68	Ur=116	Au=197?
	C=12	Si=28	?=70	Sn=118	
	N=14	P=31	As=75	Sb=122	Bi=210?
	O=16	S=32	Se=79,4	Te=128?	
	F=19	Cl=35,5	Br=80	I=127	
Li=7	Na=23	K=39	Rb=85,4	Cs=133	Tl=204.
		Ca=40	Sr=87,6	Ba=137	Pb=207.
		?=45	Ce=92		
		?Er=56	La=94		
		?Yt=60	Di=95		
		?In=75,6	Th=118?		

Д. Менделѣевъ

The Modern Periodic Table

The modern periodic table is now arranged in order of increasing atomic number -

ie. an elements properties are a function of atomic number.



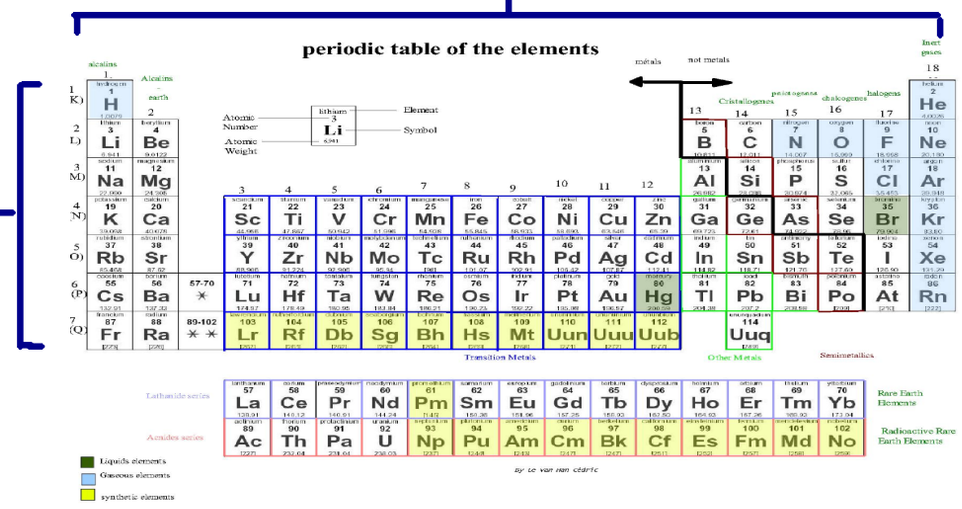
Groups and Periods

Horizontal rows are called ***periods or rows***

Vertical columns are called ***groups or families***. Elements within a group share similar chemical properties as they have the same number of valence electrons.

Groups

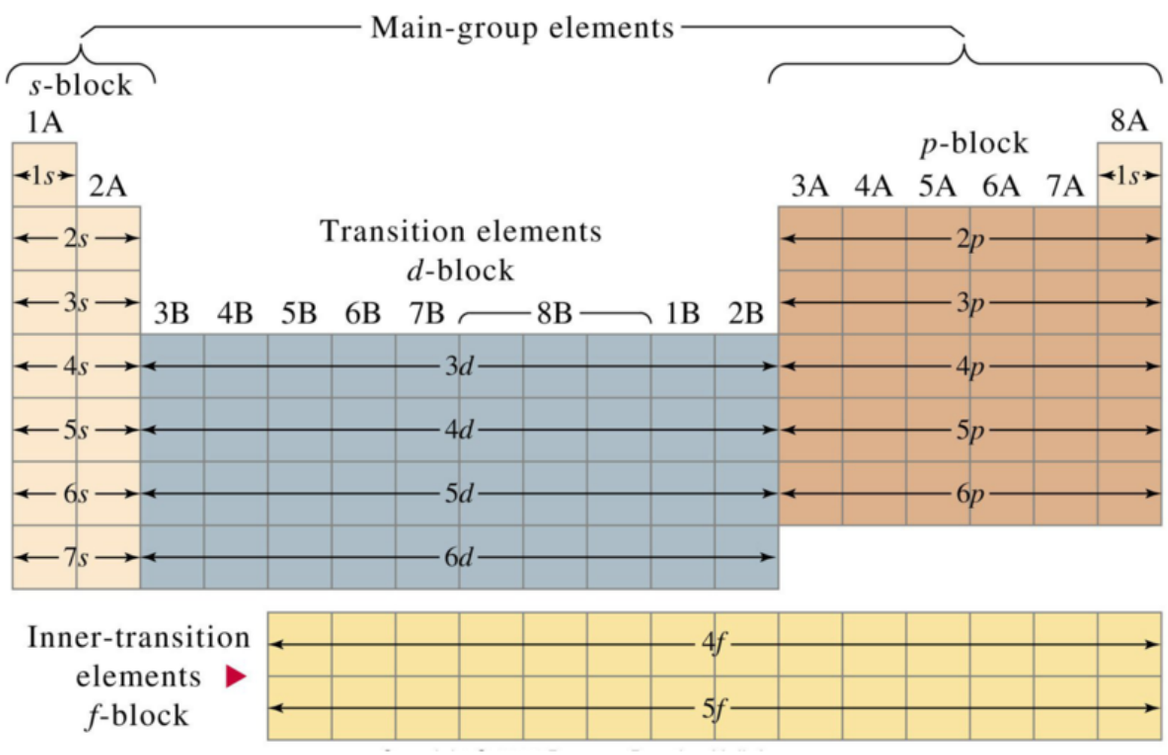
Periods



Quantum Numbers and the Periodic Table

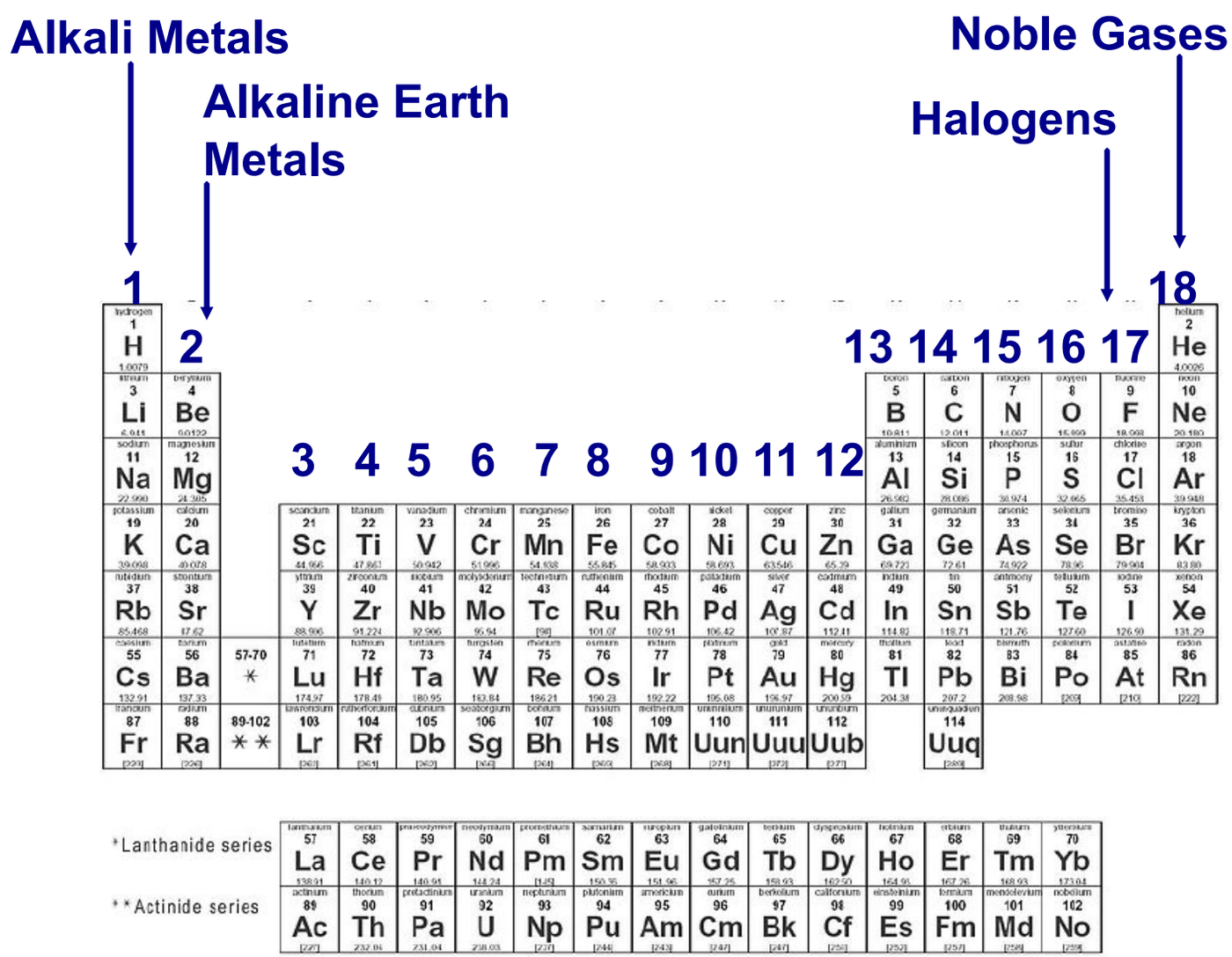
As we mentioned earlier, elements are grouped according to their chemical properties which are determined by the arrangement of their electrons. The arrangement of electrons is determined by the four quantum numbers.

The periodic table can be divided into regions where certain orbitals are filling.



Particular Group Names

Certain groups have specific names.



Ion Formation

Having a full outer s and p orbital is energetically favorable. Atoms will often gain or lose electrons to reach this state.

When atoms gain electrons, they become negatively charged.

$$F + e^- \rightarrow F^-$$

When atoms lose electrons, they become positively charged.

$$Ca \rightarrow 2e^- + Ca^{2+}$$

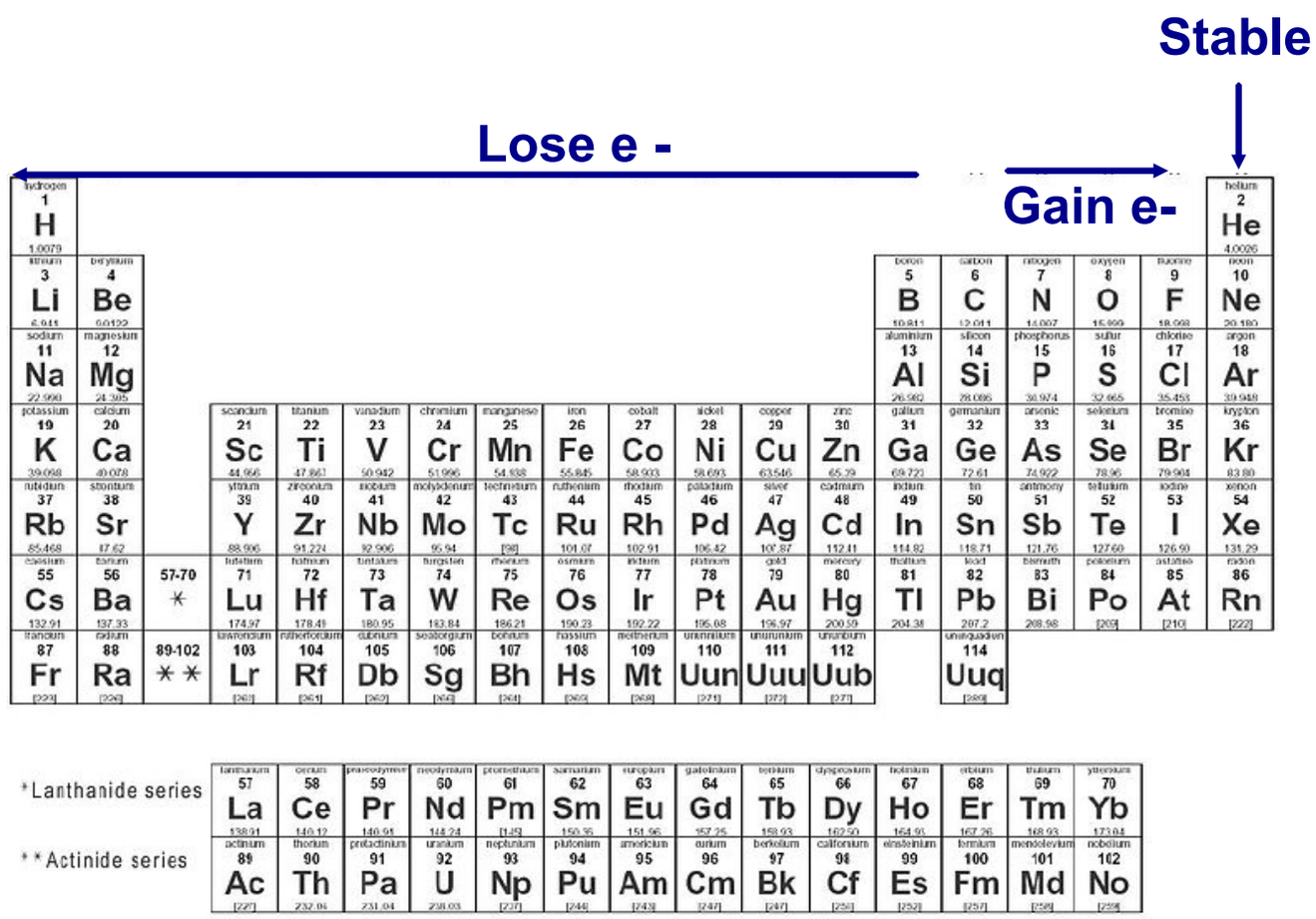
Any charged atom is called an ion.

- ion = anion

+ ion = cation

Groups and Ion Formation

Noble gases have a full outer energy level so they are inert or unreactive. The other groups of elements will have to lose or gain electrons to reach this stable state.



Predicting Charges

<u>Predict the charge of:</u>

a) Hydrogen ion:

H^+ or H^- (hydride)

b) Magnesium ion:

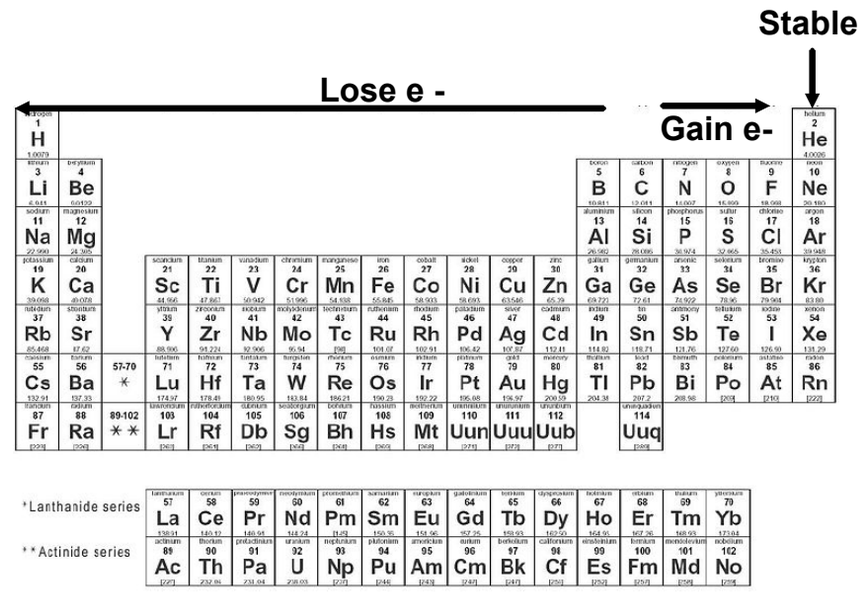
Mg^{2+}

c) Phospide ion:

P^{3-}

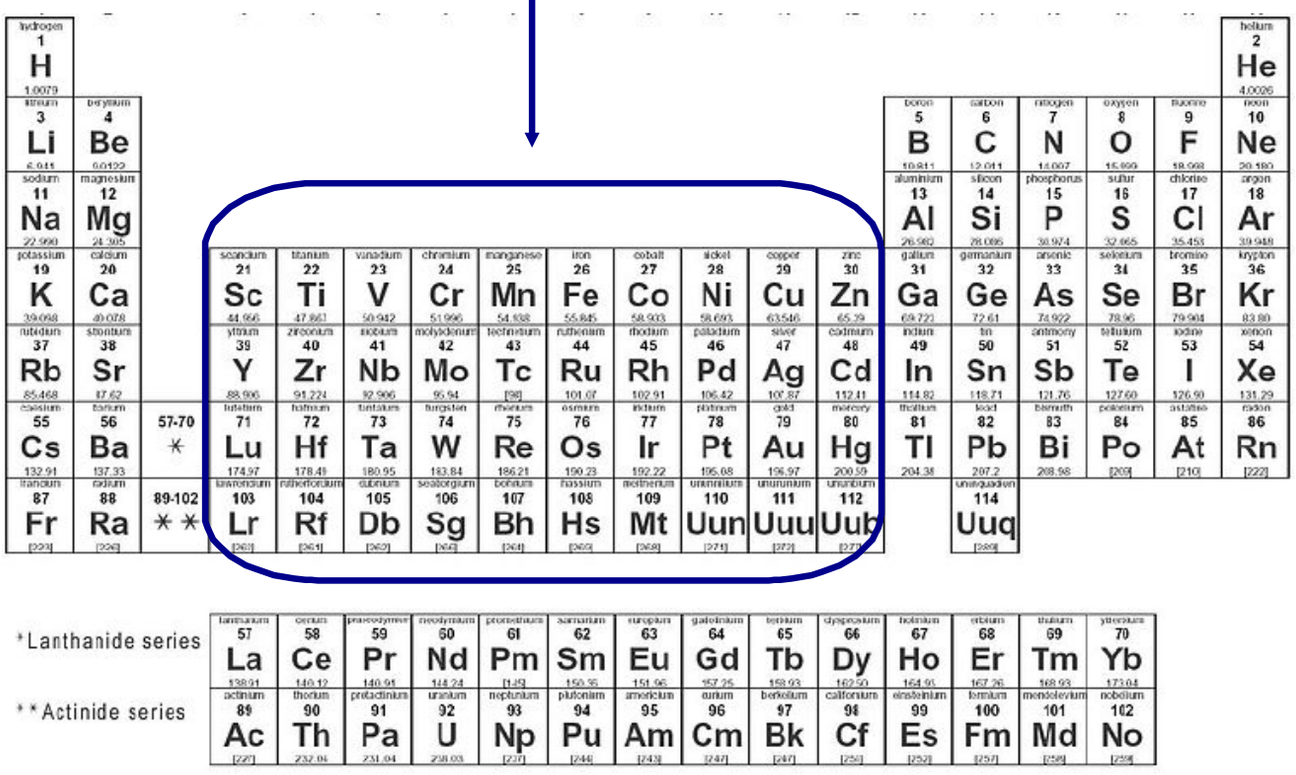
d) Selenide ion:

Se^{2-}



Predicting Charges

Transition or "d" block elements often lose their outermost "s" electrons and occasionally some "d" orbital electrons also. Their common ionic charge is therefore +2 but it cannot be predicted for most.



27 Which of the following describes the location of calcium on the periodic table?

A Period 4, Group 2 - The alkali metals

B Period 2, Group 4 - The alkali metals

C Period 2, Group 4 - The alkaline earth metals

D Period 4, Group 2 - The alkaline earth metals

Answer

28 Elements were organized into groups by reacting the element with oxygen and determining the formula of the oxide created. Was this a physical property they were observing?

Yes

No

Answer

29 Elements within the alkali metal group decrease in melting point as their atomic number increases. Is this a physical property that is being observed?

Yes

No

Answer

30 Which of the following is/are TRUE of our modern periodic table?

A Elements are arranged in order of increasing atomic mass

B Elements are arranged in order of increasing atomic number

C Elements in the same period share similar properties

D B and C

E A, B, and C

Answer

31 Which of the following is correctly matched?

A Na - halogen

B Ca - transition metal

C P = p block element

D Ni = noble gas

E O = s block element

Answer

32 Which of the following matches the correct number of electrons lost or gained needed to form the ion?

A Oxygen ion = lose 2 e-

B Aluminum ion = gain 3 e-

C Barium ion = gaine 2 e-

D Chloride ion = gain 2 e-

E Magnesium ion = lose 2 e-

Answer

33 What is the most likely charge on a gallium ion?

A +1

B -5

C +3

D +5

E No charge = it's a noble gas

Answer

34 Which of the following ions would be most difficult to predict the charge of?

A sodium ion

B bromide ion

C strontium ion

D chromium ion

E sulfide ion

Answer

Writing Formulas for Ionic Compounds

Recall that ionic compounds consist of positively charged metal ions bound to negatively charged non-metal ions.

The number of ions of each involved depends on how many of each is required to form a neutral compound.

Example: calcium oxide

Step 1: Find their charges:

Ca^{2+} O^{2-}

Step 2: Determine how many of each is required to form a neutral compound:

one of each is needed --> *CaO*

Writing Formulas for Ionic Compounds

Example: copper (I) oxide

Step 1: Find their charges:

Cu^{+} O^{2-}

Step 2: Determine how many of each is required to form a neutral compound:

two copper ions are required to balance the O2- charge

Cu_2O

Writing Formulas for Ionic Compounds

Example: aluminum sulfide

Step 1: Find their charges:

Al^{3+} S^{2-}

Step 2: Determine how many of each is required to form a neutral compound:

The least common multiple is 6.

$2 \times Al^{3+} = 6+$ AND $3 \times S^{2-} = 6-$

Al_2S_3

Ionic Compounds and Polyatomic ions

As you may recall, some ions are composed of multiple atoms bound together creating a charged species - these are known as polyatomic ions.

H^+ = proton
or hydrogen ion

or bicarbonate

Selected Polyatomic Ions			
H_3O^+	hydronium	CrO_4^{2-}	chromate
Hg_2^{2+}	dimercury(I)	$Cr_2O_7^{2-}$	dichromate
NH_4^+	ammonium	MnO_4^-	permanganate
$C_2H_3O_2^-$ / CH_3COO^-	acetate	NO_2^-	nitrite
		NO_3^-	nitrate
CN^-	cyanide	O_2^{2-}	peroxide
CO_3^{2-}	carbonate	OH^-	hydroxide
HCO_3^-	hydrogen carbonate	PO_4^{3-}	phosphate
$C_2O_4^{2-}$	oxalate	SCN^-	thiocyanate
ClO^-	hypochlorite	SO_3^{2-}	sulfite
ClO_2^-	chlorite	SO_4^{2-}	sulfate
ClO_3^-	chlorate	HSO_4^-	hydrogen sulfate
ClO_4^-	percholrate	$S_2O_3^{2-}$	thiosulfate

The formulas and charges of these ions MUST be memorized.

If it ends in "ite" or "ate" it's definitely a polyatomic ion.

Writing Formulas for Polyatomics

Writing formulas involving polyatomics is as easy as writing them for other ionic compounds.

Example: aluminum sulfite

Step 1: Find their charges:

Al^{3+} SO_3^{2-}

Step 2: Determine how many of each is required to form a neutral compound:

The least common multiple is 6.

$2 \times Al^{3+} = 6+$ AND $3 \times SO_3^{2-} = 6-$

$\mathbf{Al_2(SO_3)_3}$

Note the need for parenthesis. If more than 1 polyatomic ion is present parenthesis are required.

Writing Formulas for Polyatomics

Example: ammonium phosphide

Step 1: Find their charges:

NH_4^+ P^{3-}

Step 2: Determine how many of each is required to form a neutral compound:

The least common multiple is 3.

$3 \times NH_4^+ = 3+$ AND $1 \times P^{3-} = 3-$

$(NH_4)_3P$

Note the need for parenthesis. If more than 1 polyatomic ion is present parenthesis are required.

35 The formula for copper (II) sulfide is

A CuS_2

B CuS

C Cu_2S_2

D $(CuS)_2$

E Cu_2S

Answer

36 Which one of the following compounds is copper(I) chloride?

A $CuCl$

B $CuCl_2$

C Cu_2Cl

D Cu_2Cl_2

E Cu_3Cl_2

Answer

37 What is the formula for strontium bromide?

A $SrBr$

B $SrBr_2$

C Sr_2Br

D $BrSr_2$

Answer

38 What is the formula for sodium phosphide?

A SP_3

B NaP

C Na_3P

D NaP_3

Answer

39 The ionic compound formed between Ca and N is:

A CaN

B Ca_2N_2

C Ca_3N_2

D Ca_2N_3

Answer

40 The formula for aluminum phosphate is:

A $AlPO_4$

B $Al_3(PO_4)$

C $Al_2(PO_4)_3$

D $Al_3(PO_4)_3$

Answer

41 What would be the correct formula for cobalt(III) carbonate?

A Co_3CO_3

B Co_2CO_3

C $Co_2(CO_3)_3$

D $Co_3(CO_3)_2$

E $CoCO_3$

Answer

42 The formula for sodium hydroxide is

A $Na(OH)_2$

B $NaOH$

C $Na(OH_2)$

D $Na(HO)$

E $NaOH_2$

Answer

43 The formula for calcium sulfate is

A $CaSO_4$

B $Ca_2(SO_4)_2$

C $Ca(SO_3)$

D $Ca_2(SO_3)_2$

E CaS

Answer

44 How many nitrate ions are present in the formula of aluminum nitrate? (Write formula first to find out)

A 1
B 2
C 3
D 4
E 5

Answer

45 How many total ions (cations and anions) are present in the formula of lithium acetate?

A 1
B 2
C 3
D 4
E 5

Answer

PRACTICE
Writing Formulas for Ionic Compounds

Complete the table by filling in the formula for the ionic compound formed by each pair of cations and anions, as shown for the first pair.

ION	K^+	NH_4^+	Mg^{2+}	Fe^{3+}
Cl^-	KCl			
OH^-				
CO_3^{2-}				
PO_4^{3-}				

Mole Concept and Conversions

1 mole → 6.022×10^{23} particles

molar mass → mass (in grams) of 1 mole of any atom, molecule, or formula unit. This can be found on the periodic table.

molar volume → volume (in L) of 1 mole of any gas @STP = 22.4 L

Molarity → moles of solute dissolved in 1 liter of solution

Mole Concept and Conversions

Each of these equalities can be used to convert from one unit to another.

Example: Use molar mass to convert between g and mol

$$127 \text{ g Cu} \times \frac{1 \text{ mol Cu}}{63.55 \text{ g}} = 2.0 \text{ mol Cu}$$

Example: Use avogadro's number to get from particles to mol

$$3.01 \times 10^{23} \text{ molecules CO} \times \frac{1 \text{ mol CO}}{6.02 \times 10^{23} \text{ molecules CO}} = 0.5 \text{ mol CO}$$

Mole Concept and Conversions

A chemical formula provides the mole and thereby mass ratio of one substance to another.

Example: Using a formula to convert from mol "X" to mol "Y"

$$3 \text{ mol } Al_2S_3 \times \frac{3 \text{ mol S}}{1 \text{ mol } Al_2S_3} = 9 \text{ mol S}$$

Example: Using a formula to convert from g "X" to g "Y"

$$75 \text{ g } Al_2S_3 \times \frac{96 \text{ g S}}{150 \text{ g } Al_2S_3} = 48 \text{ g S}$$

Mole Concept and Conversions

The law of conservation of mass can be used to determine how much of an element must have reacted or been produced in a chemical reaction.

Example: If 61 g of $KClO_3$ decompose, how many grams of oxygen gas (O_2) can be produced?

$$61 \text{ g } KClO_3 \times \frac{48 \text{ g O}}{122 \text{ g } KClO_3} = 24 \text{ g O} = 24 \text{ g } O_2(g)$$

Mole Concept and Conversions

Practice

What is the mass of 2.4 moles of Cu_2O?

move for answer

How many ions of S are in 3.5 moles of Al2S3?

move for answer

Mole Concept and Conversions

More Practice

How many grams of H_2S in a 11.2 L sample @STP?

move for answer

How many grams of ammonium oxide would contain 50.0 grams of N?

move for answer

46 Which contains more atoms of fluorine?

A 11 grams of F_2 gas

B 22 grams of CaF_2 solid

C 22 grams of LiF

D 11 grams of HF

E They all contain the same number of atoms of F

Answer

47 Which sample contains more moles of water?

A 0.34 grams of water

B 0.34 L of water vapor @STP

C 7.8 x 1023 molecules of water

D 1.2 moles of water

E They all contain the same number of moles of water

Answer

48 What is the molar mass of calcium nitrite(write the proper formula first)?

Answer

49 How many oxygen atoms are present in a 240 gram sample of calcium nitrite?

Answer

50 If 36 grams of water are decomposed completely, how many grams of hydrogen gas could be produced?

Answer

51 A hydrated crystal contains water bound within. How many grams of water can be extracted from 500 grams of $CuSO_4*5H_2O$?

Answer

Molarity

Recall that Molarity is defined as (moles solute/L solution)

Solute - what is dissolved

Solution - mixture of solute and solvent

What is the molarity of a 250 mL aqueous solution containing 23 grams of NaCl?

$$23 \text{ g NaCl} \times \frac{1 \text{ mol NaCl}}{58 \text{ g NaCl}} = 0.40 \text{ mol NaCl}$$

$$\frac{0.40 \text{ mol NaCl}}{0.250 \text{ L solution}} = 1.6 \text{ M (mol/L)}$$

Molarity

How many moles of ammonium ions are present in 120 mL of a 3.4 M aqueous ammonium carbonate solution?

$$M = \frac{mol}{L} \qquad L \times M = mol$$

$$0.120\ L \times \frac{3.4\ moles\ (NH_4)_2CO_3}{1\ L} \times \frac{2\ mol\ NH_4^+}{1\ mol\ (NH_4)_2CO_3} =$$

0.818 mol NH_4^+

52 Which of the following would contain a higher concentration of nitrate ions?

A 100 mL of 0.22 M $NaNO_3$

B 100 mL of 0.022 M $Ca(NO_3)_2$

C 50 mL of 0.24 M $Ca(NO_3)_2$

D 50 mL of 0.15 M $Al(NO_3)_3$

E They all contain the same number of moles of nitrate ion

Answer

53 What is the M of solution prepared by adding water to 34 grams of NaOH in order to reach a total solution volume of 220 mL?

Answer

54 What volume of solution would be required to prepare a 0.25 M aqueous solution from 20 grams of solid $CaCl_2$?

Answer

55 Assuming all of the HCl dissolves, what is the molarity of an aqueous solution prepared by bubbling 10 L of HCl(g) @STP into water with a total solution volume of 450 mL?

Answer

Obviously we didn't review all of our general chemistry concepts but we did review enough to be ready for the big leagues!

Let's start AP Chemistry!!