Chemistry SOL Review

1. Laboratory Safety

- Always wear ~~goggles~~!
- Never ~~taste~~ chemicals!
- To smell a chemical ~~waft~~!
- When mixing solutions ADD ~~acid~~ to ~~water~~!
- Always rinse chemicals off skin with water!

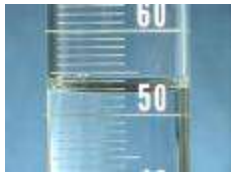
Chemistry SOL Review—Scientific Investigation

Safety

What to you do if you spill anything on yourself in the lab?

Identify three things that are unsafe in the picture below:

2. Lab Equipment



- Balance – measures mass in g, mg, kg
- Beaker/Erlenmeyer Flask – measures volume in ~~mL, L~~
- Graduated Cylinder – measures volume
- Pipet – measures volume
- Crucible – used for ~~heating~~

3. Scientific Method

Parts of an Experiment

- Independent variable: variable changed on purpose—goes on x-axis
- Dependent variable: responding variable—goes on y-axis
- Control experiment: experiment where the independent variable is set to zero
- Constants: variables that are kept constant during a set of trials

Analyze the following experiment and identify the control experiment, independent variable, dependent variable, and constants.

A student designed this experiment to determine the effect of dissolving calcium chloride on water temperature. Different amounts of calcium chloride were added to room temperature water and the final temperature recorded.

	Trials			
	1	2	3	4
mL water	50	50	50	50
Starting water temperature	20˚C	20˚C	20˚C	20˚C
grams $CaCl_2$	0	5	10	15
Final Water Temperature	20˚C	26˚C	31˚C	37˚C

4. Percent Error

- Used to tell how “off” you are from the value you should have gotten. Used mostly in lab.
- Ex: The specific heat capacity of iron is 0.45 J/gC. A student uses a calorimeter to experimentally determine the specific heat of iron to be 0.60 J/gC. What is the student’s percent error?

(Accepted – experimental)/Accepted X 100

(0.45 – 0.60)/0.45 x 100

5. Graphing

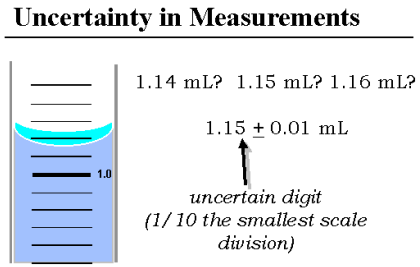
- Indirect Relationship

- Direct Relationship

6. Scientific Notation

- Ex: 2.5×10^{-3}
- If the exponent is negative then the number in standard notation is smaller than 1
- If the exponent is positive then the number in standard notation is greater than 1

7. Uncertainty and Significant Figures



- When taking a measurement, always measure one decimal place past the scale of your instrument. For instance, the graduated cylinder to the left is measured with a 0.1 scale. The measurement recorded is 1.15 mL (1 place past the scale of the instrument). The "5" is the digit we are uncertain about.

Significant Figures in Measurements:

- Non-zero digits are always significant.
- Any zeros between two significant digits are significant.
- A final zero or trailing zeros in the decimal portion ONLY are significant

How many significant figures does each number below contain?

123 3 103 3 0.001 1 10300. 5 10300 3 0.003010 4

8. Uncertainty and Significant Figures

- Addition and Subtraction
  - The answer cannot have more places after the decimal than your measurement with the fewest places after the decimal.
  - Ex: 2.59 + 2.3 = 2.9
  - 4.506 cm + 2.9 cm = 7.406 → 7.4 cm
  - 2.5 g - .36 g = 2.14 → 2.1 g
- Multiplication and Division
  - The answer cannot have more significant figures than your measurement with the fewest number of significant figures.
  - Ex: Ex: 2.500 x 2.0 = 5.0
  - 6.5 x 3 = 19.5 → 20
  - 100 / 4.00 = 25.00 → 30

9. Precision vs. Accuracy

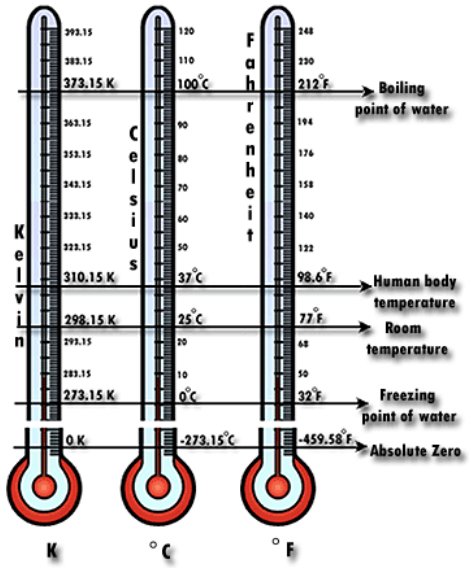
- Precision - repeatability of results
- Accuracy - getting the “right” answer

  – 0.200 cm
  – 0.190 cm
  – 0.201 cm

  (accepted value = 0.201 cm)

- How would you describe these results?
  – Accurate, but not precise

10. Temperature Conversions



- Celsius → Kelvin
  - K = C + 273
- What is human body temperature in Celsius, Fahrenheit, and Kelvin?

K = ~~392.98~~ C = 119.88

11. Density

- D = mass/volume
  - Units = g/mL, g/cm^3
- Density determines whether or not an object will:
  - Sink or Float
- If an object has a mass of 5.0 g and a density of 20.0 g/mL, what is the volume of the object?
  - 20.0 g/mL = 5.0 g/V

  V = 0.25 mL
- A graduated cylinder is filled to the 10.0 mL line with water. A cube of tin (density = 7.3 g/mL) is placed in the graduated cylinder. The water level in the graduated cylinder rises to 20.0 mL. What is the mass of the cube of tin?
  - 7.3 g/mL = m/10 mL

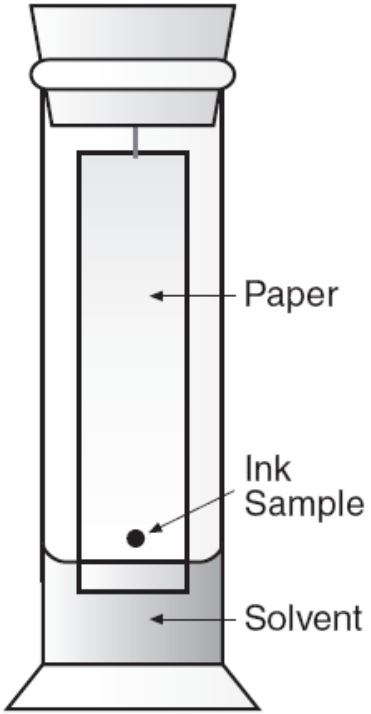
  M = 73 g

12. Metric Conversions

- 1000 mL = 1 L
- 1000 mm = 1 m
- 100 cm = 1m
- 1000 m = 1 km

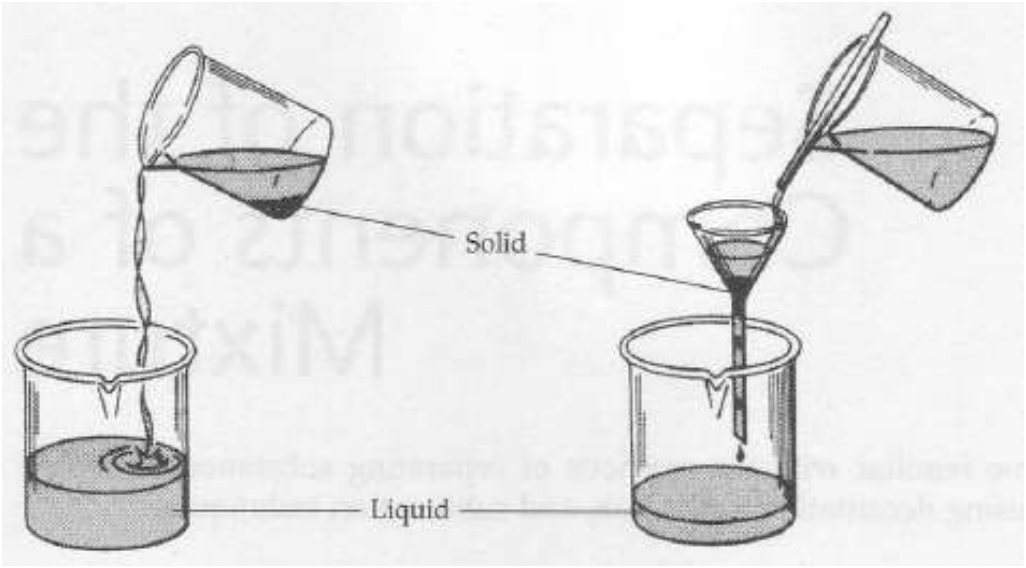
- My house is 2.5 km from Deep Run. What is this distance in meters?
  - 2.5 km → 2500 m

13. Separating Mixtures



The figure shows an experimental setup used to separate the components of a colored ink sample. Which of the following describes this laboratory technique?

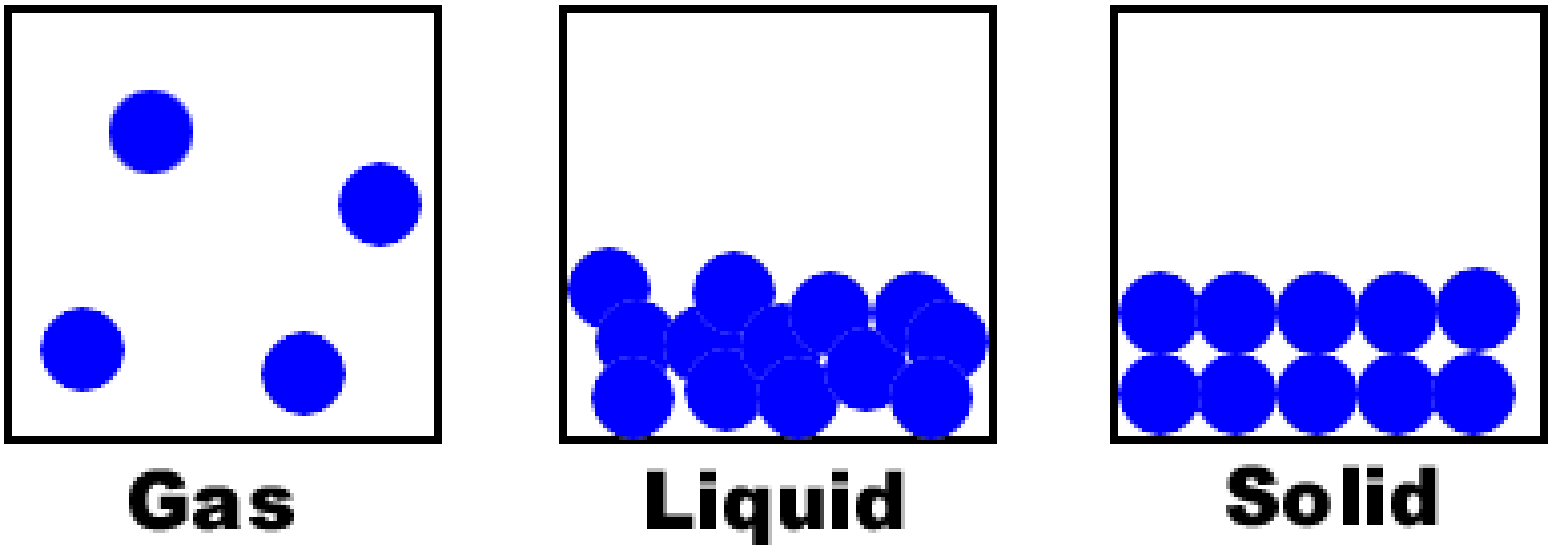
A Chromatography
B Filtration
C Decanting
D Distillation



This figures shows an experimental setup used to separate solids form liquids. Which laboratory technique is shown on the right?

A. Chromatograhy
B. Filtration
C. Decanting
D. Distillation

14. Properties of States of Matter



15. Intermolecular Forces

Intermolecular Attractions and Molecular Properties

As intermolecular forces increase, the molecules are held more strongly together.

Solids resist melting because melting requires breaking intermolecular attractions and reforming new ones as the molecules slide past each other.

Liquids resist boiling because the liquid molecules will have to overcome the intermolecular attraction of the other liquid molecules to enter the gas phase.

16. Chemical and Physical Changes

- Physical Changes:
  - changes that do not affect the composition of the substance
  - Any change in the state of matter of a substance is a PHYSICAL change!
  - Solid → liquid = melting
  - Liquid → solid = freezing
  - Liquid → gas = evaporation
  - Gas → liquid = condensation
  - Solid → gas = sublimation

16. Chemical and Physical Changes

- Chemical Changes:
  - changes in which a new substance is formed

- What are four signs that a chemical reaction has occurred?
  - Bubbles
  - Color Change
  - Heat Absorbed or Released
  - Precipitate formed

17. Specific Heat Capacity

- Specific heat capacity:
  - the amount of energy required to raise the temperature of 1 g of a substance by 1 degree Celsius

- If an object has a _low_ specific heat capacity, it heats up quickly.
- If an object has a ~~high~~ specific heat capacity, it heats up slowly.

- J/g°C

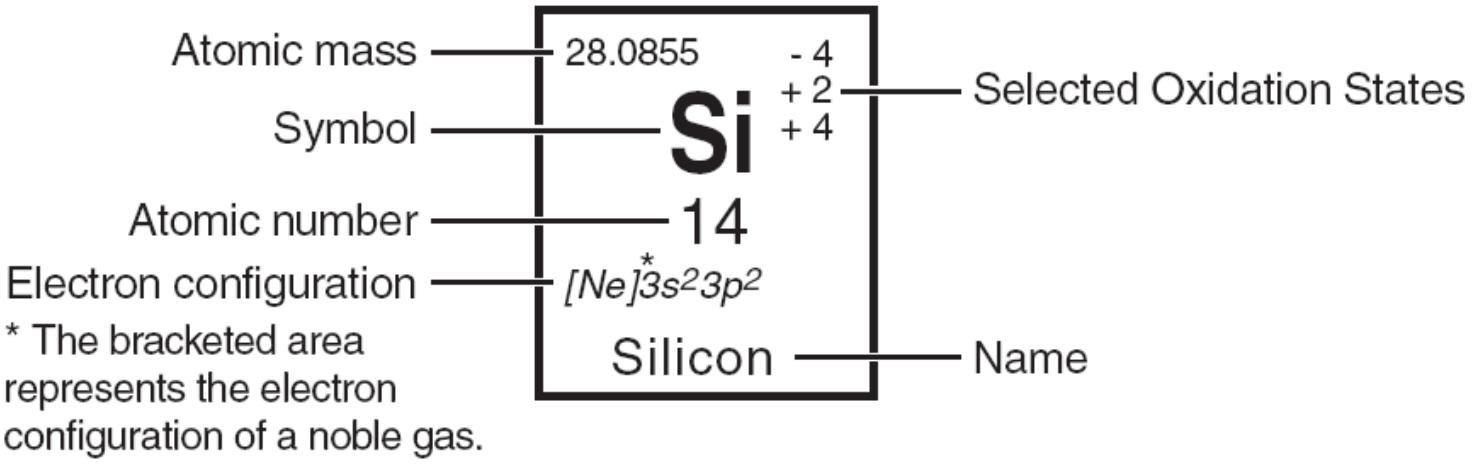
- *A 5.0 g object is heated from 25 C to 45 C. If it has a specific heat of 4.5 J/*g°C*, what is the heat generated by the object?*

18. Atomic Structure

Using the SOL Periodic Table

Let's use the periodic table to answer some questions about Silicon.

How many protons does Silicon have?



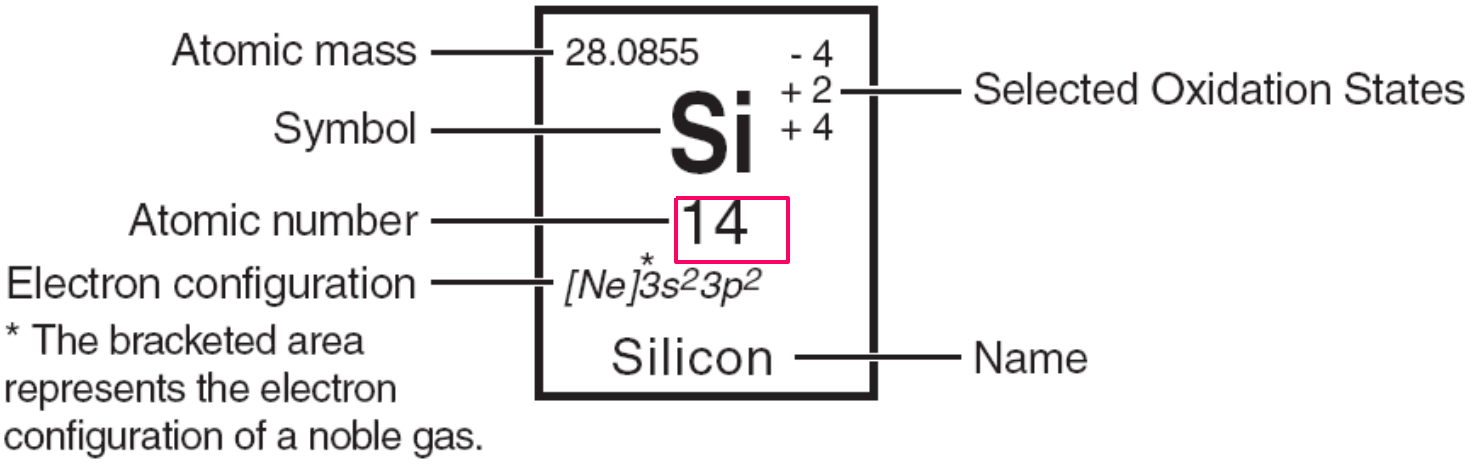
Atomic Structure

Using the SOL Periodic Table

Let's use the periodic table to answer some questions about Silicon.

How many protons does Silicon have? 14 protons = atomic number.

How many electrons does neutral Silicon have?



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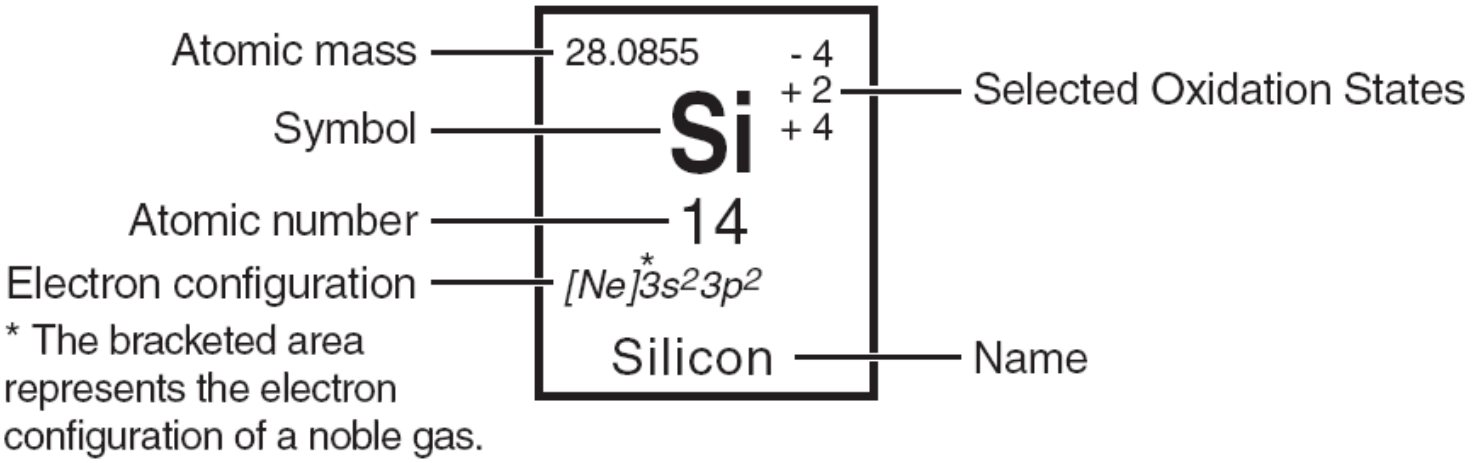
How many electrons does neutral Silicon have? 14 electrons (# electrons = # protons in neutral atoms)

How many neutrons does Silicon-30 have?



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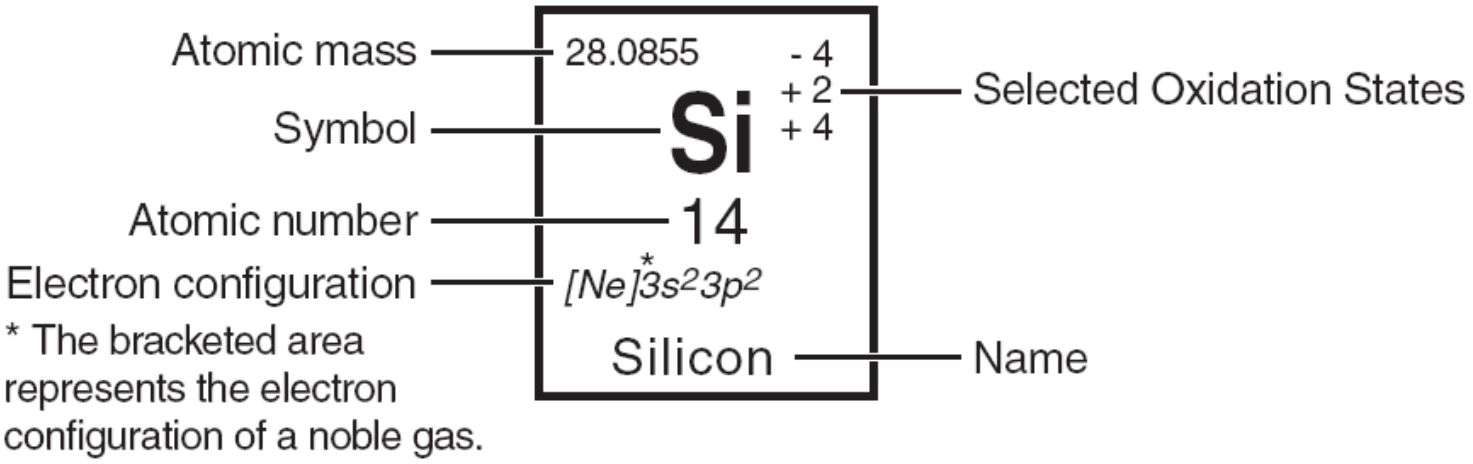
How many neutrons does Silicon-30 have? 16 neutrons. Silicon-30 is an isotope of Silicon. It has a mass number of 30. The mass number is protons + neutrons.



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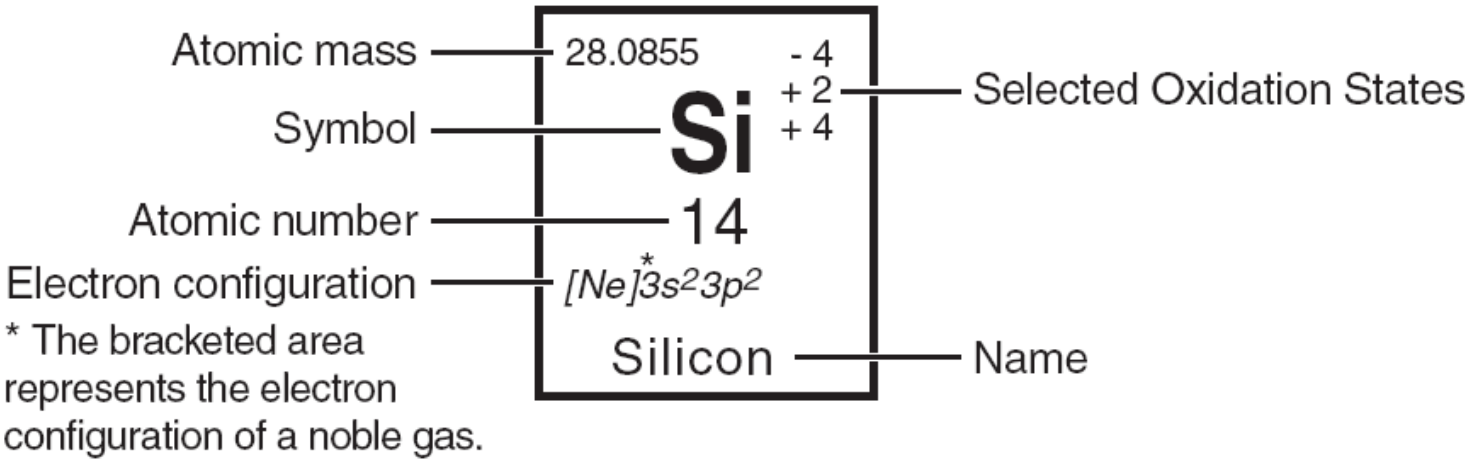
What is the molar mass of Silicon?



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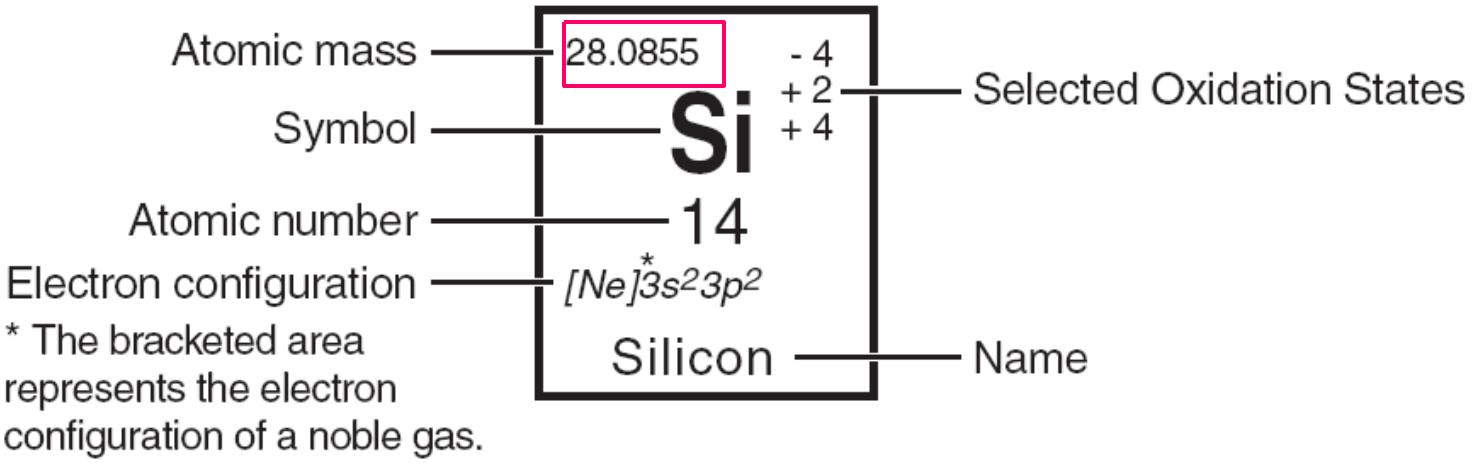
How many neutrons does Silicon-30 have? 30 neutrons. Silicon-30 is an isotope of Silicon. It has a mass number of 30. The mass number is protons + neutrons.

What is the molar mass of Silicon? 28.0855 grams/mole (this is the same as the atomic mass on the periodic table)



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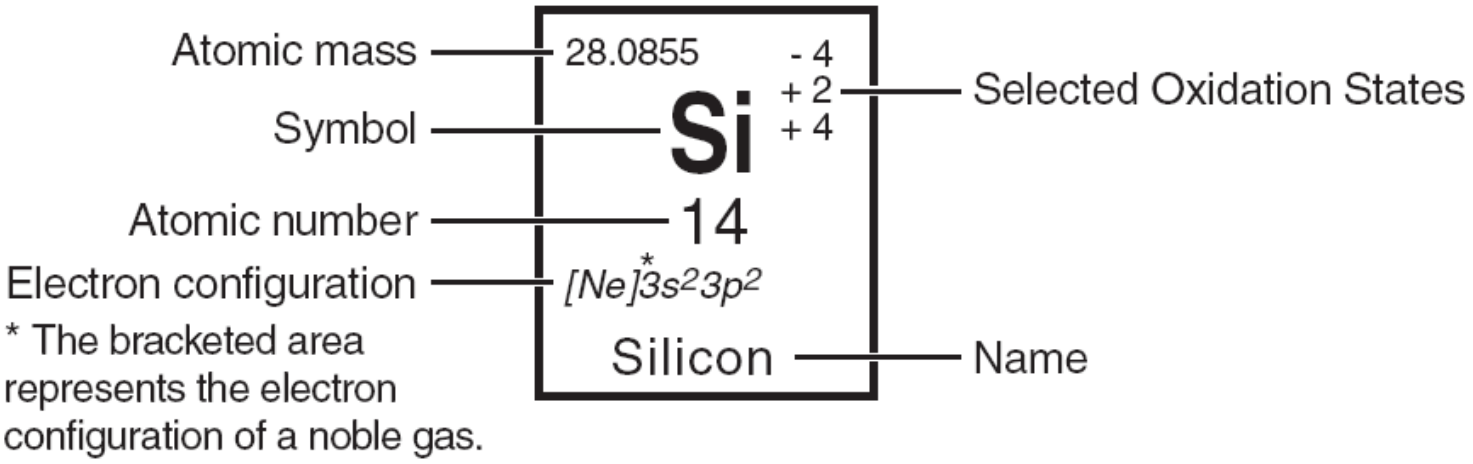
How many valence electrons does Silicon have?



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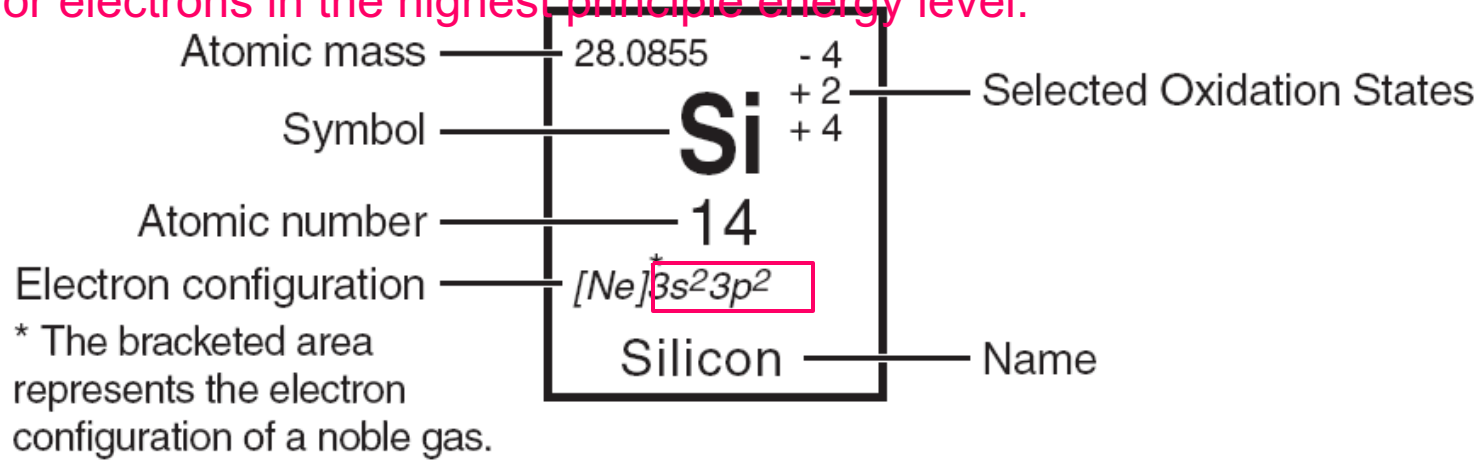
What is the molar mass of Silicon? 28.0855 grams/mole (this is the same as the atomic mass on the periodic table)

How many valence electrons does Silicon have? 4 valence electrons. Look for electrons in the highest principle energy level.



18. Atomic Structure

- Protons – found in nucleus have charge of +1
- Electrons – found in electron cloud have charge of -1
- Neutrons – found in nucleus have charge of 0

- The number of protons always equals the number of electrons in a neutral atom.
- In a magnesium ion, there are 2 more electrons than protons giving the ion a total charge of +2.
- In a phosphide ion, there are 3 more electrons than protons giving the ion a total charge of -3.

- ONLY ELECTRONS CAN BE LOST OR GAINED!!!

19. Isotopes/Ions/Atomic Structure Review

- Isotopes – atoms of the same element with different numbers of neutrons .
- Ions - charged particles

Symbol	Atomic Number	Atomic Mass	# protons	# neutrons	# electrons	Charge
P	15	31	15	16	15	0
Cl^-	17	35	17	18	18	-1
Ca^{2+}	20	40	20	20	18	+2
$^{37}_{17}Cl$	17	37	17	20	17	0

20. Average Atomic Mass

- The average atomic mass is an ~~average~~ of all the isotopes of an element.
  - (This is why the atomic mass on the periodic table is a decimal. That should make sense – you can't have .01 neutrons!)

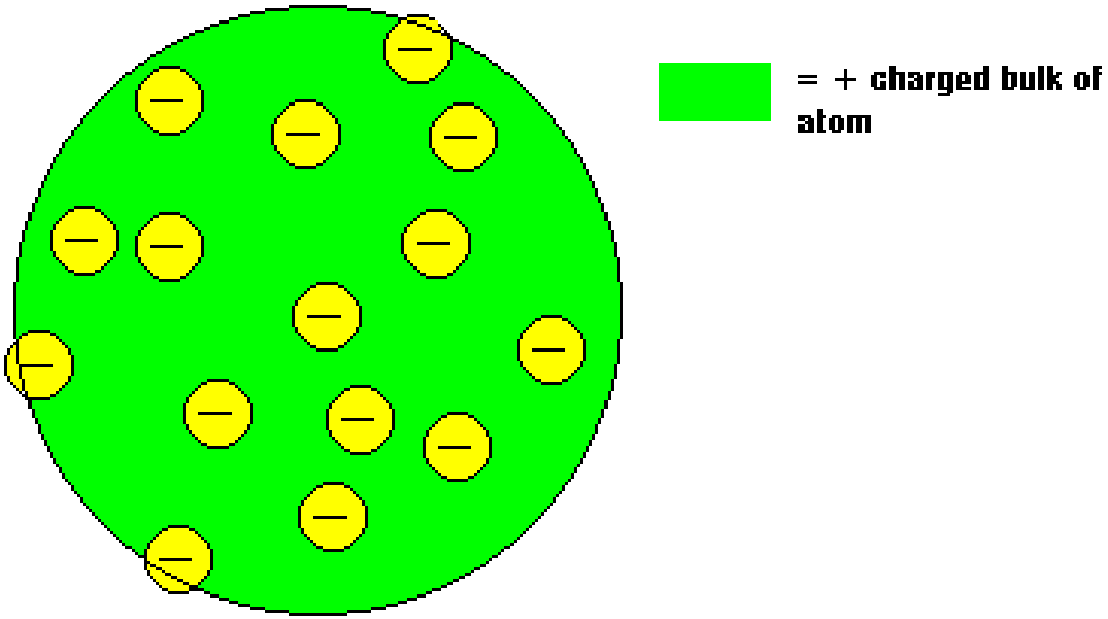
- **Average Atomic Mass = (% abundance x mass number) + (% abundance + mass number) + …**

- There are two isotopes of chlorine, 35Cl which is 75% of the chlorine in the world, and 37Cl. What is the AAM of chlorine?

35.5

Thompson Model

- The atom is a positively charged diffuse mass with negatively charged electrons stuck in it.



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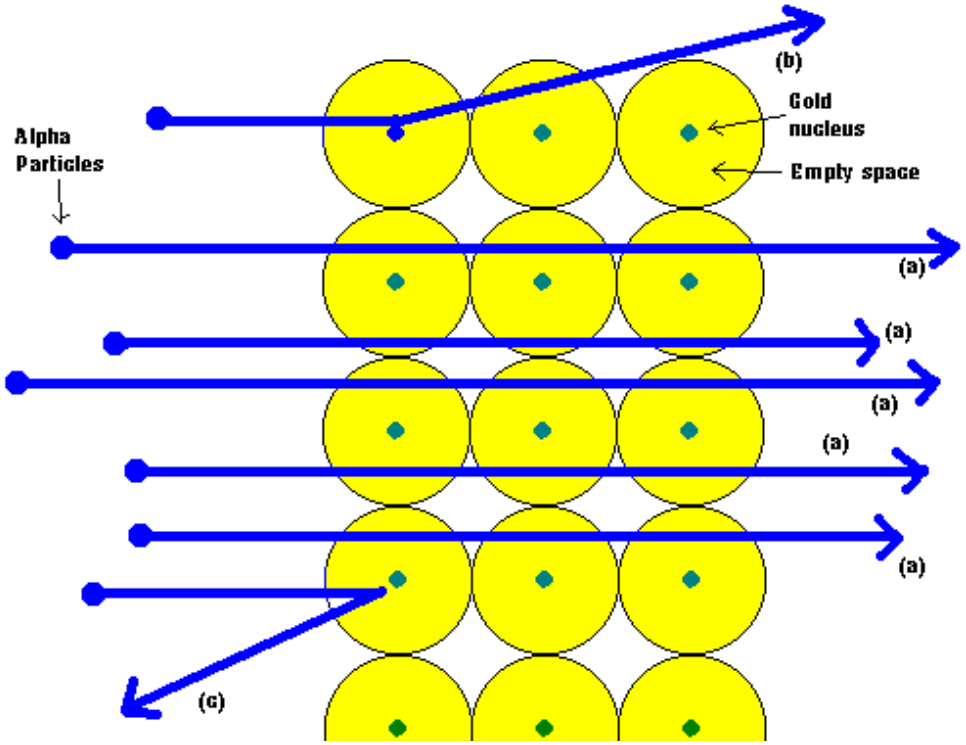
Rutherford Model

The atom is made of a small, dense, positively charged nucleus with electrons at a distance, the vast majority of the volume of the atom is empty space.



Alpha particles shot at a thin sheet of gold foil: most go through (empty space). Some deflect or bounce off (small + charged nucleus).

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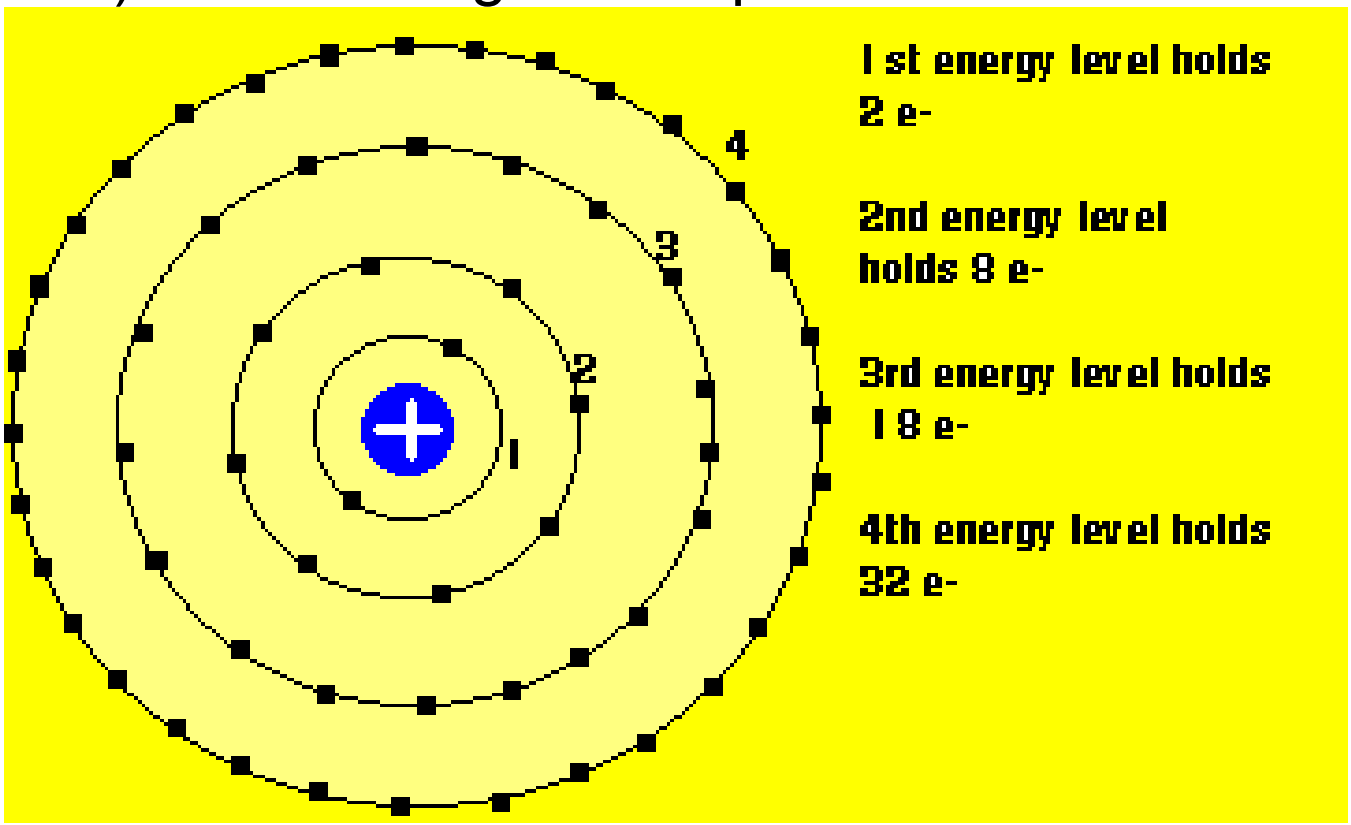
Bohr Model

Electrons orbit around the nucleus in energy levels (shells). Atomic bright-line spectra was the clue.



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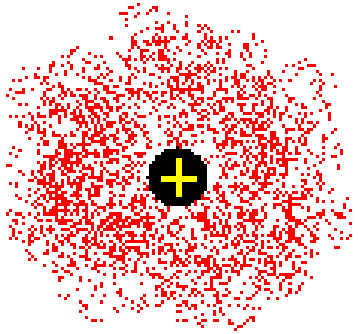
Quantum-Mechanical Model

Electron energy levels are wave functions.
Electrons are found in orbitals, regions of space where an electron is most likely to be found.
You can't know both where the electron is and where it is going at the same time.
Electrons buzz around the nucleus like gnats buzzing around your head.



Each red dot represents where an electron might be found at any given instant in time. This picture represents the motion of one electron around the nucleus of a hydrogen atom.

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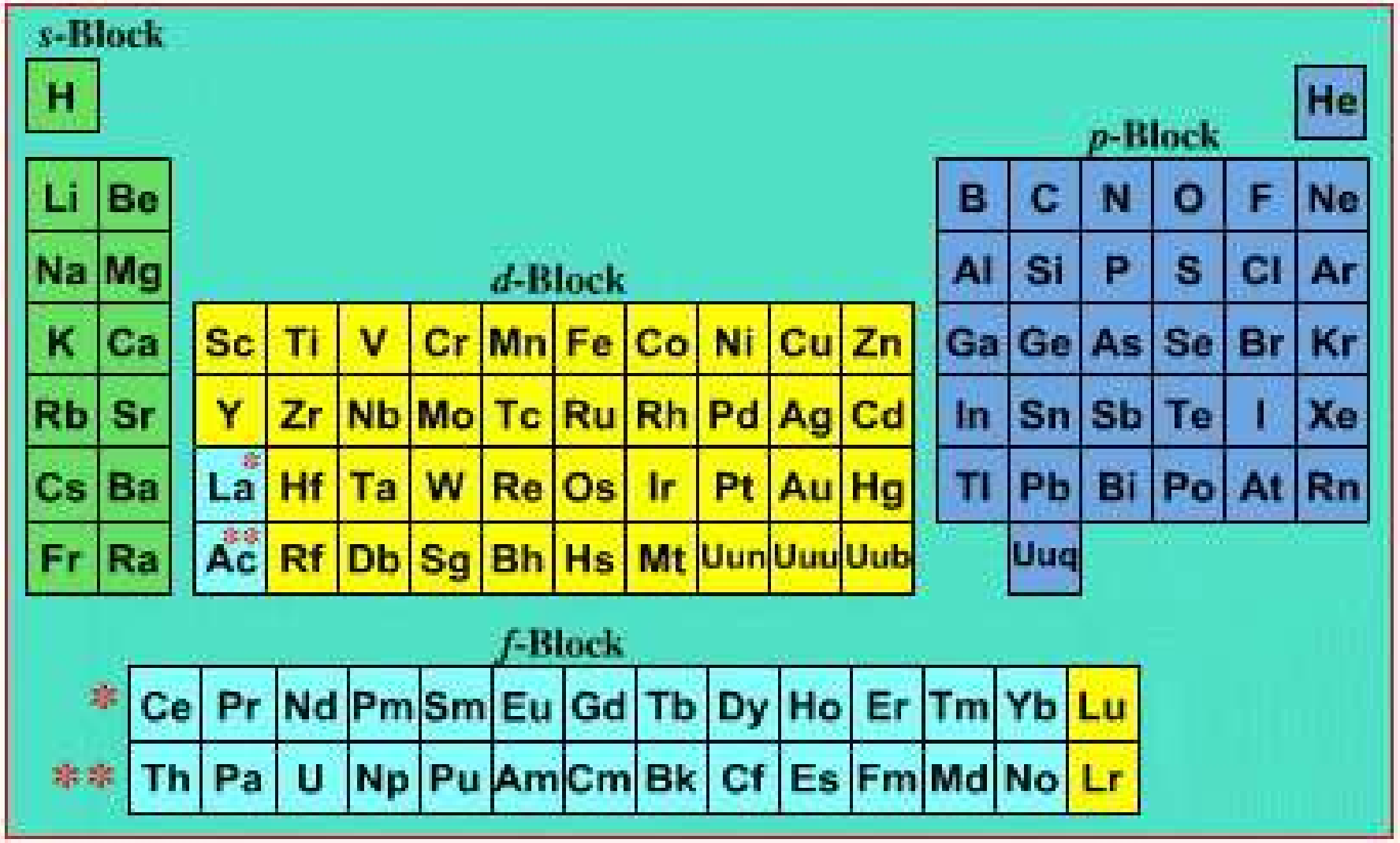
21. Chemists and their Contributions

- Dalton: Atomic Theory / orbitals have 1 electron
- Pauli: 2 electrons per orbital / have opposite spin
- Heisenberg: Uncertainty Principle
- Milikan: charge on electron
- Democritus: coined word “atom”
- Hund: within a sublevel, don’t pair e- until all
- Chadwick: neutrons
- Moseley: Periodic Table by Atomic #
- Mendeleev: Periodic Table by Atomic Mass

22. The orbitals and the periodic table



23. Electron Configurations

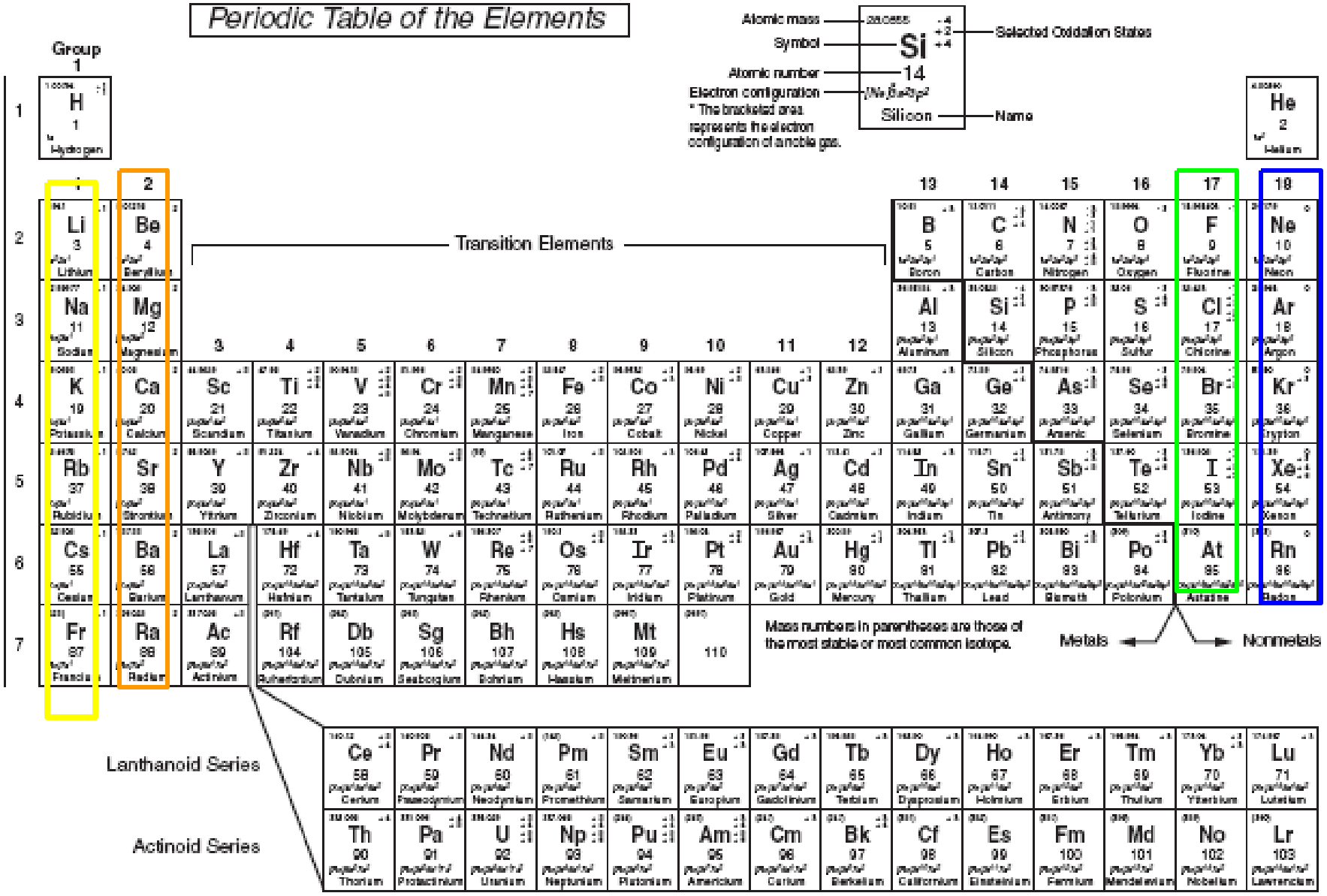
- Noble Gas Core
  - Use noble gas before element as a shortcut
- s, p, d, f Blocks

- What is the electron configuration for Cd?
  - $[Kr]5s^2 4d^{10}$
- What is the configuration for the Cd2+ ion?
  - $[Kr]4d^{10}$

24. Orbital Diagrams

- Draw an orbital diagram for nickel

25. Family names

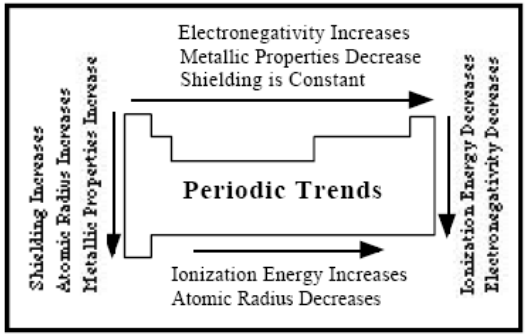


Name the groups boxed in yellow, orange, green and blue.

26. Periodic Table Trends

Period Group

- Atomic Radius — Down Up
- Ionization Energy — Up Down
- Electronegativity — Up Down
- Reactivity — Up Down

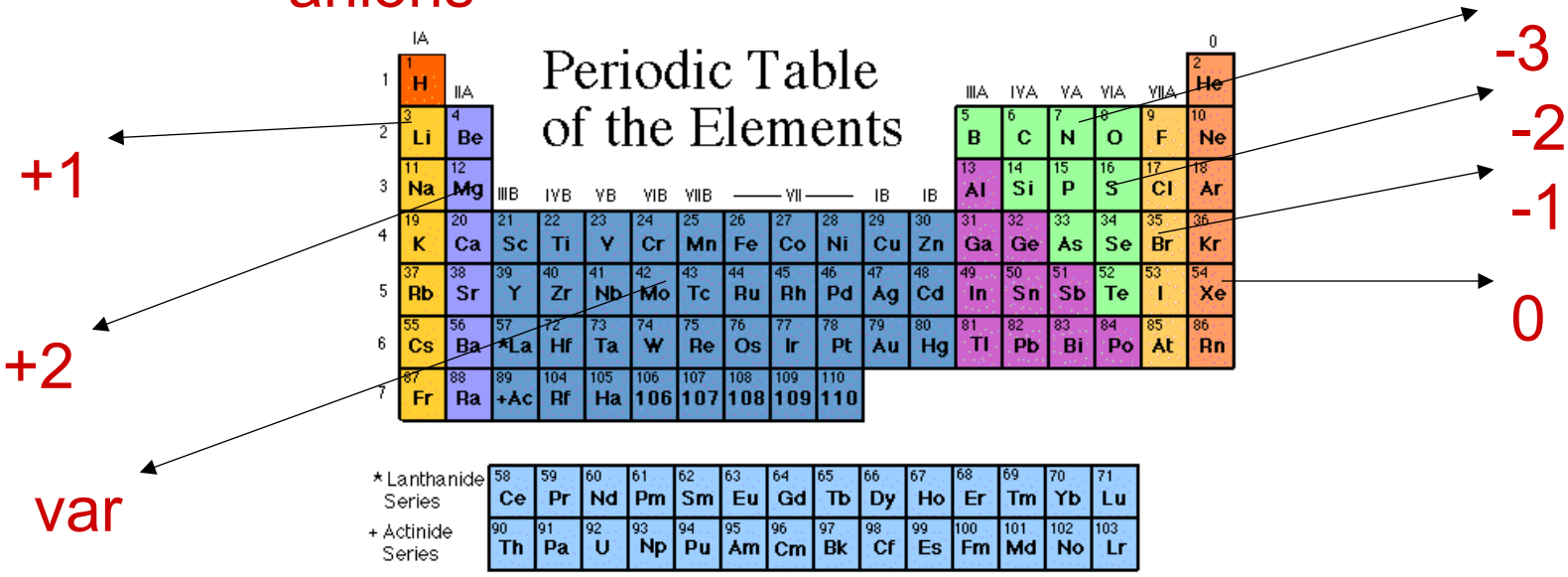


Will Ca form an ion larger or smaller than the original atom? P?

smaller, larger

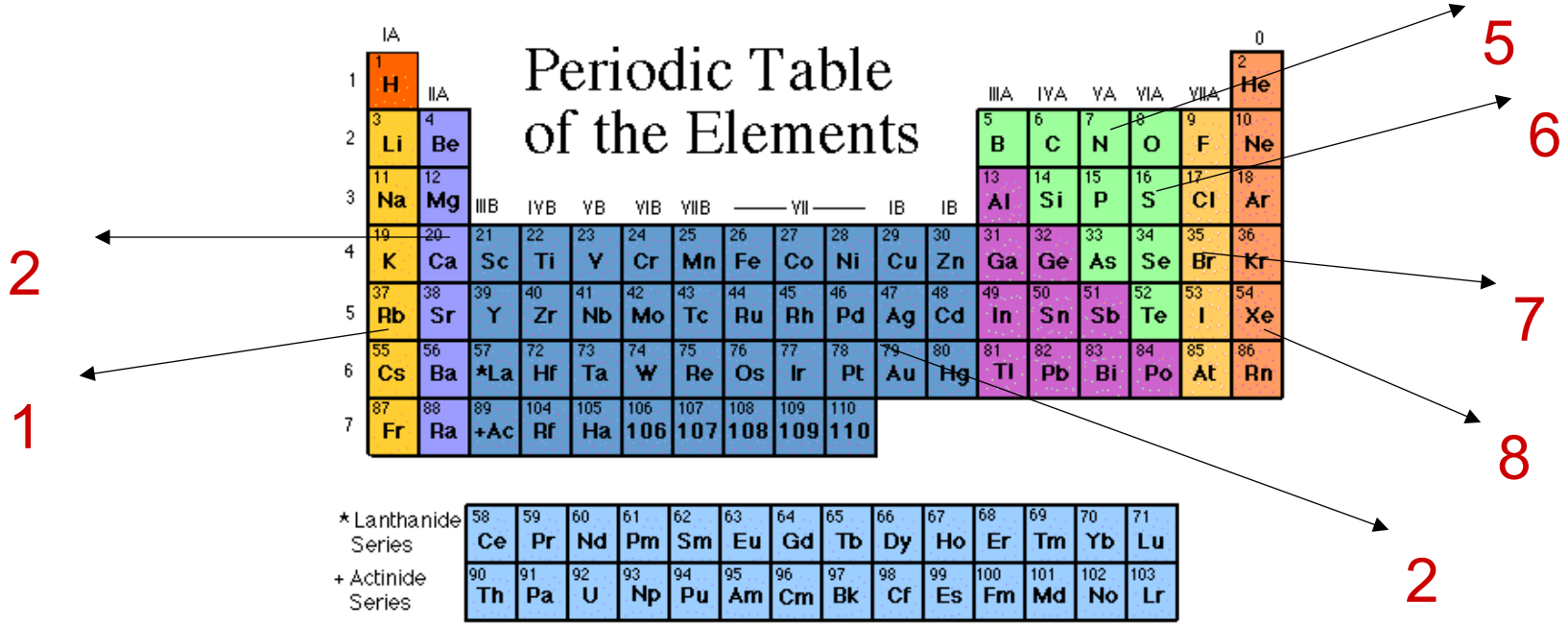
27. Oxidation Numbers (Charges)

- Charge results when an atom _loses_ or _gains_ an _electron_.
- Metals _lose_ electrons, therefore become _positive_ ions called _cations_.
- Nonmetals _gain_ electrons, therefore become _negative_ called _anions_.



28. Valence Electrons

- Valence electrons –
  - electrons in the outer energy level (the highest numbered energy level)

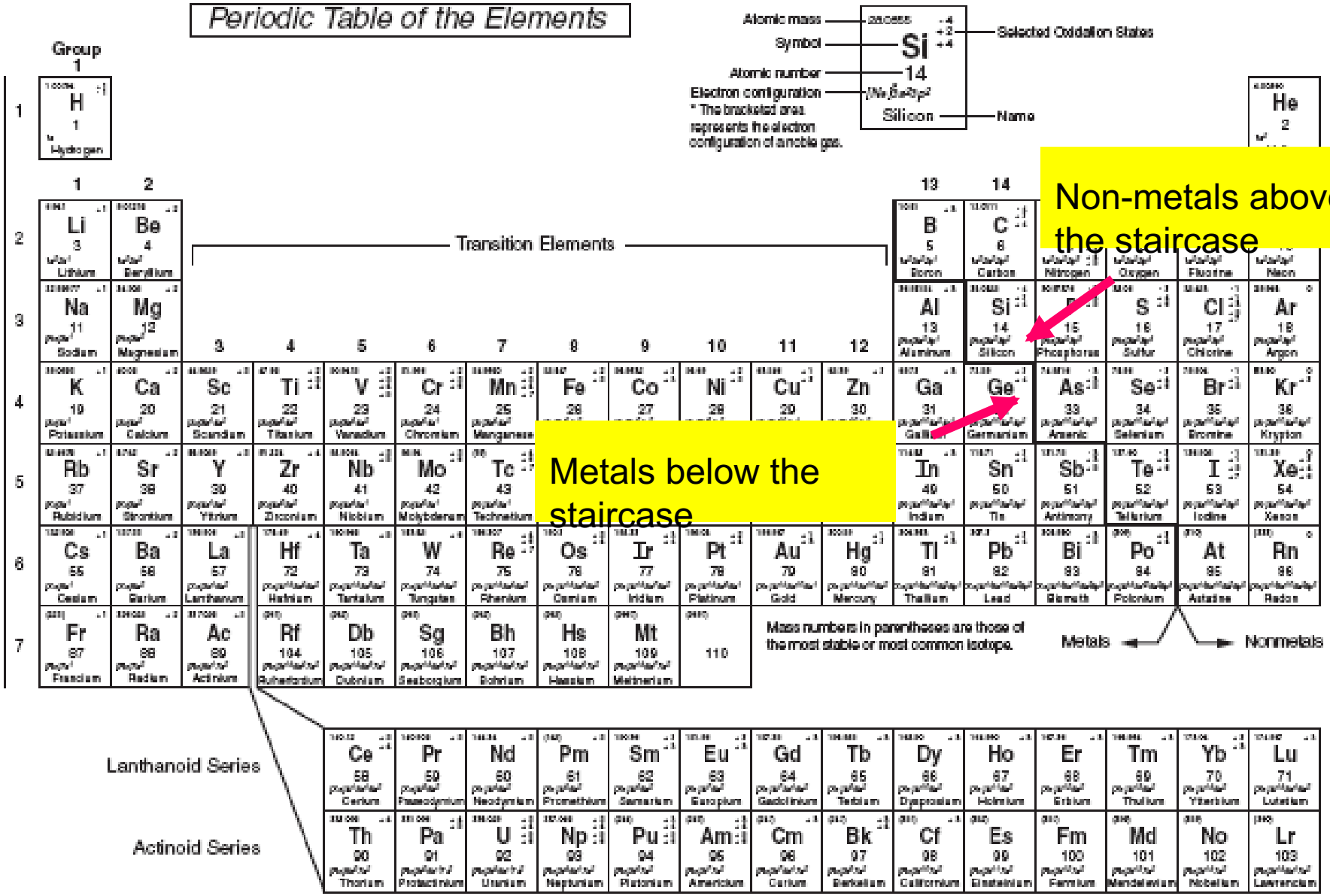


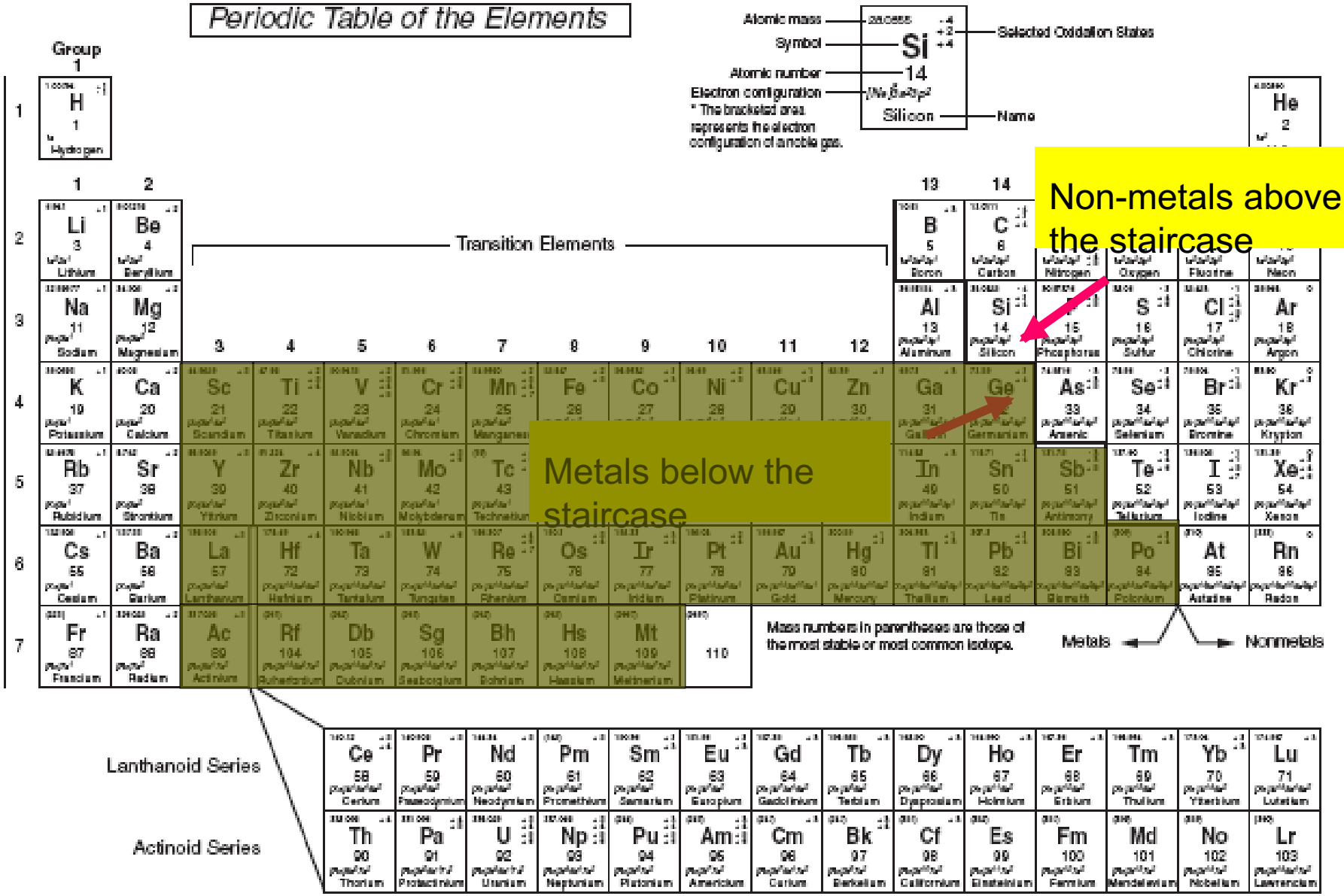
29. How do I tell if the Compound is Ionic or Covalent or Both?

- Check to see what the compound is made up of:
  - A metal and a nonmetal…It's IONIC!
  - 2 nonmetals…It's COVALENT!
  - A polyatomic ion and another element…It's BOTH!
    - (The polyatomic ion is the covalent part, the whole compound will be ionic.)

30. Ionic Bonds

- Ionic bonds are formed when _electrons_ are _transferred_ between a _metal_ and a _nonmetal_.


Periodic Table of the Elements
Atomic mass
Symbol
Atomic number
Electron configuration
* The bracketed area represents the electron configuration of a noble gas.
Si
14
Silicon
Selected Oxidation States
Name
Group
1
2
13
14
Transition Elements
Non-metals above the staircase
Metals below the staircase
Mass numbers in parentheses are those of the most stable or most common isotope.
Metals
Nonmetals
Lanthanoid Series
Actinoid Series

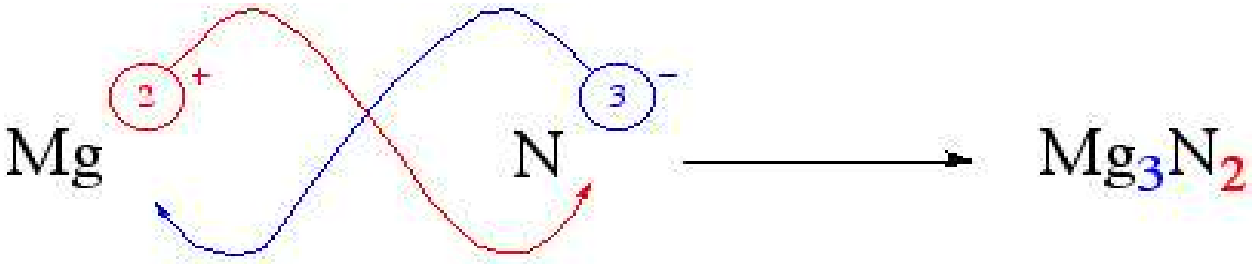


The yellow shaded metals can take on multiple charges/oxidation states

Types of Compounds (Ionic vs. Molecular)

Ionic compounds form from metals and non-metals (across the tracks) and transfer electrons between elements.

You figure out the formula for an ionic compound by criss-crossing charges to subscripts and reducing subscripts if possible.



Ca^{2+} and F^{1-} form _____

Li^{1+} and PO_4^{3-} form_____

Pb^{4+} and S^{2-} form _____

Mn^{2+} and NO_3^{-1} form _____

Types of Compounds (Ionic vs. Covalent)

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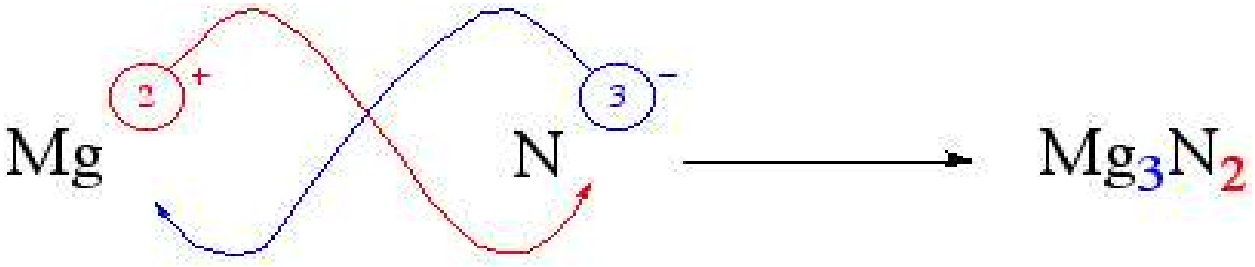

Ca^{2+} and F^{1-} form CaF_2

Li^{1+} and PO_4^{3-} form Li_3PO_4

Pb^{4+} and S^{2-} form Pb_2S_4 which reduces to PbS_2

Mn^{2+} and NO_3^{-1} form $Mn(NO_3)_2$

Naming Ionic Compounds

- Write the name of the cation.
- If the anion is an element, change its ending to -*ide*; if the anion is a polyatomic ion, simply write the name of the polyatomic ion.
- If the cation can have more than one possible charge, write the charge as a Roman numeral in parentheses.

Name the following compounds

CaF_2 _____

Li_3PO_4 _____

PbS_2 _____

$Mn(NO_3)_2$ _____

Naming Ionic Compounds

- Write the name of the cation.
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Name the following compounds

CaF_2 Calcium fluoride

Li_3PO_4 Lithium phosphate

PbS_2 Lead (IV) sulfide

$Mn(NO_3)_2$ Manganese (II) nitrate

31. Covalent Bonds

- Covalent bonds are formed when ~~electrons~~ are ~~shared~~ between two ~~nonmetals~~.

Covalent Compounds

Covalent compounds are composed of two non-metals (above the staircase)

Indicate # of each atom using prefixes (mono, di, tri, tetra, penta, hexa, hepta, octa, nona, deca)

The first element does not use mono if there's only one.

Examples:

OF_2 is named oxygen diflouride

N_2O is named dinitrogen monoxide

You try:
NO_2 _____

P_2O_4 _____

Molecular Compounds

Molecular compounds are composed of two non-metals (above the staircase)

Indicate # of each atom using prefixes (mono, di, tri, tetra, penta, hexa, hepta, octa, nona, deca)

The first element does not use mono if there's only one.

Examples:

OF_2 is named oxygen diflouride

N_2O is named dinitrogen monoxide

You try:
NO_2
nitrogen dioxide

P_2O_4
diphosphorus tetroxide

32. Polyatomic Ions

- Nitrate
- Nitrite
- Sulfate
- Sulfite
- Phosphate
- Carbonate
- Hydroxide
- Ammonium

List formulas

33. Diatomic Elements

- hydrogen
- nitrogen
- oxygen
- fluorine
- chlorine
- bromine
- iodine

Remember!

HNOFClBrI

34. Drawing Lewis Structures

- Don’t forget Lewis Structures only use VALENCE Electrons!

- Draw structures for H_2O, CO_2, CCl_4, and NH_3

35. VSEPR Theory

- **V**alence **S**hell **E**lectron **P**air **R**epulsion Theory:
  - basically means that the electrons want to be as far away from each other as possible
- Important shapes for the SOL:

Shape	Structure	Example
Bent	Draw	H_2O
Trigonal planar	Draw	BF_3
Trigonal pyramidal	Draw	NH_3
Tetrahedral	Draw	CH_4
Linear	draw	CO_2

36. Polarity

- Covalent bonds are when electrons are shared between two nonmetals.
- If the electrons are shared equally, it is a nonpolar covalent bond.
- If the electrons are shared unequally (meaning they are pulled closer to the more electronegative element), it is a polar covalent bond.

36. Polarity

- To determine whether a bond is polar, nonpolar, or ionic, you must use a table of electronegativities. (This will be given to you on the SOL if you are supposed to use it.) When you subtract the two values, if the difference is…
  - …between 0 and 0.4, the bond is **nonpolar**, meaning the electrons are shared equally between the two atoms
  - …between 0.4 and 2, the bond is **polar**, meaning the more electronegative element is pulling harder on the electrons
  - …greater than 2, the bond is **ionic**, meaning the more electronegative element pulled so hard on the electrons, that they came off one atom and were transferred to the other atom.

37. Writing Chemical Equations

- REACTANTS → PRODUCTS

- Write: Solid potassium chloride reacts with oxygen gas to yield solid potassium chlorate.

$KCl(s) + O_2(g) \rightarrow KClO_3(s)$

37. Types of Chemical Reactions

- Synthesis: $A + B \rightarrow AB$
- Decomposition: $AB \rightarrow A + B$
- Single Replacement: $AB + C \rightarrow AC + B$
- Double Replacement: $AB + CD \rightarrow AD + CB$
- Combustion: $C_xH_y + O_2 \rightarrow CO_2 + H_2O$
- Acid / Base: $HX + MOH \rightarrow H_2O + MX$

38. Balancing Chemical Equations

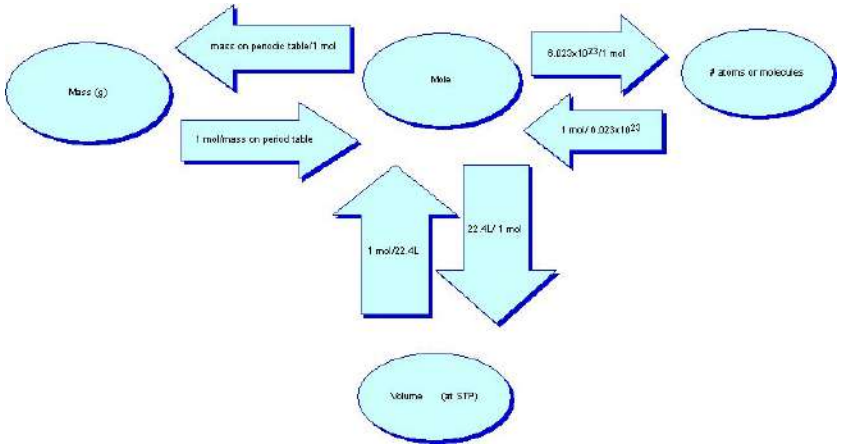
- Balance equations to satisfy:
  - the law of conservation of mass

- Write and balance:
  - Magnesium reacts with nitrogen to yield magnesium nitride.

$$3Mg + N_2 \rightarrow Mg_3N_2$$

39. Moles

- 1 mole = **6.022 x 10^{23}** units
- 1 mole of gas at STP = **22.4 L**
- How many atoms are found in 10.0 g of sodium?
  - 2.62 x 10^{23} atoms
- 13 L of hydrogen at STP has a mass of 1.2 g



40. Molar Mass

- grams / mole
  - Also known as:
    - Molecular weight
    - Formula mass
    - Formula weight

- Find the molar mass of potassium nitrate?
  - KNO_3 = 101.11g

41. Percent Composition

- % composition =
  - mass element / entire mass

- Find the percent magnesium in magnesium oxide?
  - MgO 60 %

42. Stoichiometry

** Must have a balanced equation to solve these problems!

- **Remember: grams to moles, mole ratio, moles to grams**

- $2H_2 + O_2 \rightarrow 2H_2O$
- How many grams of water will be produced from 5.0 g of hydrogen?
  - 45 g H_2O

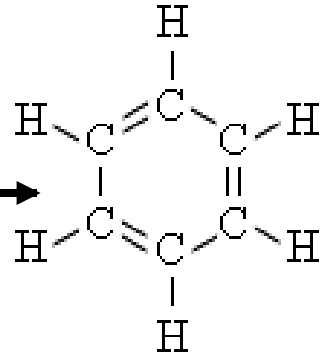
43. Molecular and Empirical Formulas

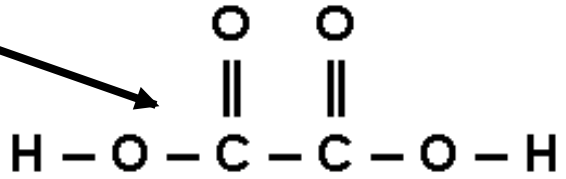
Molecular Formulas provide the true number of atoms in a compound

Empirical formulas give the ratio of the elements found in a compound

Structural formulas show how the atoms are connected.

Molecular Formula	Empirical Formula
C_6H_6	CH
C_2H_6	CH_3
$C_2H_2O_4$	CHO_2





43. Empirical Formulas

Empirical Formulas are the reduced form of Molecular formulas.

For example: The empirical formula for C_5H_{10} is CH_2.

A favorite SOL type question:

What is the empirical formula of a compound that contains 30% Nitrogen and 70% Oxygen?

a) N_2O
b) NO_2 
c) N_2O_5
d) NO

This is really a percent composition problem. Figure out which compound contains 30% nitrogen.

44. Kinetic Molecular Theory

- The Major Points
  - Temperature is related to kinetic energy
  - Gas particles are in constant random motion
  - Gas particles have no volume

Kinetic Molecular Theory

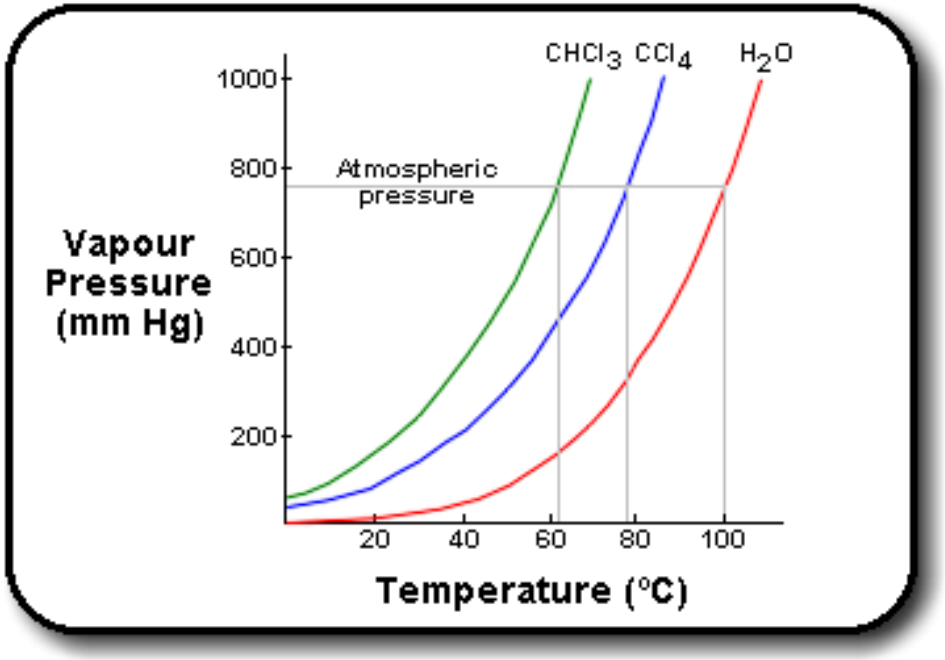
LIQUIDS

When gas molecules lose kinetic energy (cool and slow down) then intermolecular forces can cause the molecules to stick together and liquify.

Evaporation: molecules with enough kinetic energy to overcome the intermolecular attractions in a liquid can escape the liquid and enter the gas phase.

Vapor Pressure: the force due to the gas above a liquid. This increases as temperature increases.

The curves are different for each liquid due to intermolecular forces



Kinetic Molecular Theory

LIQUIDS

Boiling Point: the temperature where a liquid's vapor pressure equals the external pressure or atmospheric pressure.

Boiling Point increases as external/atmospheric pressure increases.

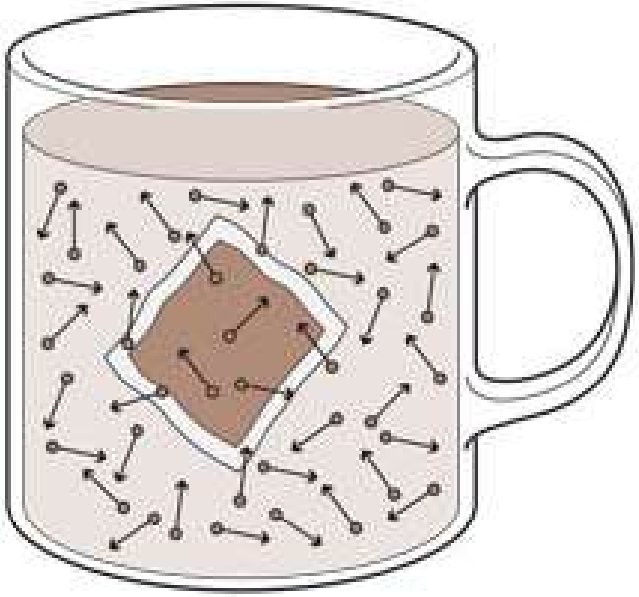
Boiling Point decreases as external/atmospheric pressure decreases.

Kinetic Molecular Theory

LIQUIDS

Making a cup of tea in your kitchen

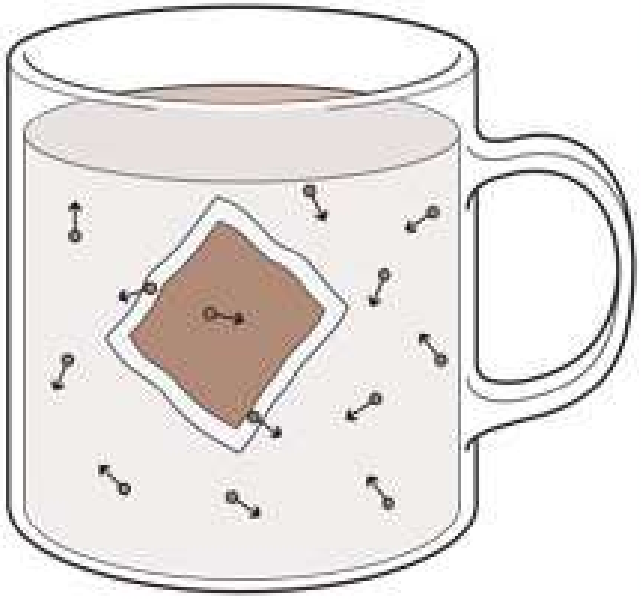
Sea level (Altitude = 0 m)
Atmospheric pressure = 101 kPa
Boiling point of water = 100°c



The chemicals which give tea its flavour diffuse out of the tea bag. Individual particles gain lots of energy from the hot water and move quickly, spreading the great taste of the tea through the cup of water.

Making a cup of tea on Everest

Altitude = 8,850 metres
Atmospheric pressure = 33 kPa
Boiling point of water = 70°c



At the summit of Everest water boils at just 70°c. This means that particles diffusing out of the tea bag do not gain as much energy and do not diffuse as quickly through the cup of water.

Kinetic Molecular Theory

SOLIDS

1. Particles in liquids are free to slide past each other
2. Particles in solids do not slide past each other, but vibrate in place.
3. Melting point: temperature where a solid becomes a liquid.

45. Gas Laws

- Boyle's

  $P_1V_1 = P_2V_2$ @ constant temperature

- Charles's

  $V_1T_2 = V_2T_1$

45. Gas Laws

- Combined

$$\frac{PV}{T} = \frac{PV}{T}$$

46. Ideal Gas Law

- **PV = nRT**

- Remember: No change occurs!

- P = pressure in atm or kPa
- V = volume in L
- N = Moles
- R = constant (0.0821 L.atm/mol.K **OR** 8.314 L.kPa/mol.K)
- T = temperature in K

47. Endothermic Reactions

- Heat is ~~absorbed~~.
- It appears on the ~~left~~ side of the equation
- The quantity of heat will be ~~positive~~.

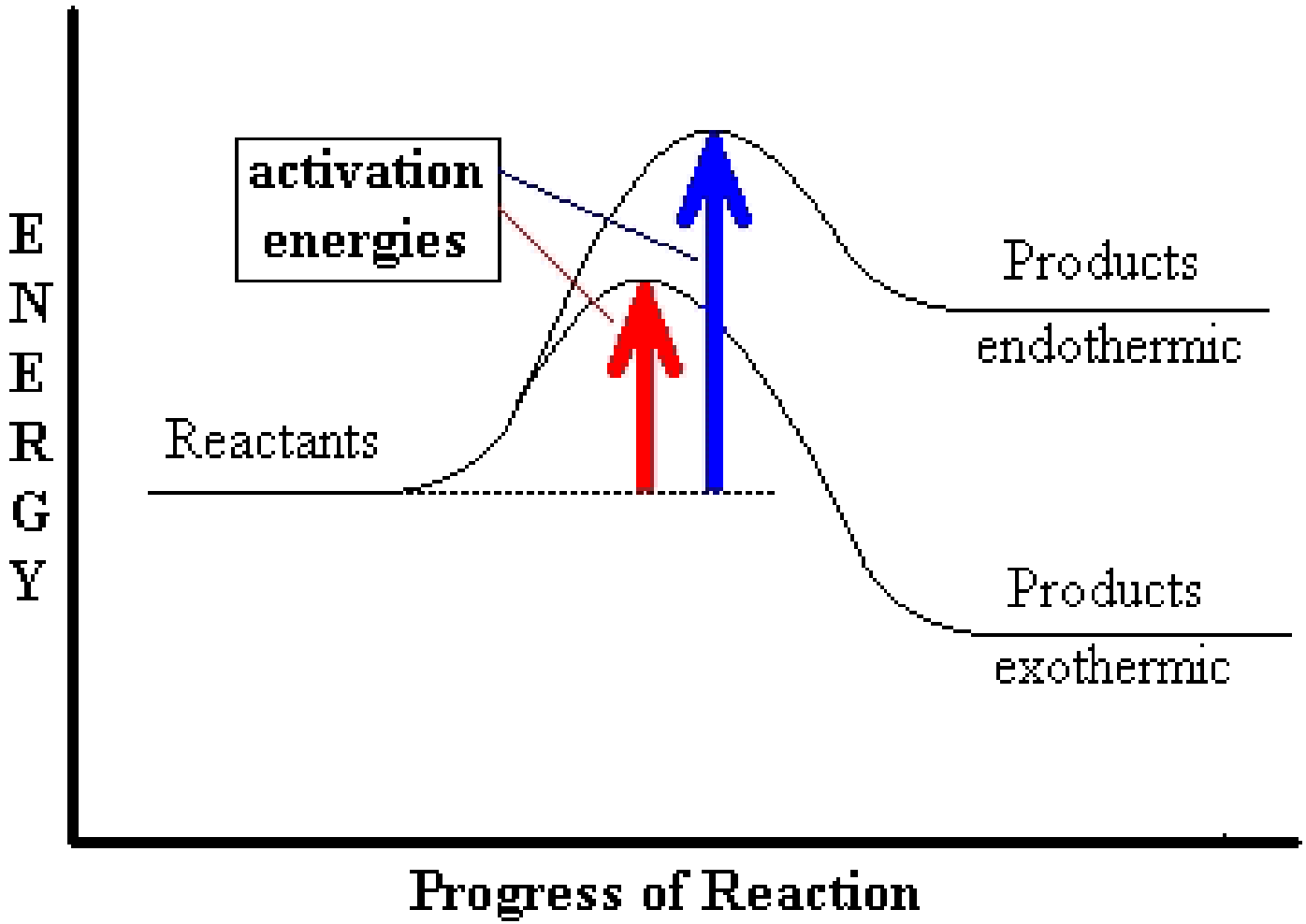
48. Exothermic Reactions

- Heat is ~~released~~.
- It appears on the ~~right~~ side of the equation
- The quantity of heat will be ~~negative~~.

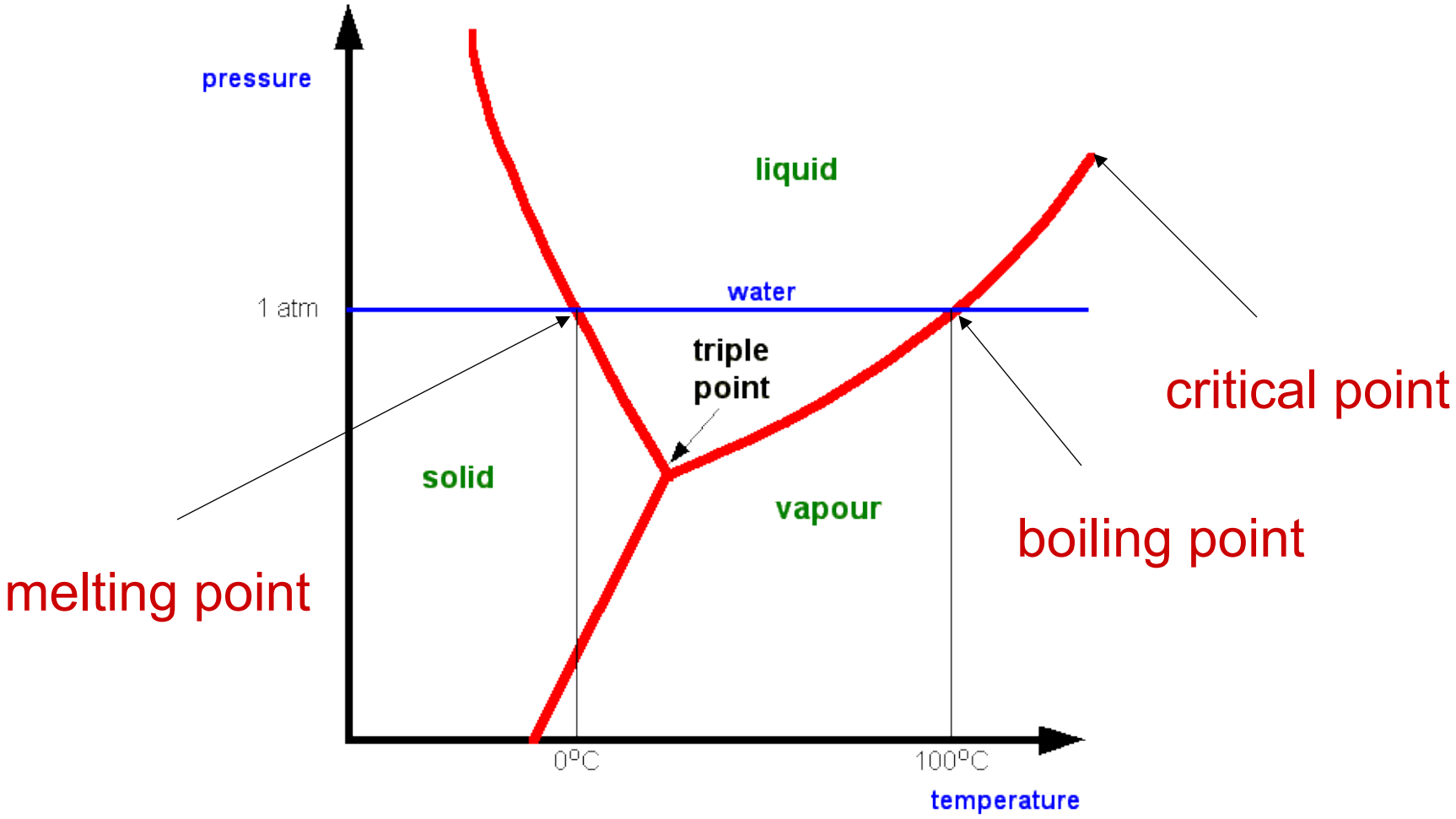
49. Activation Energy

- The energy required to ~~start a reaction~~.
- A catalyst ~~lowers~~ the activation energy.

50. Reaction Progress Diagram

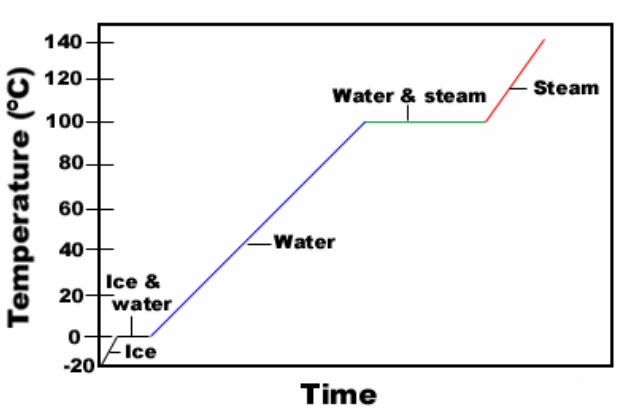


51. Phase Diagrams



52. Heating Curves

- Temperature **does not change** during a phase change!
- How much energy is required to melt 15.0 g of ice if the heat of fusion for water is 6.02 J/g?
  - 90.3 J
- How much energy is required to raise the temperature of 15.0 g of water from 10 C to 25 C?
  - 900 J (1 sig fig)



53. Kinetics

- Kinetics - Study of the rate of a reaction

- What are four things that affect the rate of a reaction?
  - Concentration
  - Temperature
  - Presence of catalyst
  - Nature of reactants

- What is the collision theory?
  - particles must collide for a reaction to occur

54. Catalysts

- Increase the rate of a reaction by:
  - lowering the activation energy

- Not used up in a reaction

55. Electrolytes

- An electrolyte ~~dissociates~~ in a solution.
  - (breaks up into ions)

- STRONG ELECTROLYTES:
  - Conduct well
  - Dissociate completely

- WEAK ELECTROLYTES
  - Conduct poorly
  - Dissociate partially

56. Molarity

- Molarity = moles of solute/L of solution

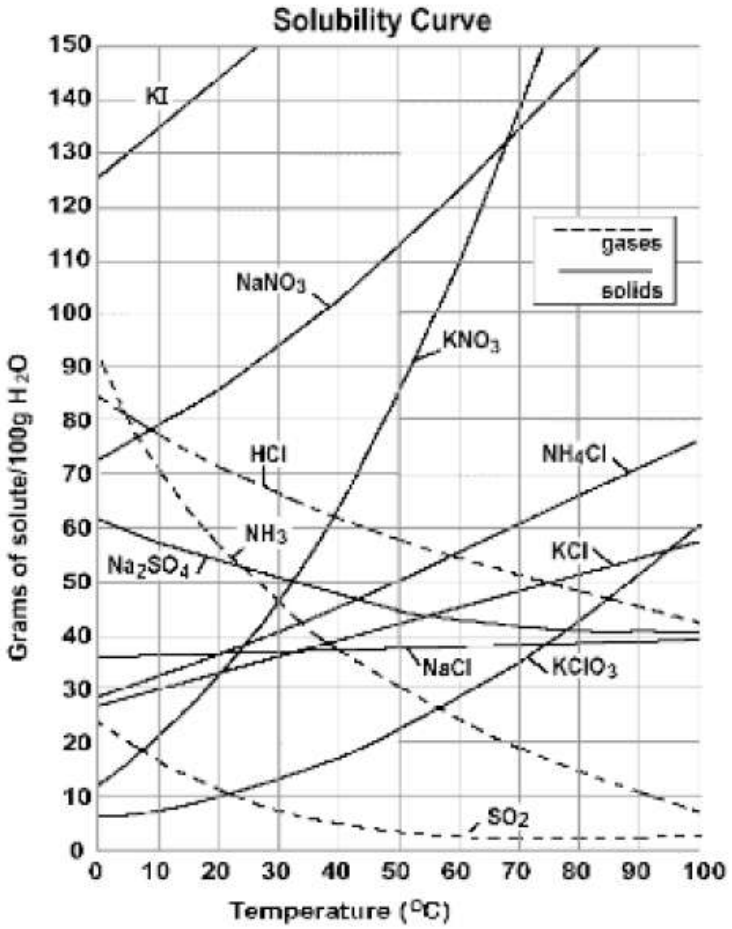
- Calculate the molarity of a solution in which 15.0 g of NaCl is dissolved in 100. mL of water.
  - 2.59 M

57. Dilution

- $Molarity_1 \times Volume_1 = Molarity_2 \times Volume_2$

- What volume of a 4.0 M HCl solution should be used to make 100 mL of a 0.15 M HCl solution?
  - 0.00375 L (3.75 mL)

58. Solubility Curves



How many grams of $NaNO_3$ will dissolve in 100 g of water at 20 C?

85 g

A supersaturated solution of KNO_3 at 50 C would have more than 85 g of solute in solution.

How many grams of KI will dissolve in 400 g of solution at 10 C?

540 g

59. Colligative Properties

- Properties that depend on how much solute is present

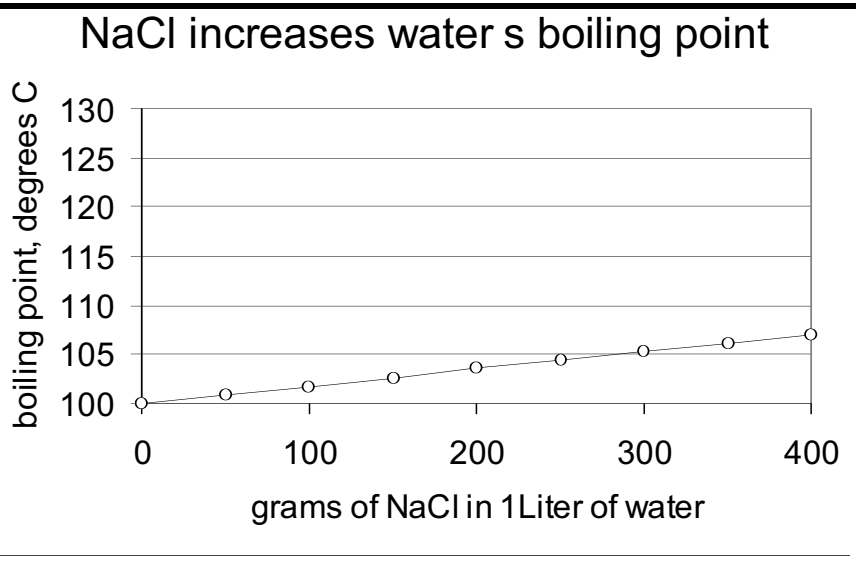
Colligative Properties

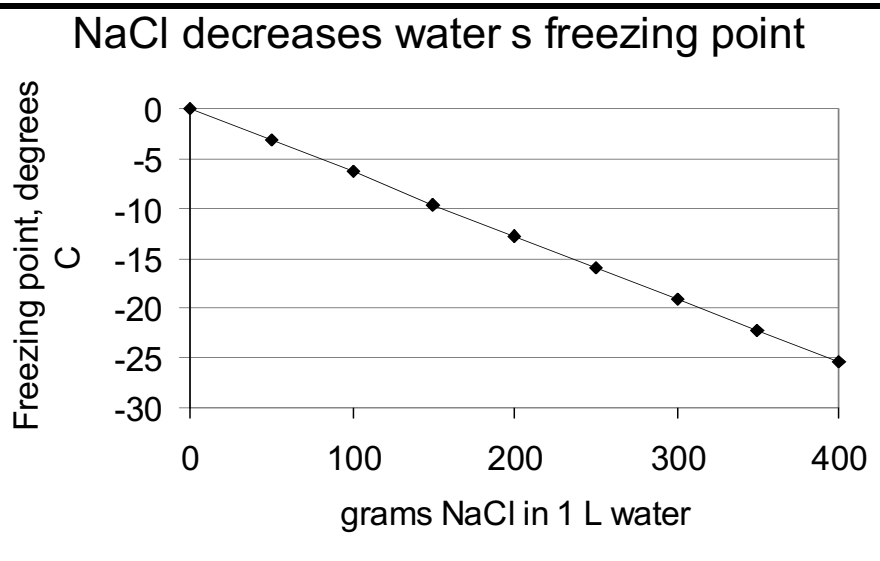
Adding impurities to a liquid increases the boiling point and decreases the freezing point (widens the liquid temperature range)

Examples:

Adding antifreeze to the water in the radiator to prevent boiling in summer and freezing in winter.

Putting salt on the road to prevent the road from icing up.





60. Chemical Equilibrium

- Equilibrium –
  - when the concentration of reactants and products are constant

- Reversible reactions –
  - reactions that can go in either direction

61. LeChatelier's Principle

- A reaction at equilibrium wants to stay at equilibrium.
- To accomplish this, the reaction will shift to the left or right to maintain equilibrium when a change is made.

6. If the concentration of nitrogen gas is decreased, which way will the reaction below shift and why? Also write the equilibrium expression.

$N_2H_4(g) + O_2(g) \leftrightarrow N_2(g) + 2\,H_2O(g)$

Shift Right

7. Will an increase in pressure cause the reaction below to shift to the right or to the left? Why? Write an equilibrium expression.

$N_2(g) + Br_2(l) \leftrightarrow NBr_3(s)$

Shift Right

62. Acids

- Properties of Acids:
  - H+ ions
  - Low pH (can be negative)
  - Tastes sour (vinegar)

63. Bases

- Properties of Bases:
  - High pH
  - OH- ions
  - Bitter taste (soap, cleaning products)
  - Slippery

Acid/Base Theory

What is pH?

pH indicates the hydrogen ion molarity [H+] in a solution

pH = make [H+] exponent positive

pOH indicates the hydroxide ion molarity [OH^-] in a solution.

pOH = make [OH-] exponent positive

Example: A 1.0 x 10^{-3} molar solution of HCl would have a pH of __3__

Example: A 1.0 x 10^{-4} molar solution of KOH would have a pOH of __4__

Memorize: pH + pOH = 14.

Example: A solution with a pH of 8 will have a pOH of: __6__.

64. Titrations

- Add acid to base to find the molarity of either the acid or the base.
- An indicator changes color to show the endpoint of the titration.

65. Half Life

- A sample of element X has a half life of 8 days.

- If you start with 200 g of the sample, how much is left after 40 days?
  - 6.25 g

66. Organic Chemistry

- Organic molecules have carbon.

- You cannot be asked anything specific to organic molecules, however you will most likely see organic molecules in other questions.