KEY 2015

100 Things to Know For Your Chemistry Midyear Exam

1. ***Protons*** are positively charged (+) with a mass of 1 amu.
   Example: Which has the greatest nuclear charge? Cl-35 Ar-40 K-39 (Ca-40)

2. ***Neutrons*** have no charge and a mass of 1 amu.

3. ***Electrons*** are small and are negatively charged (-) with a mass of almost 0 amu..

4. Protons & neutrons are in an atom's nucleus (***nucleons***).
   Which has the greatest number of nucleons?
   Sn-119 Sb-122 (Te-128) I-127

5. Electrons are found in "clouds" (***orbitals***) around an atom's nucleus.
   Where is most of the mass of an atom found? the nucleus
   Where is most of the size (volume) of an atom found? the electron cloud

6. The ***mass number*** is equal to an atom's number of protons and neutrons added together or the # of nucleons.
   What is the mass number of an atom with 18 protons and 22 neutrons? 40

7. The ***atomic number*** is equal to the number of protons in the nucleus of an atom.
   Which has the greatest atomic number?
   S Cl Ar (K)

8. The ***number of neutrons*** = mass number - atomic number.
   Which correctly represents an atom of neon containing 11 neutrons?
   $^{11}_{10}Ne$ ($^{21}_{10}Ne$) $^{20}_{10}Ne$ $^{22}_{10}Ne$

9. In a neutral atom the number of protons = the number of electrons.
   Circle the correct nuclear symbol for the neutral atom: $^{16}_{8}O^{2-}$ $^{14}_{7}N^{3-}$ $^{19}_{9}F^{1-}$ ($^{21}_{10}Ne$)

10. ***Isotopes*** are atoms with equal numbers of protons, but differ in their neutron numbers.
    Two isotopes of the same element will have the same number of
    neutrons and electrons, neutrons and nucleons,
    protons and nucleons, (protons and electrons)

11. ***Cations*** are *positive* (+) ions and form when a neutral atom *loses* electrons.
    They ***are*** *smaller* than their parent atom.
    Which of the following will form an ion with a smaller radius that that of its atom?
    Cl N Br (Ba)

12. ***Anions*** are negative ions and form when a neutral atom *gains* electrons.
    They are larger than their parent atom.
    Which electron configuration is correct for a fluoride ion?
    $[He]2s^2 2p^5$ ($[He]2s^2 2p^6$) $[He]2s^2 2p^6 3s^1$ $[He]2s^2 2p^4$

13. Ernest ***Rutherford's*** *gold foil experiment* showed that an atom is mostly empty space with a small, dense, positively charged nucleus.
    Describe the gold-foil experiment, explain how Rutherford was able to make his conclusions about the structure of the atom and draw a picture of the nuclear atom (~1911) → Shot alpha (+) particles at a thin sheet of gold foil. Most passed through but a few were deflected. He concluded that the atom was mostly empty space w/a small, dense, (+) nucleus surrounded by the electrons.

14. ***J.J. Thompson*** discovered the electron and developed the "plum-pudding" model of the atom.

Draw and describe his model (late 1800s): → Discovered electron or that the atom had negatively charged subatomic particles which he believed were scattered around a positively charged substance like plumbs in a pudding.

15. ***Dalton's*** model of the atom was a solid sphere of matter that was uniform throughout.

Describe Dalton's atomic theory and what important laws it included.

→ atoms are tiny, indivisible, particles → atoms combine in small, whole # ratios to form compds • Law of Definite proportions

→ atoms of different elements are different → Atoms are neither created nor destroyed in chemical reactions • Law of Conservation of Mass

16. The ***Bohr Model*** of the atom placed electrons in "planet-like" orbits around the nucleus of an atom.

Draw an example of his model using oxygen-16 → ${}^{16}_{8}O$ *(~1916):*

→ electrons could only exist in specific energy levels

17. The current, ***quantum or wave-mechanical model*** of the atom has electrons in "clouds" (orbitals) around the nucleus. *How many orbital(s) in the following sublevels?* s 1 p 3 d 5 f 7

18. Electrons can be excited to jump to higher energy levels.

They emit energy as light when they fall from higher energy levels back down to lower (***ground state***) energy levels. ***Bright line spectra*** are produced.

What is the frequency of a red photon with a wavelength of 6.56 x 10^{-7} meters? What is its energy?

$\nu = \frac{c}{\lambda} = \frac{3.00\times10^{8}\ m/s}{6.56\times10^{-7}\ m} = 4.57\times10^{14}\ Hz$ $E = h\nu = (6.626\times10^{-34}\ J\cdot s)(4.57\times10^{14}\ \frac{1}{s}) = 3.03\times10^{-19}\ J$

19. ***Elements*** are pure substances composed of atoms with the same atomic number. They cannot be decomposed.

A compound differs from an element in that a compound

Has a homogeneous composition *has one set of properties*

Has a heterogeneous composition *can be decomposed*

20. ***Binary compounds*** are substances made up of only *two* kinds of atoms.

"Ternary" compounds contain three (or more) kinds of atoms.

Which substance is a binary compound? (Look up the formulas if you don't know them)

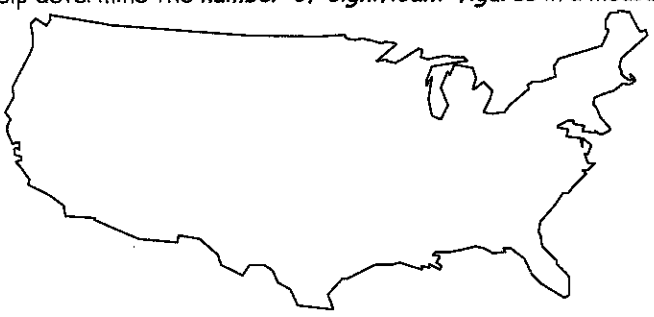
Ammonia	*magnesium*	*potassium nitrate*	*methanol*
NH_3	Mg	KNO_3	CH_3OH

21. ***Diatomic molecules*** are elements that form two atom molecules in their natural form at STP.

Which element is a diatomic liquid at STP?

Chlorine *fluorine* *bromine* *iodine*

22. Use this diagram to help determine the ***number of significant figures*** in a measured value...



Pacific **Atlantic**

If the decimal point is ***present***, start counting digits from the ***Pacific*** (left) side, starting with the first non-zero digit.

0.003100 4 sig. figs.

If the decimal point is absent, start counting digits from the Atlantic (right) side, starting with the first non-zero digit.

31,400 3 sig. figs.

23. When **multiplying** or **dividing** measurements, final answer must have as many digits as the measurement with the fewest number of digits. When **adding** or **subtracting**, use place value.

What is the density of the object measured in lab by the displacement of water according to the data below:

Mass of object:	*23.6 g*	$V = 18.2\ mL - 15.0\ mL = 3.2\ mL$
Volume of water:	*15.0 mL*	
Volume of water + object:	*18.2 mL*	$D = \frac{m}{V} = \frac{23.6\ g}{3.2\ mL} = 7.4\ g/mL$

24. ***Solutions*** are the best examples of ***homogeneous mixtures***. They look uniform even though each substance's properties do not change.

How many phases are there in a solution or homogeneous mixture? one phase

25. ***Heterogeneous mixtures*** have discernable components and ***are not*** uniform throughout.

Air is classified chemically as a(n)

Substance *compound* *element* *(mixture)*

26. A ***solute*** is the substance being dissolved; the ***solvent*** is the substance that dissolves the solute.

NaCl (s) is added to water and mixed. The solute is NaCl *the solvent is* H_2O *the solution is* NaCl(aq)

27. **Isotopes** are written in a number of ways: C-14 is also Carbon-14, and is als $^{14}_{6}C$

atomic number = 6 *mass number =* 14

28. The **average atomic mass** is the weighted average mass of all the known isotopes of an element.

Find the average atomic mass of lithium if 7.4 % are ^{6}Li and 92.6% are ^{7}Li.

$(.074 \times 6) + (.926 \times 7) = 6.926$ amu

29. The distribution of electrons in an atom is its ***electron configuration***.

Write the symbol of the element represented by the following electron configurations:

$1s^2 2s^2 2p^6 3s^2 3p^5$ Cl $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$ Zn $1s^2 2s^2 2p^5$ F

30. The outermost electrons in an atom's electron configurations are the **valence electrons.**

How many valence electrons do each of the elements contain in their electron configurations:

$1s^2 2s^2 2p^6 3s^2 3p^5$ 7 $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$ 2 $1s^2 2s^2 2p^5$ 7

31. ***Electron dot model*** is a way of representing the valence electron of an atom.

represents the electron-dot symbol of this element *C* *O* *B* *(N)*

32. The ***kernel*** of an atom includes everything in an atom *except* the atom's valence electrons.

The kernel of this element contains 11 protons and 10 electrons

O *F* *Ne* *(Na)*

33. **Polyatomic ions** are groups of atoms, **covalently** bonded together, with an overall charge.

Give the name or formula of the following: Nitrate: NO_3^-, NH_4^+: ammonium sulfite: SO_3^{2-}

Which of the following contains both ionic and covalent bonds?

(NaOH) *CH_3OH* *NaCl* *Cl_2*

34. **Chemical formulas** are written so that the charges of cations and anions neutralize (cancel) one another.

calcium phosphate: Ca^{2+} PO_4^{3-} = $Ca_3(PO_4)_2$ → remember the criss-cross method

35. When naming **binary** ionic compounds, write the name of the positive ion (cation) first, followed by the name of the negative ion (anion) with the name ending in "-ide."

$CaCl_2$ calcium chloride *MgS* Magnesium Sulfide

36. When naming compounds containing **polyatomic ions**, keep the name of the polyatomic ion the same as it is written in your reference sheet.

NH_4Cl ammonium chloride *copper (I) nitrate* $CuNO_3$

37. **Roman numerals** are used to show the positive oxidation number of the cation if it has more than one positive oxidation number

FeO: iron (II) oxide *Nickel (III) sulfate:* $Ni_2(SO_4)_3$

38. ***Physical changes*** do not form new substances. They merely change the appearance of the original material. Example: (The melting of ice) H_2O (s) → H_2O (l)

Give three other examples of physical changes: Breaking a pencil, crushing a salt crystal, dissolving in water, etc.

39. ***Chemical changes*** result in the formation of new substances.

Which process is an example of a chemical change?

the melting of ice *the electrolysis of water* *the boiling of water*

40. ***Reactants*** are on the left side of the reaction arrow and ***products*** are on the right.

41. ***Temperature*** is a measure of average kinetic.

Which sample has the highest average kinetic energy?

H_2O (l) at 0°C *H_2O (s) at 0°C* *CO_2 (g) at STP* 0°C *Mg (s) at 298K* 25°C

42. The masses (and energy and charge) of the reactants in a chemical equation is always equal to the masses (and energy and charge) of the products. "***Law of Conservation of Mass (and Energy)***."

An iron nail weighing 5.10 g is allowed to react with oxygen, according to the reaction below.

$$4Fe + 3O_2 \rightarrow 2Fe_2O_3$$

A layer of iron(III) oxide forms on the nail, increasing the nail's mass. How much oxygen has reacted with the iron if the mass of the nail has increased to 5.89 g? $5.10\,g + X = 5.89\,g$ $X = 0.79\,g\ O_2$

43. ***6.02 x 10^{23}*** is called ***Avogadro's number*** and is the number of particles in ***1 mole*** of a substance.

Equal volumes of gases contain an equal number of molecules.

Under similar conditions, which sample contains the same number of moles of particles as 1 liter of O_2 (g)?

1 L Ne(g) *0.5 L SO_2 (g)* *2 L N_2 (g)* *1 L H_2O(l)*

44. The **kinetic molecular theory** explains the behavior of matter as particles with energy and motion.

45. ***Solids*** have a definite shape and volume.

46. ***Liquids*** have closely-spaced particles that easily slide past one another; they have no definite shape, but have a definite volume.

47. ***Gases*** have widely-spaced particles that are in random motion (collide with container to create pressure).

48. ***Gases*** are easily compressed and have no definite shape or volume.

49. Substances that ***sublime*** turn from a solid directly into a gas.

They have very weak attractive forces. (examples include CO_2 & I_2)

50. **Temperature** is a measure of the average kinetic energy of a substance. The SI unit for temp. is the Kelvin.

Degrees Kelvin = °C + 273

Room temperature = 25°C = 298 *K Boiling point of helium = 4 K =* -269 *°C*

51. Mixtures may be separated by several physical means:

Distillation separates mixtures with different boiling points.

Fractional distillation is a common method to separate and collect

Hydrocarbons *Ionic solids* *Metals* *Precipitates*

Filtration separates mixtures of solids and liquids.

*What would collect **in filter paper** if a mixture of NaCl (aq) and $CaCO_3$ (s) were poured through?* The $CaCO_3$ would be stopped by the filter paper

Chromatography can also be used to separate mixtures of liquids and mixtures of gases.

52. ***The Periodic Law*** states that the properties of elements are periodic functions of their *atomic numbers.*

Elements are arranged on the modern periodic table in order of increasing atomic #

53. ***Periods*** are horizontal rows on the Periodic Table.

In which energy level are the valence electrons of the elements in Period 3 found? The 3rd

54. ***Groups*** are vertical columns on the Periodic Table.

Which group on the periodic table contains a solid, liquid, and gas(es)? Halogen family

55. ***Metals*** are found left of the "**staircase**" on the Periodic Table and at the bottom, ***nonmetals*** are above it and at the top, and ***metalloids*** border it.

Which of the following Group 14 elements has the greatest metallic character?

Carbon *silicon* *germanium* (*tin*)

STP = Standard Temperature & Pressure

56. Complete and memorize this chart.

Metals	Malleable and ductile	All solids except Mercury	Lustrous	Good conductors of heat & electricity	low ionization energy and electroneg.	Tend to form + ions cations
Nonmetals	Brittle when solid	Mostly gases at STP	Dull	Good insulators	ionization energy and electroneg.	Tend to form − ions anions

57. ***Noble gases*** (Group 18) are unreactive and stable due to the fact that their valence level of electrons is completely filled. *What are the 6 noble gases?* He, Ne, Ar, Kr, Xe, Rn

58. ***Ionization energy*** increases as you go up and to the right on the Periodic Table.

Which element among the diagrams in # 65 has the lowest ionization energy? Element D

59. ***Atomic radii*** *decrease* left to right across a period due to increasing nuclear charge.

Which period 3 element among the diagrams in # 65 has the largest radius? Element D

60. ***Atomic radii*** *increase* as you go down a group due to increased electron energy levels.

Which alkali metal among the diagrams in # 65 has the largest radius? Element D

61. ***Electronegativity*** is a measure of an element's attraction for electrons.

Which of the following atoms has the greatest tendency to attract electrons?

calcium *carbon* *copper* (*chlorine*)

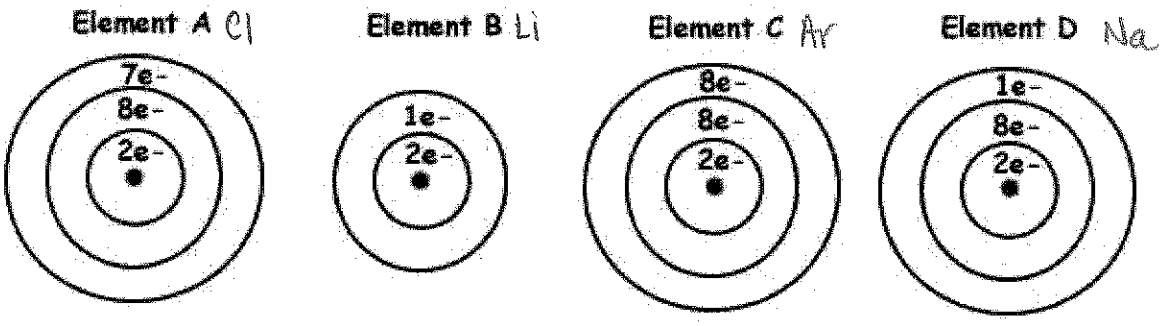
62. **Electronegativity** *increases* as you go up and to the right on the Periodic Table.

Which element among the diagrams in # 65 has the greatest electronegativity? Element A

63. The elements in Group 1 are the ***alkali metals***; those in Group 2 are the ***alkaline earth metals***.
Which atom below represents the alkali metal of period 2? B

64. The elements in Group 17 are the ***halogens***.
Which element among the diagrams below is a halogen? A

65. The elements in Group 18 are the ***noble gases***.
Which element among the diagrams below is a noble gas? C



66. The last digit of a representative element's group number is equal to its ***number of valence electrons***.
Which contains the greatest number of valence electrons?
Ca *Ge* *Se* *Kr*

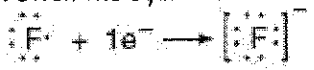
67. Draw one dot for each valence electron when drawing an element's or ion's ***Lewis electron dot diagram***.
Which dot model would contain the fewest dots as valence electrons?
Ca *Ge* *Se* *Kr*

68. **Metallic bonds** can be thought of as a crystalline lattice of kernels surrounded by a "sea" of mobile valence electrons. *Metallic bonding occurs between atoms of*
sulfur *sodium* *fluoride* *carbon*

69. Atoms are most stable when they have 8 valence electrons (an ***octet***) and tend to form ions to obtain such a configuration of electrons.
*Which of the following atoms forms a stable ion that does **not** have an octet structure?*
Li *F* *Na* *Cl*

70. ***Ionic bonds*** form when one atom ***transfers*** an electron to another atom when forming a bond with it.
Which substance exhibits ionic bonding rather than covalent bonding?
CO_2 N_2O_4 SiO_2 $CaBr_2$ $C_6H_{12}O_6$

71. **Dot models** may be used to represent the formation of ions or covalent molecules.
. Given the equation:



This equation represents the formation of a
fluoride ion, which is smaller in radius than a fluorine atom
fluoride ion, which is larger in radius than a fluorine atom
fluorine atom, which is smaller in radius than a fluoride ion
fluorine atom, which is larger is radius than a fluoride ion

72. ***Ionic bonds*** form when the electronegativity difference between two bonding atoms is *greater than* 1.7. Normally these atoms are further apart on the periodic table.
What is the electronegativity difference between a sodium atom and a fluorine atom? Would they form an ionic bond?
4.0 (F) − 0.9 (Na) = 3.1 = highly ionic bond

73. Substances containing mostly ionic bonds are called ***ionic compounds***.
They are made of metal and nonmetallic ions. They are held together by electrostatic (ionic) forces.
Use Lewis electron-dot structures to illustrate the formation of ionic bonds between sodium metal and oxygen.

74. Complete and memorize this table.

Substance Type	Properties
Ionic	Hard *(Low/high) melting and boiling points* Conduct electricity when molten or aqueous
Covalent (Molecular)	Soft *(Low/high) melting and boiling points* Do not conduct electricity (insulators)

75. Unstable atoms that are radioactive are called ***radioisotopes***. (use ***Table N***)
Which of the following represents a stable nuclide?
Calcium-37 *Potassium-42* *Nitrogen-14* *Phosphorus-32*

76. Each radioactive isotope has a specific mode and rate of decay (**half-life**). n = the # of half-lives past
Which sample will decay least over a period of 30 days? [Refer to Reference Table N]
10 g of Au-198 2.695d *10 g of I-131* 8.021d *10 g of P-32* 14.28d *10 g of Rn-222* 3.823d
11.1 = n m_f = 4.6 x 10^{-3} g 3.7 = n m_f = 0.77g 2.1 = n m_f = 2.3g 7.8 = n m_f = 0.045g

77. Radioisotopes can decay by giving off any of the particles/emanations listed in ***Table O***.
Which of the following decays by positron emission(use table N)?
Gold-198 β⁻ *Neon-19* β⁺ *Plutonium-239* α *Technetium-99* β⁻

78. ***Alpha particles*** (see Table O) are positively charged (+). ***Beta particles*** (Table O) are negatively charged (-).
Neutrons and **gamma rays** lack charge.
Which particle cannot be accelerated in a magnetic field?
alpha particle *beta particle* *neutron* *proton*

79. The sum of the mass numbers and atomic numbers must be equal on both sides of the reaction arrow for **nuclear equations**.

$$\underset{9}{^{14}_{7}N} + \underset{2}{^{4}_{2}He} \rightarrow \underset{9}{^{17}_{8}O} + \underset{1}{^{1}_{1}H}$$

Complete the following nuclear equations:

a) $^{35}_{17}Cl + ^{1}_{0}n \rightarrow ^{35}_{16}S +$ $^{1}_{1}H$
b) $^{229}_{90}Th \rightarrow ^{4}_{2}He +$ $^{225}_{88}Ra$
c) $^{20}_{8}O \rightarrow ^{20}_{9}F +$ $^{0}_{-1}e$
d) $^{54}_{26}Fe + ^{1}_{0}n \rightarrow ^{1}_{1}H +$ $^{54}_{25}Mn$
e) $^{104}_{47}Ag \rightarrow ^{0}_{-1}e +$ $^{104}_{48}Cd$
f) $^{54}_{25}Mn + ^{0}_{-1}e \rightarrow ^{54}_{24}Cr$
g) $^{238}_{92}U + ^{12}_{6}C \rightarrow ^{246}_{98}Cf +$ $4^{1}_{0}n$
h) $^{207}_{83}Bi + ^{0}_{-1}e \rightarrow ^{207}_{82}Pb$

80. When radioactive nuclei **decay**, they undergo natural transmutation to form new, more stable atoms.
Complete the following decay equation for the alpha decay of thorium-232:

$^{232}_{90}Th \rightarrow$ $^{4}_{2}He + ^{228}_{88}Ra$

81. When bombarded by radioactive particles, stable atoms undergo artificial **transmutation**
Identify the element produced when aluminum-27 is bombarded with an alpha particle.
(A neutron is also released).

$^{27}_{13}Al + ^{4}_{2}He \rightarrow ^{1}_{0}n +$ $^{30}_{15}P$

82. ***Fission reactions*** split heavy nuclei into smaller ones.

$$^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{139}_{56}Ba + {}^{94}_{36}Kr + 3\,{}^{1}_{0}n + \text{Energy}$$

83. ***Fusion reactions*** occur when light nuclei combine to form a heavy nucleus and *a lot of energy.*

$$^{2}_{1}H + {}^{2}_{1}H \rightarrow {}^{4}_{2}He + \text{ENERGY}$$

What are some of the positives of fusion reactions? The negatives? endless supply of Hydrogen no waste hazardous

What type of nuclear reactions take place on the sun? fusion

84. The ***half life*** of a radioisotope is the *length of time* it takes for one half of the atoms in a sample to radioactively decay. (Table N)

Which sample will decay least over a period of 30 days? [Refer to Reference Table N]
10 g of Au-198 *10 g of I-131* *10 g of P-32* *10 g of Rn-222* #76

Carbon-14 has a half-life of 5,730 years. If a plant contained 2.0 g of $^{14}_{6}C$ when it died, how much is left after 34,380 years? $n = \frac{T}{t_{1/2}} = \frac{34,380\ y}{5,730\ y} = 6$ $2.0g \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 0.031g$ or $(2.0g)(.5)^6 = 0.031g$

85. Radioactive isotopes have a variety of important uses.
Carbon-14, C-14, is used to determine the ages of organic material up to 23,000 years old.
Uranium-238, U-238, is used to determine the ages of rocks.
Iodine-131, I-131, is used to treat thyroid disorders.
Cobalt-60, Co-60, is used to treat cancer tumors.

86. The 3 main types of nuclear radiation are alpha radiation, beta radiation, and gamma radiation. The different types of radiation can be separated by an electric field based on their charge.
List the characteristics of each of the 3 types of radiation including their composition, symbol, charge, mass, penetrating power, and shielding.

alpha $^{4}_{2}H$ +2 charge 4 = mass low penetrating power shielding = paper
beta $^{0}_{-1}e$ -1 " 0 = " med. " " " = lead/wood
gamma $^{0}_{0}\gamma$ 0 " 0 " high " " " = concrete

87. In **scientific notation**, a given number is written as the product two numbers: a coefficient and a 10 raised to a power. *Write the following numbers in scientific notation with significant figures:*
602,000,000,000,000,000,000,000 = 6.02×10^{23} 0.0000000005030 = 5.030×10^{-10}

88. Chemists, like all scientists use the **scientific method**, a logical, systematic approach to the solution of a scientific problem. *In the scientific method what is the testable statement giving a proposed explanation for an observation/problem called?* Hypothesis

89. An **experiment** is a procedure used to test a hypothesis. Within an experimental design there are **variables**, or factors that can change.
What is the variable that you can change during the experiment called? independent
What is the variable that is observed during the experiment called? dependent

90. In a quantitative experiment, success relies on the ability to make reliable measurements that are both correct and reproducible. **Accuracy** is a measure of how close a measurement comes to the actual or true value of whatever is measured and **precision** is a measure of how close a series of measurements are to one another.
Three students in a lab group measured the mass of a copper cylinder using a different balance and obtained these measurements: 47.95g 47.93g 47.93g. Describe the accuracy and precision of the students if the correct mass of the cylinder is 47.32 g. Not accurate because they were not close to the true mass. Precise because very close together
Ave: 47.94g

91. **Dimensional analysis** is a way to analyze and solve problems using the units, or dimensions, of the measurements.
Use dimensional analysis to convert .750 kg to grams and 3.25 quarts to μL.

$$.750\,kg \left| \frac{1000\,g}{1\,kg} \right. = 750.\,g \qquad 3.25\,qt \left| \frac{1\,L}{1.057\,qt} \right| \frac{1\times10^{6}\,\mu L}{1\,L} = 3.07\times10^{6}\,\mu L$$

92. **Density** is an intensive property that depends only on the composition of the substance, not on the size of the sample. *What quantities do you need to measure in order to calculate the density of an object?*
Mass + Volume

93. The five commonly used **SI units** are the meter, kilogram, kelvin, second, and mole.
What type of measurements do each of the 5 units represent?
length Mass temperature time amount

95. **Mendeleev** arranged the elements in his periodic table in order of increasing atomic mass. He also arranged the elements into groups or families based on a set of repeating properties. Mendeleev developed his periodic table before scientists know about the structure of atoms.
Who was the British physicist who determined the atomic number for each known element?
Henry Moseley

96. There are three classes of elements: **metals**, **nonmetals**, and **metalloids**. Across a period, the properties of the elements become less metallic and more metallic. *Classify the following elements:* P N Si metalloid K metal

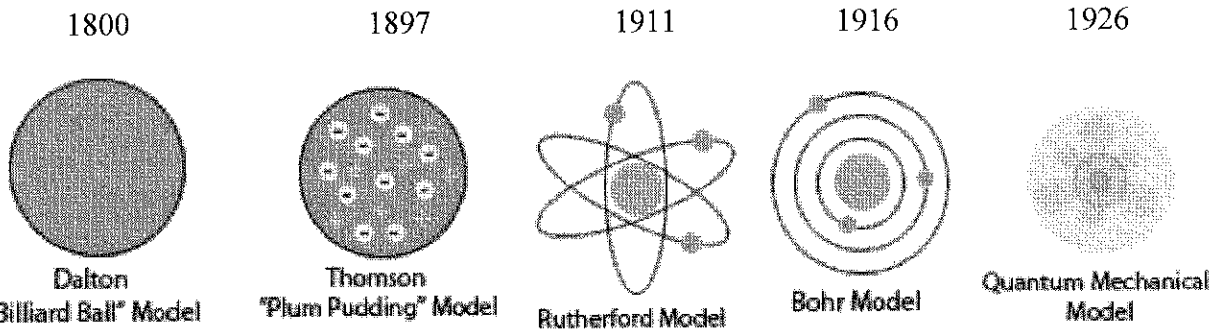
97. **Metals** are good conductors or heat and electric current. Metallic bonding with the metal's mobile valence electrons (*sea of electrons*) allow metallic substances to conduct. *What are some other properties of metals?*
• good conductors • luster • malleable • ductile

98. In the modern periodic table, elements are arranged in order of increasing atomic number. The elements within a **group** in the table have similar properties.
What family on the periodic table has the most reactive metals? alkali metals *Nonmetals?* halogens

99. **Alloys** are mixtures of composed of 2 or more elements, at least one of which is a metal. Alloys are important because their properties are often superior to those of their component elements.
What are 2 important alloys? Steal brass

100. Chemistry is the study of the composition of **matter** and the changes that matter undergoes.
All matter has what 2 specific properties? mass + volume

ATOMIC MODELS



UNIT 4 ELECTRONS IN ATOMS

$c \rightarrow$ speed of light = 3.00×10^{8} m/s

$h \rightarrow$ Planck's constant = 6.626×10^{-34} J·s

$\lambda \rightarrow$ wavelength (meters)

$\nu \rightarrow$ frequency (1/s)

$E \rightarrow$ engery (J)

$1nm = 1 \times 10^{-9}m$ $1pm = 1 \times 10^{-12}m$

Formulas

1. $c = \lambda \cdot \nu$
2. $E = h \cdot \nu$
3. $E = \frac{h \cdot c}{\lambda}$

Table O
Symbols Used in Nuclear Chemistry

Name	Notation	Symbol
alpha particle	$^{4}_{2}\mathrm{He}$ or $^{4}_{2}\alpha$	α
beta particle	$^{0}_{-1}\mathrm{e}$ or $^{0}_{-1}\beta$	β^-
gamma radiation	$^{0}_{0}\gamma$	γ
neutron	$^{1}_{0}\mathrm{n}$	n
proton	$^{1}_{1}\mathrm{H}$ or $^{1}_{1}\mathrm{p}$	p
positron	$^{0}_{+1}\mathrm{e}$ or $^{0}_{+1}\beta$	β^+

Table N
Selected Radioisotopes

Nuclide	Half-Life	Decay Mode	Nuclide Name
^{198}Au	2.695 d	β^-	gold-198
^{14}C	5715 y	β^-	carbon-14
^{37}Ca	182 ms	β^+	calcium-37
^{60}Co	5.271 y	β^-	cobalt-60
^{137}Cs	30.2 y	β^-	cesium-137
^{53}Fe	8.51 min	β^+	iron-53
^{220}Fr	27.4 s	α	francium-220
^{3}H	12.31 y	β^-	hydrogen-3
^{131}I	8.021 d	β^-	iodine-131
^{37}K	1.23 s	β^+	potassium-37
^{42}K	12.36 h	β^-	potassium-42
^{85}Kr	10.73 y	β^-	krypton-85
^{16}N	7.13 s	β^-	nitrogen-16
^{19}Ne	17.22 s	β^+	neon-19
^{32}P	14.28 d	β^-	phosphorus-32
^{239}Pu	2.410×10^{4} y	α	plutonium-239
^{226}Ra	1599 y	α	radium-226
^{222}Rn	3.823 d	α	radon-222
^{90}Sr	29.1 y	β^-	strontium-90
^{99}Tc	2.13×10^{5} y	β^-	technetium-99
^{232}Th	1.40×10^{10} y	α	thorium-232
^{233}U	1.592×10^{5} y	α	uranium-233
^{235}U	7.04×10^{8} y	α	uranium-235
^{238}U	4.47×10^{9} y	α	uranium-238

Source: *CRC Handbook of Chemistry and Physics*, 91st ed., 2010–2011, CRC Press