**First Semester Final Exam Review – 2020**

This review is to give you an idea of some areas you may need to study and to give you a little practice with the concepts. It is **NOT** a complete list. If you discover sections that you've struggled with during the school year, you should return to your NOTES and ALL HOMEWORK and CLASSWORK HANDOUTS for that topic.

Bring pencils and a scientific calculator with you to the exam. NO sharing of calculators will be permitted. You will be able to use: 1) periodic table, 2) polyatomic ion sheet, 3) periodic trends handout, and 4) your composition book

# Introduction to Chemistry

Vocabulary Words and/or Topics: mass, matter, qualitative data, quantitative data,

1. Define matter any substance with mass and volume
2. Contrast mass and weight. Mass is the amount of matter. Weight is a force due to gravity. SO . . . if an astronaut travels to the moon, they will have the SAME MASS but less WEIGHT (due to lower gravity)

# Data Analysis

Vocabulary Words and/or Topics:

Accuracy, precision, conversion factor, density, dimensional or unit analysis, graph, scientific notation, significant figures

1. Write the following numbers in scientific notation and indicate the number of significant figures in each.

|  |  |  |
| --- | --- | --- |
| Convert to scientific notation  ↓ |  | # of Significant Figures?  ↓ |
| 7.51 x 102 m | 751 meters | 3 |
| 7.81 x 105 m | 781000 meters | 3 |
| 7.810000 x 105 m | 781000.0 meters | 7 |
| 5.0 x 10-3 g | 0.0050 grams | 2 |
| 7.45 x 10-6 g | 0.00000745 grams | 3 |
| 3 x 100 K | 3 Kelvin | 1 |
| 3.0 x 109 atoms | 3.0 billion atoms | 2 |

2. Perform the following operations and report the answer to the proper number of significant figures with the proper units

* + 1. 10.2 m x 178.9 m = 1820 m2
    2. 10.1 cm + 0.672 cm = 10.8 cm
    3. 5.70 cm x 6.40 cm x 7.320 cm = 267 cm3
    4. 5.73 g / 7.64 cm3 = 0.750 g/cm3
    5. *0.01472 kg* + 735.0 kg = 735.0 kg (the 0.01472 added is “insignificant” when you round to sig figs)

3. Convert each of the following quantities and answer with the correct number of significant figures and units.

* + 1. 0.143 hours to seconds 515 seconds
    2. 1.098 km to m 1098 m
    3. 1.70 mL to L 0.00170 L
    4. 5.7 mm to cm 0.57 cm
    5. 0.924 kg to grams 924 g
    6. 16 ft3 to in3 28000 in3
    7. 35.72 mL to cm3 35.72 cm3

4. What is the density of a substance that has a volume of 3.07 cm3 and a mass of 8.76 g? 2.85 g/cm3

5. Calcium chloride is used as a de-icer on roads in winter. It has a density of 2.50 g/cm3. What is the volume of 7.91 g of this substance? 3.16 cm3

**Matter: Properties and Changes** Vocabulary Words and/or Topics: allotropes, atom, chemical change, chemical properties, compounds, element, extensive properties, gas, heterogeneous mixture, homogeneous mixture, intensive properties, law of conservation of mass, liquid, mixture, periodic table, physical change, physical properties, solid, solution, states of matter, substance, vapor

1. Classify the following materials as heterogeneous mixtures (HE), solutions (HO), compounds (C), or elements (E):

A. air HO

* 1. paper HE
  2. table salt C
  3. granite HE
  4. whole milk HE
  5. plutonium E
  6. distilled water C

1. How many phases are present in a glass of soda on ice? Three. Solid ice. Liquid water. Gas bubbles

1. Classify the following properties as intensive or extensive:
   1. mass extensive; mass is different depending on how much
   2. color intensive; a small amount or large amount will be the same color
   3. ductility intensive
   4. length extensive
   5. melting point intensive

1. Classify the following as chemical or physical properties:

|  |  |  |  |
| --- | --- | --- | --- |
| color P | stability C | stiffness P | reactivity C |
| flammability C | ductility P | melting point P | reacts with air C |
| solubility P | electrical conductivity P | corrosive C | blue P |

1. Differentiate between homogenous mixtures dissolved and evenly mixed; uniform composition; Gatorade and heterogeneous mixtures NOT dissolved; not mixed on a particle level; cookies. Give examples of each.
2. What are chemical properties? Properties that can only be observed by attempting a chemical reaction
3. Why is a change of phase considered to be a physical change? A change in state of matter doesn’t change the chemical. For example, ice is H2O and liquid water is still H2O
4. What is a compound? chemical combination of 2 or more different elements; the compound has a DEFINITE composition
5. What is the difference between qualitative and quantitative data? qualitative is description; quantitative is numbers/measurements
6. What is an alloy? Is it a homogeneous mixture, heterogeneous mixture, or a compound? Give an example. An alloy is a homogeneous mixture of 2 or more different types of metal. Brass is a mixture of copper and zinc.
7. Which of the following are a pair of isotopes? Why?
   1. ~~14~~~~N and~~ ~~14~~~~O~~ NO
   2. 35Cl and 34Cl YES; because they are the same element
   3. ~~Si that has 12 neutrons and sulfur that has 12 neutrons~~ NO
   4. two bromine atoms with 54 neutrons each YES; because they are the same element . . . even though they have the same mass number, they can be called “isotopes” when comparing do other bromine isotopes

4

2

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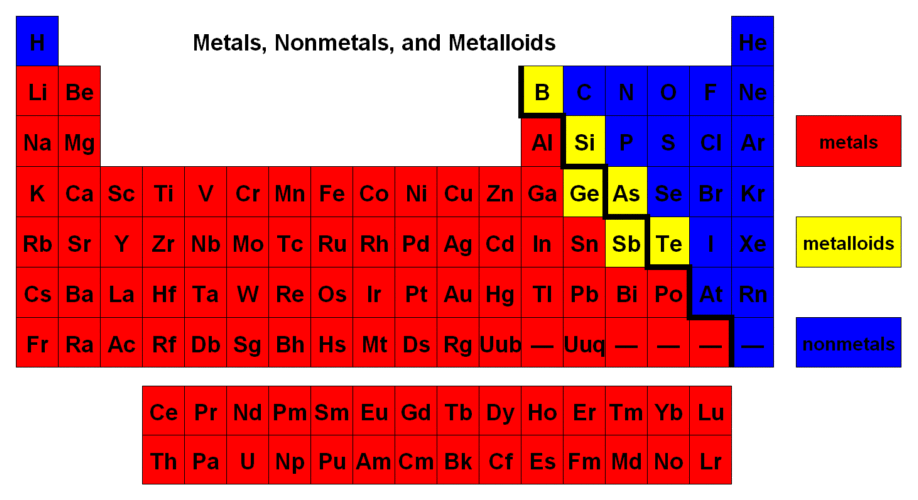
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# Development of the Modern Periodic Table and the Elements

Vocabulary Words and/or Topics: actinides, alkali metals, alkaline earth metals, groups, halogen, transition metal, ion, ionization energy, metal, metalloid, noble gas, nonmetal, octet rule, period, periodic law

1. How do chemists use the periodic law to classify elements? Elements are classified and organized based on those chemical and physical properties. They are placed in groups according to valence electrons
2. What is the name of a vertical column on the periodic table? group A horizontal row? period
3. Why is beryllium in group 2? properties of Alkaline earth metals What do all atoms in Group 2 have in common? 2 valence electrons
4. Who developed the modern periodic table? How was it later modified? Mendeleev designed the 1st periodic table in order of increasing *atomic mass* and grouped elements based on similar physical and chemical properties. Moseley improved on the organization by placing them in increasing *atomic number*

1. Sketch a simplified version of the periodic table and indicate the location of groups, periods, metals, nonmetals, and metalloids. group = column period = row



1. How does the shielding effect affect atomic size? Greater shielding effect generally “pushes” electrons further from the nucleus and increases atomic radius

1. Which has a larger radius?
   1. **Mg** or Si *(Si has more protons than Mg which “pull” electrons closer to the nucleus)*
   2. **Ti** or Cr *(Cr has more protons than Ti which “pull” electrons closer to the nucleus)*
   3. Li or **Cs** *(Cs has more energy levels and greater shielding effect than Li)*
   4. **Ni** or Zn *(Zn has more protons than Ni which “pull” electrons closer to the nucleus)*
2. Which has the higher ionization energy?
   1. Ba or **Bi** *(Bi has more protons than Ba which “pull” electrons closer to the nucleus and requires MORE energy to remove one electron)*
   2. **Al** or Ti *(Ti has more energy levels and greater shielding effect than Al, so MORE energy is required to remove an electron from Al which is closer to the nucleus and has less shielding)*
   3. C or **O** *(O has more protons than C which “pull” electrons closer to the nucleus and requires MORE energy to remove one electron)*
   4. Br or **Kr** *(Kr has more protons than Br which “pull” electrons closer to the nucleus and requires MORE energy to remove one electron)*
   5. P or **O** *(P has more energy levels and greater shielding effect than O, so MORE energy is required to remove an electron from O which is closer to the nucleus and has less shielding)*
3. Which has the larger electronegativity?
   1. B or **F** *(F has more protons than B which “pull” electrons to the nucleus with GREATER electronegativity)*
   2. **Cl** or S *(Cl has more protons than S which “pull” electrons to the nucleus with GREATER electronegativity)*

1. For the element aluminum, the number 26.98 represents atomic mass (or average atomic mass)

# Atomic Structure

Vocabulary Words and/or Topics: proton, neutron, electron, atomic number, mass number, quantum numbers, orbital, sublevel, energy level, group, period

1. Describe what each of these scientists discovered about the atom. What was the name of each of their theories?
   1. Dalton billiard ball (solid, indestructible spheres)
   2. Thomson plum pudding (electrons randomly suspended in a positively-charged “gel/pudding”)
   3. Rutherford nuclear model (protons located in a small nucleus, surrounded by moving electrons; the atom is mostly empty space)
   4. Bohr planetary model or solar system model (improvement on Rutherford; Bohr model describes the location of electrons in “energy levels” based on increasing energy/distance from the nucleus)
2. What are the symbols for the 4 orbital shapes? s, p, d, f

How many sublevels are in the 1st energy level? 1s 2nd? 2s, 2p 3rd? 3s, 3p, 3d 4th? 4s, 4p, 4d, 4f

1. What is the symbol for one electron in an orbital diagram? Arrow What is the maximum number of electrons that can occupy the 2s sublevel? 2 The 4f sublevel? 7 The 5d sublevel? 10 The 3p sublevel? 6

1. Explain what the energy levels of an atom correspond to on the periodic table. Each period represents electrons entering a new energy level

1. Explain how an electron configuration describes an atom. Electron configuration describes the a) energy level with a “big” number, b) the sublevel with a “big number and lowercase letter”, and c) the number of electrons in each sublevel with a superscript number. EXAMPLE: 1s22s22p4 is oxygen

1. Explain what its orbital diagram describes about an atom. Orbital diagram describes the a) energy level with a “big” number, b) the sublevel with a “big number and lowercase letter”, and c) the number of orbitals indicated by the number of boxes, and d) the number of electrons AND the spin of each electron with an arrow.

EXAMPLE: orbital diagram for oxygen is below

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ↑↓ |  | ↑↓ |  | ↑↓ | ↑ | ↑ |
| 1s |  | 2s |  |  | 2p |

1. If an atom has 14 protons and a mass number of 38, tell the following:
   1. number of electrons 14 electrons (*atoms* has no charge, so the same number of protons/electrons)
   2. number of neutrons 24 neutrons
   3. atomic number 14 atomic number
2. If an atom has an atomic number of 7 and 8 neutrons, tell the following:
   1. number of protons 7 protons
   2. number of electrons 7 electrons
   3. mass number 15 mass number
3. Write out the complete electron configuration for the following atoms (NO SHORT CUT)

A. sodium 1s22s22p63s1

* 1. zinc 1s22s22p63s23p64s23d10
  2. sulfur 1s22s22p63s23p4
  3. neon 1s22s22p6

10. Write the noble gas notation for the electron configuration for the atoms above (9A through 9D)

A. sodium [Ne]3s1

B. zinc [Ar]4s23d10

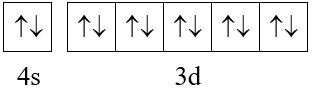
C. sulfur [Ne]3s23p4

D. neon [He]2s22p6

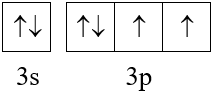
1. Write the noble gas notation for the orbital diagram for each atom above (9A through 9D)



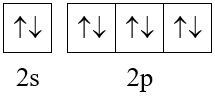
A. sodium [Ne]



B. zinc [Ar]



C. sulfur [Ne]



D. neon [He]

1. Draw Lewis diagram for ONE ATOM of each of the following *(not doing dashes and bonds, yet)*:

a) sodium , b) carbon, c) fluorine , d) calcium , e) phosphorus 

# Ionic Compounds

Vocabulary Words and/or Topics: ion, cation, anion, oxidation number, transition metal, roman numerals, polyatomic ions, superscript, subscript, valence electrons, chemical bond, ionic bond

1. What type of bond will be formed between:
   1. carbon and fluorine polar covalent
   2. magnesium and chlorine ionic
   3. zinc and copper metallic
   4. hydrogen and oxygen polar covalent
2. How many valence electrons are in the following atoms: lithium 1, nitrogen 5, aluminum 3, fluorine 7, neon 8, bromine 7, sulfur 6, calcium 2
3. Using the octet rule, when the atoms in Problem #2 above turn into ions, what is the charge of each? lithium +1, nitrogen −3, aluminum +3, fluorine −1, neon no ion, bromine −1, sulfur −2, calcium +2

**Naming and Formulas for Compounds**

* Naming and Formulas for Ionic Compounds
* Naming and Formulas for Covalent Compounds

*Write the chemical formula: Write the chemical name:*

* 1. sodium fluoride NaF 8. NaI sodium iodide
  2. hydrogen monofluoride HF 9. AlBr3 aluminum bromide
  3. aluminum sulfide Al2S3 10. H2SO4 hydrogen sulfate
  4. barium sulfide BaS 11. Cl2O7 dichlorine heptoxide
  5. phosphorus pentachloride PCl5 12. HBr hydrogen bromide
  6. dinitrogen tetroxide N2O4 13. N2O5 dinitrogen pentoxide
  7. hydrogen nitrate HNO3 14. ICl3 iodine trichloride

*Write the chemical formula:* *Write the chemical name:*

* 1. sodium sulfite Na2SO3 22. HCl hydrogen monochloride
  2. magnesium ion Mg2+ 23. Na2SO4 sodium sulfate
  3. ammonium fluoride NH4F 24. KNO3 potassium nitrate
  4. oxygen O2 25. NH4+ ammonium
  5. oxide O2− 26. Mg(OH)2 magnesium hydroxide
  6. hydrogen chlorate HClO3 27. H2CO3 hydrogen carbonate
  7. barium cyanide Ba(CN)2

*Write the chemical formula:* *Write the chemical name:*

* 1. iron(II) chloride FeCl2 33. NiF2 nickel(II) fluoride
  2. iron(III) chloride FeCl3 34. F2 fluorine
  3. chromium(III) oxide Cr2O3 35. F- fluoride
  4. iron(III) perchlorate Fe(ClO4)3 36. Fe2S3 iron(III) sulfide

32. nickel(III) acetate Ni(C2H3O2)3 37. CrO chromium(II) oxide

38. Ca3(PO4)2 calcium phosphate

# BONDING

* Determining type of bond between 2 elements: ionic, metallic, polar covalent, or nonpolar covalent
* Drawing Lewis diagrams for covalent compounds
* Determine the shape of a covalent molecule and whether the molecule is polar or nonpolar

# Type of Bond

Indicate the type of bond formed between the following elements.

1. N and Cl polar covalent 6. K and Br ionic

2. N and N nonpolar covalent 7. Mg and Mg metallic

3. Ca and O ionic 8. Al and Cl ionic

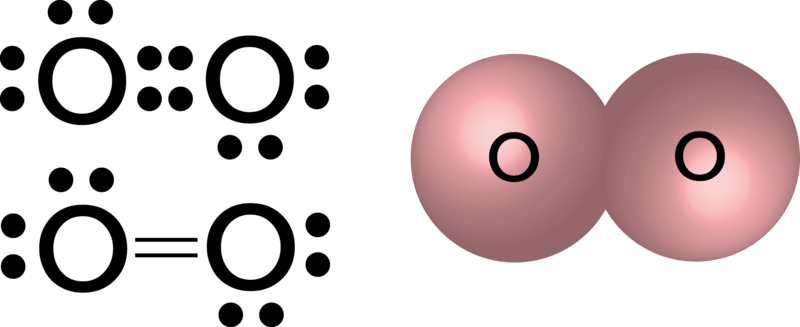
4. C and F polar covalent 9. Si and Cl polar covalent

5. H and O polar covalent 10. Cu and Sn metallic

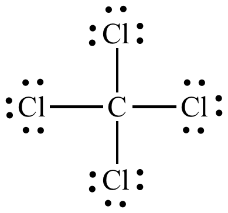
# Lewis Diagrams

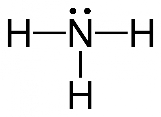
For the following compounds: a) draw a Lewis diagram, b) determine the shape of the molecule, and c) determine if the molecule is polar or nonpolar

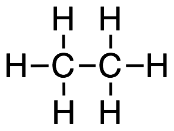
H2 Image result for h2 lewis structure linear diatomic nonpolar

O2  linear diatomic nonpolar

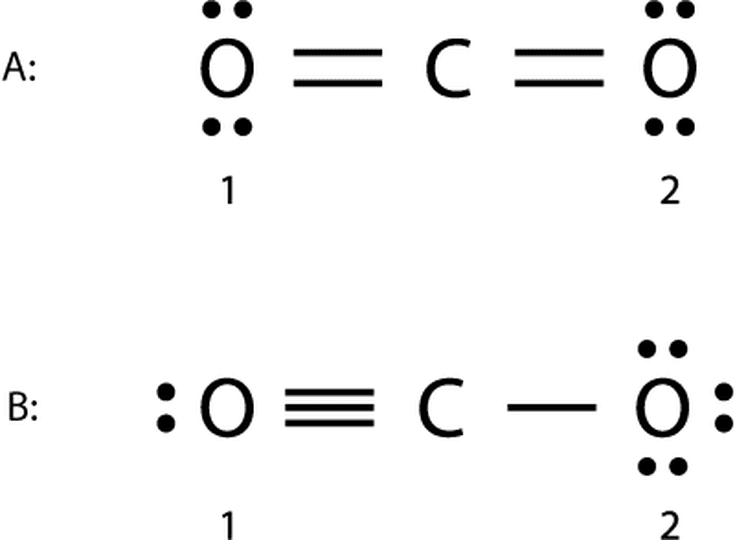
N2  linear diatomic nonpolar

CCl4 tetrahedral nonpolar

NH3 trigonal pyramidal polar

C2H6 nonpolar *(tetrahedral around each C – you don’t need to know that)*

SF2bent polar

CO2  linear triatomic nonpolar