Chemistry Unit 2 Classwork/Homework

1. Create a table to record your data. The table will contain the mass and the abundance of each type of snack present in the mixture.
2. Open your snack mix bag and organize the snack pieces into groups based on their types.
3. Count the number of snack pieces in each of your groups.
4. Record the number of snack pieces in each group in your data table. Write the total number of pieces beneath the table.
5. Measure the mass of one piece from each group and record the mass in your data table.
6. Find the percent abundance of the pieces by dividing the individual piece quantity by the total number of snack pieces. Record in table.

	# of pieces	Mass of one piece	% Abundance (# pieces/total # pieces)x100
Squiggle breadstick			
Round pretzel			
Bagel chip			
Square pretzel			
Rye chip			
Chex			

Total number of pieces in bag: ______

Weighted Average Atomic Mass for Snackium: ________

1. Use the percent abundance (convert to decimal) of the snack pieces and the mass to calculate the weighted average atomic mass for your element Snackium. (mass)(% abundance) + (mass)(% abundance)...

2. Why are the atomic masses on the periodic table not expressed as whole numbers like the mass number of an element?

3. Gather the average atomic mass data from other lab groups. Explain any differences between your data and the data obtained by other groups.

Radioactivity is a part of our earth - it has existed all along. Naturally occurring radioactive materials are present in its crust, the floors and walls of our homes, schools, or offices and in the food we eat and drink. There are radioactive gases in the air we breathe. Our own bodies - muscles, bones, and tissue - contain naturally occurring radioactive elements. Man has always been exposed to natural radiation arising from the earth as well as from outside the earth. The radiation we receive from outer space is called cosmic radiation or cosmic rays. We also receive exposure from man-made radiation, such as X-rays, radiation used to diagnose diseases and for cancer therapy. Fallout from nuclear explosives testing, and small quantities of radioactive materials released to the environment from coal and nuclear power plants, are also sources of radiation exposure to man.

Radioactivity is the term used to describe disintegration of atoms. The atom can be characterized by the number of protons in the nucleus. Some natural elements are unstable. Therefore, their nuclei disintegrate or decay, thus releasing energy in the form of radiation. This physical phenomenon is called radioactivity and the radioactive atoms are called nuclei. The radioactive decay is expressed in units called becquerels. One becquerel equals one disintegration per second.

The radionuclides decay at a characteristic rate that remains constant regardless of external influences, such as temperature or pressure. The time that it takes for half the radionuclides to disintegrate or decay is called half-life. This differs for each radioelement, ranging from fractions of a second to billions of years. For example, the half-life of Iodine 131 is eight days, but for Uranium 238, which is present in varying amounts all over the world, it is 4.5 billion years. Potassium 40, the main source of radioactivity in our bodies, has a half-life of 1.42 billion years.

Types of Radiation

The term "radiation" is very broad, and includes such things as light and radio waves. In our context it refers to "ionizing" radiation, which means that because such radiation passes through matter, it can cause it to become electrically charged or ionized. In living tissues, the electrical ions produced by radiation can affect normal biological processes.

There are various types of radiation, each having different characteristics. The common ionizing radiations generally talked about are:

- **Alpha radiation** consists of heavy, positively charged particles emitted by atoms of elements such as uranium and radium. Alpha radiation can be stopped completely by a sheet of paper or by the thin surface layer of our skin (epidermis). However, if alpha-emitting materials are taken into the body by breathing, eating, or drinking, they can expose internal tissues directly and may, therefore, cause biological damage.
- **Beta radiation** consists of electrons. They are more penetrating than alpha particles and can pass through 1-2 centimetres of water. In general, a sheet of aluminum a few millimetres thick will stop beta radiation.
- **Gamma rays** are electromagnetic radiation similar to X-rays, light, and radio waves. Gamma rays, depending on their energy, can pass right through the human body, but can be stopped by thick walls of concrete or lead.

- **Neutrons** are uncharged particles and do not produce ionization directly. But, their interaction with the atoms of matter can give rise to alpha, beta, gamma, or X-rays which then produce ionization. Neutrons are penetrating and can be stopped only by thick masses of concrete, water or paraffin.

Although we cannot see or feel the presence of radiation, it can be detected and measured in the most minute quantities with quite simple radiation measuring instruments.

Radiation Dose

Sunlight feels warm because our body absorbs the infra-red rays it contains. But, infra-red rays do not produce ionization in body tissue. In contrast, ionizing radiation can impair the normal functioning of the cells or even kill them. The amount of energy necessary to cause significant biological effects through ionization is so small that our bodies cannot feel this energy as in the case of infra-red rays which produce heat.

The biological effects of ionizing radiation vary with the type and energy. A measure of the risk of biological harm is the dose of radiation that the tissues receive. The unit of absorbed radiation dose is the sievert (Sv). Since one sievert is a large quantity, radiation doses normally encountered are expressed in millisievert (mSv) or microsievert (μSv) which are one-thousandth or one millionth of a sievert. For example, one chest X-ray will give about 0.2 mSv of radiation dose.

On average, our radiation exposure due to all natural sources amounts to about 2.4 mSv a year - though this figure can vary, depending on the geographical location by several hundred percent. In homes and buildings, there are radioactive elements in the air. These radioactive elements are radon (Radon 222), thoron (Radon 220) and by products formed by the decay of radium (Radium 226) and thorium present in many sorts of rocks, other building materials and in the soil. By far the largest source of natural radiation exposure comes from varying amounts of uranium and thorium in the soil around the world. The radiation exposure due to cosmic rays is very dependent on altitude, and slightly on latitude: people who travel by air, thereby, increase their exposure to radiation.

We are exposed to ionizing radiation from natural sources in two ways:

- We are surrounded by naturally-occurring radioactive elements in the soil and stones, and are bathed with cosmic rays entering the earth's atmosphere from outer space.
- We receive internal exposure from radioactive elements which we take into our bodies through food and water, and through the air we breathe. In addition, we have radioactive elements (Potassium 40, Carbon 14, Radium 226) in our blood or bones.

Additionally, we are exposed to varying amounts of radiation from sources such as dental and other medical X-rays, industrial uses of nuclear techniques and other consumer products such as luminized wrist watches, ionization smoke detectors, etc. We are also exposed to radiation from radioactive elements contained in fallout from nuclear explosives testing, and routine normal discharges from nuclear and coal power stations.

Radiation Protection

It has long been recognized that large doses of ionizing radiation can damage human tissues. Over the years, as more was learned, scientists became increasingly concerned about the potentially damaging effects of exposure to large doses of radiation. The need to regulate exposure to radiation prompted the formation of a number of expert bodies to consider what is needed to be done. In 1928, an independent non-governmental body of experts in the field, the International X-ray and Radium Protection Committee was established. It later was renamed the International Commission on Radiological Protection (ICRP). Its purpose is to establish basic principles for, and issue recommendations on, radiation protection.

These principles and recommendations form the basis for national regulations governing the exposure of radiation workers and members of the public. They also have been incorporated by the International Atomic Energy Agency (IAEA) into its Basic Safety Standards for Radiation Protection published jointly with the World Health Organization (WHO), International Labour Organization (ILO), and the OECD Nuclear Energy Agency (NEA). These standards are used worldwide to ensure safety and radiation protection of radiation workers and the general public.

An intergovernmental body was formed in 1955 by the General Assembly of the United Nations as the UN Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). UNSCEAR is directed to assemble, study and disseminate information on observed levels of ionizing radiation and radioactivity (natural and man-made) in the environment, and on the effects of such radiation on man and the environment.

Basic approaches to radiation protection are consistent all over the world. The ICRP recommends that any exposure above the natural background radiation should be kept as low as reasonably achievable, but below the individual dose limits. The individual dose limit for radiation workers averaged over 5 years is 100 mSv, and for members of the general public, is 1 mSv per year. These dose limits have been established based on a prudent approach by assuming that there is no threshold dose below which there would be no effect. It means that any additional dose will cause a proportional increase in the chance of a health effect. This relationship has not yet been established in the low dose range where the dose limits have been set.

There are many high natural background radiation areas around the world where the annual radiation dose received by members of the general public is several times higher than the ICRP dose limit for radiation workers. The numbers of people exposed are too small to expect to detect any increases in health effects epidemiologically. Still the fact that there is no evidence so far of any increase does not mean the risk is being totally disregarded.

The ICRP and the IAEA recommend the individual dose must be kept as low as reasonably achievable, and consideration must be given to the presence of other sources which may cause simultaneous radiation exposure to the same group of the public. Also, allowance for future sources or practices must be kept in mind so that the total dose received by an individual member of the public does not exceed the dose limit. In general, the average annual dose received by radiation workers is found to be considerably lower than the individual dose limits. Good radiation protection practice can thus result in low radiation exposure to workers.

At What Level is Radiation Harmful?

The effects of radiation at high doses and dose rates are reasonably well documented. A very large dose delivered to the whole body over a short time will result in the death of the exposed person within days. Much has been learned by studying the health records of the survivors of the bombing of Hiroshima and Nagasaki. We know from these that some of the health effects of exposure to radiation do not appear unless a certain quite large dose is absorbed. However, many other effects, especially cancers are readily detectable and occur more often in those with moderate doses. At lower doses and dose rates, there is a degree of recovery in cells and in tissues.

However, at low doses of radiation, there is still considerable uncertainty about the overall effects. It is presumed that exposure to radiation, even at the levels of natural background, may involve some additional risk of cancer. However, this has yet to be established. To determine precisely the risk at low doses by epidemiology would mean observing millions of people at higher and lower dose levels. Such an analysis would be complicated by the absence of a control group which had not been exposed to any radiation. In addition, there are thousands of substances in our everyday life besides radiation that can also cause cancer, including tobacco smoke, ultraviolet light, asbestos, some chemical dyes, fungal toxins in food, viruses, and even heat. Only in exceptional cases is it possible to identify conclusively the cause of a particular cancer.

There is also experimental evidence from animal studies that exposure to radiation can cause genetic effects. However, the studies of the survivors of Hiroshima and Nagasaki give no indication of this for humans. Again, if there were any hereditary effects of exposure to low-level radiation, they could be detected only by careful analysis of a large volume of statistical data. Moreover, they would have to be distinguished from those of a number of other agents which might also cause genetic disorders, but whose effect may not be recognised until the damage has been done (thalidomide, once prescribed for pregnant women as a tranquilizer, is one example). It is likely that the resolution of the scientific debate will not come via epidemiology but from an understanding of the mechanisms through molecular biology. With all the knowledge so far collected on effects of radiation, there is still no definite conclusion as to whether exposure due to natural background carries a health risk, even though it has been demonstrated for exposure at a level a few times higher.

Risks and Benefits

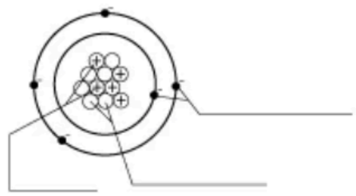
We all face risks in everyday life. It is impossible to eliminate them all, but it is possible to reduce them. The use of coal, oil, and nuclear energy for electricity production, for example, is associated with some sort of risk to health, however small. In general, society accepts the associated risk in order to derive the relevant benefits. Any individual exposed to carcinogenic pollutants will carry some risk of getting cancer. Strenuous attempts are made in the nuclear industry to reduce such risks to as low as reasonably achievable. Radiation protection sets examples for other safety disciplines in two unique respects:

- First, there is the assumption that any increased level of radiation above natural background will carry some risk of harm to health.
- Second, it aims to protect future generations from activities conducted today.

The use of radiation and nuclear techniques in medicine, industry, agriculture, energy and other scientific and technological fields has brought tremendous benefits to society. The benefits in medicine for diagnosis and treatment in terms of human lives saved are enormous. Radiation is a key tool in the treatment of certain kinds of cancer. Three out of every four patients hospitalized in the industrial countries benefit from some form of nuclear medicine. The beneficial impacts in other fields are similar. No human activity or practice is totally devoid of associated risks. Radiation should be viewed from the perspective that the benefit from it to mankind is less harmful than from many other agents.

Basic Atomic Structure

1. Label the parts of an atom in the diagram below



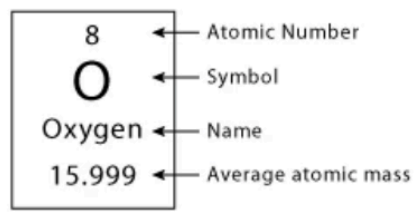
a) What type of charge does a proton have? ____________

b) What type of charge does a neutron have? ____________

c) What type of charge does an electron have? ____________

d) Which two subatomic particles are located in the nucleus of an atom? ____________________

2. An element is represented by its chemical symbol along with a few numbers. Based on the example on the right, fill in the numbers of protons (P), neutrons (N), and electrons (E) for the following elements.



6
C
Carbon
12.011

#P ____
#N ____
#E ____

10
Ne
Neon
20.108

#P ____
#N ____
#E ____

19
K
Potassium
39.098

#P ____
#N ____
#E ____

3. Complete the table using your knowledge of the periodic table.

Symbol	Atomic Number	Mass Number	Number of Protons	Number of Electrons	Number of Neutrons
Na			11		12
K		39		19	
			38		50
F				9	10
	20	40		20	
	50			50	69
I	53	127			

Name : ______________________________

Electron Configuration Worksheet

1. Name the elements that have the following electron configurations.

i. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^5$ ____________

ii. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^4$ ____________

2. Write the ground state electron configuration for a neutral atom of the following elements.

i. Oxygen ______________________________

ii. Krypton ______________________________

iii. Chromium ______________________________

3. Using the long method, give the electron configuration of

i. Magnesium (Mg) _________________________

ii. Potassium (K) _________________________

iii. Lithium (Li) _________________________

iv. Nickel (Ni) _________________________

v. Sulfur (S) _________________________

4. Identify the following elements.

i. $1s^2\ 2s^2\ 2p^2$ __________

ii. $1s^2\ 2s^2\ 2p^6$ __________

iii. $[Ar]\ 4s^2\ 3d^{10}\ 4p^5$ __________

iv. $[Kr]\ 5s^2\ 4d^1$ __________

v. $[Ne]\ 3s^2\ 3p^3$ __________

5. Determine the electron configuration using the short method.

i. Strontium _________________

ii. Bromine _________________

iii. Zirconium _________________

iv. Molybdenum _________________

v. Silver _________________

Trends in Periodic Table (Worksheet)

For each of the following circle the correct element.

Metal Na P S

Nonmetal Li Zn O

Metalloid F Al Si

Halogen Cl He B

Noble gas Mg Ar Ag

Transitional metal K I Cu

Smallest ionization energy N P As

Largest atomic mass Sc Ca K

Member of the halogen family P F He

Greatest electron affinity Na C P

Largest atomic radius Ga B Si

Largest atomic number V Zn Cs

Member of noble gases Rb As Xe

4 energy levels Si Ge Sn

Member of alkali metals Na Mg Al

6 valence electrons As O Br

Member of transition metals Mo K Cl

Electron distribution ending in s^2p^1 Li Be B

Metalloid Sb Sr Sn

Gas at room temperature C N S

Electron distribution ending in s^2d^2 Ti Mg Sc

Chemistry Study Guide

Chapter 4

1. What 4 categories did Aristotle classify elements as? (page 103)
   Earth, fire, air, water

2. What are the parts of Dalton's atomic theory? (page 104)
   Matter is composed of extremely small particles called atoms.
   Atoms are indivisible and indestructible. (this we discovered is not actually true)
   Atoms of a given element are identical in size, mass, and chemical properties. (this is also not entirely true because of isotopes)
   Atoms of a specific element are different from those of another element.
   Different atoms combine in simple whole-number ratios to form compounds.
   In a chemical reaction, atoms are separated, combined, or rearranged.
3. What is the Law of Conservation of Mass? (p. 105 and also covered back on page 77)
   Mass of the reactants = mass of the products
   Mass is neither created nor destroyed during a chemical reaction

4. What is the charge of a proton? An electron? A neutron? (p. 114)
   Proton charge is positive
   Neutron has no charge
   Electron charge is negative

5. Where do you find a proton in the atom? A neutron? An electron? (p. 114)
   Protons and neutrons are in the nucleus.
   Electrons are in space surrounding the nucleus.

6. Which is smallest: a proton, neutron, or electron? (p. 114)
   Electron

7. What is the difference between atomic number (p. 115), mass number (p. 117) and atomic mass (p. 119)? Where do you find atomic number and atomic mass on the periodic table?
   Atomic number = number of protons = number of electrons
   Mass number = atomic number + number of neutrons
   Atomic mass = the weighted average mass of isotopes of that element

8. What is an isotope? (p. 117)
   Atoms with the same number of protons but different numbers of neutrons.

9. Calculate the atomic mass for magnesium if it has the following isotope masses and percent abundances: 78.99% has mass of 23.985 amu. 10.00% has mass of 24.986 amu. 11.01% has mass of 25.982 (example in figure 18 p. 119 and Example Problem 3 on p. 121).

   (.7899)(23.985) + (.1000)(24.986) + (.1101)(25.982) = 24.31 amu

10. Unstable nuclei release radiation in a spontaneous process called radioactive decay. What are the 3 types of radiation it emits? (p. 123-124)
    Alpha, beta, and gamma radiation

Chapter 5

11. What kind of properties does light have according to Planck and Einstein's research? (see p. 143 "Light's Dual Nature")
    Light has wave-like and particle-like properties.

12. Who concluded that we can't know the exact location and speed of an electron? (p. 151)
    Heisenberg

13. Schroedinger built on the work of Bohr and de Broglie and concluded that an electron can not only have particle characteristics, but also characteristics like what? (p. 152) waves

14. What is an orbital and how many electrons can each letter hold? (p. 152-154, 156) Orbitals describe an electron's probable location. There is an s orbital (holding 2 electrons), 3 p orbitals (holding 6 electrons), 5 d orbitals (holding 10 electrons), and 7 f orbitals (holding 14 electrons).

15. What is the Pauli exclusion principle? (p. 157)
    Only 2 electrons can occupy a single atomic orbital, but only if they have opposite spins.

16. Know how to write an electron configuration or noble gas configuration for an element- try it for tin**:** . (p. 156-159)
1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^10 4p^6 5s^2 4d^10 5p^2
[Kr]5s^2 4d^10 5p^2

17. Know how to draw an electron-dot structure for each representative element, try it for iodine**:** (p. 161) This should look like an I with 7 dots around it, 3 pairs on each side, and one dot on the other side.

Chapter 6

18. What are periods and what are groups? Which one has elements with similar characteristics? (p. 177) Periods are the rows on the periodic table and groups are the columns. Groups have elements with similar characteristics.

19. What are characteristics of metals, metalloids, and nonmetals and where are they on the periodic table? (p. 177-181)
Metals are the majority of the left side of the table (except hydrogen). The characteristics are malleable, ductile, are generally shiny and smooth and good conductors. Nonmetals are in the top right of the periodic table. They are generally gasses or brittle, dull looking solids and poor conductors. Metalloids are between the two and have characteristics of both.

20. What are the names of groups 1, 2, 17, and 18? (p. 177 and 180)
Group 1: alkali metals
Group 2: alkali earth metals
Group 17: halogens
Group 18: noble gases

21. How many valence electrons are in each group of the representative elements? (p. 183 figure 7)
Group 1: 1, Group 2: 2, Group 13: 3, Group 14: 4, Group 15: 5, Group 16: 6, Group 17: 7, Group 18:8.

22. Where are the s, p, d, and f blocks on the periodic table? (p. 183)
s is group 1 and group 2
p is groups 13-18
d is groups 3-12 (transition metals)
f is within periods 6 and 7 (inner transition metals)

23. Know how to recognize an electron configuration and identify the element that it represents, 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4 (p. 184-185)
chromium

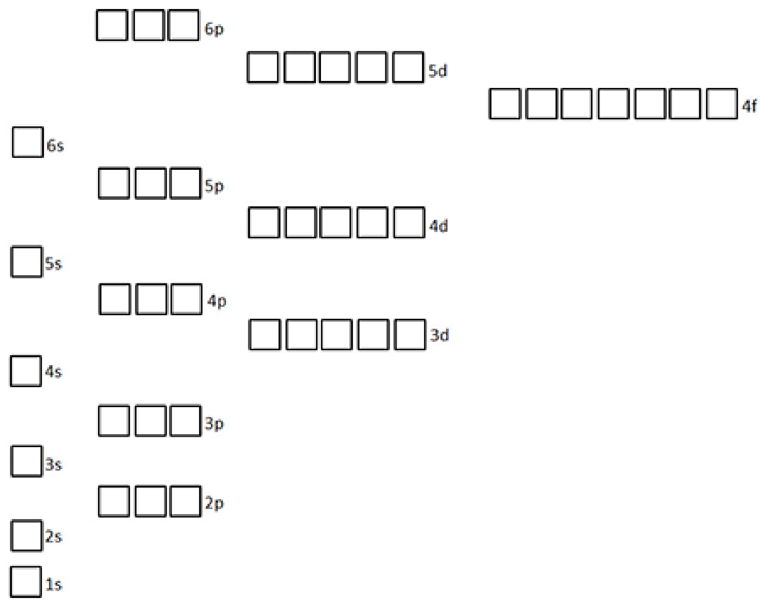
24. What is the atomic radius and how does it change across and down the periodic table? (p. 187-188) The atomic radius is half the distance between nuclei of identical atoms that are chemically bonded together. The radius decreases across a period (from left to right) and increases down a group (top to bottom).

25. What is ionization energy and how does it change across and down the periodic table? (p. 191-192) Ionization energy is the energy that it takes to remove an electron from a gaseous atom. It increases across a period (left to right) and decreases down a group (top to bottom).

26. What is the octet rule? (p. 193)
Atoms tend to gain, lose, or share electrons in order to acquire a full set of eight valence electrons.

27. What is electronegativity and how does it change across and down the periodic table? (p. 194)
Electronegativity is the relative ability of its atoms to attract electrons in a chemical bond. Electronegativity increases across a period (left to right) and decreases down a group (top to bottom).

Diagrams



s,p,d,f blocks in the periodic table.