Honors Chemistry Midterm Review – Form B (Chap 4,5,6)

1) **What is an isotope?**

Isotopes of an element have different numbers of neutrons, they also have different mass numbers

2) **Describe how do you calculate the atomic mass of an element when given the percent abundance of each isotope (see page 117).**

Atomic Abundance Example Chemistry Problem:

The element boron consists of two isotopes, $^{10}_{5}B$ and $^{11}_{5}B$. Their masses, based on the carbon scale, are 10.01 and 11.01, respectively. The abundance of $^{10}_{5}B$ is 20.0% and the abundance of $^{11}_{5}B$ is 80.0%.
What is the atomic mass of boron?

Solution: The percentages of multiple isotopes must add up to 100%. Apply the following equation to the problem:

atomic mass = (atomic mass X_1) · (% of X_1)/100 + (atomic mass X_2) · (% of X_2)/100 + ...
where X is an isotope of the element and % of X is the abundance of the isotope X.

Substitutie the values for boron in this equation:

atomic mass of B = (atomic mass of $^{10}_{5}B$ · % of $^{10}_{5}B$/100) + (atomic mass of $^{11}_{5}B$ · % of $^{11}_{5}B$/100)
atomic mass of B = (10.01· 20.0/100) + (11.01· 80.0/100)
atomic mass of B = 2.00 + 8.81
atomic mass of B = 10.81

Answer:

The atomic mass of boron is 10.81 grams or a.m.u.

Note that this is the value listed in the Periodic Table for the atomic mass of boron. Although the atomic number of boron is 10, its atomic mass is nearer to 11 than to 10, reflecting the fact that the heavier isotope is more abundant than the lighter isotope.

3) **Sample problems to complete about isotopes**

- **Which of the following sets of symbols represents isotopes of the same element?**

a $^{91}_{42}J$ $^{92}_{42}J$ $^{93}_{40}J$

b. $^{50}_{19}L$ $^{50}_{20}L$ $^{50}_{21}L$

c. $^{84}_{38}M$ $^{86}_{38}M$ $^{87}_{38}M$

d. $^{138}_{59}Q$ $^{133}_{55}Q$ $^{133}_{54}Q$

- **What does the number 84 in the name krypton-84 represent? It represents the mass number which is the sum of protons and neutrons.**

- **Which of the following isotopes has the same number of neutrons as phosphorus-31?**

  a. $^{32}_{15}P$ **b.** $^{29}_{14}Si$ **c.** $^{32}_{16}S$ **d.** $^{28}_{14}Si$

- **Chlorine has two naturally occurring isotopes, Cl-35 and Cl-37. The atomic mass of chlorine is 35.45. Which of these two isotopes of chlorine is more abundant? Cl-35**

- **Consider an element Z that has two naturally occurring isotopes with the following percent abundances: the isotope with a mass number of 19.0 is 55 % abundant; the isotope with a mass number 21 of is 45% abundant. What is the average atomic mass for element Z?**

  (19.0 x .55 = 10.45) + (21 x .45 = 9.45) = 19.9 grams or amu = Atomic mass of element Z

4) **What radioisotopes are listed in your book that are used in medicine? What characteristics should medical radioisotopes have?(chap 25)**

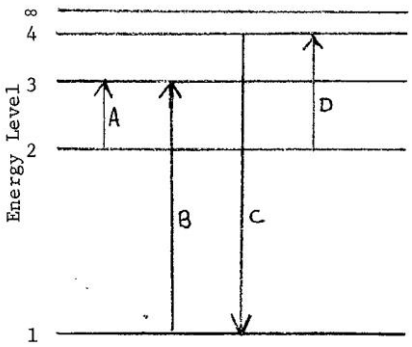
   Iodine-131 is used to detect thyroid problems.

5) **How are elements arranged on the periodic table? In the order of increasing atomic number. All atoms of the same element have the same number of protons.**

6) **What is a valence electron? Why are they important in chemistry?**

A valence electron is an electron that occupies the outermost principal energy level. Valence electrons are involved in chemical bonds.

7) **Review atomic spectra (Chap 5)**



a) **Which line absorbs the most energy**
   Line B
b) **Which line shows an electron returning to ground state and giving off light?**
   Line C
c) **Bright line spectra/How do you identify an unknown element/What are excited state, energy transitions and ground state (go to page 140-143)**
   Bright line spectra can be used to identify an element. Each element has its own unique bright line spectra.
   The bright line spectra is produced when excited electrons return to ground state giving off their energy in the form of light.

8) **When electrons return to their lower state emitting light this light is called the bright line spectra or atomic emission spectrum**

9) **Review electron configuration and how an orbital is filled in. page (go to pages 133-136).**

- **Aubau is defined as .** electrons occupy the lowest energy levels first.

- **Pauli – is defined as** atomic orbital may contain at most two electrons. (Electron spin must be paired one clockwise the other counter clockwise ↓ or ↑.) An orbital containing paired electrons is written as ↑↓ .

  .
- **Hund's** states that electron's occupy orbitals of the same energy in a way that makes the number of electron in the same direction as large as possible, for example

10) Write electron configurations for the following atom and ion of that atom.

A) phosphorus atom

$1s^2, 2s^2, 2p^6, 3s^2, 3p^3$

b) phosphide ion, P^{-3}

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6$

11) A neutral atom has an electron configuration of $1s^2 2s^2 2p^1$. Determine the identity of the atom. It is Boron.

12) A neutral atom has <u>excited electron configuration</u> of $1s^2 2s^2 2p^5 3s^2$. Determine the identity of the atom. It is Sodium.

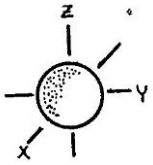
13) What is the electron configuration of potassium (K)?
$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$

14) Which of the following "rules" is being violated in each electron configuration below? Explain your answer for each. *Hund's Rule, Pauli Exclusion Principle, Aufbau Principle*

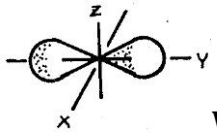
Which of the following "rules" is being violated in each electron configuration below? Explain your answer for each. ***Hund's Rule, Pauli Exclusion Principle, Aufbau Principle*** **(p. 133-135)**

1.	↑↓ ↑↓ ↑↓ _ _ 1s 2s 2p Hunds rule – the number of electrons spinning in the same direction should be as large as possible so in 2p the electrons should occupy each orbital singly in the same direction before doubling up
2.	↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ___ ↑↓ ↑_ ↑_ 1s 2s 2p 3s 3p Aubau principle, skipped 3s
3.	↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↑ ↑↓ ↑↓ ↑_ 1s 2s 2p 3s 3p Pauli Exclusion Principle, in 3s the electrons should go in opposite directions
4.	↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ___ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ 1s 2s 2p 3s 3p 4s 3d Aubau principle, skipped 4s

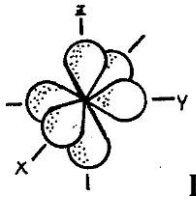
***15) Also review orbital shapes of both "s" and "p" orbitals**



what orbital has this shape? The s orbital



What orbital has this shape? The p orbital



How many and what kind of orbitals does this shape have? Three P orbitals

16)What types of orbital are in each of the first four principal energy levels and what is the maximum number of electrons each principal energy level can contain.

1st principal energy level– -2

2 nd principal energy level – 8

3 rd principal energy level .18

4 th principal energy level – 32

17) What is an alkali metal, alkali earth metal, halogen, noble gas and how many valence electrons does each group have .(go to pages 161-168)

Alkali metal – one valence electron – a group of active metals that are very reactive with water

Alkaline earth metals – two valence – a group of metals

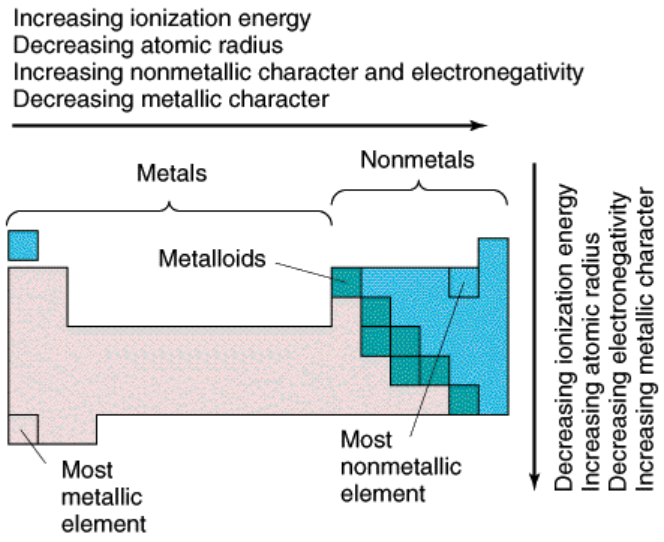
Halogens – seven valence electrons – non-metals that react to form salts

Noble gases – eight valence electrons (except He with only 2 electrons) – non metal gases that tend to react very little.

18)Why are alkali metals so reactive?

Because they only need to lose one electron to form a cation with a electron configuration of a noble gas

19) Define the following periodic trends? (go to pages 170-178) for atomic radii, ionization energy and electronegativity.



The trends that exist can be explained by variations in atomic structure. The increase in nuclear charge within groups and across periods explains many trends. Within groups an increase in shielding has a significant effect.

20) How does and Why does electronegativity decrease within a family as the atomic number increases? . This due to shielding (the inner layers of electrons create a shield between the positive nucleus and the outer electrons)

21) Going from Cl to Ar what happens to the atomic size? It decreases due to the strong nuclear force created by the increasing number of protons.

22) What is the trend showing the increase in ionization energy on the periodic table

Ionization energy increases as you move from left to right and up the periodic table. Ionization energy is defined as the amount of energy needed to remove an electron from an atom.