

# Atomic Structure: SOL Review #2

Chapters 3, 4, 5, Nuclear Chemistry

Name: \_\_\_\_\_

Core Concept: Protons, Electrons, Neutrons, Ions, Isotopes, Atomic Number

Fringe Concepts:

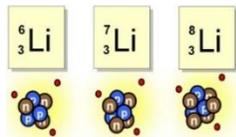
Historical Developments of the Atom & Chemistry  
Calculating Atomic Mass  
Diatomic Elements  
Half-Life  
Electron Configuration  
Periodic Table  
Periodic Trends

## Historical Developments

- 1) Democritus all things made of tiny particles
- 2) Dalton solid sphere model; Atomic Theory: all elements made of atoms, atoms of an element are identical
- 3) Thomson cathode ray tube; discovered electron; plum pudding model
- 4) Millikan oil drop; discovered mass and charge of electron
- 5) Rutherford gold foil; discovered nucleus; the atom is mostly empty space
- 6) Bohr planetary model; (ex) flame test lab: electron goes from ground state to excited state
- 7) Heisenberg uncertainty principle; can't know momentum & position of electron at same time
- 8) Mendeleev arranged periodic table by atomic mass
- 9) Moseley arranged periodic table by atomic number

## Atomic Structure (see online activities for practice)

- 10) Atoms of the same element must have the same number of protons (atomic number).
- 11) Contrast cations and anions:  
cations = positive charge because LOST electrons; anions = negative charge because GAINED electrons
- 12) What do all isotopes of an element have in common?  
same number of protons (that determines the element's identity)
- 13) What is the difference between the isotopes of an element?  
different number of neutrons (therefore different mass number)
- 14) For Silicon, the periodic table reads: 28.086 amu. What does this number mean? Atomic mass is a weighted average of all possible isotopes of an element, with respect to their percent abundance.
- 15) A neutral atom of Chlorine-35 contains: protons = 17, electrons = 17, neutrons = 18
- 16) Write the notation  $^{\text{Mass\#}}_{\text{Atomic\#}}\text{X}^{\text{charge}}$  for the isotope that contains 13 protons, 14 neutrons, 10 electrons:  $^{27}_{13}\text{Al}^{+3}$
- 17)  $^{114}_{48}\text{Cd}^{+2}$  contains: protons = 48, electrons = 46, neutrons = 66
- 18)  $\text{S}^{-2}$  contains: protons = 16, electrons = 18, neutrons = 16 (round atomic mass on PT to nearest whole number)
- 19)  $\text{Na}^{+1}$  contains: protons = 11, electrons = 10, neutrons = 12 (round atomic mass on PT to nearest whole number)
- 20) How many neutrons are present in the isotope  $^{78}_{34}\text{Se}$ ? neutrons = 44
- 21) How many electrons does the cobalt ion have when it forms the ionic compound  $\text{Co}_2\text{S}_3$ ? 24 (because  $\text{Co}^{+3}$ )
- 22) How many electrons does the oxygen ion have when it forms the ionic compound  $\text{Li}_2\text{O}$ ? 10 (because  $\text{O}^{-2}$ )



- 23) What are similarities and differences between the three isotopes of lithium?  
similar: same number of protons; both neutral (same number of electrons)  
different: different numbers of neutrons gives them a different mass number

## Calculating Atomic Mass

- 24) Magnesium has three isotopes. Magnesium-24 is 78.9% abundant, Magnesium-25 is 10.0% abundant, and Magnesium-26 is 11.1% abundant. Calculate the atomic mass of magnesium. **24.322 amu**  
 $\text{Atomic Mass} = (\text{mass number } A \times \text{abundance } A) + (\text{mass number } B \times \text{abundance } B) + \dots$

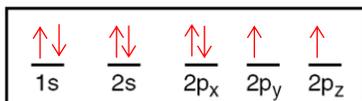
## Half-Life

- 25) What is radiation? **An unstable nucleus decays**
- 26) Identify the three forms of radiation: Alpha: **helium nucleus** Beta: **electron** Gamma: **high energy wave**
- 27) What is half-life? **amount of time it takes for half of a radioactive sample to decay**
- 28) If carbon has a half-life of 5730 years, how much of a 500 gram sample will be left after 17190 years?  
**62.5 g**
- 29) Radioactive iodine-131 has a half-life of eight days. How much of a 600.0 gram sample will be left after 32 days?  
**37.5 g**

## Electron Configuration

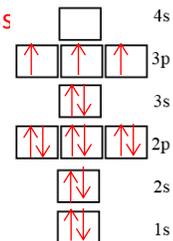
- 30) Write the electron configuration of Sulfur  **$1s^2 2s^2 2p^6 3s^2 3p^4$**
- 31) Write the electron configuration of Nitrogen in the ground state  **$1s^2 2s^2 2p^3$**
- 32) Write the noble gas configuration of Calcium  **$[Ar] 4s^2$**
- 33) Write the noble gas configuration of Chlorine  **$[Ne] 3s^2 3p^5$**
- 34) Write the electron configuration of the  $Na^{+1}$  ion  **$1s^2 2s^2 2p^6$**
- 35) Write the electron configuration of the  $P^{-3}$  ion  **$1s^2 2s^2 2p^6 3s^2 3p^6$**
- 36) What is the electron configuration of scandium (Sc) in  $Sc(NO_3)_3$   **$1s^2 2s^2 2p^6 3s$**

Orbital box diagram:

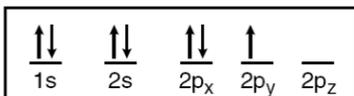


37) Oxygen:  **$1s^2 2s^2 2p^4$**

38) Phosphorus:  **$1s^2 2s^2 2p^6 3s^2 3p^3$**



39) How does the following orbital box diagram for Nitrogen violate Hund's rule?



The electrons are not "singly before pairing." Electrons repel each other, so they do not pair until there is no more "space" left in the sublevel.

## Periodic Table and Periodic Trends

- 40) Which elements would have similar properties to Na? Mg **(K)** Al **(Li)**
- 41) What is a period on the periodic table? **row**
- 42) What are two other names for a column on the periodic table? **group, family**
- 43) What is electronegativity? **An atom's ability to attract electrons to itself within a covalent bond.**
- 44) What is ionization energy? **The energy required to remove an electron.**
- 45) Rank from largest to smallest atomic radius: Ge, Br, Se, As  **$Ge > As > Se > Br$**
- 46) Rank from largest to smallest atomic radius: K, Rb, Li, Na  **$Rb > K > Na > Li$**
- 47) Rank from highest to lowest electronegativity: Si, S, P, Cl  **$Cl > S > P > Si$**