Atomic Structure

1.

Symbol	Atomic Mass	Atomic Number	Number of Protons	Number of Neutrons	Number of Electrons	Full Atomic Symbol
	36	18			18	
Ag				61		
Al	27					
			33	42	33	
	210	85			85	
		79		118	79	
X^{2+} =	227				87	
X^{3+} =		95		148		

Atomic mass, Isotope

1.) How many protons are in the nucleus of each of the following?

a.) Be
b.) U
c.) Mn

2.) How many electrons are there in a neutral atom of each of the following?

a.) C
b.) Fe
c.) Ar

3.) How many electrons are there in each of the following atoms?

a.) Na^{+}
b.) Mg^{2+}
c.) V^{3+}
d.) O^{2-}
e.) Cl^{-}
f.) Al^{3+}
g.) Sb^{3-}
h.) Fe^{2+}
i.) H^{-}
j.) As^{3+}

4.) What is the ion produced when:

a.) Two electrons are added to S?
b.) Two electrons are removed from Ca?
c.) An electron is added to Cl?

d.) Three electrons are removed from Al?
e.) An electron is added to Cr^{3+}?
f.) Two electrons are removed from Mn^{2+}?
g.) An electron is removed from V^{4+}?
h.) Two electrons are added to Sb^{-}?

5.) What is the charge on the nucleus of each of the following?
a.) Mg
b.) Ne
c.) K^{+}
d.) S^{2-}

6.) The following mixtures of isotopes are found in nature. Calculate the average mass of each mixture.
a.) ^{69}Ga = 60.0%, ^{71}Ga = 40.0%
b.) ^{107}Ag = 51.8%, ^{109}Ag = 48.2%
c.) ^{70}Ge = 20.5%, ^{72}Ge = 27.4%, ^{73}Ge = 7.8%, ^{74}Ge = 36.5%, ^{76}Ge = 7.8%
d.) ^{64}Zn = 48.9%, ^{66}Zn = 27.8%, ^{67}Zn = 4.1%, ^{68}Zn = 18.6%, ^{70}Zn = 0.6%

Periodic Table

1.) Predict the properties of the unknown element using the properties of its neighbours and whatever mathematical methods seem appropriate. If Mendel could do it, so can you!

	Al	**Si**	**P**
Atomic mass	27.1	28.1	31.0
Density ($\frac{g}{mL}$)	2.70	2.33	1.82
Density of oxide ($\frac{g}{mL}$)	3.97	2.65	2.14
Formula of chloride	$AlCl_3$	$SiCl_4$	$PCl_{3\,(l)}$, $PCl_{5\,(g)}$
Density of chloride ($\frac{g}{mL}$)	2.44	1.48	1.57 (liquid)
Colour	Silvery white	Grey	Pale yellow
Lustre	metallic	metallic	waxy
	Ga	??????? ???????	**As**
Atomic mass	69.7		74.9
Density ($\frac{g}{mL}$)	5.90		5.73
Density of oxide ($\frac{g}{mL}$)	5.88		3.87
Formula of chloride	$GaCl_3$		$AsCl_3$
Density of chloride ($\frac{g}{mL}$)	2.47		2.16
Colour	Silvery		Steel grey
Lustre	metallic		Dull metallic
	In	**Sn**	**Sb**
Atomic mass	114.8	118.627.1	121.8
Density ($\frac{g}{mL}$)	7.31	7.28	6.69
Density of oxide ($\frac{g}{mL}$)	7.18	6.95	5.67
Formula of chloride	$InCl_3$	$SnCl_2$, $SnCl_4$	$SbCl_3$, $SbCl_5$
Density of chloride ($\frac{g}{mL}$)	3.46	3.95, 2.23	3.14, 2.34
Colour	Silvery white	Silvery white	Bluish-white
Lustre	metallic	metallic	metallic

2.) State the chemical family or group to which each of the following elements belongs.

a) Radon
b) Iron
c) Iodine
d) Lithium
e) Calcium
f) Cesium
g) Zinc
h) Chlorine

3.) Give the symbol for two other elements in the same family as the following:

a) Na
b) Ar
c) Mg
d) Br

4.) Give the symbols for two other elements in the same period as the following:

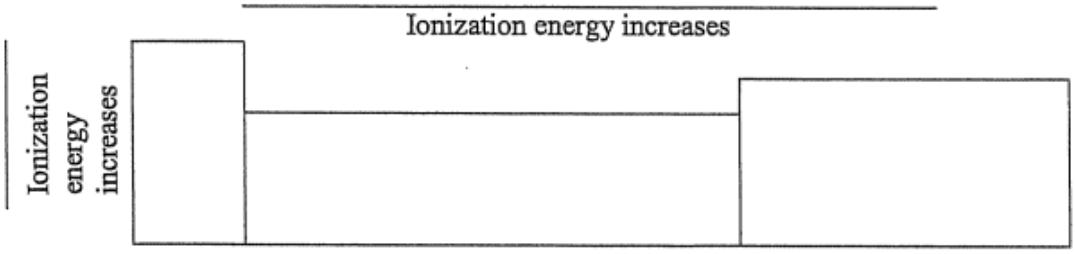
a) C

b) S

Periodic Trends

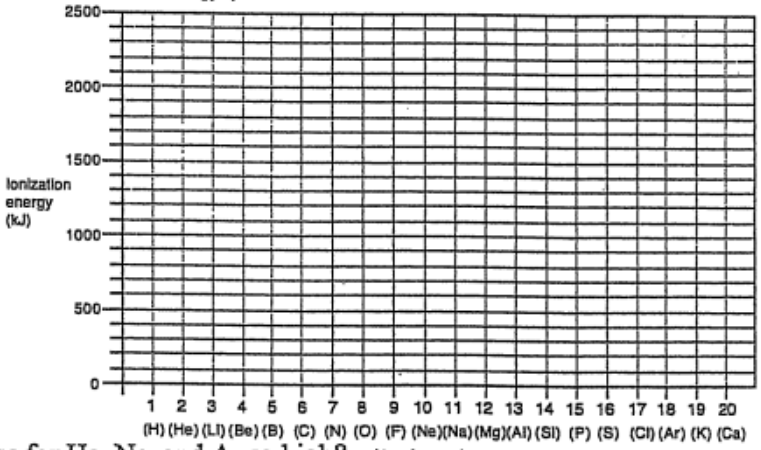
1. Attract or repel? a. positive and positive b. negative and negative c. positive and negative

2. Place arrowheads in the correct direction on the horizontal and vertical lines below.



3. Which member of each of the following pairs should have a greater ionization energy?
   a) Br or Cl b) Al or Cl c) Ne or Xe d) Mg or Ba e) F or Ne f) Rb or I

Plot the ionization energy versus atomic number on the following graph and connect each point to the next with a straight line. Then answer the following questions.



a) Why are the ionization energies for He, Ne, and Ar so high?
b) Why do the ionization energies decrease going from He to Ne to Ar?
c) Why is there a general increase in ionization energy going from Li to Ne?
d) "Filled subshells and half-filled subshells have a special stability which requires extra energy to be applied before electron removal can occur". This general statement is supported by the existence of the electron configuration exceptions found for Cu and Cr. What experimental evidence exists in the graph "ionization energy versus atomic number"?

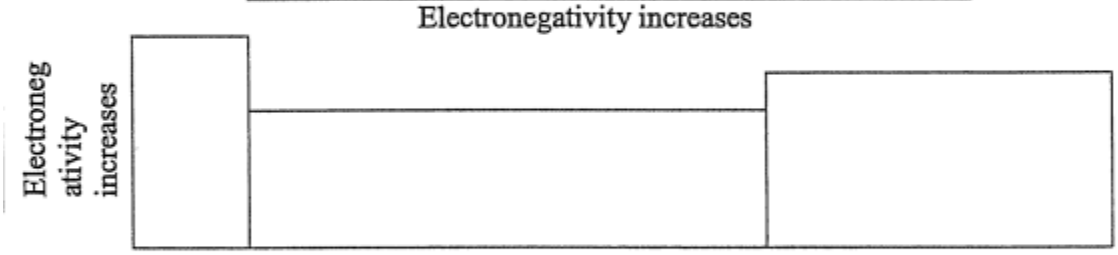
5. Consider two atoms: O and Te.
    a) Which atom has the larger atomic radius?
    b) Which atom has the larger ionization energy?
    c) Which atom has more shells?
    d) How many valence electrons does Te have?
    e) What is the valence of Te?
    f) Which atom has a greater electrostatic attraction between its nucleus and outermost electrons?

6. Consider two atoms: Ga and Br.
    a) Which atom has a larger atomic radius?
    b) Which atom has the larger ionization energy?
    c) Which atom has more shells?
    d) How many valence electrons does each atom have?
    e) What is the valence of each atom?
    f) Which atom has a greater electrostatic attraction between its nucleus and outermost electrons?

7. Consider two atoms: Li and F.
    a) Which atom is larger?
    b) Which atom has the stronger attraction to the outer electrons on a neighbouring atom, based only on the atomic radius?
    c) Which atom has the greater nuclear charge?
    d) Which atom can attract electrons from an adjacent atom most strongly, based on both size and nuclear charge?
    e) Fill in the blanks: In general, when going from left to right across the periodic table the electronegativity of the atoms will _____.

8. Consider two atoms: F and I.
    a) Which atom is larger?
    b) Which atom has a stronger attraction to the outer elelctrons of another atoms?
    c) Fill in the blanks: In general, when going down a family of the periodic table the electronegativity of the atoms will _____.

9. Place arrowheads in the correct direction on the horizontal and vertical lines below.



10.
    a) Ignoring the noble gases, which atom is the most electronegative?
    b) Ignoring the noble gases, which atom is the least electronegative?
    c) Which is more electronegative, K or Be?
    d) Which is more electronegative, Pb or S?

Periodic Table Trends

1.) What is the difference between electronegativity and ionization energy?

2.) Why does fluorine have a higher ionization energy than iodine?

3.) Why do elements in the same family generally have similar properties?

4.) Which is the largest atom in Group 14?

5.) Which is the smallest atom in Group 17?

6.) Which is the smallest atom in period 5?

7.) Rank the following elements by increasing atomic radius: carbon, aluminium, oxygen, potassium.

8.) Rank the following elements by increasing electronegativity: sulphur, oxygen, neon, aluminium.

9.) Arrange the following atoms in order of decreasing atomic radius: Na, Al, P, Cl, Mg

10.) For each of the following pairs, circle the element that is larger:
a) N^{3-} or F^{-}
b) Mg^{2+} or Ca^{2+}
c) Fe^{2+} or Fe^{3+}

11.) Circle the element in each pair that has the larger radius:
a) Mg or Mg^{2+}
b) O or O^{2-}
c) K^{+} or Cl^{-}
d) P^{3-} or S^{2-}

12.) In each of the following pairs, circle the species with the higher first ionization energy:
a) Li or Cs
b) Cl or Ar
c) Ca or Br
d) Na or Ne
e) B or Be

13.) In each of the following pairs, circle the species with the larger atomic radius:
a) Mg or Ba
b) S or S^{2-}
c) Cu^{2+} or Cu
d) He or H
e) Na or Cl

14.) Circle the best choice in each list:
a) Highest first ionization energy: C, N, Si
b) Highest electronegativity: As, Sn, S
c) Largest radius: S^{2-}, Cl^{-}, Cl

15.) Order the following groups from largest to smallest radii:
a) Ar, Cl^{-}, K, S^{2-}
b) C, Al, F, Si
c) Na, Mg, Ar, P
d) I^{-}, Ba^{2+}, Cs^{+}, F^{-}

16.) For each of the following sets of atoms, rank the atoms from smallest to largest atomic radius:
a) Li, C, F
b) Li, Na, K
c) Ge, P, O
d) C, N, Al
e) Al, Cl, Ga

17.) For each of the following sets of ions, rank them from smallest to largest ionic radius:
a) Mg^{2+}, Si^{4-}, S^{2-}
b) Ca^{2+}, Ba^{2+}, Mg^{2+}
c) Br^{-}, Cl^{-}, F^{-}
d) Ba^{2+}, Cu^{2+}, Zn^{+}
e) Si^{4-}, P^{3-}, O^{2-}

18.) For each of the following sets of atoms, rank them from lowest to highest ionization energy:
a) Mg, S, Si
b) Ba, Ca, Mg
c) Br, Cl, F
d) Ba, Cu, Ne
e) He, P, Si

19.) For each of the following sets of atoms, rank them from lowest to highest electronegativity:
a) C, Li, N
b) C, Ne, O
c) O, P, Si
d) K, Mg, P
e) S, F, He

Electron configuration

1. Write the electron configurations for the following.

a) P	
b) Ti	
c) Co	
d) Br	
e) Sr	
f) Ar	
g) K	
h) Cd	
i) Ca	
j) Xe	
k) Cs	
l) Pb	
m) Ga	
n) Mn	
o) Zr	

2. Write the electron configurations for the following using core notation.

a) P	
b) Ti	
c) Co	
d) Br	
e) Sr	
f) Ar	

3. Write the electron configurations for the following ions, using core notation.

a) H^-	
b) Sr^{2+}	
c) Br^-	
d) N^{3+}	
e) Ti^{2+}	
f) N^{2-}	
g) Mn^{2+}	
h) Ge^{4+}	
i) Fe^{3+}	
j) Ge^{2+}	
k) Ru^{3+}	
l) Sb^{3+}	

4. Write the electron configurations for the following. How many valence electrons does each one contain?

a) O		
b) P		
c) V		
d) Ca		
e) Xe		
f) Hg		
g) Te		
h) Cl^-		
i) I^{5+}		
j) Xe^{2+}		
k) Zn^{2+}		
l) Ge^{4+}		
m) Tc^{4+}		
n) Sb^{3+}		
o) O^-		
p) Nb^{3+}		