Q1-6 *(1 point each)* Please place the correct letter/s in the box.

1) How many electrons can the third principal quantum level (n = 3) hold?

a. 2
b. 8
c. 16
d. 18
e. 32

1) D

2) Arrange the elements given in order from largest to smallest atomic radii.

Al Ca Sr Mg S

a. Sr > Ca > Mg > Al >S
b. Sr > Ca > S > Al > Mg
c. Al > Sr > S > Ca > Mg
d. Ca > Mg > Sr > Al > S
e. Mg > Al > S > Ca > Sr

2) A

3) Which of the following has the largest ionic radius?

a. Li^+
b. F^-
c. S^{2-}
d. Na^+
e. Cl^-

3) C

4) Which of the following is a correct electron configuration: What element does it represent?

a) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^6$
b) $1s^2 2s^2 2p^5 3s^2 3p^6$
c) $1s^2 2s^2 2p^6 3s^2 3d^{10}$
d) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$
e) $1s^2 2s^2 2p^6 3s^2 3p^7 4s^1$

4) D Zn

5) In general, the periodic trend for this property increases as you go up the periodic table and from left to right across the periodic table. (Note, there may be more than one correct answer)

a) density
b) # of oxygen atoms the elements combine with
c) Electronegativity
d) Atomic weight
e) Atomic radius
f) Ionization energy

5) C, F

6) Which statement/s about electrons is false?

a. Electrons have the same charge as alpha particles.
b. Electrons are attracted to positively charged electrodes.
c. Electrons have the same mass as neutrons.
d. Electrons have much less mass than any atom.
e. Electrons are negatively charged.

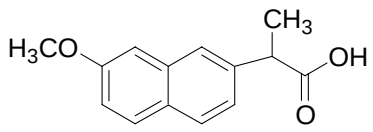
6) A,C

7) *(1 point)* Rutherford estimated the nucleus of an atom to be 1/10000 of the size of the entire atom. The box that you used to model Rutherford's experiment in lecture was 8 inches by 6 inches by 4 inches. If the box were an atom, what would the volume of its nucleus be in mm^3? (1 inch = 2.54 cm)

$$(8\text{in} \times 6\text{ in} \times 4\text{ in}) \frac{(2.54\text{ cm})^3}{(1\text{ in})^3} \frac{(10\text{mm})^3}{(1\text{cm})^3} = 3146316\text{ mm}^3 \quad \frac{(\ 1\ )}{(10000)} = 314.63\text{ mm}^3$$

Volume of nucleus: ~300 mm^3

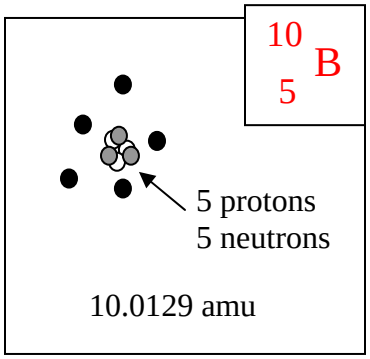
8) (*2 points*) A tablet of Aleve contains 200. mg of its active ingredient naproxen. How many molecules of naproxen are in each Aleve tablet? Fill in the two empty boxes in the table.

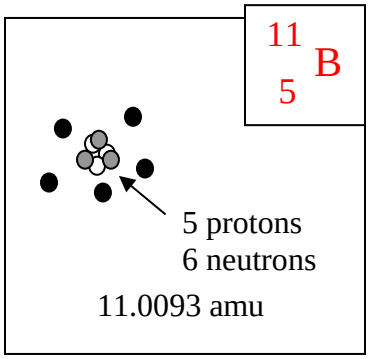
	Aleve (naproxen) 
Molecular formula	$C_{14}H_{14}O_3$
Dose	200. mg
Molecular weight	14 (12) + 14(1) + 3(6) = 230 g/mol

Number of molecules in dose:

$$200\text{ mg} \frac{(\ 1\text{g}\ )}{(1000\text{mg})} \frac{(\ 1\text{ mol})}{(230\text{ g})} \frac{(6.02\text{x}10^{23}\text{ molecules})}{(\ 1\text{mol})} = 5.2\text{ x}10^{20}\text{ molecules}$$

9a) (*5 points*) The following model is missing some information. Fill in the empty boxes in the upper right of each model with its elemental symbol, atomic number, and mass number: $^{A}_{Z}X$





b) What word is used to describe the relationship between the two atoms represented in the models on the left.

isotopes

Relative abundance:
20%

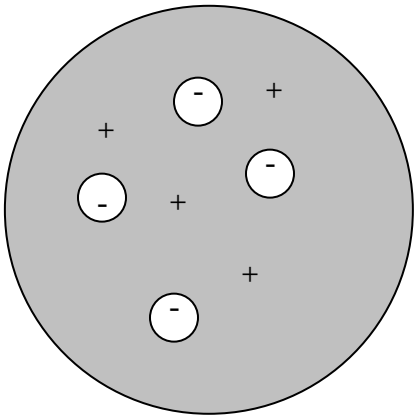
Relative abundance:
80 %

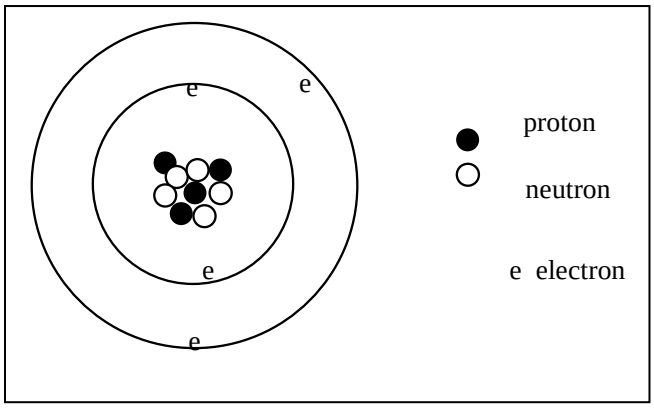
c) Using the periodic table, find the relative abundance of each atom. Show your work below and fill in the abundances in the boxes above.

$10.0129\,x + 11.0093\,(1-x) = 10.81$

$0.200 = x$

10) (*2 points*) Using the correct number of protons, neutrons, and electrons, draw beryllium atom (Be) as it would appear using the chocolate chip cookie model (the plum pudding model), and according to a modern model of the atom.





Plum pudding: electrons in a sea of protons (occupying the shaded area)

Modern model. Note orbitals are spherical

a) Write the chemical formula for the most common oxide of magnesium: MgO

b) Predict the ionization energy for arsenic (As). Briefly explain your choice.
Br has an ionization energy of 1139.9 kJ/mol; Ga has an ionization energy of 578.9 kJ/mol; Ge has an ionization energy of 762.1 kJ/mol; Se has an ionization energy of 940.9 kJ/mol

Actual value 947 kJ/mol Range ~940-1050;kJ/mol
Generally IE increases from left to right; exception at ½ filled p shell + 1 (group 5)

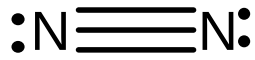
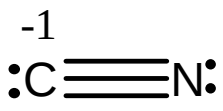
c) Estimate the electron affinity for silicon (Si). Briefly explain your reasoning.
Al has an electron affinity of -43 kJ/mol; Cl has an electron affinity of -349 kJ/mol; P has an electron affinity of -72 kJ/mol; S has an electron affinity of -200 kJ/mol

Actual value -134 kJ/mol Range: -65 to -175 kJ/mol
EA generally becomes more negative from left to right; exception at ½ filled p shell (group 4)

12) (*4 points*) For the valence electrons of chlorine (Cl) write out a set of possible quantum numbers in the table below: (You may or may not use all of the boxes.)

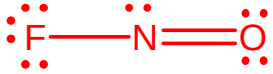
n	**l**	**m_l**	**m_s**
3	0	0	+ ½
3	0	0	- ½
3	1	-1	+ ½
3	1	-1	- ½
3	1	0	+ ½
3	1	0	- ½
3	1	+1	+ ½

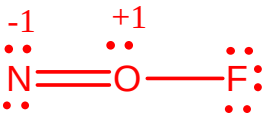
13) (*5 points*) In the middle column, write one of the symbols: <, > or =. *(In order to receive credit for your answer, all estimation and work must be shown.)*

The density of Amalthea The Galileo spacecraft obtained the following data on Amalthea, one of Jupiter's moons, on the 5th of November 2002: a mass of 2.08 x 10^{18} kilograms and in 1996 and 19997: a volume of 2.43 x 10^{6} cubic kilometers. 2.08 x10^{18}kg/2.43x10^{6}km^3= 0.86g/cm^3	<	The density of water (1 g/cm^3)
The number of significant figures in the completed calculation: 12.567 – (9.04/3.7345) 10.51	>	The number of significant figures in the completed calculation: (10.0*7.64) + 0.0345 76. 4
The number of atoms in 1 mole of hydrogen gas 1 mol H^2 $\frac{(6.02 \times 10^{23} \text{ atoms})}{(1 \text{ mol})}$ *2 = ~12x10^{23} atoms	>	The number of atoms in 8.12 g of lithium metal 8.12 g Li $\frac{(1\text{mol Li})}{(6.941 \text{ g Li})}$ $\frac{(6.02\text{x}10^{23}\text{atoms})}{(1 \text{ mol})}$ - ~ 7 x10^{23} atoms
The bond order of the nitrogen-nitrogen bond in N_2 	=	The bond order of the carbon nitrogen bond in CN^- 
The number of water molecules in a 100.0 g apple that is 85% water. 85 g H_2O $\frac{(1 \text{ mol } H_2O)}{(18 \text{ g } H_2O)}$ (6.02×10^{23}) = ~ 2.8 x10^{24} mol	>	The number of sugar molecules in a 100.0 g apple that is 15% sugar ($C_6H_{12}O_6$) 15 g $C_6H_{12}O_6$ $\frac{(1\text{mol } C_6H_{12}O_6)}{(120 \text{ g } C_6H_{12}O_6)}$$(6.02\text{x}10^{23})$ = ~ 7.5 x10^{22} mol

14) (*10 points*) $BrO_3F_2^-$ has recently been synthesized by reacting BrO_3F with NOF. (*J. Am. Chem. Soc*. **2005**,*127*, 9416-9427.)

a) Draw the Lewis structures for F-N-O and N-O-F. Include formal charges. Which is the more probably structure for a molecule with this formula? Why?





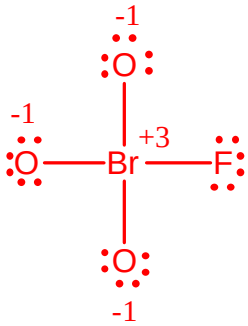
no formal charge; more probable

b) Would you be able to distinguish the molecules from their shape? Explain.
No. Both are bent/angular

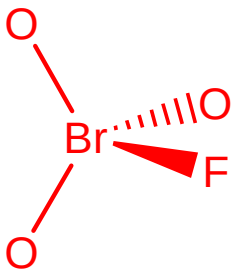
B) For BrO_3F: a) count the number of valence electrons; b) draw the Lewis Structure including any formal charges; c) draw out the shape of the molecule according to VSEPR; d) name the electron pair geometry, and e) name the molecular geometry.

Valence electrons: 32

Lewis structure



VSEPR shape



electron pair geometry:
tetrahedral

molecular geometry:
tetrahedral