1. Calculate the following quantities.

a. 75.6°F in Kelvin.

$$\left(75.6\ ^{\circ}\text{F} - 32\ ^{\circ}\text{F}\right)\left(\frac{5\ \text{K}}{9\ ^{\circ}\text{F}}\right) + 273.15\ \text{K} = 297.4\ \text{K}$$

b. 164.3 lb in milligrams (1 lb = 16 oz, 1 oz = 28.35 g)

$$?\ \text{mg} = 164.3\ \text{lb} \times \frac{16\ \text{oz}}{1\ \text{lb}} \times \frac{28.35\ \text{g}}{1\ \text{oz}} \times \frac{1\ \text{mg}}{10^{-3}\ \text{g}} = 7.543 \times 10^{-7}\ \text{mg}$$

c. The volume of a room that measures 10.5 ft by 21.2 ft by 9.1 ft in Liters. (1 in = 2.54 cm, 1 ft = 12 in)

$$?\text{L} = \left(10.5\ \text{ft} \times 21.2\ \text{ft} \times 9.1\ \text{ft}\right) \times \left(\frac{12\ \text{in}}{1\ \text{ft}}\right)^3 \times \left(\frac{2.54\ \text{cm}}{1\ \text{in}}\right)^3 \times \frac{1\ \text{mL}}{1\ \text{cm}^3} \times \frac{10^{-3}\ \text{L}}{1\ \text{mL}} = 6.0 \times 10^4\ \text{L}$$

d. A speed of 55 miles per hour in kilometers per second. (see conversions above and 1 mi = 5280 ft)

$$?\frac{\text{km}}{\text{s}} = \frac{55\ \text{mi}}{\text{h}} \times \frac{1\ \text{h}}{60\ \text{min}} \times \frac{1\ \text{min}}{60\ \text{sec}} \times \frac{5280\ \text{ft}}{1\ \text{mi}} \times \frac{12\ \text{in}}{1\ \text{ft}} \times \frac{2.54\ \text{cm}}{1\ \text{in}} \times \frac{10^{-2}\ \text{m}}{1\ \text{cm}} \times \frac{1\ \text{km}}{10^3\ \text{m}} = 2.46 \times 10^{-2}\ \text{km/s}$$

2. Complete the following table.

Name of Element	Complete Symbol	Number of protons	Number of Neutrons	Atomic Number	Mass Number
Tin	$^{119}_{50}Sn$	50	69	50	119
Molybdenum	$^{96}_{42}Mo$	42	54	42	96
Molybdenum	$^{95}_{42}Mo$	42	53	42	95
Uranium	$^{235}_{92}U$	92	143	92	235
Sulfur	$^{32}_{16}S$	16	16	16	32
Iron	$^{57}_{26}Fe$	26	31	26	57

3. An element has the following isotopic composition:

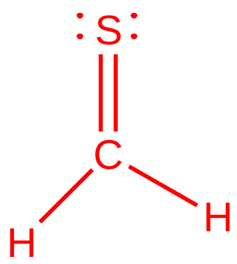
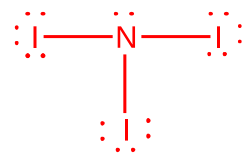
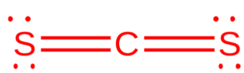
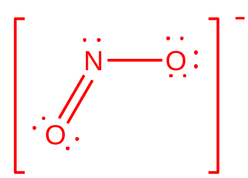
Isotopic mass (amu)	Percent abundance
83.913425	0.56
85.9092624	9.86
86.9088793	7.00
87.9056143	82.58

Calculate the ***relative average atomic mass*** of this element. What is the ***name of the element***? What ***group and period*** is this element in?

$$(83.913425 \text{ amu})(0.0056) + (85.9092624 \text{ amu})(0.0986)$$
$$+ (86.9088793 \text{ amu})(0.0700) + (87.9056143 \text{ amu})(0.8258)$$
$$= 87.62 \text{ amu}$$

The name of the element is Strontium. It's in group IIA and period 5.

4. Complete the following table:

CH_2S 	Electron Pair Geometry Trigonal Planar	NI_3 	Electron Pair Geometry Tetrahedral
	Molecular Geometry Trigonal Planar		Molecular Geometry Trigonal Pyramidal
	Polar? Yes		Polar? Yes
CS_2 	Electron Pair Geometry Linear	NO_2^- 	Electron Pair Geometry Trigonal Planar
	Molecular Geometry Linear		Molecular Geometry Bent
	Polar? No		Polar? Yes

5. Complete the following table:

Name of Compound	Formula
Sodium Dichromate	$Na_2Cr_2O_7$
Dinitrogen Trioxide	N_2O_3
Lithium Phosphate	Li_3PO_4
Ammonia	NH_3
Tetraphosphorus Decoxide	P_4O_{10}
Hydrochloric acid	HCl(*aq*)
Carbon Tetrafluoride	CF_4
Water	H_2O
Calcium Chlorite	$Ca(ClO_2)_2$
Iron(III) Perchlorate	$Fe(ClO_4)_3$
Ammonium Sulfide	$(NH_4)_2S$
Gold(I) Chloride	AuCl

6. Ammonium Sulfide solution reacts with Iron(III) Nitrate solution in a double replacement reaction. Write the balanced chemical and net ionic equations. Calculate the ***mass of the solid produced*** if 25.66 mL of 0.1566 M Ammonium Sulfide solution reacts with excess Iron(III) Nitrate solution.
(Solubility rules are on the back of your periodic table.)

$$3\ (NH_4)_2S + 2\ Fe(NO_3)_3 \rightarrow 6\ NH_4NO_3 + Fe_2S_3$$
$$2\ Fe^{3+} + 3\ S^{2-} \rightarrow Fe_2S_3$$

$$?\ \text{g } Fe_2S_3 = 25.66\ \text{mL } (NH_4)_2S \times \frac{0.1566\ \text{mol } (NH_4)_2S}{1000\ \text{mL } (NH_4)_2S} \times \frac{1\ \text{mol } Fe_2S_3}{3\ \text{mol } (NH_4)_2S} \times \frac{207.889\ \text{g } Fe_2S_3}{1\ \text{mol } Fe_2S_3}$$

$$= 0.2785\ \text{g } Fe_2S_3$$

7. A rigid 25.67 L container is filled with 25.76 g of Carbon Dioxide gas, 15.77 g of Helium gas and 32.54 g of Nitrogen gas. The temperature of the container is -15.67°C. Calculate the ***total pressure in the container in atm*** and the ***partial pressure of each of the gases in atm***.

$$P_{CO_2} = \frac{(25.76\text{ g})\left(\frac{1\text{ mol}}{44.0095\text{ g}}\right)(0.082057\text{ L atm mol}^{-1}\text{ K}^{-1})(288.82\text{ K})}{(25.67\text{ L})} = 0.5385\text{ atm}$$

$$P_{He} = \frac{(15.77\text{ g})\left(\frac{1\text{ mol}}{4.002602\text{ g}}\right)(0.082057\text{ L atm mol}^{-1}\text{ K}^{-1})(288.82\text{ K})}{(25.67\text{ L})} = 3.638\text{ atm}$$

$$P_{N_2} = \frac{(32.54\text{ g})\left(\frac{1\text{ mol}}{28.0134\text{ g}}\right)(0.082057\text{ L atm mol}^{-1}\text{ K}^{-1})(288.82\text{ K})}{(25.67\text{ L})} = 1.072\text{ atm}$$

$$P_{Total} = P_{CO_2} + P_{He} + P_{N_2} = 0.5385\text{ atm} + 3.683\text{ atm} + 1.072\text{ atm} = 5.249\text{ atm}$$

8. 150.0 g of fructose ($C_5H_{10}O_5$) reacts with 100.0 L of Oxygen gas at 45.6°C and a pressure of 1.336 atm. The products are Carbon Dioxide gas and liquid water. Calculate ***the volume of liquid water*** that can be produced from this reaction (density of water at 45°C is 0.9884 g mL^{-1}). If only 80.00 mL of water is produced what is the percent yield of the reaction?

$$C_5H_{10}O_5 + 5\ O_2 \rightarrow 5\ CO_2 + 5\ H_2O$$

$$?\text{ mL } H_2O = 150.0\text{ g } C_5H_{10}O_5 \times \frac{1\text{ mol } C_5H_{10}O_5}{150.1299\text{ g } C_5H_{10}O_5} \times \frac{5\text{ mol } H_2O}{1\text{ mol } C_5H_{10}O_5} \times \frac{18.0153\text{ g } H_2O}{1\text{ mol } H_2O} \times \frac{1\text{ mL } H_2O}{0.9884\text{ g } H_2O} = 91.05\text{ mL } H_2O$$

$$?\text{ mL } H_2O = \frac{(100.0\text{ L})(1.336\text{ atm})}{(0.082057\text{ L atm mol}^{-1}\text{ K}^{-1})(318.8\text{ K})} \times \frac{5\text{ mol } H_2O}{5\text{ mol } O_2} \times \frac{18.0153\text{ g } H_2O}{1\text{ mol } H_2O} \times \frac{1\text{ mL } H_2O}{0.9884\text{ g } H_2O} = 93.10\text{ mL } H_2O$$

9. A compound is found to have a density of 6.206 g/L at 756.3 mmHg and 24.1°C. When 43.78 mg of this compound is burned it produces 38.00 mg CO_2, 20.74 mg H_2O and 8.06 mg N_2. What is the ***molecular formula*** of this compound?

$$M = \frac{dRT}{P} = \frac{\left(\frac{6.206\text{ g}}{\text{L}}\right)\left(62.364\text{ L mmHg mol}^{-1}\text{ K}^{-1}\right)\left(297.3\text{ K}\right)}{756.3\text{ mmHg}} = 152.1\text{ g mol}^{-1}$$

$$n_C = 38.00\text{ mg CO}_2 \times \frac{1\text{ mol CO}_2}{44.0095\text{ g CO}_2} \times \frac{1\text{ mol C}}{1\text{ mol CO}_2} = 0.8634499\text{ mmol C}$$

$$\times \frac{12.0107\text{ g C}}{1\text{ mol C}} = 10.37\text{ mg C}$$

$$n_C = 20.75\text{ mg H}_2\text{O} \times \frac{1\text{ mol H}_2\text{O}}{18.0153\text{ g H}_2\text{O}} \times \frac{2\text{ mol H}}{1\text{ mol H}_2\text{O}} = 2.3035975\text{ mmol H}$$

$$\times \frac{1.00794\text{ g H}}{1\text{ mol H}} = 2.322\text{ mg H}$$

$$n_N = 8.06\text{ mg N}_2 = 8.06\text{ mg N} = 0.5754389\text{ mmol N}$$

$$m_O = 43.78\text{ mg} - 10.37\text{ mg} - 2.322\text{ mg} - 8.06\text{ mg}$$

$$= 23.03\text{ mg O} \times \frac{1\text{ mol O}}{15.9994\text{ g O}} = 1.439304\text{ mmol O}$$

$$C = \frac{0.8634499}{0.5754389} = 1.500 \times 2 = 3 \qquad H = \frac{2.3035975}{0.5754389} = 4.003 \times 2 = 8$$

$$N = \frac{0.5754389}{0.5754389} = 1.000 \times 2 = 2 \qquad O = \frac{1.439304}{0.5754389} = 2.501 \times 2 = 5$$

Empirical Formula = $C_3H_8N_2O_5$; Empirical Mass = 152.1060 g mol^{-1}

$$n = \frac{\text{Molar mass}}{\text{Empirical Mass}} = \frac{152.1\text{ g mol}^{-1}}{152.1060\text{ g mol}^{-1}} = 0.9999604 = 1$$

The molecular formula is $C_3H_8N_2O_5$.