Ferrofluid Review Questions

Name _____
Date _____ Hour _____

1. Elemental iron is ferromagnetic, yet an iron nail does not attract iron filings.
   a. Explain.

   In the absence of an external magnetic field, the magnetic domains of iron are randomly oriented; thus, there insufficient net magnetization for attraction to occur.

   b. If, however, a magnet is rubbed over the surface of a nail, the nail will attract iron fillings. Why?

   The magnet aligns or orients the domains with the applied external field, creating a larger net magnetization in the nail.

2. Analysis of a compound shows it to be potassium, 49.4%; sulfur, 20.2%; and oxygen, 30.4%. What is its empirical formula?

   Assume 100 g so 49.4% = 49.4g, 20.2% = 20.2g, 30.4% = 30.4g

   Potassium = 39.1 g/mol ----- 49.4g x $\dfrac{1mol}{39.1g}$ = 1.26 mol

   Sulfur = 32.1 g/mol ----- 20.2g x $\dfrac{1\ mol}{32.1g}$ = 0.629 mol

   Oxygen = 16.0 g/mol ----- 30.4g x $\dfrac{1\ mol}{16.0g}$ = 1.9 mol

   Divide each number of moles by the smallest amount of moles.
   $\dfrac{1.26\ mol\ K}{0.629\ mol}$ ~ 2 $\dfrac{0.629\ mol\ S}{0.629\ mol}$ ~ 1 $\dfrac{1.9\ mol\ O}{0.629\ mol}$ ~ 3

   Therefore, the empirical formula is K_2SO_3.

3. Consider the layered structures below and determine the total number of each type of atom beloning to the unit cell and the empirical formulas for the compound.

Potassium Atoms	Sites in the Cell	Atoms in the Unit Cell From that Site
0	Corners	0
0	Edges	0
8	Faces	4
0	Inside	0
----------	Total in Cell	4

Platinum Atoms	Sites in the Unit Cell	Atoms in the Unit Cell From that Site
8	Corners	1
0	Edges	0
0	Faces	0
1	Inside	1
----------	Total in Cell	2

Chloride Atoms	Sites in the Unit Cell	Atoms in the Unit Cell From that Site
0	Corners	0
8	Edges	2
8	Faces	4
6	Inside	6
----------	Total in Cell	12

Use the data from the tables above.

a. What is the total number of each type of atom in the unit cell? K __**4**__
    Pt __**2**__; Cl __**12**

b. What is the empirical formula for this compound? _____ **K$_2$PtCl$_6$**_____

4. Determine the mole ratios from the balanced equation below.

$$3\ CuO + 2\ NH_3 \qquad 3\ Cu + \ N_2 + 3\ H_2O$$
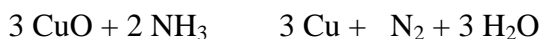
CuO : Cu	NH$_3$: CuO	N$_2$: NH$_3$	Cu : H$_2$O
3 : 3 or 1 : 1	**2 : 3**	**1 : 2**	**3 : 3 or 1 : 1**

5. Compare the solids VO and V_2O_5 in their attraction to a magnetic field.

   Note: **This question requires knowledge of electron configurations and oxidation states**

   Vanadium in VO has a formal oxidation state of +2 and an odd number of electrons (3), making it paramagnetic. In contrast, V_2O_5 has a formal oxidation state of +5 and no unpaired electrons, making it diamagnetic. Thus, VO is more strongly attracted to a magnetic field.