

Ferrofluid Assessment

Name _____

Date _____ Hour _____

Matching

Match the word with the best definition.

- E** 1. stoichiometry
- D** 2. spikes
- H** 3. ferromagnetism
- F** 4. colloid
- I** 5. hole
- G** 6. ferrimagnetism
- C** 7. magnetic domain
- B** 8. Unit cell
- J** 9. Nanoparticle
- L** 10. empirical formula
- M** 11. surfactant
- N** 12. ferrofluid
- K** 13. magnetite
- A** 14. Van der Waals forces
- a. weak forces of attraction between molecules
- b. a 3-D parallelepiped that, when shifted along each edge by the length of the edge creates the entire structure of atoms in a crystal
- c. regions where unpaired electrons strongly interact with one another and align, even in the absence of a magnetic field
- d. a pattern of uplifted suspended particles that results from placing a magnet near a ferrofluid
- e. a word describing that part of chemistry that deals with the relative amounts of substances involved in chemical reactions
- f. a dispersion of particles from ~ 1 nm to 1000 nm
- g. a phenomenon in which the internal magnetic moments of multiple spin sets of unpaired electrons within the magnetite domain of a solid partially cancel and thus leave a net spin
- h. a phenomenon in which the internal magnetic moments of unpaired electrons within a domain of the solid are aligned and act cooperatively
- i. an empty site in a crystalline solid
- j. a very small particle on a scale of nanometers (10^{-9} m)
- k. the name for Fe_3O_4
- l. information that gives the simplest ratio between the atoms of the elements present in a compound
- m. a molecule that surrounds particles and isolates them from the attractive forces of their neighbors
- n. a suspension of a magnetic solid in a liquid that responds to an external magnetic field

Multiple Choice

Choose the best answer.

- A 15. Ferrofluids exhibit magnetic properties because
- they consist of a magnetic solid suspended in a liquid medium.
 - they become magnetic under the influence of the earth's magnetic field.
 - they consist of positively and negatively charged ions.
 - none of the above.
- D 16. The potential advantage of using a ferrofluid to administer medication is
- that it is cheaper.
 - that it also acts as an iron supplement.
 - that it tastes better.
 - that it can be directed to specific sites in the body.
- B 17. In the production of a ferrofluid, the van der Waals attractions can be overcome by
- shielding the reaction vessel from the earth's magnetic field.
 - adding a substance called a surfactant.
 - adding a substance called a catalyst.
 - adding a coagulating agent.

Problems

18. a. Not all of the atoms occupying each site in a unit cell belong to that unit cell. What fraction of each of the following belong to a given unit cell?

Edge 1/4 Face 1/2
Corner 1/8 Inside 1

- b. Based on your answers in part *a*, sodium thallide was constructed and contained the following

Sodium Atoms	Sites in the Unit Cell	Atoms in the Unit Cell From that Site
8	Corners	1
0	Edges	0
4	Faces	2
4	Inside	4
	Total in Cell	7

Thallium Atoms	Sites in the Unit Cell	Atoms in the Unit Cell From that Site
0	Corners	0
12	Edges	3
0	Faces	0
4	Inside	4
	Total in Cell	7

- c. What is the total number of each type of atom in this compound? Na₇Tl₇

- d. What is the empirical formula for this compound? NaTi
19. Determine the percent composition of each element in magnetite.

$$\text{Oxygen} = 16.0 \text{ g/mol} \quad \text{-----} \quad 4 \times 16.0 \text{ g/mol} = 64.0 \text{ g/mol}$$

$$\text{Iron} = 55.8 \text{ g/mol} \quad \text{-----} \quad 3 \times 55.8 \text{ g/mol} = 167.4 \text{ g/mol}$$

$$\text{Total compound formula weight} = 231.4 \text{ g/mol}$$

$$\text{Percent oxygen by mass} = (64.0 / 231.4) \times 100 = 27.7\%$$

$$\text{Percent iron by mass} = (167.4 / 231.4) \times 100 = 72.3\%$$

20. The mole ratio of NH_4OH to NH_4Cl was experimentally determined to be 4 : 2; balance the equation below.

