Name_____

GLY 4200C **HOMEWORK EXERCISE 1**
Fall 2019

SPECIFIC GRAVITY AND DENSITY

Density is the mass per unit volume. In System International units, it is expressed as kilograms per cubic meter. The older style, and one still used by many mineralogists and geologists, is to express density as grams per cubic centimeter.

Density may be calculated from mineral data as follows;

$$D = \frac{Z \times M}{N \times V}$$

where Z = # of formula units per unit cell

M = molecular weight of the substance in question - these can be calculated using the table of atomic weights in the textbook (page 39)

N = Avogadro's number 6.02338×10^{23}

V = volume of the unit cell, converted to appropriate units

V is often given in Angstroms (Å) or nm. One Å = 10^{-10} meters, while 1 nm = 10^{-9} meters. To convert $Å^3$ to cm^3, it is necessary to multiply by $(10^{-8})^3$, or 10^{-24}. To convert nm^3 to cm^3, it is necessary to multiply by $(10^{-7})^3$, or 10^{-21}.

Unit cells are an expression of the three-dimensional lattices used to describe mineral structures. This topic will be developed more later in the course. Units cells have three dimensions (a, b, and c) which may or may not be orthogonal. For the purposes of this exercise, all units cells will be orthogonal. For non-orthogonal cells, trigonometric corrections must be used to correct for the non-orthogonal axis or axes.

Specific gravity is a relative weight, mineral to an equal volume of water. It may be calculated using the formula;

$$G = \frac{W_A}{(W_A - W_W)}$$

where W_A is the weight in air

W_W is the weight in water

Note: Since specific gravity is a ratio, it is dimension less.

Problems: Show all work! Work unsupported by clear, logically organized calculations will receive the credit it deserves (probably zero). Clearly label your answer, including units, if any.

1. The mineral hessite (Ag_2Te) has an isometric unit cell whose dimension is 0.6572 nm above 149.5°C. Isometric means that all three unit cell dimensions are identical. Z = 4. What is the calculated value of the density? Express your answer in grams per cubic centimeter, then convert the answer to kilograms per cubic meter.(5 points)

2. The mineral bismuthinite, Bi_2S_3, is orthorhombic, with unit cell dimensions:

$$a = 11.13\ \text{Å},\ b = 11.27\ \text{Å},\ c = 3.97\ \text{Å} \qquad Z = 4$$

What is the calculated value of the density, expressed in a) grams per cubic centimeter and b) kilograms per cubic meter? (5 points)

3. The mineral nadorite, $PbSbO_2Cl$, has a density of 7,024 kg/m^3. Express this density in g/cm^3. (2 points)

4. A sample of claudetite, As_2O_3, has a weight in air of 11.72 grams. The same sample has a weight in water of 8.90 grams. What is G? (2 points)

5. A sample of strengite, $Fe(PO_4)_2.2\ H_2O$, is weighed in air. The weight is 18.53 grams. The weight of the same sample in water is 12.07 grams. What is G? (2 points)