1. The mineral hessite (Ag\textsubscript{2}Te) 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)

\[
D = \frac{Z \cdot M}{N \cdot V} \\
M = 2 \cdot 107.868 + 127.60 = 343.34 \text{ g mol}^{-1}
\]

\[
V = a^3 = (0.6572 \text{ nm})^3 = (0.6572 \cdot 10^{-7} \text{ cm})^3 = 2.839 \cdot 10^{-22} \text{ cm}^3 \text{ mol}^{-1}
\]

\[
D = \frac{4(343.43)}{(6.023 \cdot 10^{23})(2.839 \cdot 10^{-22})} = \frac{1373.72}{170.993} = 8.034 \text{ g cm}^{-3}
\]

1 gram/cubic centimeter = 1000 kilogram/cubic meter, so:

\[
8.034 \text{ g cm}^{-3} = 8.034 \times 10^3 \text{ kg m}^{-3}
\]
2. The mineral bismuthinite, $\text{Bi}_2\text{S}_3$, is orthorhombic, with unit cell dimensions:

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

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

\[
M = (2(208.9804) + 3(32.064)) = 514.153 \frac{g}{\text{mol}} \\
V = a \cdot b \cdot c = (11.13 \cdot 10^{-8})(11.27 \cdot 10^{-8})(3.97 \cdot 10^{-8}) = 4.980 \cdot 10^{-22} \frac{\text{cm}^3}{\text{mol}}
\]

\[
D = \frac{4(514.153)}{(6.023 \cdot 10^{23})(4.980 \cdot 10^{-22})} = \frac{2056.6}{299.95} = 6.86 \frac{g}{\text{cm}^3}
\]

\[
6.86 \frac{g}{\text{cm}^3} \cdot \frac{10^6 \text{ cm}^3}{\text{m}^3} \cdot \frac{\text{kg}}{1000 \, \text{g}} = 6.86 \times 10^3 \frac{\text{kg}}{\text{m}^3}
\]

3. The mineral nadorite, $\text{PbSbO}_2\text{Cl}$, has a density of 7,024 kg/m$^3$. Express this density in g/cm$^3$. (2 points)

\[
7024 \frac{\text{kg}}{\text{m}^3} \cdot \frac{\text{m}^3}{10^6 \, \text{cm}^3} \cdot \frac{1000 \, \text{g}}{\text{kg}} = 7.024 \frac{g}{\text{cm}^3}
\]
4. A sample of claudetite, As$_2$O$_3$, 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)

\[ G = \frac{W_A}{W_A - W_W} = \frac{11.72}{11.72 - 8.90} = \frac{11.72}{2.82} = 4.16 \]

5. A sample of strengite, Fe(PO$_4$)$_2\cdot$2H$_2$O, 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)

\[ G = \frac{18.53}{18.53 - 12.07} = \frac{18.53}{6.46} = 2.868 \]

4 points for correct number of significant figures throughout paper

Total Possible - 20 points