

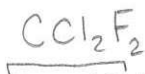
**Unit 5: Naming, Moles & Math**  
**Free Response Review #2**

**Directions:** The suggested time is about 15 minutes for answering the constructed response section of the chemistry test. The parts within a question may not have equal weight. For calculations, show all your work in the spaces provided after each part. Pay particular attention to the proper use of units. Be sure your final answer is rounded to the correct number of significant figures. Make sure your work is legible. Illegible work will receive a grade of zero.

**Question 1 [10 POINTS]**

Freon is a registered trademark of The Chemours Company, which it uses for a number of halocarbon products. They are stable, nonflammable, moderately toxic gases or liquids which have typically been used as refrigerants and as aerosol propellants. These include the chlorofluorocarbons (CFCs) that cause ozone depletion (such as chlorodifluoromethane), but also include newer refrigerants which typically include fluorine instead of chlorine and do not deplete the ozone layer. Two very stable compounds, Freon-12 and Freon-14, are used as liquid refrigerants. **A Freon-12 molecule consists of one carbon atom, two chlorine atoms, and two fluorine atoms. A Freon-14 molecule consists of one carbon atom and four fluorine atoms.** Carbon is the central atom in both molecules.

A. Complete the following calculations.



i. What is the percent by mass of fluorine in Freon-12? [2 POINTS]

$$\% F = \frac{2 \times 19.00}{120.91} \times 100 = \boxed{31.43\%}$$



ii. What is the percent by mass of fluorine in Freon-14? [2 POINTS]

$$\% F = \frac{4 \times 19.00}{88.01} \times 100 = \boxed{86.35\%}$$

B. Show a numerical setup using dimensional analysis and determine the total number of moles of Freon-12 in 60.4 grams of Freon-12. [2 POINTS]

$$60.4 \text{ g} \times \frac{1 \text{ mol}}{120.91 \text{ g}} = \boxed{0.499 \text{ mol CCl}_2\text{F}_2}$$

- C. Show a numerical setup using dimensional analysis and determine the total number of fluorine atoms in 60.4 grams of Freon-12. [2 POINTS]

$$0.499 \text{ mol CCl}_2\text{F}_2 \times \frac{2 \text{ mol F}}{1 \text{ mol CCl}_2\text{F}_2} \times \frac{6.022 \times 10^{23} \text{ atoms F}}{1 \text{ mol F}} = \boxed{6.01 \times 10^{23} \text{ atoms F}}$$

- D. An HVAC technician uses 60.4 grams of Freon-12 in one refrigeration process and 60.4 grams of Freon-14 in a separate refrigeration process. Is the number of molecules of Freon-12 used greater than, less than, or equal to the number of Freon-14 molecules used? Show a numerical setup using dimensional analysis to justify your response. [2 POINTS]

$$60.4 \text{ g CCl}_2\text{F}_2 \times \frac{1 \text{ mol}}{120.91 \text{ g}} \times \frac{6.022 \times 10^{23} \text{ molec.}}{1 \text{ mol}} = 3.01 \times 10^{23} \text{ molec. CCl}_2\text{F}_2$$

freon-12

$$60.4 \text{ g CF}_4 \times \frac{1 \text{ mol}}{88.01 \text{ g}} \times \frac{6.022 \times 10^{23} \text{ molec.}}{1 \text{ mol}} = 4.13 \times 10^{23} \text{ molec. CF}_4$$

freon-14

freon-14 > freon-12