

name KEY

Scored grade (instructor use only!) _____

1. Write **balanced** chemical equations, with appropriate phase labels, for the following reactions. In both cases, you may use as much scratch space as you need, but write your final answer legibly in the box.

a. [10 pts] The combustion of gaseous cyclopropane, C_3H_6 .



(remember to balance rxn and include phase labels.)

**b. [10 pts]

Chlorine trifluoride gas and sodium hydroxide produce sodium chlorite, sodium fluoride and water.



(remember to balance rxn and include phase labels.)

2. (a) [3 pts] A covalent compound of H, Si and F is 41.86% Si and 56.63% F. What is the empirical formula for the compound? Show your work below to earn credit and write the formula in the space.

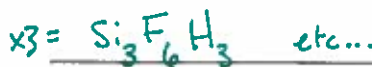
$$Si: 41.86g \times \frac{1 \text{ mol}}{28.09g} = 1.49 \text{ mol} \quad !$$

$$F: 56.63g \times \frac{1 \text{ mol}}{19.00g} = 2.98 \text{ mol} \quad 2$$

$$H: 1.51g \times \frac{1 \text{ mol}}{1.008g} = 1.49 \text{ mol} \quad 1$$

Answer: SiF₂H

(b) [2 pts] Write two other possible chemical formulas for the compound that are consistent with the empirical formula you wrote above.



(c) [3 pts] In a 50.00-g sample of this substance, how many atoms of fluorine are present? Show your work below to earn credit and write your answer, rounded appropriately, in the space.

The compound is 56.63% F, so:

$$50.00g \times 0.5663 = 28.315g F \times \frac{\text{mol}}{19.00g} \times \frac{6.022 \times 10^{23} \text{ atoms}}{\text{mol}} \text{ Answer: } 8.974 \times 10^{23} \text{ atoms}$$

↑
keep extra s.f.
since next step is
also x ÷

(There are other approaches.)

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4. [2 pts] By far the two most abundant isotopes of carbon on earth are ^{12}C and ^{13}C . Based on the average atomic mass of carbon from the periodic table, which value is closest to the abundance of ^{12}C ?

- 1% 10% 25% 50% 75% 90% 99%

eyeball approach: 12.01 average indicates $\frac{1}{100}$ of the way between 12 and 13 (much more 12 than 13). If $\frac{1}{100}$ or 1% of C is ^{13}C , that would give us an average of 12.01.

Mathematical approach: $(100)(12.01) = (x)(12) + (100-x)(13)$ $x = 99\%$

5. **a) [2 pts] What is the molar mass of $(\text{NH}_4)_2\text{CO}_3$? Show your work below, and report your answer, rounded appropriately and with correct unit(s), in the space provided.

$$\begin{array}{r} 2 \text{ N} \rightarrow 2(14.01) = 28.02 \\ 8 \text{ H} \rightarrow 8(1.008) = 8.064 \\ 1 \text{ C} \rightarrow 12.01 \\ 3 \text{ O} \rightarrow 3(16.00) = 48.00 \\ \hline 96.094 \end{array}$$

Answer: 96.09 g/mol

(b) [2 pts] What is the systematic name for $(\text{NH}_4)_2\text{CO}_3$? ammonium carbonate

(c) [6 pts] In a 2.00-mol sample of $(\text{NH}_4)_2\text{CO}_3$,

How many moles of nitrogen are present? 4.00 mol N $2.00 \text{ mol compound} \times \frac{2 \text{ mol N}}{1 \text{ mol compound}}$

How many grams of carbon are present? 24.0 g C $2.00 \text{ mol compound} \times \frac{1 \text{ mol C}}{1 \text{ mol compound}} \times \frac{12.01 \text{ g C}}{1 \text{ mol C}}$

How many atoms of hydrogen are present? 9.64×10^{24} atoms $2.00 \text{ mol compound} \times \frac{8 \text{ mol H}}{1 \text{ mol compound}} \times \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol}}$

6. [12 pts] Fill in the blanks. (In some cases there could be more than one acceptable answer; pick one.)

C \rightarrow could be element or compound \rightarrow could be ionic or covalent
A substance that forms a network solid under normal laboratory conditions. any ionic, C, Si, SiO₂

5
The number of significant figures that should be reported for the molar mass of H₂AsO₄ $3 \times 1.008 = 3.024$
 74.92

Al₂O₃
The product formed in the combustion of aluminum metal. \rightarrow aluminum oxide
 $\text{Al}^{3+} \quad \text{O}^{2-} \rightarrow \text{Al}_2\text{O}_3$ $4 \times 16.00 = 64.00$
Pb
A main-group metal with variable charge. Any metal in Group 14, 15 or 16
141.944

H
An element that commonly forms both a cation and an anion. H can form H⁺ and H⁻

20
The number of neutrons in an atom of ^{37}Cl . $37 - 17 = 20$
mass # - at # = neutrons

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7. [16 pts] Clearly indicate whether each statement is TRUE or FALSE. If we can't tell which you mean, it's wrong.

False A typical atom of sulfur has 16.07 neutrons. *neutrons are objects - must be a whole #*False Hydrogen is an alkali metal. *It's in Group 1 but it's a nonmetal & is not included in the term "alkali metals"*true Different isotopes of an element have the same number of protons. *but different #s of neutrons - definition of "isotope"*true The designation "transition elements" only includes metals.False O₂ is ~~binary~~ and diatomic. *"binary" = made of 2 different elements*true Ammonium nitrate contains both covalent and ionic bonds. *Nbly NO₃ polyatomic ions contain covalent bonds.*false The formula of a covalent network substance can be determined from the charges on its ions. *↳ no ions*false Transition metals have variable charges, but main-group metals always form constant-charge cations. *↳ metals in groups 14, 15, 16 are variable-charge*

8. [2 pts] Identify each of the following as an element, a covalent compound or an ionic compound.

IF₃ covalent compoundF₂ element

9. [14 pts] Give a correct systematic name for each of the following. Spelling counts.

calcium hydrogen carbonate **Ca(HCO₃)₂hydrogen bromide **HBrZinc permanganate **Zn(MnO₄)₂manganese acetate **Mn(CH₃COO)₃silicon tetrafluoride **SiF₄butane **C₄H₁₀magnesium hydride **MgH₂

**10. [16 pts] Give the correct chemical formula for each of the following.

(NH₄)₂C₂O₄ **^{NH₄⁺} ammonium ^{C₂O₄²⁻} oxalateH₂O₂ **hydrogen peroxideSe₂Se₆ **diselenium hexasulfidePbSO₄ **^{Pb²⁺} lead(II) ^{SO₄²⁻} sulfateSO₃ **sulfur trioxideMnO₂ **^{Mn⁴⁺} manganese(IV) ^{O²⁻} oxideH₂ elemental hydrogenBrO₄⁻ perbromate ion