4.1 PROPORTIONS IN COMPOUNDS

PRACTICE

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Understanding Concepts

1. Students will largely reproduce Table 1 on page 160 of the text, adding information on the chemical properties of the two compounds, e.g.:

Comparing CO and CO_2

	CO	**CO_2**
physical properties		
melting point (°C)	–199.0	–78.5
boiling point (°C)	–191.5	–78.5
density (g/L)	1.250	1.977
colour	none	none
solubility (g/100mL H_2O)	0.004	0.339
chemical properties		
odour	none	none
toxicity	high	low
taste	none	slightly acid
blood	binds to hemoglobin	affects acidity
photosynthesis	not used	reactant
applications	?	dry ice; carbonation; fire extinguishers

2. Carbon monoxide is toxic because it bonds to hemoglobin in the bloodstream, preventing blood cells from carrying oxygen to body tissues.
3. Carbonated beverages are made with carbon dioxide gas. Its physical property of dissolving under pressure and escaping when pressure is low makes the drink "fizzy." Its chemical properties make the drink taste "tangy."
   Carbon dioxide is useful in fire extinguishers. It can be liquified and stored under pressure, and will propel itself out of its container when opened. It is chemically unreactive and doesn't support combustion of most substances.

PRACTICE

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Understanding Concepts

4. When compounds form from elements, the ratio of masses of those elements in the compound is always precisely the same.
5. Stoichiometry refers to the study of quantities of substances involved in chemical reactions.
6. (a) Nonmetals can often form many bonds, and bond to each other in several different ways, resulting in numerous different compounds.
   (b) Sulfur and phosphorus should bond to oxygen in more than one way, since they are nonmetals.
7. (a) $CuCl_{(s)}$ and $CuCl_{2(s)}$
   (b) $FeO_{(s)}$ and $Fe_2O_{3(s)}$
   (c) $PbS_{(s)}$ and $PbS_{2(s)}$

Making Connections

8. Examples might include medical lab technologist, food chemistry, cosmetics chemistry, plastics chemistry, or detergent/cleanser chemistry analyst, and so on.

SECTION 4.1 QUESTIONS

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Understanding Concepts

1. Statements (a), (b), and (c) illustrate the law of definite proportions, and (d) does not.

Applying Inquiry Skills

2. **Experimental Design**

Aqueous silver ions and chromate ions will be mixed indifferent ratios to see how they combine. The solutions of ions will each contain the same number of ions per unit volume.

Materials

- lab apron
- eye protection
- 5 small test tubes of equal size
- test-tube rack
- eyedropper
- 10 mL of silver nitrate solution (0.10 mol/L)
- 10 mL of sodium chromate solution (0.10 mol/L)
- distilled water

Procedure

Safety: Chromate compounds are poisonous if ingested. Wash hands after use.

1. Number the test tubes from 1 to 5, and place in the test-tube rack.
2. Using the dropper, add drops of silver nitrate solution to each test tube. Add 2, 4, 6, 8, and 10 drops respectively, to tubes 1, 2, 3, 4, and 5.
3. Wash the dropper thoroughly with distilled water and use the same dropper to add drops of sodium chromate solution to each test tube. Add 10, 8, 6, 4, and 2 drops respectively, to tubes 1, 2, 3, 4, and 5. After you have finished putting drops in each tube, the test tubes should be filled to equal depth since they contain the same number of drops (12 drops total).
4. Swirl each test tube gently to mix the contents. Allow the precipitates to settle for about 5 minutes.
5. Wash your hands thoroughly.

Analysis

(a) The test tube with the most precipitate indicates the ratio of combination of silver and chromate ions — which will be proportional to the ratio of drops used in that tube.

(b) This experiment can be done with any desired ratio of drops, but the result will always be that silver and chromate combine in a 2:1 ratio, showing that the proportions of the precipitate compound are fixed.

Making Connections

3.

Compound	Colour	Hazard	Use
$N_2O_{(g)}$	colourless	slight	anesthetic
$NO_{(g)}$	colourless	toxic/irritant	bleaching
$NO_{2(g)}$	red–brown	very toxic	rocket fuels

GO TO www.science.nelson.com, Chemistry 11, Teacher Centre.