

## Table T Important Formulas And Equations

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| <p>1 Which compound has the smallest percent composition by mass of chlorine?<br/>         (1) HCl                                      (3) LiCl<br/>         (2) KCl                                      (4) NaCl</p> <p>2 A 220.0-mL sample of helium gas is in a cylinder with a movable piston at 105 kPa and 275 K. The piston is pushed in until the sample has a volume of 95.0 mL. The new temperature of the gas is 310. K. What is the new pressure of the sample?<br/>         (1) 51.1 kPa                                      (3) 243 kPa<br/>         (2) 216 kPa                                      (4) 274 kPa</p> <p>3 The concentration of a solution can be expressed in<br/>         (1) milliliters per minute    (3) grams per kelvin<br/>         (2) parts per million            (4) joules per gram</p> <p>4 When a sample of a gas is heated in a sealed, rigid container from 200. K to 400. K, the pressure exerted by the gas is<br/>         (1) decreased by a factor of 2<br/>         (2) increased by a factor of 2<br/>         (3) decreased by a factor of 200.<br/>         (4) increased by a factor of 200.</p> | <p>5 Parts per million is used to express the<br/>         (1) atomic mass of an element<br/>         (2) concentration of a solution<br/>         (3) volume of a substance<br/>         (4) rate of heat transfer</p> <p>6 What is the mass of 1.5 moles of CO<sub>2</sub>?<br/>         (1) 66 g                                      (3) 33 g<br/>         (2) 44 g                                      (4) 29 g</p> <p>7 A rigid cylinder with a movable piston contains a sample of gas. At 300. K, this sample has a pressure of 240. kilopascals and a volume of 70.0 milliliters. What is the volume of this sample when the temperature is changed to 150. K and the pressure is changed to 160. kilopascals?<br/>         (1) 35.0 mL                                      (3) 70.0 mL<br/>         (2) 52.5 mL                                      (4) 105 mL</p> |
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Base your answers to questions 8 on the information below.

Ammonium chloride is dissolved in water to form a 0.10 M NH<sub>4</sub>Cl(aq) solution. This dissolving process is represented by the equation below.



- 8 Determine the number of moles of NH<sub>4</sub>Cl(s) used to produce 2.0 liters of this solution.

Base your answers to questions 9 on the information below.

Nitrogen gas and oxygen gas make up about 99% of Earth's atmosphere. Other atmospheric gases include argon, carbon dioxide, methane, ozone, hydrogen, etc.

The amount of carbon dioxide in the atmosphere can vary. Data for the concentration of  $\text{CO}_2(\text{g})$  from 1960 to 2000 are shown in the table below.

Atmospheric Concentration of  $\text{CO}_2(\text{g})$

Year	Concentration (ppm)
1960	316.9
1980	338.7
2000	369.4

- 9 Show a numerical setup for calculating the mass of carbon dioxide in a 100.0-gram sample of air taken in 1980.

Base your answers to questions 10 on the information below.

The element boron, a trace element in Earth's crust, is found in foods produced from plants. Boron has only two naturally occurring stable isotopes, boron-10 and boron-11.

- 10 One sample of a green vegetable contains 0.0035 gram of boron. Determine the total number of moles of boron in this sample.

Base your answers to questions 11 on the information below.

The active ingredient in the pain reliever aspirin is acetylsalicylic acid. This compound can be produced by reacting salicylic acid with acetic acid. The label of one aspirin bottle indicates that the accepted mass of acetylsalicylic acid in each tablet is 325 milligrams.

In a laboratory, an aspirin tablet is crushed and mixed with water to dissolve all of the acetylsalicylic acid. The measured pH of the resulting solution is 3.0.

- 11 The mass of acetylsalicylic acid in one aspirin tablet is determined to be 320. milligrams. Show a numerical setup for calculating the percent error for the mass of acetylsalicylic acid in this aspirin tablet.

Base your answers to questions 12 on the information below and on your knowledge of chemistry.

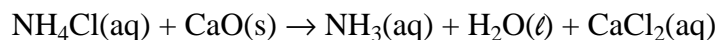
In a titration, 50.0 milliliters of 0.026 M  $\text{HCl}(\text{aq})$  is neutralized by 38.5 milliliters of  $\text{KOH}(\text{aq})$ .

- 12 Show a numerical setup for calculating the molarity of the  $\text{KOH}(\text{aq})$ .

Base your answers to questions 13 on the information below and on your knowledge of chemistry.

Baking soda,  $\text{NaHCO}_3$ , can be commercially produced during a series of chemical reactions called the Solvay process. In this process,  $\text{NH}_3(\text{aq})$ ,  $\text{NaCl}(\text{aq})$ , and other chemicals are used to produce  $\text{NaHCO}_3(\text{s})$  and  $\text{NH}_4\text{Cl}(\text{aq})$ .

To reduce production costs,  $\text{NH}_3(\text{aq})$  is recovered from  $\text{NH}_4\text{Cl}(\text{aq})$  through a different series of reactions. This series of reactions can be summarized by the overall reaction represented by the unbalanced equation below.



13 Determine the percent composition by mass of carbon in baking soda (gram-formula mass = 84 grams per mole).

14 Show a numerical setup for calculating the percent composition by mass of silicon in  $\text{SiO}_2$ .

Base your answers to questions 15 on the information below and on your knowledge of chemistry.

A  $\text{NaOH}(\text{aq})$  solution and an acid-base indicator are used to determine the molarity of an  $\text{HCl}(\text{aq})$  solution. A 25.0-milliliter sample of the  $\text{HCl}(\text{aq})$  is exactly neutralized by 15.0 milliliters of 0.20 M  $\text{NaOH}(\text{aq})$ .

15 Using the data, determine the concentration of the  $\text{HCl}(\text{aq})$ .

## Answer Keys

1 2

2 4

3 2

4 2

5 2

6 1

7 2

8 Allow 1 credit for 0.20 mol. Significant figures do not need to be shown.

9 Allow 1 credit. Acceptable responses include, but are not limited to:

- 338.7 ppm =

- $\frac{x}{100.0 \text{ g}} \times 10^6$

10 Allow 1 credit for 0.000 32 mol or  $3.2 \times 10^{-4}$  mol. Significant figures do not need to be shown.

11 Allow 1 credit. Acceptable responses include, but are not limited to:

- $\frac{320. \text{ mg} - 325 \text{ mg}}{325 \text{ mg}} \times 100$

$$\frac{(-5)(100)}{325}$$

12 Allow 1 credit. Acceptable responses include, but are not limited to:

- $(0.026 \text{ M})(50.0 \text{ mL}) = M_B (38.5 \text{ mL})$

- $\frac{(0.026)(50)}{38.5}$

13 Allow 1 credit for 14% or for any value from 14.28% to 14.3%, inclusive.

14 Allow 1 credit. Acceptable responses include, but are not limited to:

- $\frac{28.0855 \text{ g}}{28.0855 \text{ g} + 2(15.9994 \text{ g})} \times 100$

$$\frac{28.1 \text{ u}}{60.1 \text{ u}} \times 100$$

$$\frac{28(100)}{60}$$

15 Allow 1 credit for 0.12 M. Significant figures do not need to be shown.