

Experiment #7 – Reaction Enthalpy

1. The specific heat capacity of helium gas (4.003 g/mol) is 5.3 J/g K. The specific heat capacity of hydrogen gas (2.016 g/mol) is 14.3 J/g K. One thousand joules of energy is transferred to each of two, one-liter, perfectly adiabatic calorimeters containing one liter of each gas at 1.00 atm and 298K. Which of the following statement is true?

- a) the calorimeter containing helium gas will reach a higher final temperature.
- b) the mass of gas in each calorimeter is the same.
- c) the calorimeter containing hydrogen gas will reach a higher final temperature.
- d) An adiabatic calorimeter does not change temperature.
- e) both calorimeters will reach the same final temperature.

2. The reaction of an acid such as HCl with a base such as NaOH in water involves the exothermic reaction



In one experiment, a student placed 50.0 mL of 1.00 M HCl in a coffee-cup calorimeter and carefully measured its temperature to be 20.5°C. To this was added 50.0 mL of 1.00 M NaOH solution whose temperature was also 20.5°C. The mixture was quickly stirred, and the student noticed that the temperature of the mixture rose to 27.6°C. What was the heat of reaction? Ignore the heat capacity of the calorimeter in your calculation. The heat capacity of all solutions is 4.19 J/g K. The density of all solutions is 0.995 g/mL.

- a) +59 kJ/mol.
- b) +30 kJ/mol.
- c) –118 kJ/mol.
- d) –30 kJ/mol.
- e) –59 kJ/mol.

Experiment #8 – Molar Volume

3. Sulfur Hexafluoride is used as a gaseous dielectric in high voltage switches, circuit breakers and other electrical equipment. It is expected to behave non-ideally as evidenced by its very large van der Waals "a" and "b" constant values. The molar volume of sulfur hexafluoride was determined using the method of Experiment #8.

The following data was collected.

Mass of flask with air = 225.765 g

Mass of water occupying the gaseous volume of the flask = 123.345 g

Mass of flask filled with SF₆ = 226.392 g

Determine the **experimentally measured** molar volume of SF₆ gas at one atm and 298 K from this measurement.

R = 8.314 J/mol K = 0.08206 L atm/ mol K

Density of air = 1.622 g/L

Atomic mass SF₆ = 146.07

Density of water = 1.099 g/mL

Your experimental measurement contains error.
Simply using the ideal gas law to calculate $V/n = RT/P$ will result in the wrong answer.

- a) 10.1 L.
- b) 20.3 L.**
- c) 22.4 L.
- d) 24.5 L.
- e) 30.4 L.

4. The density of dry ice is 1.5 g/mL. What is the volume of carbon dioxide produced at 298 K and one atmosphere by vaporizing a cube of dry ice that is 15 mm on each side?

R = 8.314 J/mol K = 0.08206 L atm/ mol K

Molar mass CO₂ = 44.01 g

- a) 0.003 L.
- b) 1.25 L.
- c) 2.8 L.**
- d) 12.5 L.
- e) 2.81×10^3 L.

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Experiment #9 – Volumetric Analysis of Hydrogen Peroxide Solution

$$R = 8.314 \text{ J/mol K} = 0.08206 \text{ L atm/ mol K}$$

5. Thomasina Trojan performs Experiment #9 in two different ways. First, the way you did it in class. Next she repeats Experiment #9, by putting her open Erlenmeyer flask, containing the same volume of hydrogen peroxide solution as the first trial, on an analytical balance and observes the change in mass after adding the correct amount of potassium iodide. The room pressure is 760 torr and the temperature is 298K. The ratio of the mass of the oxygen collected in the second trial to the volume of dry oxygen collected in the first trial is
- the inverse of the molar volume of oxygen at 298K and 1 atm pressure.
 - equal to the density of oxygen gas at 298 K and 1 atm pressure.
 - increases with increasing volume of hydrogen peroxide solution.
 - increases with increasing concentration of hydrogen peroxide solution.
 - cannot be determined without knowing the volume of solution used.
6. The iodide ion is used as a catalyst in this reaction. The stockroom runs out of potassium iodide (formula weight 166 g), and advises students to use sodium iodide (formula weight 150 g). If 2.0 grams of KI produces 15.0 mL of gas from 50 mL of hydrogen peroxide solution, how many mL of gas will be produced from the same solution by 2.5 grams of NaI?
- 12.5 mL.
 - 15.0 mL.
 - 18.8 mL.
 - 20.8 mL.
 - 30.0 mL.

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