Gas Conversion Factors

Unit: Gases

MA Curriculum Frameworks (2016): HS-PS2-8(MA)

Mastery Objective(s): (Students will be able to…)

- Choose conversion factors based on the units needed for a calculation or conversion.

Success Criteria:

- Conversion factor has the same units as other numbers in a chosen word problem or situation.

Tier 2 Vocabulary: conversion, absolute, standard, vacuum

Language Objectives:

- Explain and defend the choice of a conversion factor or constant for use in a problem involving gases.

Notes:

absolute zero: the temperature at which molecules are moving so slowly that they can't transfer energy to other molecules. Absolute zero is −273.15 °C = 0 K

vacuum: the absence of gas molecules. In a total vacuum, the Pressure = 0

"Standard Pressure" = 1 bar*

"Standard Temperature" = 0°C = 273.15 K

S.T.P. ("Standard Temperature and Pressure") = 0 °C and 1 bar.

"Room Temperature" = 25 °C = 298 K

1 mole of an ideal gas has a volume of 22.7 L at S.T.P.

* In 1982, the IUPAC defined standard pressure to be exactly 1 bar (= 100 kPa = 0.987 atm). However, many chemists and many standardized assessments still use 1 atm.

Use this space for summary and/or additional notes:

Conversion Factors

Pressure:

1 atm $\equiv$ 101.325 kPa $\equiv$ 0.101 325 MPa $\equiv$ 1.01325 bar
$\equiv 101\,325\ \frac{N}{m^2} \equiv 101\,325$ Pa

1 atm $\equiv$ 760 mm Hg $\equiv$ 760 torr = 29.92 in. Hg

1 atm = 14.696 $\frac{\text{lb.}}{\text{in.}^2}$ = 14.696 psi (“psi” = “pounds per square inch”)

Volume:

1 mL $\equiv$ 1 cm^3

1 L $\equiv$ 1000 m^3

Moles:

1 mol = 22.7 L at S.T.P.*

Use dimensional analysis to turn the molar mass of a compound (measured in $\frac{g}{mol}$) into a conversion factor between grams and moles.

Temperature:

K $\equiv$ °C + 273.15 °F $\equiv$ (1.8 × °C) + 32 °R $\equiv$ °F + 459.67

The Gas Constant:

The gas constant R is a natural constant that appears in several relationships in chemistry, including the ideal gas law (which we will study in a subsequent class).

$$R = 0.0821 \frac{L\cdot atm}{mol\cdot K}$$

$$R = 8.31 \frac{L\cdot kPa}{mol\cdot K} = 8.31 \frac{J}{mol\cdot K} = 8.31 \times 10^{-3} \frac{kJ}{mol\cdot K}$$

$$R = 62.4 \frac{L\cdot torr}{mol\cdot K}$$

$$R = 1.987 \frac{cal}{mol\cdot K} \equiv 1.987 \frac{BTU}{lb\text{-}mol\cdot {}^\circ R}$$

* Massachusetts assessments still use the outdated definition of S.T.P. The volume of one mole of an ideal gas at 1 atm and 0 °C is 22.4 L.

Use this space for summary and/or additional notes: