**Boyle’s Law**

* relationship between pressure and volume

V

Pressure (kPa)

V

1/Pressure (1/kPa)

**BOYLE’S LAW** 🡪 at constant temperature, the volume of a fixed mass of any gas is inversely proportional to its pressure

**P1V1 = P2V2**

Ex. 1 A balloon with a volume of 5.0 L is filled with air at 101 kPa pressure. The balloon is taken up to the mountains where the atmospheric pressure is 91 kPa. If the temperature is the same in both places, what is the new volume of the balloon?

**Charles’ Law**

* relationship between volume and temperature

V

T (K)

V

T (°C)

Absolute zero 🡪 temperature at which particles would cease to move and would therefore have zero kinetic energy (zero volume)

Kelvin temperature scale 🡪 °C + 273.15 = K or °C = K – 273.15

**CHARLES’ LAW** 🡪 at constant pressure, the volume of a fixed mass of any gas is directly proportional to its Kelvin temperature

V1 = V2

T1 T2

Ex. A balloon is filled with helium gas to a volume of 1.20 L at a pressure of 105 kPa and a temperature of 15.0°C. If the pressure remains constant and the temperature rises to 30.0°C, what will be the new volume of the balloon?

**Gay-Lussac’s Law (P-T Law)**

* relationship between pressure and temperature
* if a gas is contained in a vessel that cannot expand, as the temperature increases the pressure increases

**GAY-LUSSAC’S LAW** – at constant volume, the pressure of a fixed mass of any gas is proportional to its Kelvin temperature

P1 = P2 P α T

T1 T2

Ex. A steel cylinder with a volume of 450 mL contains a gas at a pressure of 520 kPa at 25 °C. If the cylinder is heated to
410 °C, what will the new pressure be?

**The Combined Gas Law Equation**

* in each of the three gas laws discussed, one of the variables (pressure, volume or temperature) was held constant
* in practice, we often find that all three variables change

**COMBINED GAS LAW EQUATION** – combination of the equations pertaining to Boyle’s Law, Charles’ Law, and Gay-Lussac’s Law

P1V1 = P2V2

T1 T2

P1V1 = P2V2 P1V1 = P2V2 P1V1 = P2V2

T1 T2 T1 T2 T1 T2

T = constant P = constant V = constant

Boyle’s Law Charles’ Law Gay-Lussac’s Law

Ex. 1 An aerosol can with a volume of 325 mL contains a gas at 445 kPa and 12 °C. What volume would the gas occupy if it was allowed to escape at 101 kPa and 21 °C?

STP – standard temperature and pressure

SATP – standard ambient temperature and pressure

HW: Summary Chart including the following: Law Formula Constant

Boyle’s Law Q#1-3 pg 514 Charles’ Law Q#11,12,14 pg 522 GL Q#21-23 pg 525

Combined Q#2-4 pg 542