STURMAN KEY

14.2 THE GAS LAWS

25 possible ≥ 18 (+3)

Section Review

Objectives

- Describe the relationship among the temperature, volume, and pressure of a gas
- Use the combined gas law to solve problems

Vocabulary

- Boyle's law
- Charles's law
- Gay-Lussac's law
- combined gas law

Key Equations

- Boyle's law: $P_1 \times V_1 = P_2 \times V_2$
- Charles's law: $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
- Gay-Lussac's law: $\frac{P_1}{T_1} = \frac{P_2}{T_2}$
- combined gas law: $\frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2}$

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

The pressure and volume of a fixed mass of gas are __1__ related. If one decreases, the other __2__. This relationship is known as __3__ law. The volume of a fixed __4__ of a gas is directly proportional to its __5__ temperature. This relationship is known as __6__ law. __7__ law states that the pressure of a gas is __8__ proportional to the Kelvin temperature if the volume remains constant.

These three separate gas laws can be written as a single expression called the __9__ gas law. It can be used in situations in which only the __10__ of gas is constant.

1. inversely
2. increases
3. Boyle's
4. amount (mass)
5. kelvin
6. Charles'
7. Gay-Lussac's
8. directly
9. combined
10. amount (moles)

Date _____ Class _____

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

NT 11. According to Charles's law, $T_2 = \frac{V_1 \times V_2}{T_2}$. $\frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow T_2 = \frac{V_2 T_1}{V_1}$

AT 12. According to Boyle's law, when the volume of a gas at constant temperature increases, the pressure decreases.

AT 13. A balloon with a volume of 60 L at 100 kPa pressure will expand to a volume of 120 L at a pressure of 50 kPa.

NT 14. In an inverse relationship, the ratio of two variable quantities is constant.

NT 15. When using the combined gas law, pressure must always be in kilopascals but temperature can be in kelvins or degrees Celsius.

AT 16. When 20.0 L of O_2 is warmed from −30.0°C to 85.0°C at constant pressure, the new volume is 29.5 L. $\frac{20.0\text{ L}}{243\text{ K}} = \frac{x}{358}$ $-30.0 + 273 = 243$ 85

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A		Column B
C 17. Boyle's law		a. The volume of a fixed mass of gas is directly proportional to its Kelvin temperature if the pressure is kept constant
B 18. combined gas law		b. $\frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2}$
E 19. absolute zero		c. For a fixed mass of gas at constant temperature, the volume of gas varies inversely with pressure.
A 20. Charles's law		d. The pressure of a gas is directly proportional to the Kelvin temperature if the volume remains constant.
D 21. Gay-Lussac's law		e. −273.15°C

Part D Questions and Problems

Answer the following in the space provided.

+2

22. A rigid container holds a gas at a pressure of 55 kPa and a temperature of −100.0°C. What will the pressure be when the temperature is increased to 200.0°C?

$P_1 = 55\text{ kPa}$ $P_2 = ?$

$T_1 = -100.0° + 273 = 173\text{ K}$ $T_2 = 200.0° + 273 = 473$

$\frac{55}{173} = \frac{P_2}{473}$

$P_2 = 150\text{ kPa}$

+2

23. What is the volume of a sample of CO_2 at STP that has a volume of 75.0 mL at 30.0°C and 91 kPa?

$V_2 = ?$ $V_1 = 75.0\text{ mL}$

$P_2 = 1\text{ atm} = 101.3\text{ kPa}$ $T_1 = 30.0°C + 273 = 303\text{ K}$

$T_2 = 0°C = 273\text{ K}$ $P_1 = 91\text{ kPa}$

$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \Rightarrow \frac{(91\text{ kPa})(75.0)}{303} = \frac{(101.3)(V_2)}{273}$

$V_2 = 60.7 \rightarrow 61\text{ mL}$