14 Guided Notes **The Behavior of Gases** Name KEY

14.1 Properties of Gases

1. What property of gases allows an air bag in a car to absorb some of the energy from the impact of a collision?
compressibility
2. Describe the relationship between compressibility and gas molecules.
you can measure how compressible a gas is by how much the volume changes under pressure (ie how far away particle are)
3. Gases are easily compressed because of the empty space b/w particles.
4. List in order from least amount of space between particles to greatest amount of space between particles: gas, liquid, solid.
solid, liquid, gas
5. How does the volume of the particles in a gas compare to the overall volume that the gas occupies?
insignificant
6. What factors affect gas pressure?
amount of gas (moles)
volume, temperature, pressure
7. How does adding more gas to an inflatable raft increase the pressure in the raft?
↑ particles. ↑ in pressure (collisions)
8. T F Gas pressure is increased in a piston (Figure 14.6) when the volume is increased. ↓ pressure
9. How does decreasing the temperature of a gas in a closed plastic bag decrease the gas pressure inside the bag?
particles slow down, hitting/colliding with the sides less often which lowers pressure
10. If a gas in a container remains at a constant temperature, how else could you increase the gas pressure in the container?
① decreasing volume
② increasing amount of gas (adding particles)

14.2 The Gas Laws

11. Boyle's Law (in words): If temp (+ amt of gas) is contant, as the pressure of a gas increases, the volume decreases. (inversely proportional)

12. Examine Figure 14.8 and answer the **Interpreting Graphs** questions.

a. 50 kPa   b. 33 kPa   c. inversely proportional

13. Write the mathematical equation for Boyle's Law.

$P_1V_1 = P_2V_2$

14. Nitrous oxide is used as an anesthetic. The pressure on 2.50 L of N2O changes from 105 kPa to 40.5 kPa. If the temperature does not change, what will the new volume be?

$(105 kPa)(2.50 L) = (40.5 kPa)(V_2)$

$\boxed{V_2 = 6.48 L}$

15. A gas with a volume of 4.00 L at a pressure of 205 kPa is allowed to expand to a volume of 12.0 L. What is the pressure in the container if the temperature remains constant?

$(205 kPa)(4.00 L) = P_2(12.0 L)$

$\boxed{P_2 = 68.3 kPa}$

16. Charles's Law (in words): when pressure is contant, as the temp. of an enclosed gas increases, the volume increases (directly proportional)

17. Examine Figure 14.10 and answer the **Interpreting Graphs** questions.

a. Kelvin   b. it also rises   c. 0 L

18. Write the mathematical equation for Charles's Law.

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

19. What is the equation for converting degrees Celsius to Kelvin?

$°C + 273 = K$

20. If a sample of gas occupies 6.80 L at 325° C, what will its volume be at 25° C if the pressure does not change? (Do not forget to convert the temperatures to Kelvin before you do the math!)

$\frac{6.80 L}{598 K} = \frac{V_2}{298}$ $\boxed{V_2 = 3.39 L}$

21. Exactly 5.00 L of air at -50.0° C is warmed to 100.0° C. What is the new volume if the pressure remains constant?

$$\frac{5.00L}{223} = \frac{V_2}{373} \qquad V_2 = 8.36L$$

22. Gay-Lussac's Law (in words):

as you increase pressure, you increase temp (when volume is consta
(directly proportional)

23. Write the mathematical equation for Gay-Lussac's Law.

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

24. How does a pressure cooker affect the time needed to cook food?

↑ pressure, ↑ temp (cooks food @ higher temp)

25. A sample of nitrogen gas has a pressure of 6.58 kPa at 539 K. If the volume does not change, what will the pressure be at 211 K?

$$\frac{6.58kPa}{539} = \frac{P_2}{211} = \boxed{P_2 = 2.58 kPa}$$

26. The pressure in a car tire is 198 kPa at 27° C. After a long drive, the pressure is 225 kPa. What is the temperature of the air in the tire? Assume that the volume is constant.

$$\frac{198kPa}{300K} = \frac{225kPa}{T_2} \qquad \boxed{T_2 = 341K}$$

or -273

27. When is the Combined Gas Law used?

PT and V are changing and amount of moles is constant. 68°C

28. What is the equation for the Combined Gas Law?

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

29. A gas at 155 kPa and 25° C has an initial volume of 1.00 L. The pressure of the gas increases to 605 kPa as the temperature is raised to 125° C. What is the new volume?

$$\frac{(155kPa)(1.00L)}{298} = \frac{(605kPa)(V_2)}{398} = \boxed{0.34L}$$

30. The volume of a weather balloon increases as the balloon rises in the atmosphere. Why doesn't the drop in temperature at higher altitudes cause the volume to decrease?

The pressure from the atmosphere decreases on the balloon as it rises.

14.3 Ideal Gases

31. What variable is held constant in the previous gas laws that is now included in this new law? amount of gas (n)

32. Write the mathematical equation for the Ideal Gas Law.

$PV = nRT$

33. When the temperature of a rigid hollow sphere containing 685 L of helium gas is held at 621 K, the pressure of the gas 1.89×10^3 kPa. How many moles of helium does the sphere contain?

$(1.89 \times 10^3 \text{ kPa})(685 \text{ L}) = n(8.314 \frac{\text{L} \cdot \text{kPa}}{\text{mol} \cdot \text{K}})(621 \text{ K})$

34. T/F If an **ideal gas** follows the gas laws under all conditions of temperature and pressure then its particles would have no volume, and there would be no attraction between particles in the gas. In other words, this is impossible and ideal gases cannot really exist. Does occur in most cases, however.

35. What are the characteristics of a **real gas**?

(1) occupy a volume
(2) have IMF's intermolecular forces

36. Under what conditions do real gases differ from ideal gases most?

extreme conditions: ↑ PRESSURE, ↓ TEMP

14.4 Gases: Mixtures and Movements

37. What is partial pressure? pressure exerted by each gas in a mixture

38. In a mixture of gases, the total pressure is the sum of the partial pressures of the gases.

39. What is the mathematical equation for Dalton's law of partial pressures?

$P_{total} = P_1 + P_2 + P_3$

40. Examine Figure 14.16. Look at the relative pressures in containers A and C; what is the relationship between these pressures and the number of gas particles in these containers.

twice the pressure, twice the # of particles

41. A gas mixture containing oxygen, nitrogen, and carbon dioxide has a total pressure of 32.9 kPa. If $P_{oxygen} = 6.6$ kPa and $P_{nitrogen} = 23.0$ kPa, what is the $P_{carbon\ dioxide}$?

$32.9 = 6.6 + 23 + P_{CO_2}$

$\boxed{P_{CO_2} = 3.3 \text{ KPa}}$

42. Why must Kelvin temperature be used in calculations that involve gases?

Kelvin has NO negatives and the Knowns are in Kelvin (R)

43. Why do aerosol containers display the warning, "Do not incinerate"? (If you are not sure what incinerate means, please look it up.)

The containers are pressurized, and an increase in temp will cause that pressure to rise even more, EXPLODING.

44. What is Graham's law of effusion?

$$\frac{V_1}{V_2} = \sqrt{\frac{m_2}{m_1}} \quad \text{or} \quad \frac{\sqrt{m_2}}{\sqrt{m_1}}$$

45. If two bodies with different masses have the same kinetic energy, the one with the greater mass must move faster/slower. (circle one)

Speed + mass = 'inversely'

46. A carbon dioxide molecule travels at 45.0 m/s at a certain temperature. At the same temperature, find the velocity of an oxygen molecule.

$$\frac{v_1}{v_2} = \sqrt{\frac{m_2}{m_1}}$$

$$\frac{45 m/s}{V_2} = \frac{\sqrt{O_2 = 32 g/mol}}{\sqrt{CO_2 = 44.02 g/mol}}$$

$$\boxed{= 52.8 m/s}$$

Combined Gas Law

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

Ideal Gas Law

$PV = nRT$ where $R = 8.314$

Dalton's Law

$P_{total} = P_1 + P_2 + P_3 \ldots$

Graham's Law

$$\frac{V_1}{V_2} = \frac{\sqrt{m_1}}{\sqrt{m_2}}$$

→ smaller mass = moves faster
but don't forget HONClBrIF

Boyle's Law

$P_1V_1 = P_2V_2$

Charles Law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Gay Lussac's Law

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Diffusion vs. Effusion

Diffusion ↓ move to lower concentration

Effusion ↓ move through small openings