

Match each example below with the appropriate gas property it illustrates.

- |   |                                 |
|---|---------------------------------|
| <u>B</u> 1. the fragrance of perfume spreads through the room           | a. compressibility              |
| <u>E</u> 2. a balloon filled with air weighs more than an empty balloon | b. diffuses through other gases |
| <u>C</u> 3. a syringe closing on a marshmallow                          | c. exerts pressure              |
| <u>A</u> 4. the can demonstration                                       | d. fills container              |
| <u>D</u> 5. a balloon is inflated with helium                           | e. has mass                     |

Circle the **Laws** that apply to the statement: (B)oyles (C)harles (L)ussacs.

THERE MAY BE MORE THAN ONE LAW

- B C L 6. Direct Relationship between variables  
B C L 7. Inverse Relationship between variables  
B C L 8. Pressure and Temperature  
B C L 9. Volume and Temperature  
B C L 10. Volume and Pressure  
B C L 11. Negative sloping graph  
B C L 12. Positive sloping graph  
B C L 13. Volume held constant  
B C L 14. Temperature held constant

STP stands for  
Standard Temperature & Pressure  
The value for pressure at STP is  
101.3 in kpa  
1 in atm  
760 in torr (mmHg)  
What is the value for temperature at STP  
273 in Kelvin  
0 in °C

Complete the following statements by writing "decreases," "increases," or "remains the same" on the line provided.

As a gas is compressed in a cylinder

15. its mass remains the same  
16. the number of gas molecules remains the same  
17. its pressure increases  
18. its volume decreases  
19. the distance between gas molecules decreases  
20. its density increases

21. A 7.0 liter balloon at room temperature ( $22^{\circ}\text{C}$ ) contains hydrogen gas. If the balloon is carried outside to where the temperature is  $-3.0^{\circ}\text{C}$ , what volume will the balloon occupy?

Law Used

Answer

Charles

6.4L

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

$$\frac{7}{295} = \frac{x}{270}$$

$$295x = 7(270)$$

22. A 5.0 liter tank of oxygen gas is at a pressure of 3 atm. What volume of oxygen will be available if the oxygen is used at standard pressure?

Law Used

Answer

Boyle

15L

$$P_1V_1 = P_2V_2$$

$$3(5) = 1(x)$$

23. A 500 liter volume of helium gas is at a pressure of .9 atm and has a temperature of 300K. What is the volume of the same gas at STP?

Law Used

Answer

Combined

409.5K

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

$$\frac{.9(500)}{300} = \frac{1(x)}{273}$$

$$300x = .9(500)273$$

24. Nitrogen (80 atm), oxygen (21.0 atm), carbon dioxide (0.03 atm), and water vapor (2.0 atm) are the usual atmospheric components. What is the total atmospheric pressure?

Law Used

Answer

Dalton's Law

103.03 atm

$$P_{\text{total}} = P_1 + P_2 + P_3 + \dots$$

$$P_{\text{total}} = 80 + 21 + .03 + 2$$

Complete the following statements about the nature of gases as presented in the kinetic molecular theory by filling in the appropriate word (s) from the list below.

kinetic energy

no force

low

one

volume

barometer

not

high

constant motion

zero

25. Gas particles exert no force on one another.

26. Gas molecules are said to be in constant motion.

27. Gas particles themselves are said to have virtually no volume.

28. The collisions between gas particles do not lose energy.

29. The temperature of a gas is a measurement of the average kinetic energy of the gas particles.

30. Gases are ideal at 1 atm pressure and 273K temperature.

31. Standard temperature is zero Celsius.

32. Standard pressure is one atm.

33. Atmospheric pressure is measured with a Barometer.

2

**1 atm = 760 mmHg = 101.3 kPa**

Convert the following (show work!):

34. 1 atm = 101.3 kPa

35. 200 kPa = 1500.5 mmHg

36. 3.5 atm = 2660 mmHg

37. 300 kPa = 2.96 atm

38. At **STP**, a sample of gas occupies 24.5 mL. Calculate the volume of this gas at a pressure of 2.3 atm and a temperature of 301 K.

Law Used Combined

Answer 11.7 mL

$$\frac{1(24.5)}{273} = \frac{2.3(x)}{301}$$

$$273(2.3)x = 24.5(301)$$

39. A sample of gas has a volume of 5.23 cm<sup>3</sup> at a pressure of 0.6 atm and a temperature of 25°C. What will be the volume of the gas if the pressure is changed to 1.24 atm and the temperature is changed to 0°C?

Law Used Combined

Answer 2.3 cm<sup>3</sup>

$$\frac{0.6(5.23)}{298} = \frac{1.24(x)}{273}$$

$$298(1.24)x = 0.6(5.23)(273)$$

40. Calculate the pressure of 0.421 mole of helium gas at 254 K when it occupies a volume of 3.32 L.

Law Used Ideal

Answer 2.64 atm

$$PV = nRT$$

$$x(3.32) = 0.421(.0821)254$$

41. How many moles of Helium are in 250L? (AT STP)

Law Used T bar or PV = nRT

Answer 11.16 moles

$$PV = nRT$$

$$1(250) = x(.0821)(273)$$

OR

$$\frac{250L \times 1 \text{ mol}}{22.4L} =$$

42. What is the volume of 2.3 mol of Carbon dioxide? (STP)

Law Used T bar or PV = nRT

Answer 51.52 L

$$PV = nRT$$

$$1(x) = 2.3(.0821)273$$

$$\left\{ \begin{array}{l} 2.3 \text{ mol} \\ \hline 22.4 \text{ L} \\ \hline 1 \text{ mol} \end{array} \right. =$$

**3**

43. A glass sphere is filled to full volume with a gas. The pressure of the gas inside the sphere is 30.0 atm, and the temperature is 25.0°C. The sphere is taken outside on a cold day. The temperature of the gas decreases to 10.0°C. What is the new pressure of the gas?

Law Used Lussac  
 Answer 28.48 atm

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

$$\frac{30}{298} = \frac{x}{283} \quad 298x = 30(283)$$

44. The gas pressure in an aerosol can is 1.5 atm at 25.0°C, what would the pressure be inside the can at 300.0°C?

Law Used Lussac  
 Answer 2.88 atm

$$\frac{1.5}{298} = \frac{x}{573}$$

$$298x = 1.5(573)$$

45. 2.00 L of a gas is at 7.4 atm pressure. What is its volume at standard pressure?

Law Used Boyle  
 Answer 14.8 L

$$P_1 V_1 = P_2 V_2 \quad P = 1 \text{ atm}$$

$$7.4(2) = 1(x)$$

46. A gas is collected and found to fill 2.85 L at 25.0°C. What will be its volume at standard temp?

Law Used Charles  
 Answer 2.61 L

$$\frac{2.85}{298} = \frac{x}{273} \quad 298x = 2.85(273)$$

$$x = 2.61$$

47. What happens to a marshmallow when placed in a microwave? Why?

Temperature increases, so the volume of mallow increases

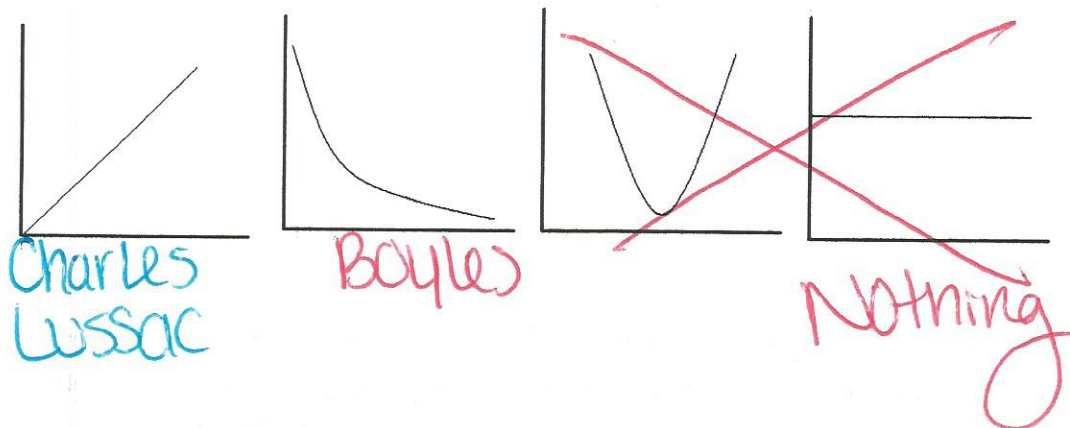
48. What happens to a balloon dipped into liquid nitrogen (has a temperature of -203°C)? Why?

Volume decreases b/c temperature decreases

49. What happens to the air in your tires on a cold day? Why?

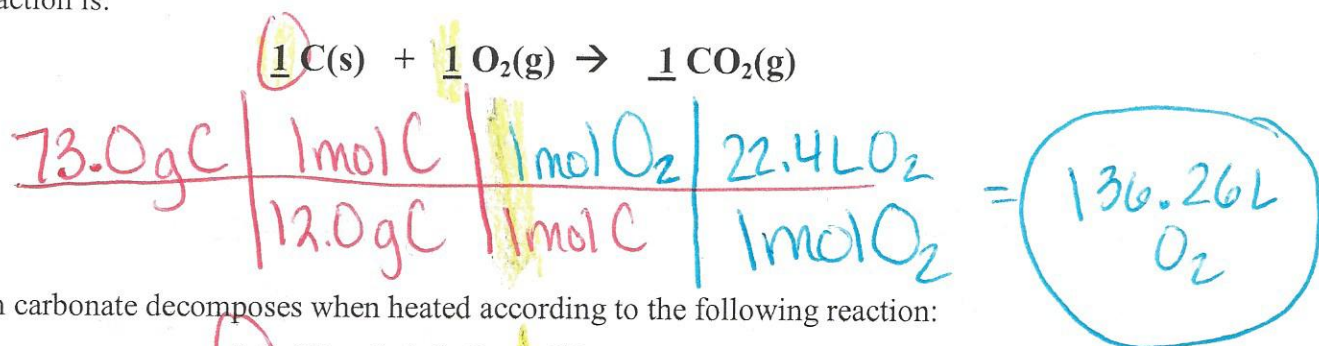
Volume goes down b/c temp decreases

50. Label the Laws with their graph: Boyle's, Charles', and Lussac's

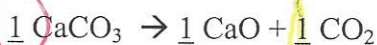


51. What volume of oxygen gas at STP is needed to completely react with 73.0 g of graphite (pure carbon)?

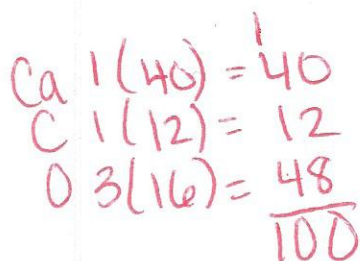
The reaction is:



52. Calcium carbonate decomposes when heated according to the following reaction:



Calculate the volume of carbon dioxide at STP produced from the decomposition of 25.0 g of calcium carbonate. (Molar mass of  $\text{CaCO}_3$  is 100.09 g/mol)



5.6 L  $\text{CO}_2$