54 Gas Problems **ANSWERS**

1. At constant temperature, the pressure on 8.0 liters of a gas is increased from 1.0 atm. to 4.0 atm. What will be the new volume of this gas?

   $P_1V_1 = P_2V_2$ (1.0 atm)(8.0 L) = (4.0 atm)(V_2) V_2 = 2.0 Liters

2. If the pressure on 36.0 milliliters of neon at STP is changed to 0.250 atm. at constant temperature, what will be the new volume of the neon?

   $P_1V_1 = P_2V_2$ (1 atm)(36 mL) = (0.25 atm)(V_2) V_2 = 144 milliliters

3. The pressure on 200. liters of xenon is decreased at constant temperature from 130. kPa to 120 kPa, what is the new volume of xenon in liters?

   $P_1V_1 = P_2V_2$ (130 kPa)(200. L) = (120kPa)(V_2) V_2 = 217 Liters

4. The pressure on 150 milliliters of nitrogen gas at constant temperature is changed from 50.65 kPa to 101.3 kPa. What is the new volume of nitrogen?

   $P_1V_1 = P_2V_2$ (50.65 kPa)(150 mL) = (101.3 kPa)(V_2) V_2 = 75 milliliters

5. A 114.5 liter sample of oxygen is held at standard temperature while the pressure is changed from normal to just 560. mm of Hg. What is the new volume in liters?

   $P_1V_1 = P_2V_2$ (760 mm Hg)(114.5 L) = (560. mm Hg)(V_2) V_2 = 155 Liters

6. A sample of gas has a volume of 6.0 liters at 0°C and 50.65 kPa. What will be its volume when the pressure is changed to 101.3 kPa at constant temperature?

   $P_1V_1 = P_2V_2$ (50.65 kPa)(6.0 L) = (101.3 kPa)(V_2) V_2 = 3.0 Liters

7. The volume of a sample of hydrogen gas at STP is 1.00 liters. As the temperature decreases, the pressure remains constant, the volume of this gas will ____. To do this, make up an example with some of your own numbers, see how what changes and make a decision.

   $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\frac{1.00\ L}{273\ K} = \frac{V_2}{223\ K}$ $V_2 = \frac{223}{273}$ V_2 = .817 Liters **volume DECREASES**

8. A gas at STP has a volume of 22.4 liters. If the volume is held constant but the temperature changes to 373K, waht is the new pressure on this gas? VOLUME CONSTANT

   $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\frac{101.3\ kPa}{273\ K} = \frac{P_2}{373\ K}$ = 273X = 37784.9 P_2 = 138.4 kPa

9. A sample of gas occupies 6.00 liters at a temperature of 200K. if the pressure is held constant while the temperature is raised up to 600K, the new volume of gas would be ___?

   $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\frac{6.00\ L}{200K} = \frac{V_2}{600\ K}$ 200X = 3600 V_2 = 18.0 Liters

10. A bottle of radon gas fills a 36.0 mL space at standard pressure. If the pressure changes to 0.250 atm what is the new volume on the gas if temperature is 0°C?

$P_1V_1 = P_2V_2$ (1.0 atm)(36.0 mL) = (0.250 atm)(V_2) $\frac{36.0}{0.250} = V_2$ V_2 = 144mL

11. A sample of gas is at 10.0°C. If pressure remains constant, the volume will increase when the temperature is changed to: 283K or 273K or 293K or 263K ? Make up a volume and temperature and fit them into the formula to see what happens.

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\frac{100\ L}{283\ K} = \frac{V_2}{293\ K}$ 29300 = 283X V_2 = 103.5 L

12. At constant pressure, 205 mL of argon is at 10.0°C is heated to 27.0°C. The new volume of the gas in mL, is equal to ___?

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\frac{205\ mL}{283\ K} = \frac{V_2}{300\ K}$ 283X = 61500 V_2 = 217.3 mL

13. hahaha gas law is excellent stuff

14. Under the same conditions of temperature and pressure, which gas would behave most like an ideal gas? helium

15. Which gas will most closely resemble an ideal gas at STP? hydrogen

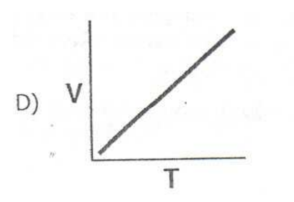
16. Under what conditions does a real gas behave most like an ideal gas?
A. high temp & low pressure

17. Helium behaves most like an ideal gas for several reasons. Under high pressure it tends to stay a gas, at low temperatures it does not collapse into a liquid, there are almost no intermolecular forces of attraction or repulsion in helium, the particles are very small.

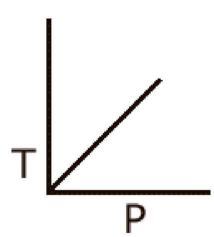
18. At high temps the gases are less likely to collapse into a liquid because they have too much kinetic energy. At low pressure there is little chance for the particles of a gas to bump into each other and form liquid either.

19. Which gas is LEAST likely to obey the ideal gas laws at very high temperature and very low pressures? Xenon is least likely because it is the largest of the four gases listed.

20. At constant pressure, which graph shows the correct relationship between the volume of a gas and its temperature?
Volume and Temperature (in Kelvin!) are directly proportional. The graph that shows this is D:



21. Temperature and Pressure are DIRECTLY PROPORTIONAL, as shown in this graph



22. **Avodgadro's Hypothesis states: Equal volumes of different gases at the same Temp and Pressure contain equal numbers of particles. In this case B is correct, because both sulfur dioxide and nitrogen exist as MOLECULES.**

23. Samples of SO_2 and N_2 contain equal numbers of molecules. If the gases are at STP, the samples have C. equal volumes

24. Equal volumes of gases at the same temperature and pressure contain equal numbers of D. particles

25. A sample of H_2 and N_2 at STP contain the same number of molecules. Each sample must have **C. same volume and different mass**

26. The three boxes below represent three 1-Liter containers of gas, all are at STP.

Ne	CO_2	NH_3

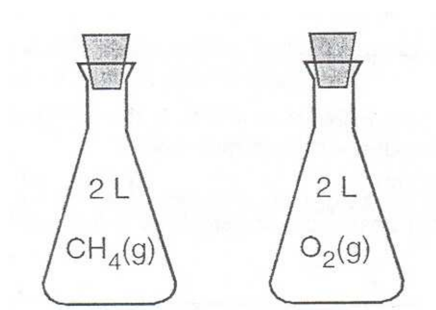
Which of the following statement correctly interprets the gas chemistry here?
B. all three containers have the same number of particles

27. A one liter flask of carbon dioxide gas and another on liter flask of hydrogen gas are both at STP. The ratio of the number of molecules of CO_2 to the number of molecules of H_2 in these flasks is: **C. 1:1 Avogadro's Hypothesis again**

28. At STP, 3.0 liters of hydrogen gas and 3.0 liters of helium gas have the same **C. number of particles (are you getting the point here?)**

29. Each stoppered flask shown here contains 2.0 liters of a gas, methane and oxygen, at STP.

Each gas sample has the same
D. number of particles
(not atoms, as methane has 5 atoms per molecule and oxygen only 2 per molecule)



30. If the pressure on a given mass of gas in an enclosed system is decreased and the temperature remains constant, the volume of the gas will
B. increase **Make up some numbers if you don't "SEE" it already.**

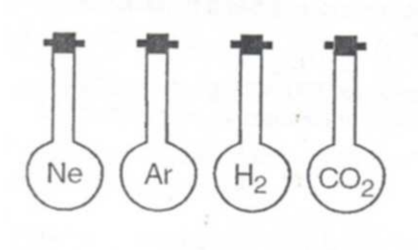
Temp Constant, so $P_1V_1 = P_2V_2$ (1 atm)(22.4 L) = (0.50 atm)(X L) X = 44.8 L
so, the volume of the gas will INCREASE, Pressure and Volume are inversely proportional.

31. As the temperature of a sample of gas increases at constant pressure, the volume of the gas
A. remains the same B. increases C. decreases
Again, make up some numbers and figure this out. Constant Pressure, so:

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\frac{22.4\text{ L}}{273\text{ K}} = \frac{X\text{ L}}{500\text{ K}}$ 273 X = 11200 X = 41 Liters

The volume increases with temperature increase

32. The diagram here represents four 500 mL flasks containing the gases neon, argon, hydrogen and carbon dioxide, at STP. Each flask contains the same number of **D. particles**



The flasks contain atoms, atoms, molecules, and molecules, in that order. The only answer that is correct is PARTICLES.

33. When the average kinetic energy of a gaseous system is increased, the average molecular velocity of the system **B. increases and the molecular mass remains the same**
Increasing kinetic energy leads to increased molecular motion, but has no effect on mass.

34. Will the volume of a 2.50 liter sample of gas at STP change in the Kelvin temperature and pressure are both DOUBLED? Make up some numbers and plug into your formula.

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(1\text{ atm})(2.50\text{ L})}{273\text{ K}} = \frac{(2\text{ atm})(V_2)}{546\text{ K}} \qquad V_2 = 2.5\text{ L}$$

The volume remains the same. Be sure to CHECK each problem like this by plugging numbers into a formula and doing the math carefully.

35. The volume of a given mass of an ideal gas at constant pressure is
D. directly proportional to Kelvin Temp

36. A gas at STP has a volume of 1.0 liters. If the pressure is doubled and the temperature remains constant, the new volume of the gas will be **C. 0.50 L**

$P_1V_1 = P_2V_2$ (temp constant) (1 atm)(1.0 L) = (2 atm)(X L) X = 0.50 L

37. As the pressure on a given sample of gas increases at constant temperature, the mass of the sample of gas **C. remains the same (mass not affected by P, V, or T)**

38. Explain in terms of the Kinetic Molecular Theory of gases, the increase in pressure of a sample of gas when the gas is heated from 273 Kelvin to 298 Kelvin. **Any increase in temperature will result in stronger collisions by particles, and in more collisions of particles, because the increase in temperature is an increase in Kinetic Energy.**

39. A sample of gas is at STP. As the pressure decreases and the temperature increases, the volume of the gas **A. increases,** because either of the two changes will:
(pressure down, volume up - inversely proportional) and
(temperature up, volume up - directly proportional)

40. A sample of gas A was stored in a container at 50°C and 0.50 atm. Compared to a gas B, stored at STP, gas A had a: **C. higher temp and lower pressure**

41. What pressure, in atmospheres, is equal to 152 kPa? **A. 1.50**

42. Question 42 was omitted.

43. The average kinetic energy of the molecules of an ideal gas is directly proportional to

C. temperature in Kelvin (Temp and KE go hand in hand)

44. Which change must result in an increase in the average kinetic energy of the molecules of a given sample of nitrogen gas?

A. temperature change from 20 to 30 degrees centigrade (increasing temperature means increasing KE) (we like to use Kelvin in all of our formula because temperatures below 0°C are common, but negative numbers or zero itself wrecks the math. The only zero in Kelvin the the "real" zero.

45. This question was omitted.

46. When a sample of gas is heated at constant pressure, the average kinetic energy of its molecules

D. increases & the volume of the gas increases, do some math with some numbers

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\frac{22.4\ L}{273\ K} = \frac{X\ L}{393\ K}$ $273X = 8803.2$ $X = 32.2$ Liters

As Kinetic Energy increases, Volume increases as well, they're directly proportional.

47. A gas has a pressure of 40.0 kPa, a temperature of 400. Kelvin and a volume of 50.0 mL. What volume will the gas have at a pressure of 20.0 kPa and 200. Kelvin?

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $\frac{(40.0\ kPa)(50.0\ mL)}{400\ K} = \frac{(20.0\ kPa)(V_2)}{200\ K}$ $V_2 = 50.0$ mL

48. A sample of carbon monoxide occupies 15.0 liters at 4.00 atm and 300.Kelvin. What is the new volume of the CO if the pressure changes to 2.00 atm and the temperature is increased to 400.Kelvin?

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $\frac{(4.00\ atm)(15.0\ L)}{300\ K} = \frac{(2.00\ atm)(V_2)}{400\ K}$ $V_2 = 40.0$ L

49. At a temperature of 273K, a 409 mL gas sample has a pressure of 101.3 kPa. If the pressure is changed to 50.65 kPa, at what temperature will the gas sample have a volume of 609 mL?

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $\frac{(101.3\ kPa)(409\ mL)}{273\ K} = \frac{(50.65\ kPa)(609\ mL)}{X\ Kelvin}$ X= 203 Kelvin

50. A gas has a volume of 1400 mL at 20.0 K and 101.3 kPa. What will be the volume when the temperature changes to 40.0 K and pressure is changed to 50.65 kPa?

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $\frac{(101.3\ kPa)(1400\ mL)}{20.0\ K} = \frac{(50.65\ kPa)(V_2)}{40.0\ K}$ $V_2 = 5600$ mL

51. One reason that a real gas deviates from an ideal gas is that the molecules of a real gas have **D. forces of attraction for each other**

52. Which gas under high pressure and low temperature will behave most like an ideal gas?
D. H_2 - Hydrogen is the smallest particle and most likely to behave ideally.

53. **Real gases are not ideal because they do form liquids under low temps and high pressures, and they do have some attraction or repulsion from each other as well**.

54. Omitted question

55. When a sample of gas is heated at constant pressure, the average kinetic energy of its molecules
D. increases and the volume of the gas increases