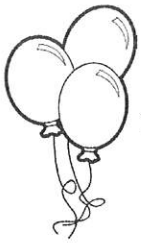
K = °C + 273



Unit 10 Gas Laws Test Review

1. We assume that particles in a gas are ideal because of the kinetic Molecular Theory. The five postulates of this theory are:
   - I. Gases particles are very small and there is lots of large space between them.
   - II. When gas particles collide with the side of its container, the collision exerts pressure on the side of the container.
   - III. Gas particles are in constant, random motion.
   - IV. Gas particles do NOT attract or repel each other.
   - V. The average kinetic energy of the gas is equal to temperature.

speed / movement = temperature

2. What conditions are indicated by STP (standard temperature and pressure)?

fast = hot
slow = cold

✱ don't need to know ✱
0°C & 1 atm

Instructions: Show all math work (except stoichiometry) in the GUESS boxes on the following pages.

3. At what temperature would 1.28 moles of hydrogen have a pressure of 1.00 atm and a volume of 55.0 L?
4. 8.4 L sample of gas contains 1.5 moles of oxygen. At the same temperature and pressure, how many moles of gas would there be in a 2.8 L sample?
5. A 1250 L tank of helium at standard pressure of 1 atm needs to fit into a tank that has a volume of 18.25 L. What is the new pressure?
6. A weather balloon is filled with 5040 L of helium on a day when the temperature is ~~18°C~~ 291 K and the pressure is 767 mmHg. It rises until the temperature is ~~-7°C~~ 266 K and the pressure is only 458 mmHg. What is the new volume?
7. A gas mixture consisting of oxygen, helium and carbon dioxide has a total pressure measurement of 921 mmHg. If the partial pressure of the oxygen is 242 mmHg and the partial pressure of the carbon dioxide is 333 mmHg, find the partial pressure of helium.
8. A balloon is filled to 2.18 L on a day when the temperature is ~~23°C~~ 296 K. Assuming no change in pressure, what is the volume of the balloon on a day when the temperature is ~~17°C~~ 290 K?
9. How many moles of gas will occupy a 5.62 L flask at standard temperature (~~0°C~~ 273 K) and pressure (1 atm)?
10. What is the pressure of hydrogen collected over water when the atmospheric (total) pressure is 741.8 mmHg? The partial pressure of water is 17.5 mmHg.
11. **Complete the sentences below!**

T↑ P↑ (hits the sides of container more)

   a) As temperature increases, gas molecules move faster and exert more pressure.
   b) 0°C is (warmer) (hot) **OR** *colder* than 200K. (273 K)
   c) Two gas samples at STP with the same number of particles (quantity) will have the same volume.
   d) Two gas samples at the same temperature will have the same average kinetic energy (same speed) of their molecules.

#3

G: $n_1 = 1.28\,mol$, $V_1 = 55\,L$, $P_1 = 1.00\,atm$

$R = 0.0821$

U: T_1

E: $PV = nRT$

S: $1.00(55) = 1.28(0.0821)(T)$

S: $T = 523.37\,K$

units

#4

G: $V_1 = 8.4\,L$, $V_2 = 2.8\,L$, $n_1 = 1.5\,mol$

U: n_2

E: $\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$ $\left\{ \frac{V_1}{n_1} = \frac{V_2}{n_2} \right.$

S: $\frac{8.4}{1.5} = \frac{2.8}{n_2}$

S: $n_2 = 0.5\,mol$

units

#5

G: $V_1 = 1250\,L$, $V_2 = 18.25\,L$, $P_1 = 1\,atm$

U: P_2

E: $\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$ $\left\{ P_1V_1 = P_2V_2 \right.$

S: $1(1250) = P_2(18.25)$

S: $P_2 = 68.49\,atm$

units

#6

G: $V_1 = 5040\,L$, $T_1 = 291\,K$, $T_2 = 266\,K$, $P_1 = 767\,mmHg$, $P_2 = 458\,mmHg$

U: V_2

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

S: $\frac{767(5040)}{291} = \frac{458(V_2)}{266}$

S: $V_2 = 7715.23\,L$

units

#7

G: $P_T = 921$ mmHg
$P_1 = 242$ mmHg $P_2 = 333$ mmHg

U: P_3

E: $P_T = P_1 + P_2 + P_3$

S: $921 = 242 + 333 + P_3$

S: $P_3 = 346$ mmHg

units

#8

G: $V_1 = 2.18$ L
$T_1 = 296$ K $T_2 = 290$ K

U: V_2

E: $\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$ $\left\}\frac{V_1}{T_1} = \frac{V_2}{T_2}\right.$

S: $\frac{2.18}{296} = \frac{V_2}{290}$

S: $V_2 = 2.14$ L

units

#9

G: $V_1 = 5.62$ L $P_1 = 1$ atm
$T_1 = 273$ K

* $R = 0.0821$

U: n_1

E: $PV = nRT$

S: $1(5.62) = n(0.0821)(273)$

S: $n = 0.25$ mol

units

#10

G: $P_T = 741.8$ mmHg
$P_1 = 17.5$ mmHg

U: P_2

E: $P_T = P_1 + P_2$

S: $741.8 = 17.5 + P_2$

S: $P_2 = 724.3$ mmHg

units

P.T.

12. If 5.45 g of potassium chlorate decompose to potassium chloride and oxygen gas, how many liters of oxygen gas are given off at STP?

$$2\,KClO_3 \rightarrow 2\,KCl + 3\,O_2$$

$$5.45\text{g } KClO_3 \times \frac{1\text{ mol}}{122.55\text{g}} \times \frac{3\text{ mol } O_2}{2\text{ mol } KClO_3} \times \frac{22.4\text{L}}{1\text{ mol}} = 1.49\text{ L } O_2$$

13. Given the following reaction: $CH_4(g) + 2\,O_2(g) \rightarrow CO_2(g) + 2\,H_2O(g)$

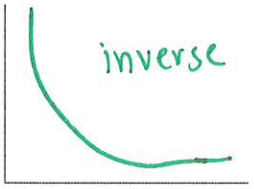
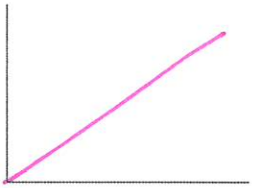
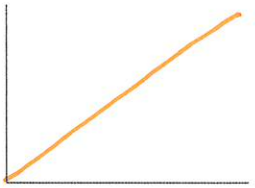
a) Determine how many grams of water will be produced by the complete combustion of 10.5 L of methane gas (CH_4) at 273 K and 1 atm.

$$10.5\text{L } CH_4 \times \frac{1\text{ mol}}{22.4\text{ L}} \times \frac{2\text{ mol } H_2O}{1\text{ mol } CH_4} \times \frac{18.016\text{g}}{1\text{ mol } H_2O} = 16.89\text{ g } H_2O$$

b) What volume of oxygen gas would be needed to make 2.5 L of carbon dioxide at STP?

$$2.5\text{L } CO_2 \times \frac{1\text{mol}}{22.4\text{L}} \times \frac{2\text{ mol } O_2}{1\text{ mol } CO_2} \times \frac{22.4\text{L}}{1\text{ mol}} = 5\text{ mol } O_2$$

14. Circle if the variables involved have a direct or indirect/inverse relationship. Then draw what the relationship would look graphically and then answers the questions below.

Variables involved	Pressure & Volume (everything else constant)	Volume & Temperature (everything else constant)	Pressure & Temperature (everything else constant
Statement of Law	direct (same) **OR** indirect/inverse (opposite) relationship	direct (same) **OR** indirect/inverse (opposite) relationship	direct (same) **OR** indirect/inverse (opposite) relationship
Graph			

inverse a) What happens to the volume of a gas if pressure increases? (temperature is constant) ↓ decrease

direct b) What happens to the pressure of a gas if temperature decreases? (volume is constant) ↓ decrease

direct c) If temperature increased, what will happen to the new volume? (pressure is constant) ↑ increase

d) How will the kinetic energy change if the temperature decreased? KE ↓

KE = T movement