Name: _____ Block: _____ Unit 4 Irwin Study Guide 2016

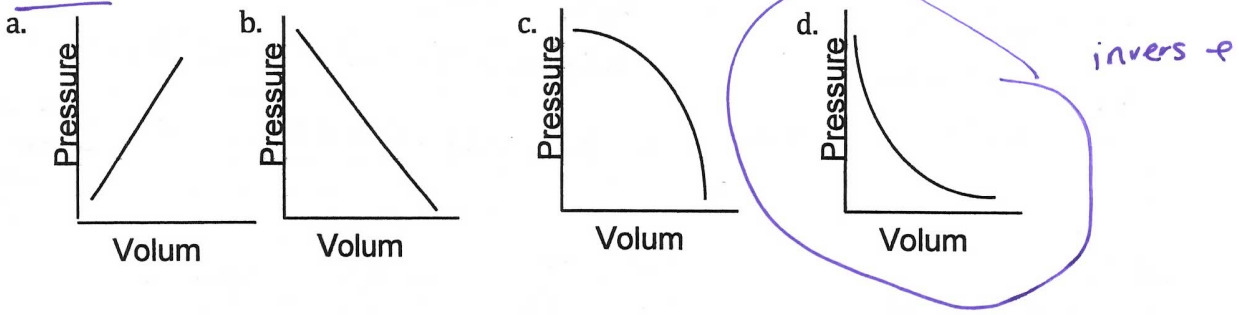
REFERENCE INFORMATION FOR THE STUDY GUIDE:
Standard Pressure: 1 atm = 760 mm Hg = 101.3 kPa = 760 torr = 101,300 kPa

Unit 8 Study Guide

What you should know and be able to do:

- Use kinetic molecular theory to describe the relationships between pressure and volume, volume and temperature, pressure and temperature, and volume and moles of gas.
- Use Boyle's Law to solve problems relating to pressure and volume
- Use Charles's Law to solve problems relating to Volume and Temperature
- Use Gay Lussac's Law to solve problems relating to pressure and temperature
- Use the Combined Gas Law to solve problems relating to Pressure, Volume and Temperature.
- Use the relationship that 1 mole occupies 22.4 L at STP (Standard Temperature and Pressure) to solve gas stoichiometry problems.
- Use Dalton's Law to calculate the Partial Pressure of a gas if you know the total pressure.
- **If you have questions on any of these topics, please see Mrs. Irwin before the test.**

1. Which of the following graphs represents the relationship that exists between pressure and volume?



2. STP is equivalent to which of the following?
   a. 0ºC and 760 mm Hg
   b. 0ºC and 1 kPa
   c. 0 K and 760 mm Hg
   d. 0 K and 1 atm

3. A sample of O_2 gas has a volume of 1.5 L at 250 K. What is its new volume if its temperature is doubled?
   a. 0.75 L
   b. 1.5 L
   c. 3.0 L
   d. 4.5 L

   V and T ↑↑

4. The volume of air in a syringe is doubled and its pressure measured. If the final pressure of the air was 1.50 kPa, what will be its initial pressure?
   a. 0.750 kPa
   b. 1.50 kPa
   c. 3.00 kPa
   d. 4.5 kPa

$P_1 = x$ $V_1 = 1$ P↓ if V↑

$P_2 = 1.50$ $V_2 = 2$

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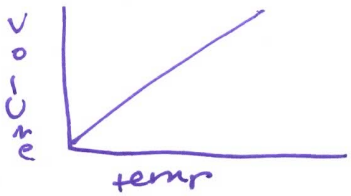
5. Draw the graph of volume versus temperature. Is it a direct or indirect relationship?



volume and temperature are directly proportional

6. Convert the following: a) 14.3 kPa to torr

see reference info on front to do these problems.

107.3 torr

$\frac{14.3\,kPa}{x\ torr} = \frac{101.3\,kPa}{760\ torr}$

b) 1356 mm Hg to atm

1.78 atm

$\frac{1356\ mmHg}{x\ atm} = \frac{760\ mmHg}{1\ atm}$

c) 1.08 atm to kPa

109.4 kPa

$\frac{1.08\,atm}{x\ kPa} = \frac{1\,atm}{101.3\,kPa}$

6. A sample of carbon dioxide gas occupies a volume of 3.50 L at 125 kPa. What pressure would the gas exert if the volume was decreased to 2.00 L?

$V_1 = 3.50\,L$
$P_1 = 125\,kPa$
$V_2 = 2.00\,L$
$P_2 = x$

$P_1V_1 = P_2V_2$

$(125\,kPa)(3.50\,L) = (x)(2.00\,L)$

$x = 218.75\,kPa$

be sure to include units

7. Oxygen gas is at a temperature of 40ºC when it occupies a volume of 2.3 liters. To what temperature should it be raised so that it occupies a volume of 6.5 liters?

$V_1 = 2.3\,L$
$T_1 = 40 + 273 = 313\,K$
$V_2 = 6.5\,L$
$T_2 = x$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\quad \frac{2.3\,L}{313\,K} = \frac{6.5\,L}{x}$

$x = 884\,K$

8. A gas is heated from 248 K to 303 K and the volume is increased from 22.0 mL to 42.5 mL by moving a large piston within a cylinder. If the original pressure was 808 mm Hg, what would the final pressure be in mm Hg?

$T_1 = 248\,K$
$V_1 = 22.0\,mL$
$P_1 = 808\,mmHg$

$T_2 = 303\,K$
$V_2 = 42.5\,mL$
$P_2 = x$

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

$\frac{(808\,mmHg)(22.0\,mL)}{248\,K} = \frac{(x)(42.5\,mL)}{303\,K}$

$x = \frac{(808)(22.0)(303)}{(248)(42.5)}$

$x = 511\,mmHg$

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9. A gas has a volume of 375 mL at -76°C and 185 mm Hg. What would the volume of the gas be at 175°C and 587 mm Hg of pressure?

$V_1 = 375$ mL
$T_1 = -76 + 273 = 197$
$P_1 = 185$ mm Hg
$V_2 = x$
$P_2 = 587$ mm Hg
$T_2 = 175 + 273 = 448$ K

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

$\frac{(185\text{ mmHg})(375\text{ mL})}{197\text{ K}} = \frac{(587\text{ mmHg})x}{448\text{ K}}$

$x = \frac{(185)(375)(448)}{(197)(587)}$

$x = 268$ mL

10. How many moles of oxygen gas are contained in 76.8 Liters at STP?

$\frac{76.8\text{ L}}{x\text{ mol}} = \frac{22.4\text{ L}}{1\text{ mole}}$

$x = 3.43$ moles

11. How many grams of Carbon Dioxide (CO_2) are contained in 184 L of carbon dioxide gas?

convert to moles first

$\frac{184\text{ L}}{x\text{ moles}} = \frac{22.4\text{ L}}{1\text{ mole}}$ $x = 8.2$ moles

$\frac{8.2\text{ moles } CO_2}{x\text{ g}} = \frac{1\text{ mole } CO_2}{44\text{ g}}$ $x = 360.8$ g

12. Given the following reaction: $2N_2(g) + 5O_2(g) \rightarrow 2N_2O_5(g)$
If this reaction takes place at STP, how many liters of oxygen gas are required to produce 15 liters of dinitrogen pentoxide, N_2O_5?

you need to know moles before you can find out anything else

$2N_2 + 5O_2 \rightarrow 2N_2O_5$

x L O_2 → 1.67 moles O_2 (find moles of O_2)
15 L N_2O_5 → 0.669 moles N_2O_5

$\frac{15\text{ L}}{x\text{ moles}} = \frac{22.4\text{ L}}{1\text{ mole}}$ $x = 0.669$ moles

$\frac{0.669\text{ moles } N_2O_5}{x\text{ mole } O_2} = \frac{2\text{ moles } N_2O_5}{5\text{ moles } O_2}$

$x = 1.67$ moles

$\frac{1.67\text{ moles } O_2}{x\text{ L}} = \frac{1\text{ mole } O_2}{22.4\text{ L}}$

$x = 37.5$ L

13. Given the following reaction: $2Al_2O_3(s) \rightarrow 4Al(s) + 3O_2(g)$
How many liters of oxygen are produced if 2.58 mol of aluminum oxide, Al_2O_3, are completely decomposed at Standard Temperature and Pressure?

decomposed means completely reacted — what we are looking for

you need to know moles of O_2 before you can find Liters

$2Al_2O_3 \rightarrow 4Al + 3O_2$

2.58 mol — find → 3.87 mole O_2

$$\frac{2.58 \text{ mol } Al_2O_3}{x \text{ mol } O_2} = \frac{2 \text{ mol } Al_2O_3}{3 \text{ mol } O_2} \qquad x = 3.87 \text{ mol } O_2$$

15. A sample of hydrogen gas, H_2, is collected over water at 20.°C at an atmospheric (total) pressure of 103.6 kPa. What is the pressure of the hydrogen gas? The vapor pressure of H_2O at 20.°C is 2.3 kPa.

$$\frac{3.87 \text{ mol } O_2}{x \text{ L } O_2} = \frac{1 \text{ mol } O_2}{22.4 \text{ L}}$$

$x = 86.7$ Liters

16. A gas mixture contains 30% hydrogen (H_2) and 70% oxygen (O_2) by volume. The mixture has a total pressure of 125 kPa. What is the partial pressure of each of these gases?