

Key

$M \cdot n = \frac{m}{M} \cdot M$ g/mol
13 g/mol

10 Multiple choice questions

Topics to be included on this section of the test:

- Combined gas law $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$
- Kinetic theory of matter
- $PV=nRT$
- Partial Pressures (Dalton's Law) $P_T = P_1 + P_2 + P_3 \dots$
- Mole fractions $X = \frac{\text{moles of individual}}{\text{Total moles}}$
- Real Gases: Deviations from ideal behavior **READ or REVIEW SECTION 10.9 PG 427**
- Graham's Law of Effusion $\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$
- Know how to convert between different pressure units
- Boyle's law $P_1 \times V_1 = \text{constant}$
- Charles's law $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
- Gay-Lussac's law $\frac{P_1}{T_1} = \frac{P_2}{T_2}$
- Using $PV=nRT$ to calculate density and Molar Mass

Density = $\frac{P_{mm}}{RT}$

Molar Mass $MM = \frac{g RT}{PV}$ or $\frac{dRT}{V}$

Two Free Response Questions: One will be long and one will be short with you answering short answer questions.

Examples of what you may see on this test

1. The *Hindenburg* was a hydrogen-filled dirigible that exploded in 1937. If the *Hindenburg* held $2.0 \times 10^5 \text{ m}^3$ of hydrogen gas at 23 degrees Celsius and 1.0 atm, what mass of hydrogen was present?

$$n = \frac{PV}{RT} = \frac{(1.0 \text{ atm}) (2.0 \times 10^5 \text{ m}^3)}{(0.0821 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}}) (296 \text{ K})} = 8.2299 \times 10^6 \text{ moles}$$

Convert to liters = $2.0 \times 10^8 \text{ L}$

Convert to grams

$$8.2299 \times 10^6 \text{ moles H}_2 \left| \frac{2.016 \text{ g H}_2}{1 \text{ mol H}_2} \right. = 1.66 \times 10^7 \text{ g}$$

2. Equal masses (0.500 g each) of hydrogen and oxygen are placed in an evacuated 4.00 L flask at 25°C. The mixture is allowed to react to completion and the flask is returned to 25°C and allowed to come to equilibrium. The equilibrium vapor pressure of water at 25°C is 23.76 torr.

a. write and balance an equation for the reactions.



b. What is the total pressure inside the flask before the reactions begins?

$$P = \frac{nRT}{V}$$

Find moles of Reactants, then use $P = \frac{nRT}{V}$

① $\frac{.500 \text{ g H}_2}{2.02 \text{ g H}_2} \left| \frac{1 \text{ mol H}_2}{2.02 \text{ g H}_2} \right. = .2475 \text{ mol H}_2$

② $\frac{.500 \text{ g O}_2}{32.0 \text{ g O}_2} \left| \frac{1 \text{ mol O}_2}{32.0 \text{ g O}_2} \right. = .0156 \text{ mol O}_2$

$$P = \frac{(.2475 + .0156)(.0821)(298)}{4.0 \text{ L}} = 1.62 \text{ atm}$$

c. What is the mass of the water vapor in the flask at equilibrium?

$$n = \frac{PV}{RT} = \frac{(.0312 \text{ atm})(4.0 \text{ L})}{(.0821 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(298 \text{ K})} = .005101 \text{ mol H}_2\text{O}$$

note: add in H₂O pressure

$= .0918 \text{ g H}_2\text{O}$

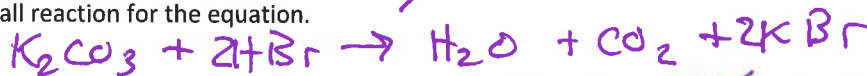
d. What is the total pressure inside the flask at equilibrium?

3. Explain, using the Kinetic Molecular Theory, how an increase in temperature of a gas confined to a sealed, rigid container causes an increase in the pressure of the gas.

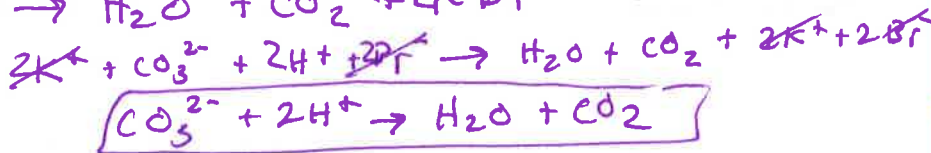
As the temp. ↑ the particles will move faster. When the particles move faster they will take up more space, and hit the side of the container more often and harder which will ↑ the pressure.

4. If 27.2 grams of potassium carbonate is reacted with 125 ml of .700 M hydrobromic acid in 3.5 L vessel at a temperature of 22.00°C and a pressure of 757 torr-

a. Write the overall reaction for the equation.



b. Give the net ionic equation for the reaction



c. What is the limiting reagent in the reaction?

L.R

$27.2 \text{ g K}_2\text{CO}_3$	$1 \text{ mol K}_2\text{CO}_3$	1 mol CO_2	$= .1967 \text{ mol CO}_2$
$138.28 \text{ g K}_2\text{CO}_3$	$1 \text{ mol K}_2\text{CO}_3$	1 mol CO_2	
$.0875 \text{ mol HBr}$	1 mol CO_2	2 mol HBr	$= .04375 \text{ mol CO}_2$

d. How many liters of CO₂ will be created? Assume the vapor pressure for water at 20°C is 22.34 torr.

$V = \frac{nRT}{P}$

$$.04375 \text{ mol CO}_2 \left(\frac{.0821 \text{ L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} \right) (295 \text{ K})$$

$= 1.096 \text{ L}$

So smallest HBr is L.R