Chapter 11
Practice Test

Name: ______________________

Date: ________________ Per: ________

Kinetic Molecular Theory

1. List the five postulates of the Kinetic-Molecular Theory.

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Name the Gas Law

2. A potato chip bag pops when taken up in the mountains. ______________
3. A balloon put in the freezer shrinks. ______________
4. A lighter gas moves faster than a heavier gas. ______________
5. The pressure of two gases is the sum of their partial pressures. ______________

Calculations, Etc.

6. Equal amounts of gas at the same temperature and pressure have the same ______________.
7. If the temperature of a sample of gas is halved at constant volume, the pressure will be ______________.
8. The temperature at which matter stops moving is called ______________.
9. The values of standard temperature are ______________.
10. The values of standard pressure (in atm & mmHg) are ______________.
11. Derive the value of R for pressure in atmospheres. (Must show work)

    How would this process be different if you were to calculate the value of R for mmHg?

12. A sample of hydrogen gas has a volume of 4.40 L at a temperature of 145 °C and a pressure of 2.30 atm.

    a) How many moles are in the sample?

    V = 4.40 L
    T = 145 °C (418 K)
    P = 2.30 atm
    n = ?
    R = 0.0821 (atm•L)/(mol•K)

    $$PV = nRT$$

    $$n = \frac{PV}{RT} = \frac{(2.30\text{ atm})(4.40\text{ L})}{(0.0821\ ^{(\text{atm}\bullet\text{L})}/_{(\text{mol}\bullet\text{K})})(418\text{ K})} = 0.29\underline{4}8\text{ mol} \Rightarrow 0.295\text{ mol } H_2$$

    b) What is the mass of the sample?

    $$\frac{0.29\underline{4}8\text{ mol } H_2 \;\Big|\; 2.018\text{ g } H_2}{\;\Big|\; 1\text{ mol } H_2} = 0.59\underline{4}3\text{ g} \Rightarrow 0.594\text{ g } H_2$$

13. A sample of gas measures 5.00 liters at 2.30 atmospheres of pressure. To change the volume to 3.50 liters at constant temperature, what pressure must be applied?

    V_1 = 5.00 L
    P_1 = 2.30 atm
    V_2 = 3.50 L
    P_2 = ?

    $$P_1V_1 = P_2V_2$$

    $$P_2 = \frac{P_1V_1}{V_2} = \frac{(2.30\text{ atm})(5.00\text{ L})}{(3.50\text{ L})} = 3.2\underline{8}57\text{ atm} \Rightarrow 3.29\text{ atm}$$

Answers: 12) a. 0.295 mol, b. 0.595 g 13) 3.29 atm 14) 3760 K 15) 36.2 L 16) 5040 L, 3.47×10^{-4} g/L 17) 24.8 L 18) 6.16 g Na 19) 5.00 atm 20) 0.28 L

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14. A 2.50 L gas container is designed to hold gases with a pressure of up to 11000. mmHg. If a gas sample that has a pressure of 740. mmHg at -20.0 °C is placed in the container, at what temperature will the container burst?

P_2 = 11000. mmHg
P_1 = 740. mmHg
T_1 = – 20.0 °C (253 K)
T_2 = ?

$T_1P_2 = T_2P_1$

The volume of the container is not important in this case as it cannot expand or contract. The volume will remain constant until the moment it bursts.

$$T_2 = \frac{T_1P_2}{P_1} = \frac{(253\ \text{K})(11000.\ \text{mmHg})}{(740.\ \text{mmHg})} = 3760.8\ \text{K} \Rightarrow 3760\ \text{K}$$

15. A quantity of gas has a volume of 23.0 L at -45.0 °C and 1000. mmHg of pressure. If the conditions are changed to STP (STP = 273 K & 760. mmHg), what will the new volume be?

V_1 = 23.0 L
T_1 = –45.0 °C (228 K)
P_1 = 1000. mmHg
T_2 = 273 K
P_2 = 760. mmHg
V_2 = ?

$P_1V_1T_2 = P_2V_2T_1$

$$V_2 = \frac{P_1V_1T_2}{P_2T_1} = \frac{(1000.\ \text{mmHg})(23.0\ \text{L})(273\ \text{K})}{(760.\ \text{mmHg})(228\ \text{K})} = 36.23\ \text{L} \Rightarrow 36.2\ \text{L}$$

16. A quantity of gas has a volume of 650. L at 65.0 °C and 7300. mmHg of pressure. If the gas has a mass of 1.75 g, what is the density of the gas at STP (STP = 273 K & 760. mmHg)?

V_1 = 650. L
T_1 = 65.0 °C (338 K)
P_1 = 7300. mmHg
T_2 = 273 K
P_2 = 760. mmHg
V_2 = ?

$P_1V_1T_2 = P_2V_2T_1$

$$V_2 = \frac{P_1V_1T_2}{P_2T_1} = \frac{(7300.\ \text{mmHg})(650.\ \text{L})(273\ \text{K})}{(760.\ \text{mmHg})(338\ \text{K})} = 5042\ \text{L}$$

m = 1.75 g
V = 5042 L

$$D = \frac{m}{V} = \frac{1.75\ \text{g}}{5042\ \text{L}} = 3.470 \times 10^{-4}\ \text{g/L} \Rightarrow 3.47 \times 10^{-4}\ \text{g/L}$$

17. Given the equation, ___ CuO(s) + ___ H_2(g) → ___ Cu(s) + ___ H_2O(g), how many liters of hydrogen are needed to react with 88.0 g of copper (II) oxide at STP *(STP means we can use 1 mol of gas = 22.4 L)*?

Analyze, rewrite, balance equation 1 CuO(s) + 1 H_2(g) → 1 Cu(s) + 1 H_2O(g)
88.0 g (CuO), *? L* (H_2)

Solve for only given

88.0 g CuO	1 mol CuO	1 mol H_2	22.4 L H_2
	79.545 CuO	1 mol CuO	1 mol H_2

= 24.78 L ⇒ 24.8 L H_2

18. Given the equation, ___ Na(s) + ___ H_2O(l) → ___ NaOH(aq) + ___ H_2(g), if 3.00 liters of hydrogen (at STP) *(STP means we can use 1 mol of gas = 22.4 L)* are produced in the above reaction, what mass of sodium was used?

Analyze, rewrite, balance equation 2 Na(s) + 2 H_2O(l) → 2 NaOH(aq) + 1 H_2(g)
? g (Na), *3.00 L* (H_2)

Solve for only given

3.00 L H_2	1 mol H_2	2 mol Na	22.990 g Na
	22.4 L H_2	1 mol H_2	1 mol Na

= 6.158 g ⇒ 6.16 g Na

Answers: 12) a. 0.295 mol, b. 0.595 g 13) 3.29 atm 14) 3760 K 15) 36.2 L 16) 5040 L, 3.47×10^{-4} g/L 17) 24.8 L 18) 6.16 g Na 19) 5.00 atm 20) 0.28 L

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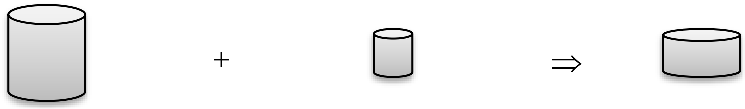
19. Two gases are combined in a 2.00 L container. If the first gas has a pressure of 1.50 atm at a volume of 4.00 L and the second gas has a pressure of 4.00 atm at a volume of 1.00 L, what is the pressure of the combined gases?

First Gas | Second Gas | Combined Gases



First Gas	Second Gas	Combined Gases
$V_1 = 4.00$ L	$V_1 = 1.00$ L	$V_2 = 2.00$ L
$P_1 = 1.50$ atm	$P_1 = 4.00$ atm	$P_{Total} = ?$

$P_2 = P_1V_1/V_2$ $\qquad$ $P_2 = P_1V_1/V_2$

$$P_2 = \frac{(1.50\text{ atm})(4.00\text{ L})}{(2.00\text{ L})} \qquad P_2 = \frac{(4.00\text{ atm})(1.00\text{ L})}{(2.00\text{ L})}$$

$P_2 = 3.00$ L $\quad + \quad$ $P_2 = 2.00$ L $\quad = \quad$ $P_{Total} = 5.00$ L

20. What volume of hydrogen gas is evolved from a reaction between 0.52 g of Na and water according to the equation $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$? The gas is collected at 20.°C and 745 mmHg.

Option 1 – Stoichiometry & Combined Gas Law

Analyze, rewrite, balance equation $\quad 2\,Na(s) + 2\,H_2O(l) \rightarrow 2\,NaOH(aq) + 1\,H_2(g)$

0.52 g $\qquad$ *? $L_{(STP)}$*

Solve for only given

$$\frac{0.52\text{ g Na}}{} \left| \frac{1\text{ mol Na}}{22.990\text{ g Na}} \right| \frac{1\text{ mol }H_2}{2\text{ mol Na}} \left| \frac{22.4\text{ L }H_2}{1\text{ mol }H_2} \right. = 0.253\text{ L }H_{2(STP)}$$

Convert gas volume from standard conditions to conditions specified in question.

$V_1 = 0.253$ L
$T_1 = 273$ K
$P_1 = 760.$ mmHg
$T_2 = 20.$ °C (293 K)
$P_2 = 745$ mmHg
$V_2 = ?$

$P_1V_1T_2 = P_2V_2T_1$

$$V_2 = \frac{P_1V_1T_2}{P_2T_1} = \frac{(760.\text{ mmHg})(0.253\text{ L})(293\text{ K})}{(745\text{ mmHg})(273\text{ K})} = 0.277\text{ L} \Rightarrow 0.28\text{ L }H_2$$

Option 2 – Stoichiometry & Ideal Gas Law

Analyze, rewrite, balance equation $\quad 2\,Na(s) + 2\,H_2O(l) \rightarrow 2\,NaOH(aq) + 1\,H_2(g)$

0.52 g $\qquad$ *? mol*

Solve for only given

$$\frac{0.52\text{ g Na}}{} \left| \frac{1\text{ mol Na}}{22.990\text{ g Na}} \right| \frac{1\text{ mol }H_2}{2\text{ mol Na}} = 0.0113\text{ mol }H_2$$

$V = ?$ L
$T = 20.$ °C (293 K)
$P = 745$ mmHg
$n = 0.0113$ mol
$R = 62.4$ (mmHg•L)/(mol•K)

$PV = nRT$

$$V = \frac{nRT}{P} = \frac{(0.0113\text{mol})(62.4\ ^{(mmHg\cdot L)}/_{(mol\cdot K)})(293\text{ K})}{(745\text{ mmHg})} = 0.277\text{ L} \Rightarrow 0.28\text{ L }H_2$$

Answers: 12) a. 0.295 mol, b. 0.595 g 13) 3.29 atm 14) 3760 K 15) 36.2 L 16) 5040 L, 3.47×10^{-4} g/L 17) 24.8 L 18) 6.16 g Na 19) 5.00 atm 20) 0.28 L