Gas Laws practice problems March 28, 2017 Name: Sheet 1

1. A child has a toy balloon with a volume of 1.8 liters. The temperature of the balloon when it was filled was 22^0 C and the pressure was 1.0 atm. If the child were to let go of the balloon and it rose into the sky where the pressure is 0.86 atm and the temperature is 8^0 C, what would the new volume of the balloon be?

2. If divers rise too quickly from a deep dive, they get a condition called "the bends" which is caused by the expansion of very small nitrogen bubbles in the blood due to decreased pressure. If the initial volume of the bubbles in a diver's blood is 15 mL and the initial pressure is 5.5 atm, what is the volume of the bubbles when the diver has surfaced to 1.00 atm pressure?

3. I have a container that holds 45.0 grams of nitrogen gas and 34.8 grams of helium gas. This container has a volume of 75.0 liters and is at room temperature (298 K). Give this information, find the partial pressures of both gases and determine the overall pressure in the container.
(Hint...pivnert is your friend)

4. I have two flasks that are connected with a small, closed valve. The first flask has a volume of 950 mL and an internal pressure of 1.0 atm. The second flask has a volume of 675 mL and an internal pressure of 1.7 atm. When I open the valve between the flasks, what will be the new pressure inside the flasks?

5. It is not safe to put aerosol canisters in a campfire, because the pressure inside the canisters gets very high and they can explode. If I have a 1.0 liter canister that holds 2.0 moles of gas, and the campfire temperature is 1400^0 C, what is the pressure inside the canister?

6. A gas cylinder has a volume of 108 L when filled with 22,700 grams of nitrogen gas. If the temperature of this cylinder is 25°, what is the pressure inside the tank?

7. Calcium carbonate decomposes at high temperatures to form carbon dioxide and calcium oxide:

8. $CaCO_{3(s)} \rightarrow CO_{2(g)} + CaO_{(s)}$

How many grams of calcium carbonate will I need to form 3.45 liters of carbon dioxide? Assume 1.0 atm, 298K

Sheet 1

(1) $V_1 = 1.8\,L$, $T_1 = 295\,K$, $P_1 = 1.0\,A$ $\quad V_2 = ?$, $T_2 = 281\,K$, $P_2 = 0.850\,A$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad V_2 = \frac{P_1V_1T_2}{T_1P_2} = \frac{(1.0)(1.8)(281)}{(295)(0.850)}$$

$$V_2 = 2.0\,L$$

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(2) $V_1 = 15\,mL$, $P_1 = 5.5\,atm$ $\quad V_2 = ?$, $P_2 = 1.0\,A$

$$P_1V_1 = P_2V_2 \qquad V_2 = \frac{P_1V_1}{P_2} = \frac{(15)(5.5)}{1.0} = 82.5\,mL$$

OUCH!

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(3) $(45.0\,g\,N_2)\left(\frac{1\,mol\,N_2}{28\,g\,N_2}\right) = 1.61\,mol\,N_2$

$(34.8\,g\,He)\left(\frac{1\,mol\,He}{4\,mol\,He}\right) = 8.7\,mol\,He$

$$P = \frac{nRT}{V} \qquad P_{N_2} = \frac{(1.61)(0.0821)(298)}{75.0} = 0.534\,A$$

$$P_{He} = \frac{(8.7)(0.0821)(298)}{75} = 2.84\,A$$

$$P_T = P_{N_2} + P_{He} = 3.37\,A$$

(4)

$$P_1 V_1 = P_2 V_2$$

$$(1.0\,A)(0.95\,L) = (1.625\,L)\,P_2$$

$$P_{2_L} = 0.59\,A$$

$$(1.7\,A)(0.675\,L) = (1.625\,L)(P_{2_R})$$

$$P_{2_R} = 0.71\,A$$

$$P_T = P_{2_L} + P_{2_R} = 0.59A + 0.71A$$

$$= 1.30A$$

(5) $V_1 = 1.0\,L$
$n = 2.0\,mol$
$T = 1673\,K$

$PV = nRT$

$$P = \frac{nRT}{V} = \frac{(2.0)(0.0821\ \frac{L\cdot atm}{mol\cdot K})(1673\,K)}{1.0\,L}$$

$$P = 274.7\,atm$$

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(6) $V = 10\,L$
$T = 298\,K$

$(22.70\,g\ N_2)\left(\frac{1\,mol\ N_2}{28\,g\ N_2}\right) = 810.7\,mol\ N_2$

$PV = nRT$

$$P = \frac{nRT}{V} = \frac{(810.7)(0.0821)(298)}{10}$$

$$P = 183.7\,ATM$$

(7)

$PV = nRT \qquad n = \frac{PV}{RT} = \frac{(1.0\,atm)(3.45\,L)}{(0.0821\,\frac{L\cdot atm}{mol\cdot K})(298\,K)} = 0.14\,mole$

$CaCO_3 \rightarrow CO_2 + CaO$

$?.g \qquad 0.14\,mole.$

$(0.14\,mol\,CO_2)\left(\frac{1\,mol\,CaCO_3}{1\,mol\,CO_2}\right) = 0.14\,mol\,CaCO_3$

$(0.14\,mol\,CaCO_3)\left(\frac{100.1\,g\,CaCO_3}{1\,mol\,CaCO_3}\right) = 14.1\,g\,CaCO_3$