SCH3U- Gas Laws Practice

Complete the following questions on lined paper.

1. Helium in a 100 mL container at a pressure of 66.6 kPa is transferred to a container with a volume of 250 mL. What is the new pressure if no change in temperature occurs?

2. What will have to happen to the temperature of a sample of methane if 1000 mL at 98.6 kPa and 25°C is given a new pressure of 108.5 kPa when the volume remains constant?

3. A gas has a volume of 225 mL at 75°C. What will be its volume at a temperature of 20°C if the pressure remains constant?

4. A gas is heated to 80°C and a pressure of 180 kPa in a 800 mL, what was the volume of the gas, (in litres), at a temperature of 50°C and 120 kPa pressure?

5. A 200 mL sample of gas is collected at 50 kPa and a temperature of 271°C. What volume would this gas occupy at a temperautre of -14°C if the pressure remains constant?

6. Correct the following volumes at STP and at SATP (this question is asking you to determine the V at STP and SATP):
   (a) 24.6 L at 25°C and 104 kPa (b) 150 mL at 100°C and 75.00 kPa

7. A certain sample of gas has a volume of 0.452 L measured at 87°C and 0.620 atm. What is its volume at 1 atm and 0°C?

8. Natural gas is usually stored in large underground reservoirs or in above ground tanks. Suppose that a supply of natural gas is stored in an underground reservoir of volume 8.0×10^5 m^3 at a pressure of 360 kPa and a temperature of 16°C. How many above ground tanks of volume 2.7×10^4 m^3 at a temperature of 6°C could be filled with the gas at a pressure of 120 kPa. (Hint: just use m^3 as your volume)

9. The human lung has an average temperature of 37°C. If one inhales Yukon air at 1 atm and -28.9°C and then holds it, to what pressure will the air in the lungs rise? (The bursting strength of the human lung is over 2 atm.) Will they burst?

10. A cylindrical coffee can is welded shut at 20°C at sea level. Its height is 20 cm and its radius is 15 cm. If the bursting strength of its "tin" plate is 3.75 atm, to what temperature may it be heated before bursting? (hint: $V_{cylinder} = \pi r^2 h$)

Gas Laws Practice

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

1. $V_1 = 100\,mL$
   $P_1 = 66.6\,kPa$
   $V_2 = 250\,mL$
   $P_2 = ?$

$$\frac{P_1V_1}{V_2} = \frac{P_2V_2}{V_2}$$

$$P_2 = \frac{(66.6\,kPa)(100\,mL)}{250\,mL}$$

$$P_2 = 26.6\,kPa.$$

2. $P_1 = 98.6\,kPa.$
   $T_1 = 298K$
   $T_2 = ?$
   $P_2 = 108.5\,kPa.$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$\frac{P_1T_2}{P_1} = \frac{P_2T_1}{P_1}$$

$$T_2 = \frac{P_2T_1}{P_1}$$

$$= \frac{(108.5\,kPa)(298\,K)}{98.6\,kPa}$$

$$T_2 = 328\,K / 55°C.$$

3. $V_1 = 225\,mL$
   $T_1 = 75 + 273 = 348K$
   $T_2 = 293K$
   $V_2 = ?$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}.$$

$$V_2 = \frac{V_1T_2}{T_1}$$

$$V_2 = \frac{(225\,mL)(293\,K)}{348K}$$

$$V_2 = 189\,mL.$$

4. $T_2 = 80°C = 353K$
   $P_2 = 180\,kPa.$
   $V_2 = 800\,mL.$
   $V_1 = ?$
   $T_1 = 50°C = 323K.$
   $P_1 = 120\,kPa.$

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

$$\frac{P_1V_1T_2}{P_1T_2} = \frac{P_2V_2T_1}{P_1T_2}$$

$$V_1 = \frac{P_2V_2T_1}{P_1T_2}$$

$$V_1 = \frac{(180\,kPa)(800\,mL)(323\,K)}{(120\,kPa)(353\,K)} = 1098\,mL$$

5. $V_1 = 200\,mL$
$P_1 = 500\,kPa$.
$T_1 = 271 + 273 = 544\,K$.
$V_2 = ?$
$T_2 = -14 + 273 = 259\,K$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}.$$

$$V_2 = \frac{V_1 T_2}{T_1}$$

$$= \frac{(200\,mL)(259\,K)}{544\,K}$$

$$V_2 = 95.2\,mL$$

6. $V_1 = 24.6\,L$
a) $T_1 = 298\,K$
$P_1 = 104\,kPa$.
$V_2 = ?$
$T_2 = 273\,K$
$P_2 = 101.325\,kPa$.

@ STP

$$V_2 = \frac{P_1 V_1 T_2}{P_2 T_1}$$

$$V_2 = \frac{(104)(24.6)(273)}{(101.325)(298)}$$

$$V_2 = 23.1\,L.$$

@ SATP
(T doesn't change).

$$P_1 V_1 = P_2 V_2$$

$$V_2 = \frac{P_1 V_1}{P_2}$$

$$V_2 = \frac{(104)(24.6)}{101}$$

$$V_2 = 25.6\,L$$

b) $V_1 = 150\,mL$
$P_1 = 75.00\,kPa$.
$T_1 = 373\,K$.

@ STP

$$V_2 = \frac{(75.00)(150)(273)}{(101.325)(373)}$$

$$V_2 = 81.3\,mL$$

@ SATP

$$V_2 = \frac{(75)(150)(298)}{(101)(373)}$$

$$V_2 = 89\,mL$$

7. $V_1 = 0.452\,L$
$T_1 = 87^\circ C = 360\,K$
$P_1 = 0.620\,atm$
$V_2 = ?$
$T_2 = 273\,K$
$P_2 = 1\,atm$.

$$V_2 = \frac{P_1 V_1 T_2}{P_2 T_1}$$

$$V_2 = \frac{(0.620\,atm)(0.452\,L)(273\,K)}{(1.0\,atm)(360\,K)}$$

$$V_2 = 0.213\,L$$

8. $V_1 = 8.0\times10^5\ m^3$

$P_1 = 360\ kPa$

$T_1 = 16°C = 289K$.

$V_2 = ?$

$T_2 = 6°C = 279K$

$P_2 = 120\ kPa$.

$$V_2 = \frac{P_1 V_1 T_2}{P_2 T_1}$$

$$V_2 = \frac{(360\ kPa)(8.0\times10^5\ m^3)(289\ K)}{(120\ kPa)(279\ K)}$$

$V_2 = 2.49\times10^6\ m^3 = V_T$.

So if each can hold $2.7\times10^4\ m^3$.

$$\frac{2.49\times10^6\ m^3}{2.7\times10^4\ m^3} = 92.2 \text{ tanks could be filled.}$$

9. $T_1 = -28.9°C = 244.1K$.

$P_1 = 1\ atm$

$P_2 = ?$

$T_2 = 37°C = 310K$.

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}.$$

$$P_2 = \frac{P_1 T_2}{T_1}$$

$$= \frac{(1\ atm)(310\ K)}{244.1\ K}.$$

$P_2 = 1.27\ atm$ ∴ will not burst.

10. $T_1 = 20°C = 293K$.

$P_1 = 1\ atm$.

$P_2 = 3.75\ atm$

$T_2 = ?$

$V = \pi(15)^2(20)$

$= 14\ 130\ cm^3$

↑

But you don't need this as V won't change until it bursts!

$$T_2 = \frac{P_2 T_1}{P_1}$$

$$T_2 = \frac{(3.75\ atm)(293K)}{1.0\ atm}$$

$T_2 = 1098.8\ K$.

$T_2 = 1099K$

$T_2 = 826°C$.