Gas Laws Review

Remember:

Relationship between Volume and Temperature: direct

Relationship between Volume and Pressure: inverse

STP Values:

Standard Temperature 0°C 273 K

Standard Pressure 1 atm 760 mmHg 101.3 kPa

Formulas:

Boyles $V_1P_1 = V_2P_2$ Charles = $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

Combined = $\frac{V_1P_1}{T_1} = \frac{V_2P_2}{T_2}$

Ideal Gas Law $PV = \underset{\text{moles}}{n}RT$ $PV\underset{\text{molar mass}}{m} = \underset{\text{grams}}{g}RT$

Density $D_{STP} = \frac{\text{molar mass}}{\underset{V_1}{22.4L}}$ $D_{new} = \frac{\text{molar mass}}{V_2*}$

* use combined gas Law to find V_2

Dalton's Law $P_{TOTAL} = P_1 + P_2 + P_3 + \ldots$

Short answer

1. inversely
2. decreases
3. elastic
4. 0°C 273K
5. 101.3 KPa 760 mmHg 1 atm

6. V_1 2.0L V_2 0.750L

P_1 2.3atm P_2 ?

~~T_1 T_2~~

$V_1 P_1 = V_2 P_2$

$(2.0L)(2.3atm) = (0.75L)(P_2)$

$\boxed{P_2 = 6.1 atm}$

7. $V_1 = 7.5L$ $V_2 = ?$

~~P_1 P_2~~

$T_1 = 305K$ $T_2 = 275K$

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

$\frac{(7.5L)}{(305K)} = \frac{V_2}{(275K)}$ $V_2 = 6.76 \rightarrow \boxed{7L}$

8. $V_1 = 275ml$ $V_2 = ?$

$P_1 = 790 mmHg$ $P_2 = 821 mmHg$

$T_1 = 378K$ $T_2 = 343K$

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

$\frac{(275ml)(790mmHg)}{378K} = \frac{V_2(821 mmHg)}{343K}$

$\boxed{V_2 = 240 ml}$

9. $V_1 = 20.0ml$ $V_2 = 40.0ml$

P_1 ~~78.9 kPa~~ 0.778 atm $P_2 = 99.2 atm$

$T_1 = 291K$ $T_2 = ?$

$78.9 kPa \times \frac{1 \ atm}{101.3 \ kPa} = 0.788 atm$

$\frac{(20.0ml)(0.778atm)}{291K} = \frac{(40.0ml)(99.2atm)}{T_2}$

$\boxed{T_2 = 74000K}$

$R = 62.4 \frac{L\,mmHg}{mol\,K}$

$PV = nRT$ (n ← moles)

$PV_m = gRT$ (V_m ← molar mass, g ← grams)

10. $P = 585\ mmHg$
$V = ?$
$m = 70.90\ g/mol$
$g = 16.0g$
$R = 62.4 \frac{L\,mmHg}{mol\,K}$
$T = 288K$

$$(585\ mmHg)(V)(70.90\ g/mol) = (16.0g)\left(62.4 \frac{L\,mmHg}{mol\,K}\right)(288K)$$

$$\boxed{V = 6.9L}$$

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11. $P = 800.0\ mmHg$
$V = 0.75L$
$n = ?$
$R = 62.4 \frac{L\,mmHg}{mol\,K}$
$T = 368K$

$$(800.0\ mmHg)(0.75L) = n\left(62.4 \frac{L\,mmHg}{mol\,K}\right)(368K)$$

$$\boxed{n = 0.026\ moles}$$

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12. $P = 985\ mmHg$
$V = 0.250L$
$m = 34.09\ g/mol$
$g = ?$
$R = 62.4 \frac{L\,mmHg}{mol\,K}$
$T = 323K$

$$(985\ mmHg)(0.250L)(34.09\ g/mol) = g\left(62.4 \frac{L\,mmHg}{mol\,K}\right)(323K)$$

$$g = \boxed{0.416g\ H_2S}$$

13. $P = ?$ $\quad (P)(0.807L)(28.02\ g/mol) = (48.3g)\left(62.4 \frac{L\,mmHg}{mol\,K}\right)(373K)$

$V = 0.807L$ $\quad P = 49716 \rightarrow \boxed{49700\ mmHg}$

$m = 28.02\ g/mol$

$g = 48.3g$

$R = 62.4 \frac{L\,mmHg}{mol\,K}$

$T = 373K$

Gas Density

14. $F_2(g)$ @ STP $\quad \frac{38.00g}{22.4L} = \boxed{1.70\ g/L}$

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15. $F_2(g)$ not at STP

$V_1 = 22.4L \quad V_2 = ?$

$P_1 = 1\ atm \quad P_2 = 1.21\ atm$

$\underbrace{T_1 = 273k}_{STP} \quad T_2 = 300K$

$\frac{(22.4L)(1atm)}{273K} = \frac{V_2(1.21atm)}{300K}$

$V_2 = 20.34L$

$D_{new} = \frac{38.00g}{20.34L} = 1.87\ g/L \rightarrow \boxed{1.9\ g/L}$

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16. $He(g)$ @ STP $\quad \frac{4.00g}{22.4L} = \boxed{0.179\ g/L}$

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17. He @ not STP

$V_1\ 22.4L \quad V_2 = ?$

$P_1\ 101.3\ kPa \quad P_2 = 78.8kPa$

$T_1\ 273K \quad T_2 = 318K$

$\frac{(22.4L)(101.3kPa)}{273K} = \frac{V_2(78.8kPa)}{318K} \quad V_2 = 33.54L$

$D_{new} = \frac{4.00g}{33.54L} = \boxed{0.12\ g/L}$

$$P_{TOT} = P_1 + P_2 + P_3 + \ldots\ldots$$

18. $P_{TOT} = 30kPa + 60kPa + 80kPa = \boxed{170.0kPa}$

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19. $1.32\ atm = 0.27atm + P_2 \quad \boxed{P_2 = 1.05\ atm}$

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20. $782\ mmHg = 392\ mmHg + 230.\ mmHg + P_3$

$\boxed{P_3 = 160\ mmHg}$