Ideal Gas Law

① Row 1 $155^\circ C \rightarrow 428\ K$

$$V = \frac{nRT}{P} = \frac{(2)(0.08206)(428\ K)}{(5)} = 14.0\ L$$

Row 2

$$n = \frac{PV}{RT} = \frac{(0.3)(2)}{(0.08206)(155)} = 0.047\ mol$$

Row 3

$$T = \frac{PV}{nR} = \frac{(4.47)(25)}{(2.01)(0.08206)} = 677.5\ K$$

Row 4 $75^\circ C \rightarrow 348\ K$

$$P = \frac{nRT}{V} = \frac{(10.5)(0.08206)(348\ K)}{(2.25)} = 133\ atm$$

② Row 1 $25^\circ C \rightarrow 298\ K$

$$7.74 \times 10^3\ Pa \times \frac{1\ atm}{101325\ Pa} = 0.076\ atm$$

$$12.2\ mL \times \frac{1\ L}{1000\ mL} = 0.0122\ L$$

$$n = \frac{PV}{RT} = \frac{(0.076)(0.0122)}{(0.08206)(298)} = 3.8 \times 10^{-5}\ mol$$

① Row 2

$$43\ mL \times \frac{1\ L}{1000\ mL} = 0.043\ L$$

$$P = \frac{nRT}{V} = \frac{(0.421)(0.08206)(223)}{(0.043)} = 179.2\ atm$$

Row 3 $331^\circ C \rightarrow 604\ K$

$$455\ torr \times \frac{1\ atm}{760\ torr} = 0.599\ atm$$

$$V = \frac{nRT}{P} = \frac{(4.4 \times 10^{-4})(0.08206)(604)}{(0.599)} = 3.64\ L$$

Row 4 $$745\ mm\ Hg \times \frac{1\ atm}{760\ mm\ Hg} = 0.98\ atm$$

$$T = \frac{PV}{nR} = \frac{(0.98)(11.2)}{(0.401)(0.08206)} = 333.6\ K$$

③ $24^\circ C \rightarrow 297\ K$

$$n = \frac{PV}{RT} = \frac{(2.7)(200)}{(0.08206)(297)} = 22.2\ mol$$

$$22.2\ mol\ He \times \frac{4\ g\ He}{1\ mol\ He} = 88.6\ g\ He$$

$$22.2\ mol\ H_2 \times \frac{2.02\ g\ H_2}{1\ mol\ H_2} = 44.8\ g\ H_2$$

④ a) $n = \frac{PV}{RT} = \frac{(1)(6)}{(0.08206)(298)} = 0.25 \text{ mol}$

b) $n = \frac{PV}{RT} = \frac{(1.97)(6)}{(0.08206)(298)} = 0.48 \text{ mol}$

c) $n = \frac{PV}{RT} = \frac{(0.296)(6)}{(0.08206)(200)} = 0.11 \text{ mol}$

⑤ $75 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = 0.075 \text{ L}$

$22^\circ\text{C} \rightarrow 295 \text{ K}$

$n = \frac{PV}{RT} = \frac{(14.5)(0.075)}{(0.08206)(295)} = 0.045 \text{ mol}$

⑥ $22^\circ\text{C} \rightarrow 295 \text{ K}$

$0.6 \text{ g } O_2 \times \frac{1 \text{ mol } O_2}{32 \text{ g } O_2} = 0.01875 \text{ mol}$

$P = \frac{nRT}{V} = \frac{(0.01875)(0.08206)(295)}{(5)} = 0.091 \text{ atm}$

⑦ $175 \text{ g Ar} \times \frac{1 \text{ mol Ar}}{39.9 \text{ g Ar}} = 4.386 \text{ mol Ar}$

a) $T = \frac{PV}{nR} = \frac{(10)(2.5)}{(4.386)(0.08206)} = 69.5 \text{ K}$

b) $P = \frac{nRT}{V} = \frac{(4.386)(0.08206)(225)}{(2.5)} = 32.4 \text{ atm}$

⑧ $1.149\ g/mL \times 0.05\ mL = 0.05745\ g\ O_2$

$0.05745\ g\ O_2 \times \frac{1\ mol\ O_2}{32\ g\ O_2} = 0.001795\ mol\ O_2$

$37°C = 310\ K$

$V = \frac{nRT}{P} = \frac{(0.001795)(0.08206)(310)}{1} = 0.046\ L$

⑨ Original $25°C \rightarrow 298\ K$

$400\ mm\ Hg \times \frac{1\ atm}{760\ mm\ Hg} = 0.526\ atm$

let $V = 1\ L$

$n = \frac{PV}{RT} = \frac{(0.526)(1)}{(0.08206)(298)} = 0.0215\ mol$

Added Gas $50°C \rightarrow 323\ K$

$800\ mm\ Hg \times \frac{1\ atm}{760\ mm\ Hg} = 1.053\ atm$

let $V = 1\ L$

$n = \frac{PV}{RT} = \frac{(1.053)(1)}{(0.08206)(323)} = 0.0397\ mol$

$0.0397 - 0.0215 = \boxed{0.0182\ mol}$

(10) Boyle: $P \times 2 \rightarrow V \times \frac{1}{2}$

Charles: $T \times \frac{1}{2} \rightarrow V \times \frac{1}{2}$

So V will be $\times \frac{1}{2} \times \frac{1}{2}$ or $\boxed{\times \frac{1}{4}}$

(11) $0^\circ C \rightarrow 273\ K$

a) $45^\circ C \rightarrow 318\ K$

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

$$\frac{P_1}{11} = \frac{318}{273}$$

$$P_1 = 12.8\ atm$$

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

$$\frac{6.5}{11} = \frac{T_1}{273}$$

$$T_1 = 161\ K \quad \text{or} \quad -112^\circ C$$

c) $$\frac{25}{11} = \frac{T_1}{273}$$

$$T_1 = 620\ K \quad \text{or} \quad 347^\circ C$$