Station 7A

Problem 2

Graham's Law: gases with smaller molar masses effuse faster, and gases with larger molar masses effuse slower.

N_2 : 28 g/mol ← faster

O_2 : 32 g/mol ← slower

BONUS:

$$\frac{rate_{N_2}}{rate_{O_2}} = \sqrt{\frac{MM_{O_2}}{MM_{N_2}}}$$

$$= \sqrt{\frac{32}{28}} = 1.07$$

N_2 will effuse at 1.07 times the rate of O_2

Station 7A

Problem 1

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

$P_{total} = 35 \text{ atm} + 5 \text{ atm} + 25 \text{ atm}$

$= \boxed{65 \text{ atm}}$

Station 6A

Problem 2

$V_1 = 28\ L$
$T_1 = 45°C = 318\ K$
$P_1 = ?$

$V_2 = 34\ L$
$T_2 = 35°C = 308\ K$
$P_2 = 2.0\ atm$

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

$$P_1 = \frac{P_2 V_2 T_1}{T_2 V_1} = \frac{(2.0\ atm)(34\ \cancel{L})(318\ \cancel{K})}{(308\ \cancel{K})(28\ \cancel{L})}$$

$$= \boxed{2.5\ atm}$$

Station 6A

Problem 1

$P_1 = 12 \text{ atm}$

$V_1 = 23 \text{ L}$

$T_1 = 200. \text{ K}$

$P_2 = 14 \text{ atm}$

$T_2 = 300. \text{ K}$

$V_2 = ?$

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

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

$$= \frac{(12 \cancel{\text{atm}})(23 \text{ L})(300. \cancel{\text{K}})}{(200. \cancel{\text{K}})(14 \cancel{\text{atm}})}$$

= [redacted] $\boxed{30. \text{ L}}$

Station 5A

Problem 2

$n = 17$ mol

$T = 67°C = 340.$ K

$V = 88.89$ L

$P = ?$ atm

$$PV = nRT$$

$$P = \frac{nRT}{V} = \frac{(17\ \text{mol})\left(0.0821\ \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}\right)(340.\ \text{K})}{88.89\ \text{L}}$$

$$= \boxed{5.3\ \text{atm}}$$

Station 5A

Problem 1

$P = 1.2\ atm$
$V = 31\ L$
$T = 87°C = 360.\ K$
$n = ?$

$$PV = nRT$$

$$n = \frac{PV}{RT} = \frac{(1.2\ \cancel{atm})(31\ \cancel{L})}{\left(0.0821\ \frac{\cancel{L}\cdot \cancel{atm}}{mol\cdot \cancel{K}}\right)(360.\ \cancel{K})}$$

$$= \boxed{1.3\ moles}$$

Station 4A

Problem 2

$$2\,H_2 + O_2 \rightarrow 2\,H_2O$$

$$\frac{55\ g\ O_2}{1} \times \frac{1\ mol\ O_2}{32.00\ g\ O_2} \times \frac{2\ mol\ H_2O}{1\ mol\ O_2} \times \frac{22.4\ L\ H_2O}{1\ mol\ H_2O}$$

77 L H_2O

↑ 1 mol of any gas at STP has a volume of 22.4 L

Station 4A

Problem 1

Since temperature and pressure are constant, we can use the mole-to-mole ratios from the B.C.E. to convert volumes.

$$2\,H_2 + O_2 \rightarrow 2\,H_2O$$

$$\frac{5\ L\ O_2}{1} \times \frac{2\ L\ H_2O}{1\ L\ O_2} = \boxed{10\ L\ H_2O}$$

Station 3A
Problem 2

$V_1 = 5.00 \text{ L}$
$T_1 = 22.0^\circ C = 295 \text{ K}$
$P_1 = 745.0 \text{ mm Hg}$

$P_2 = ?$
$T_2 = 273 \text{ K}$
$V_2 = 5.00 \text{ L}$

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

$$P_2 = \frac{P_1 T_2}{T_1} = \frac{(745.0 \text{ mm Hg})(273 \text{ K})}{295 \text{ K}}$$

$$= \boxed{689 \text{ mm Hg}}$$

Station 3A

Problem 1

$V_1 = 10.0\ L$
$P_1 = 97.0\ kPa$
$T_1 = 25.0°C = 298\ K$

$T_2 = ?$
$P_2 = 101\ kPa$ (STP)

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

$$T_2 = \frac{P_2 T_1}{P_1} = \frac{(101\ kPa)(298\ K)}{97.0\ kPa}$$

$$T_2 = 310.\ K = \boxed{37°C}$$

Station 2A

Problem 2

$V_1 = 250.\text{ mL}$

$T_1 = 19^\circ C = 292\text{ K}$

$T_2 = 60^\circ C = 333\text{ K}$

$V_2 = ?$

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

$$V_2 = \frac{V_1 T_2}{T_1} = \frac{(250.\text{ mL})(333\text{ K})}{292\text{ K}}$$

$$= \boxed{285\text{ mL}}$$

Station 1A

Problem 1

$V_1 = 1.00\ L$

$P_1 = 1.00\ atm$ (STP)

$V_2 = 473\ mL = 0.473\ L$

$P_2 = ?$

$$P_1 V_1 = P_2 V_2$$

$$P_2 = \frac{P_1 V_1}{V_2} = \frac{(1.00\ atm)(1.00\ \cancel{L})}{0.473\ \cancel{L}}$$

$$= \boxed{2.11\ atm}$$

Station 1A

Problem 2

$V_1 = 2.00 \text{ L}$
$P_1 = 1.00 \text{ atm}$
$P_2 = 6.00 \times 10^4 \text{ atm}$
$V_2 = ?$

$$P_1 V_1 = P_2 V_2$$

$$V_2 = \frac{P_1 V_1}{P_2} = \frac{(1.00 \text{ atm})(2.00 \text{ L})}{6.00 \times 10^4 \text{ atm}}$$

$$= \boxed{3.33 \times 10^{-05} \text{ L}}$$

Station 2A

Problem 1

$T_1 = 22°C = 295\ K$

$V_1 = 0.5\ L$

$T_2 = 4°C = 277\ K$

$V_2 = ?$

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

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

$$= \frac{(0.5\ L)(277\ \cancel{K})}{295\ \cancel{K}}$$

$$= 0.47\ L$$