Benchmark #1 practice problems
Answer Key

① $P = 754\ mmHg$ $\quad \frac{754\ mmHg}{760\ mmHg} \left| \frac{1\ atm}{} \right. = \boxed{0.99\ atm}$

② They all have the same # of molecules.
#3 has the most # of atoms.

③ #3 b/c NH_3 is the lightest molecule

④ $V_1 = 4.8\ L$ $\quad V_2 = 4.2\ L$
$T_1 = 26.2^\circ C + 273 = 299.2\ K$ $\quad T_2 = ?$
Charles' Law $\quad \frac{V_1}{T_1} = \frac{V_2}{T_2}$

$$\frac{4.8\ L}{299.2\ K} = \frac{4.2\ L}{T_2} \qquad T_2 = \frac{(4.2\ L)(299.2\ K)}{(4.8\ L)} = \boxed{261.8\ K}$$

⑤ $V_1 = 2.7\ L$ $\quad V_2 = 5.9\ L$ $\quad$ Avogadro's Law
$n_1 = 8.3\ mol$ $\quad n_2 = ?$ $\quad \frac{V_1}{n_1} = \frac{V_2}{n_2}$

$$\frac{2.7\ L}{8.3\ mol} = \frac{5.9\ L}{n_2} \qquad n_2 = \frac{(5.9\ L)(8.3\ mol)}{(2.7\ L)} = \boxed{18.1\ mol}$$

⑥ $PV = nRT$ $\quad P = 735\ torr$ $\quad V = 1.5\ L$ $\quad T = 25^\circ C + 273 = 298\ K$
$R = 62.4$ $\quad n = ?$

$$(735)(1.5) = n(62.4)(298)$$

$$n = \frac{(735\ torr)(1.5\ L)}{(62.4)(298\ K)} = 0.059$$

$\boxed{\text{All of them!}}$

(2)

(7) Combined Law

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

$P_1 = 0.25\ atm$

$V_1 = 1.5\ L$

$T_1 = -37°C + 273 = 236\ K$

$P_2 = ?$

$V_2 = 7.2\ L$

$T_2 = 24°C + 273 = 297\ K$

$\frac{(0.25\ atm)(1.5\ L)}{(236\ K)} = \frac{P_2 \times (7.2\ L)}{(297\ K)}$

$P_2 = \frac{(0.25)(1.5)(297)}{(236)(7.2)} = \boxed{0.066\ atm}$

(8) $V = 8.1\ L$

$T = 29°C + 273 = 302\ K$

$P = 900\ torr$

$n = ?$

$R = 62.4$

$PV = nRT$

$(900\ torr)(8.1\ L) = n(62.4)(302\ K)$

$n = \frac{(900)(8.1)}{(62.4)(302)}$

$n = 0.39\ moles$

$\frac{0.39\ moles}{1} \left| \frac{6.02 \times 10^{23}\ molecules}{1\ mol} \right. = \boxed{2.3 \times 10^{23}\ molecules}$

(9) $n = 3\ mol$ $T = 30°C + 273 = 303\ K$ $P = 1.5\ atm$

$V = ?$ $R = 0.0821$

$(1.5\ atm)(V) = (3\ mol)(0.0821)(303\ K)$

(10) 500 mL = V P_1 = 2 atm P_2 = ? T_1 = 27°C + 273 = 300K T_2 = 100°C + 273 = 373K

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \qquad \frac{2\text{ atm}}{300\text{K}} = \frac{P_2}{373\text{K}} \qquad \boxed{P_2 = 2.5\text{ atm}}$$

(11) low P, high T, low n

(12) T = 310K V = 2L n = 0.13 moles

$$\frac{5.6\text{g } CO_2}{44\text{g}} \left| \frac{1\text{ mol}}{} \right. = 0.13\text{ moles} \qquad R = 0.0821$$

$PV = nRT$ $P(2\text{L}) = (0.13)(0.0821)(310\text{K})$

$$\boxed{P = 1.65\text{ atm}}$$

(13) 400 mL = V P = 1 atm T = 0°C + 273 = 273K R = 0.0821 n = ? PV = nRT

$(1\text{atm})(0.4\text{ L}) = n(0.0821)(273\text{K})$

n = 0.018 moles molar mass = g/mol

$$\frac{2.8\text{g}}{0.018\text{ moles}} = \boxed{155.5\text{ g/mole}}$$

(4)

(14) $P_T = 0.95$ atm
$T = 298$ K
$V = 2.1$ L

$P_{Partial} = \frac{20 \text{ torr} \mid 1 \text{ atm}}{760 \text{ torr}} = 0.026 \text{ atm}$

$P_H = P_T - P_{partial} = 0.95 - 0.026 = 0.924 \text{ atm}$
$PV = nRT$

$(0.924)(2.1) = n(0.0821)(298)$ $\boxed{n = 0.08 \text{ mol } H_2 \text{ gas}}$

(15) It would increase by an unknown amount

(16) $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

$\frac{3.4 \text{g } C_2H_5OH \mid 1 \text{ mol}}{46 \text{ g}} = 0.074 \text{ moles}$

$P = 2$ atm $V = ?$ $n = 0.074$ $R = 0.0821$ $T = 301$ K
$PV = nRT$ $(2)V = (0.074)(0.0821)(301)$
$\boxed{V = 0.91 \text{ L}}$

(17) See textbook p. 329-332

(18) 2.5 mol He, 6.2 mol NO_2 } $n_{Total} = 8.7$ mol, $P_T = 8.4$ atm

$P_{He} \rightarrow \frac{2.5 \text{ mol He}}{P_{He}} = \frac{8.7 \text{ mol}}{8.4 \text{ atm}}$ $\boxed{P_{He} = 2.4 \text{ atm}}$

$P_{NO_2} \rightarrow \frac{6.2 \text{ mol } NO_2}{P_{NO_2}} = \frac{8.7 \text{ mol}}{8.4 \text{ atm}}$ $\boxed{P_{NO_2} = 5.99}$