10th Sep, 2023

CHAPTER 4
GASES

SELF-CHECK 4.1

Convert 35 Psi into

Ci) Pascal

1 atm = 101325 Pa

As, 1 atm = 14.7 Psi

101325 Pa = 14.7 Psi

14.7 Psi = 101325 Pa

$1\ Psi = \frac{101\,325\ Pa}{14.7}$

$1 \times 35\ psi = \frac{101325 \times 35\ Pa}{14.7}$

35 Psi = 241250 Pa

Answer :- 241250 Pascals

Cii) Kilo Pascal

1 atm = 101.325 kPa

&, 1 atm = 14.7 Psi

14.7 Psi = 101.325 kPa

$1\ Psi = \frac{101.325\ kPa}{14.7}$

$1 \times 35\ Psi = \frac{101.325}{14.7} \times 35\ Psi$

35 Psi = 241.25 Kilopascals or kPa

Answer = 241.25 Kilopascals.

(iii) Atmosphere

1 atm = 14.7 Psi

14.7 Psi = 1 atm

$1\ Psi = \frac{1}{14.7}\ atm$

$1 \times 35\ Psi = \frac{1}{14.7} \times 35\ atm$

35 Psi = 2.372 atm ≈ 2.38 atm

Answer = 2.38 atm

SELF-CHECK 4.2

Given

$V_1 = 375\ cm^3$ $V_2 = ?$

$P_1 = 770\ mm\ Hg$ $P_2 = 750\ mm\ Hg$

TO FIND

$V_2 = ?$

FORMULA

$P_1V_1 = P_2V_2$

SOLUTION:-

$$\frac{P_1V_1}{P_2} = V_2$$

$$V_2 = \frac{(770\ \cancel{mm\ Hg}) \times (375\ cm^3)}{(750\ \cancel{mm\ Hg})}$$

$V_2 = 385\ cm^3$

RESULT

The volume would be 385 cm^3

SELF-CHECK 4.3

GIVEN

Relation:

$V = 0.167\ T$

$V = 50\ dm^3$

Pressure = remains constant

TO FIND

Temperature = T = ?

Solution:-

$V = 0.167 * T$

$50 = 0.167 * T$

$\frac{50}{0.167} = T$

$299.4K = T$

$t = 299.4 - 273$

$= 26.40^\circ C$

RESULT

The temperature will be $26.40^\circ C$.

SELF-CHECK 4.4

(i) GIVEN :- Molecules in

$1\ dm^3$ of oxygen

1 mole of oxygen = $22.14\ dm^3$ of oxygen at ST

6.023×10^{23} molecules = $22.14\ dm^3$ of oxygen at SP

$22.14\,dm^3$ of oxygen at STP = 6.023×10^{23} molecules

$1\,dm^3$ of oxygen at STP = $\frac{6.023 \times 10^{23}}{22.14}$

$= 2.7 \times 10^{22}$ molecules

RESULT :- 2.7×10^{22} molecules

(ii) $2\,dm^3$ of Hydrogen

$22.14\,dm^3$ of oxygen H at STP = 1 mole

$22.14\,dm^3$ of H at STP = 6.023×10^{23} molecules

$1\,dm^3$ of H at STP = $\frac{6.023 \times 10^{23}}{22.14}$ molecules

$1 \times 2\,dm^3$ of H at STP = $\frac{6.023 \times 10^{23} \times 2}{22.14}$ molecules

$= 5.44 \times 10^{22}$ molecules

RESULT : 5.44×10^{22} molecules

(iii) $2.5\,dm^3$ of Nitrogen

$22.14\,dm^3$ of N at STP = 1 mole

$22.14\,dm^3$ of N at STP = 6.023×10^{23} molecules

$1\,dm^3$ of N at STP = $\frac{6.023 \times 10^{23}}{22.14}$ molecules

$1 \times 2.5\,dm^3$ of N at STP = $\frac{6.023 \times 10^{23} \times 2.5}{22.14}$ molecules

$2.5\,dm^3$ of N at STP = 6.80×10^{22} molecules

SELF-CHECK 4.5

GIVEN

$V_1 = 850\ cm^3$ $\quad V_2 = ?$

$T_1 = 320\ K$ $\quad T_2 = 273\ K$

$P_1 = 0.92 \times 10^5\ N m^{-2}$ $\quad P_2 = 1\ atm = 101325\ N m^{-2}$

FORMULA

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

TO FIND

$V_2 = ?$

Solution:- $V_2 = \dfrac{P_1 \times V_1 \times T_2}{P_2 \times T_1}$

$$V_2 = \frac{(0.92 \times 10^5\ N m^{-2}) \times (850\ cm^3) \times (273\ K)}{(101325\ N m^{-2}) \times (320\ K)}$$

$V_2 = 658.410\ cm^3$

RESULT

The volume will be $658.410\ cm^3$ Ans

QNO = 2

GIVEN

$V_1 = 2.5\ m^3$ $\quad V_2 = ?$

$T_1 = 15^\circ C + 273 = 288\ K$ $\quad T_2 = 273\ K$

$P_1 = 98\ N m^{-2}$ $\quad P_2 = 1\ atm = 101.32K\ N m^{-2}$

FORMULA

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

Solution:-

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

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

$$V_2 = \frac{(98\ N m^{-2}) \times (2.5\ m^3) \times (273\ K)}{(288\ K) \times (101325\ N m^{-2})}$$

$$= 2.3 \times 10^{-3}\ m^3 \quad \text{Ans}$$

RESULT

The volume will be $2.3 \times 10^{-3}\ m^3$

CHAPTER 4

SELF-CHECK 4.6

DATA

P moist = P dry gas + ageous tension

P dry gas = P moist - ageous tension

P dry gas = 803 mm Hg - 9.2 mm of Hg

P dry gas = 793.7 mm of Hg

Volume of gas at 10°C = $V_1 = 73 cm^3$,

$T_1 = 10°C + 273 = 283K$

Values of STP ⇒ $P_2 = 760$ mm Hg, $T_2 = 273$ K, $V_2 = ?$

FORMULA

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

SOLUTION

$$V_2 = \frac{P_1V_1T_2}{T_1 \times P_2} = \frac{793.7 \times 73 \times 273}{283 \times 760}$$

$V_2 = 73.54 cm^3$

RESULT

$V_2 = 73.54 cm^3$, The volume of dry gas is 73.54 cm^3

SELF-CHECK 4.7

DATA

$V_{SO_2} = 465\ cm^3$

$r_{SO_2} = \frac{Volume}{Time} = \frac{465}{30} = 15.5\ cm^3 s^{-1}$

$V_{H_2S} = 620\ cm^3$

$M_{SO_2} = 64\ g\,mol^{-1}$

$M_{H_2S} = 34\ g\,mol^{-1}$

$\gamma_{H_2S} = ?$

TO FIND

$\gamma_{H_2S} = ?$

FORMULA

$$\frac{\gamma_{SO_2}}{\gamma_{H_2S}} = \sqrt{\frac{M_{H_2S}}{M_{SO_2}}}$$

SOLUTION

$$\frac{15.5\ cm^3 s^{-1}}{\gamma_{H_2S}} = \sqrt{\frac{34}{64}}$$

$$\frac{15.5\ cm^3 s^{-1}}{\gamma_{H_2S}} = 0.72$$

$$\frac{15.5\ cm^3 s^{-1}}{0.72} = \gamma_{H_2S}$$

$$\gamma_{H_2S} = 21.29\ cm^3 s^{-1}$$

$$\gamma_{H_2S} = \frac{Volume}{Time} = \frac{465}{21.29} = 29.15\ sec$$

RESULT

It will take 29.15 seconds for 620 cm^3 of H_2S to diffuse through the same partition.

SELF-CHECK 4.8 [QNO:1]

DATA

Moles of Air = n = 0.115 moles

Atmospheric pressure = 100KPa = $\frac{100000}{101325}$

= 0.986 atm

Temperature = 37°C + 273 = 310K

FORMULA

$PV = nRT$

TO FIND

Maximum volume of air a person can inhale = V = ?

SOLUTION

$$V = \frac{nRT}{P}$$

$$V = \frac{0.115 \text{ moles} \times 0.0821 \text{ atm } dm^3 mol^{-1} K^{-1} \times 310K}{0.986 \text{ atm}}$$

$$= 2.96 \, dm^3$$

RESULT

The maximum volume of air a person can inhale

is 2.96 dm^3. Ans

SELF-CHECK 4.8

Q NO : 2

DATA

$V_1 = 130\ cm^3$

$P_1 = 750\ mmHg$

$T_1 = 20°C + 273$

$= 293K$

$V_2 = 150\ cm^3$

$T_2 = 35° + 273$

$= 308K$

TO FIND

P_2 = Pressure = ?

FORMULA

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

SOLUTION :-

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

$$= \frac{750\ mmHg \times 130\ cm^3 \times 308K}{293K \times 150\ cm^3}$$

$$= 683.28\ mm\ Hg$$

RESULT

The pressure is 683.28 mmHg if its volume is increased to 150 cm^3 at 35°C.