EXERCISE SOLVED NUMERICALS

Q.1 Convert the following units:

a. 850 mm Hg to atm
b. 205000 Pa to atm
c. 560 torr to cm Hg
d. 1.25 atm to Pa

Solution:

a. 850 mmHg to atm

$$760\text{mmHg} = 1\text{atm}$$
$$1\text{mmhg} = \frac{1}{760}atm$$
$$850\text{mmHg} = \frac{1}{760}\times 850atm$$
$$= 1.12\text{atm}$$

b. 205000 Pa to atm

$$101325\text{Pa} = 1\text{atm}$$
$$1\text{Pa} = \frac{1}{101325}atm$$
$$205000\text{Pa} = \frac{1}{101325}\times 205000\ \text{atm}$$
$$= 2.02\ \text{atm}$$

c. 560 torr to cm Hg

$$760\ \text{torr} = 760\ \text{mmHg}$$
$$= 76\ \text{cmHg}$$
$$1\ \text{torr} = \frac{76}{760}\text{cmHg}$$
$$560\ \text{torr} = \frac{76}{760}\times 560cmHg$$
$$= 56\text{cmHg}$$

d. 1.25 atm to Pa

$$1\ \text{atm} = 101325\text{Pa}$$
$$1.25\ \text{atm} = 1.25\times 101325\text{Pa}$$
$$= 126656\ \text{Pa}$$

Q.2 Convert the following units.

a. 750°C to K **b. 150°C to K** **c. 100 K to °C** **d. 172 K to °C**

Solution:

a. 750°C to K

$$T\ (°C) = 750\ °C$$
$$T\ (K) = ?$$
$$T\ (K) = T(°C) + 273$$
$$= 750 + 273$$
$$= 1023K$$

b. 150°C to K

$T(°C) = 150\ °C$
$T\ (K) = ?$
$T\ (K) = T(°C) + 273$
$= 150 + 273$
$= 423$

c. 100 K to °C

$T\ (K) = 100\ K$
$T\ (°C) = ?$
$T(°C) = T(K) – 273.15$
$= 100 – 273$
$= –173°C$

d. 172 K to °C

$T\ (K) = 172\ K$
$T\ (°C) = ?$
$T(°C) = T(K) – 273$
$= 172 – 273$
$= – 101°C$

Q.3 <u>A gas at pressure 912 mm of Hg has volume 450cm³. What will be its volume at 0.4 atm.</u>

Given Data:

$P_1 = 912\text{ mm Hg} = \dfrac{912\text{ mm Hg}}{760\text{ mm Hg}}$
$= 1.2\text{ atm}$
$V_1 = 450\text{ cm}^3$
$P_2 = 0.4\text{ atm}$

Required:

$V_2 = ?$

Using the equation of Boyle's Law:

$P_1V_1 = P_2V_2$

Solution:

By putting the values:

$1.2\text{ atm} \times 450\text{ cm}^3 = 0.4\text{ atm} \times V_2$

$V_2 = \dfrac{1.2\text{ atm} \times 450\text{ cm}^3}{04\text{ atm}}$

$V_2 = \dfrac{12}{4} \times 450\text{ cm}^3$

$V_2 = 3 \times 450\text{ cm}^3$

$\mathbf{V2 = 1350\ cm^3}$

Q.4 <u>A gas occupies a volume of 800 cm³ at 1 atm, when it is allowed to expand up to 1200 cm³ what will be its pressure in mm of Hg.</u>

Given Data:

$P_1 = 1\text{ atm}$
$V_1 = 800\text{ cm}^3$
$V_2 = 1200\text{ cm}^3$

Required:

$P_2 = ?$

Using the equation of Boyle's Law:

$P_1V_1 = P_2V_2$

Solution:

By putting the values

$1\text{ atm} \times 800\text{ cm}^3 = P_2 \times 1200\text{ cm}^3$

$$P_2 = \frac{1 \text{ atm} \times 800 \text{ cm}^3}{1200 \text{ cm}^3}$$

$$P_2 = \frac{2}{3} \text{ cm}^3$$

$$P_2 = 0.667 \text{ atm}$$

As $1 \text{ atm} = 760\text{mmHg}$

So $0.66 \text{ atm} = 760 \times 0.66\text{mmHg}$

$= 506.66\text{mmHg}$

Q.5 <u>It is desired to increase the volume of a fixed amount of gas from 87.5 to 118 cm³ while holding the pressure constant. What would be the final temperature if the "initial temperature is 23°C.</u>

Given Data:

$V_1 = 87.5 \text{ cm}^3$

$V_2 = 118 \text{ cm}^3$

$T_1 = 23°C\ (23+273)\ K = 296K$

Required:

$T_2 = ?$

By using the equation of charle's law

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

Solution

$$T_2V_1 = V_2 \times T_1$$

Or

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

By putting the values

$$T_2 = \frac{118\text{cm}^3 \times 296K}{87.5 \text{ cm}^3}$$

$$T_2 = 399K$$

T_2 can be converted into Celsius scale as:

$$T_2 = 299 - 273 = 126°C$$

Q.6 <u>A sample of gas is cooled at constant pressure from 30°C to 10°C. Comment:</u>

a. Will the volume of the gas decrease to one third of its original volume?

b. If not, then by what ratio will the volume decrease?

Solution:

a.

$T_1 = 30°C = (30+273)\ K = 303K$

$T_2 = 10°C = (10+273)K = 283K$

$V_1 = 1 \text{ dm}^3$

Required: $V_2 = ?$

Solution:

By using the equation of Charle's law

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

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

$$V_2 = \frac{V_1}{T} \times T_2$$

By putting the values

$$= \frac{1\text{dm}^3}{303K} \times 283K$$

$$V_2 = 0.93 dm^3$$

The volume of gas will not decrease to one third of its original volume.

(b) The volume decreases in the ration 1:0.93.

Q.7 **A balloon that contains 1.6 dm³ of air at standard temperature and pressure is taken under water to a depth at which its pressure increases to 3.0 atm. Suppose that temperature remain unchanged, what would be the new volume of the balloon. Does it contract or expand?**

Given Data:

$$P_1 = 1 \text{ atm}$$
$$V_1 = 1.6 \text{ dm}^3$$
$$P_2 = 3.0 \text{ atm}$$

Required:

$$V_2 = ?$$

Solution:

By using the equation of Boyle's law

$$P_1V_1 = P_2V_2$$

By putting the values

$$1 \text{ atm} \times 1.6 \text{ dm} = 3 \text{ atm} \times V_2$$
$$V_2 = \frac{1 \text{ atm} \times 1.6 \text{ dm}^3}{3 \text{ atm}}$$
$$V_2 = 0.53 \text{ dm}^3$$

The new volume of balloon is $0.55 dm^3$. It will contract.

Q.8 **A sample of neon gas occupies 75.0 cm³ at very low pressure of 0.4 atm. Assuming temperature remain constant what would be the volume at 1.0 atm pressure?**

Given Data:

$$P_1 = 0.4 \text{ atm}$$
$$V_1 = 75.0 \text{ cm}^3$$
$$P_2 = 1 \text{ atm}$$

Required:

$$V_2 = ?$$

Solution

By using the equation of Boyle's law

$$P_1V_1 = P_2V_2$$

By putting the values

$$0.4 \text{ atm} \times 75 \text{ cm}^3 = 1 \text{ atm} \times V_2$$
$$V_2 = \frac{0.4 \text{ atm} \times 75 \text{ cm}^3}{1 \text{ atm}}$$
$$\mathbf{V_2 = 30 \text{ cm}^3}$$

Q.9 **A gas occupies a volume of 35.0 dm³ at 17°C. If the gas temperature rises to 34°C at constant pressure, would you expect the volume to double? If not calculate the new volume.**

Given Data:

$$T_1 = 17\ ^\circ C$$
$$= 273 + 17 = 290 \text{ K}$$
$$V_1 = 35 \text{ dm}^3$$
$$T_2 = 34\ ^\circ C$$
$$= 273 + 34 = 307 \text{ K}$$

Required:

$$V_2 = ?$$

Solution:

Volume will not be doubled because the absolute temperature is not doubled.

By using the equation of Charle's law

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

By putting the values

$$\frac{35\ dm^3}{290\ K} = \frac{V_2}{307\ K} \text{ or}$$

$$V_2 = \frac{35\ dm^3 \times 307\ K}{290\ K}$$

$$37\ dm^3 = V_2$$

Q.9 **<u>The largest moon of Saturn, is Titan. It has atmospheric pressure of 1.6x10^5 Pa. What is the atmospheric pressure in atm? Is it higher than earth's atmospheric pressure?</u>**

Solution:

We know that

$$1\text{atm} = 101325\ Pa$$

Atmospheric pressure of titan in Pascal $= 1.6\times10^5 Pa.$

Atmospheric pressure of titan in atm $= \dfrac{1.6\times10^5}{101325}$

$= 1.58\text{atm}$

Thus the atmosphere pressure of titan (1.58 atm) is greater than the atmospheric pressure of earth (1.0atm).