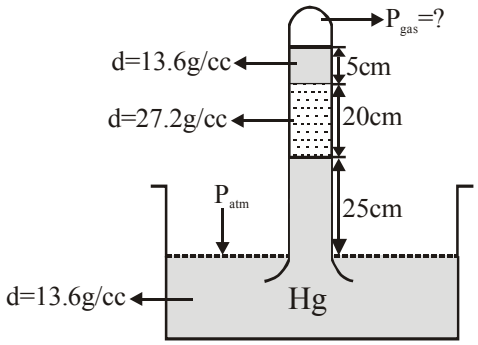
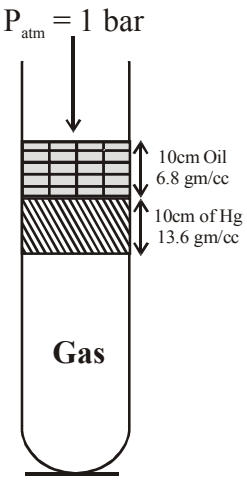
EXERCISE # S-I

1. In the following arrangement find the pressure of gas (in cm of Hg).
(Assume that atmospheric pressure P_{atm} = 75 cm of Hg)



IG0001

2.

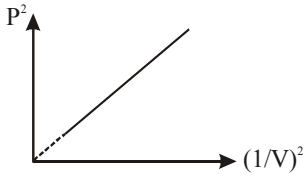


Find pressure of gas in cm of Hg enclosed in tube.

IG0002

BOYLE'S LAW

3. Consider the following graph



Graph is plotted for 1 mol of gas at 400K, find slope of curve.

[Take : $R = 0.08 \ \frac{L-atm}{mol-K}$]

IG0003

4. Two glass bulbs A and B are connected by a very small tube having a stop cock. Bulb A has a volume of 100 ml and contained the gas, while bulb B was empty on opening the stop cock, the pressure fell down to 40% at constant temperature. Find out the volume of bulb B in mL.

IG0004

5. A glass bulb of 2 L capacity is filled by helium gas at 10 atm pressure. Due to a leakage the gas leaks out. What is the volume of gas leaked if the final pressure in container is 1 atm.

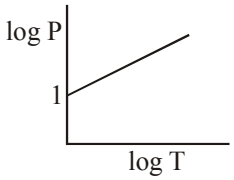
IG0005

CHARLES LAW

6. Calculate the volume which 4 litre of gas at 0ºC will occupied at 100ºC and the same pressure.

IG0006

7. In constant volume container of 0.821 litre, log P vs log T is plotted as shown in graph. Calculate number of moles of ideal gas present in container :

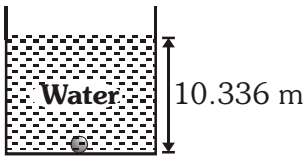


IG0007

8. A certain amount of a gas at 27°C and 1 bar pressure occupies a volume of 25 m^3. If the pressure is kept constant and the temperature is raised to 77°C, what will be the volume of the gas ?

IG0008

9. **(a)** Radius of a bubble at the bottom of the tank shown below was found to be 1 cm, then find the radius of the bubble at the surface of water considering the temperature at the surface & bottom being same.



(b) If absolute temperature at the surface is 4 times that at the bottom, then find radius of bubble at the surface.

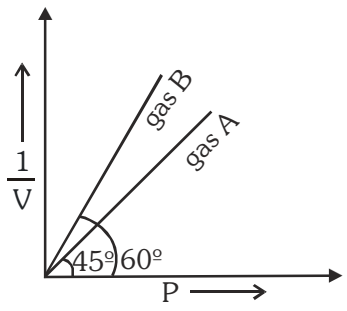
IG0009

10. **(a)** Plot the curve between PT vs T at const V & constant no. of moles.

(b) Find the number of moles of gas taken when the volume of the vessel is 82.1 ml and $\frac{d}{dT}[PT]$ at 300 K = 300 for the given curve.

IG0010

11. At constant temperature of 273 K, $\left(\frac{1}{V}\right)$ v/s P are plotted for two ideal gases A and B as shown.
(V in litre & P in atm)



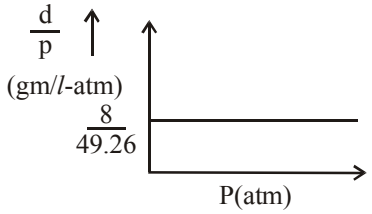
Find out the number of moles of gas A and B.

IG0011

IDEAL GAS EQUATION

12. For an ideal gas, the following graph is obtained at constant temperature of 300 K.

The molar mass of gas (in gm/mol) is -



IG0012

13. The density of phosphorus vapours at 327ºC and 1 atm is 2.52 gm/lit. If molecular formula of phosphorus is P_X, then calculate 'X'. **(Atomic weight of : P = 31)**

IG0013

14. Density of ideal gas at 2.46 atm and 300 K is 0.8 gm/l. Hence gm-molar mass of gas is [R = 0.082L-atm/mol-K]

IG0014

15. In a hospital respiratory unit the pressure gauge reads 4500 mm Hg for 10 L tank containing compressed O_2 , how many litres of O_2 can be delivered from tank at atmospheric pressure of 750 mm Hg. (Take temperature to be constant at TK)

IG0015

16. While resting, the average human male use 0.2 dm^3 of O_2 per hour at 1 atm & 300 K for each kg of body mass. Assume that all this O_2 is used to produce energy by oxidising glucose in the body . What is the mass of glucose required per hour by a resting male having mass 60 kg . What volume, at 1 atm & 300 K of CO_2 would be produced (R = 0.08 $\frac{L-atm}{mol-K}$)

IG0016

17. A human adult breathes in approximately 0.50 dm^3 of air at 1.00 bar with each breath. If an air tank holds 100 dm^3 of air at 200 bar, how many breathes the tank will supply ?

IG0017

18. A gas at a pressure of 5.0 bar is heated from 0°C to 546°C and simultaneously compressed to one third of its original volume. What will be the final pressure ?

IG0018

19. 3.6 g of an ideal gas was injected into a bulb of internal volume of 8 L at pressure P atm and temp T K. The bulb was then placed in a thermostat maintained at (T + 15)K, 0.6 g of the gas was let off to keep the original pressure. Find P and T if mol weight of gas is 44.

IG0019

DALTON'S LAW OF PARTIAL PRESSURE

20. The partial pressures of N_2, O_2 and CO_2 in a vessel are 38 cm of Hg, 190 torr and 0.5 atm, respectively . The total pressure of the mixture at the same temperature is.

IG0020

21. Equal masses of ethane and hydrogen are mixed in an empty container at 25ºC. The fraction of the total pressure exerted by hydrogen is.

IG0021

22. A mixture of hydrogen and oxygen at one bar pressure contains 20% , by weight of hydrogen. The partial pressure of hydrogen will be.

IG0022

23. A closed vessel contains equal number of nitrogen and oxygen molecules at pressure of P mm. If nitrogen is removed from the system, then the pressure will be.

IG0023

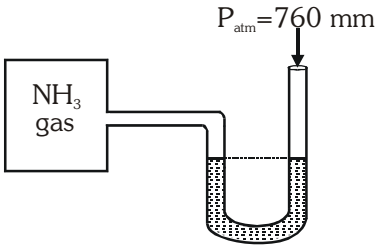
24. If 2 lit. of gas A at 1.5 atm and 3 lit. of gas B at 2 atm are mixed in a 5 lit. container then find the final pressure, considering all are at same temperature.

IG0024

25. One mole of N_2 and 3 moles of H_2 are taken in a container of capacity 8.21 lit. at 300 K to produce NH_3. Find the partial pressures of N_2 and H_2 if partial pressure of NH_3 after sufficient time was found to be 3 atm.

IG0025

26. A manometer attached to a flask contains NH_3 gas have no difference in mercury level initially as shown in diagram. After the sparking into the flask, it have difference of 19 cm in mercury level in two columns. Calculate % dissociation of ammonia.



IG0026

27. A gaseous mixture at 760 mm in a cylinder has 65% N_2, 15% O_2 and 20 % CO_2 by volume. Calculate the partial pressure of each gas.

IG0027

CONTAINNER PROBLEMS

28. A toy balloon originally held 1.0 gm of He gas and had a radius 10 cm. During the night, 0.875 gm of the gas effused from the balloon. Assuming ideal gas behaviour, under these constant P and T conditions, what was the radius of the balloon the next morning.

IG0028

29. The density of a mixture of O_2 and N_2 gases at 1 atm and 273K is 0.0013 gm/ml. If partial pressure of O_2in the mixture is A then calculate value of 25A.

IG0029

30. A containers contains air above liquid water. Total pressure was 800 torr. What will be the final pressure if volume is doubled. (Aqueous tension = 40 torr)

IG0030

31. One litre flask contains air, water vapour and a small amount of liquid water at a pressure of 200 mmHg. If this is connected to another one litre evacuated flask, what will be the final pressure of the gas mixture at equilibrium? Assume that temperature to be 50ºC. Aqueous tension at 50°C = 93 mmHg.

IG0031

DIFFUSION / EFFUSION

32. If helium and methane are allowed to diffuse out of the container under the similar conditions of temperature and pressure, then the ratio of rate of diffusion of helium to methane is.

IG0032

33. At a particular fixed temperature the gas A_n is 52% dissociated according to the following reaction $A_n(g) \rightleftharpoons nA(g)$

The equilibrium mixture effuses 1.25 times slower than pure oxygen gas under identical condition. If atomic wt. of A is 32, then find **"n"** ?

IG0033

34. H_2 and O_2 are kept in mass ratio 1 : 8 respectively at 6 atm. If small orifice is made then relative rate of effusion of H_2 with respect to O_2 initially is.

IG0034

35. A mixture of H_2 and O_2 in 2 : 1 mole ratio is allowed to diffuse through a orifice. Calculate the composition of gases coming out initially.

IG0035

36. One mole of nitrogen gas at 0.8 atm takes 38 s to diffuse through a pinhole, whereas one mole of an unknown compound of xenon with fluorine at 1.6 atm takes 57 s to diffuse through the same hole. Determine the molecular formula of the compound.

IG0036

37. A mixture of N_2 and H_2 has initially mass ratio of 196 : 1 then find after how many steps we can obtain a mixture containing 1 : 14 mole ratio of N_2 and H_2.

IG0037

38. Find the ratio of moles of SO_2 to CH_4 after fifth diffusion steps if their initially mole ratio is 8 : 1.

IG0038

KTG

39. Calculate the root mean square speed of H_2 molecules under following conditions.

(a) 2 mole of H_2 at 27ºC

(b) 3 mole of H_2 in a 5 litre container at 10^5 Pa

(c) 4 mole of H_2 at the density of 1gm / ml at 10^5 Pa

IG0039

40. Root mean square speed of an unknown gas at 727ºC is 10^5 cm/second. Calculate molar mass of unknown gas (in gram/mole) [Take R = $\frac{25}{3}$ J/mole-K].

IG0040

41. How many times is the rms speed of molecules in 8 gm O_2 gas at 1200 K and 10 bar, relative to rms speed of molecules in 16 gm O_2 gas at 300K and 20 bar ?

IG0041

42. Average translational kinetic energy of an ideal gas molecule at 27ºC is 3.88×10^{-x} eV. Hence x is **($1\ eV = 1.602 \times 10^{-19}$ J)**

IG0042

43. When the temperature of an ideal gas is increased from 27°C to 927°C the kinetic energy will be increased by x times. Find the value of x ?

IG0043

44. Two flask A and B have equal volume at 100 K and 200 K and have pressure 4 atm and 1 atm respectively. The flask A contains H_2 gas and B contains CH_4 gas. The collision diameter of CH_4 is twice that of H_2. Calculate ratio of mean free path of CH_4 to H_2.

IG0044

45. If the mean free path is 10 cm at one bar pressure then its value at 5 bar pressure, if temperature is kept constant.

IG0045