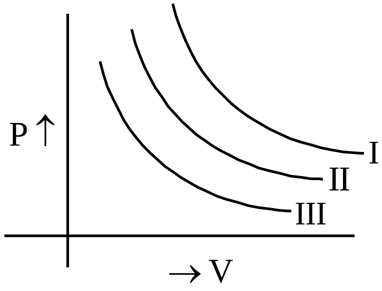
Main Booklet Solution

Gaseous State

EXERCISE - 1 [A]

1. (c)

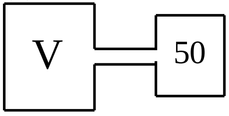


Boyle's law $\quad PV = \text{constant}$

$= nRT$

As $T\uparrow$ constant also increases. And graph shifted upward i.e. $T_1 > T_2 > T_3$

2. (a)



$P_1 = 21\text{atm} \qquad V_1 = 50\text{L}$

$P_2 = 7\text{atm} \qquad V_2 = V + 50\text{L}$

Boyle's law $\quad P_1V_1 = P_2V_2$

$21 \times 50 = 7 \times (V + 50)$

$V = 100\text{L}$

3. (c)

At constant temperature $P_1V_1 = P_2V_2$

$P_1 = P\,,\ V_1 = V$

$P_2 = ?\,,\ V_2 = 0.95V$

$$P_2 = \frac{P_1V_1}{V_2} = \frac{V}{0.95}P$$

$P_2 = 1.0526P$

% increases in $P = 5.26\%$

4. (a)

At constant pressure

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

$V_1 = V \qquad T_1 = T$

$V_2 = 1.1V \qquad T_2 = ?$

$$T_2 = \frac{V_2T_1}{V_1} = \frac{1.1V}{V}T$$

$T_2 = 1.1T$

% increases in $T = 10\%$

5. (a)

Charles's law

at constant $\frac{V}{T} = K(\text{constant}) \Rightarrow V = KT$

$$\left(\frac{dV}{dT}\right)_P = K$$

6. (b)

$V_1 = 100\text{mL}$ $T_1 = 100^\circ C = 373K$

$V_2 = 200\text{mL}$ $T_2 = ?$

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

$$T_2 = \frac{V_2T_1}{V_1} = \frac{200 \times 373}{100} = 746\,K$$

$T_2 = 746 - 273 = 473^\circ C$

7. (c)

$T_1 = 27^\circ C = 300K$ $P_1 = 12\text{atm}$

$T_2 = ?$ $P_2 = 14.9\text{atm}$

At constant V $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$$T_2 = \frac{P_2T_1}{P_1} = \frac{14.9 \times 300}{12} = 372.5K$$

$T_2 = 372.5 - 273 = 99.5^\circ C$

8. (c)

Ideal Gas Law

Both flasks have equal size

No. of moles of $H_2 = \frac{2}{2} = 1$

No of molecules of $H_2 = N_A$

No. of moles of $N_2 = \frac{2}{28} = \frac{1}{14}$

No of molecules of $N_2 = \frac{1}{14}N_A$

No. of molecules in flask A> No. of molecules in flask B

9. (d)

No. of molecule of $S_X = \frac{PV}{RT}$

$P = \frac{723}{760}\text{atm}$, $V = 0.780L, T = 450 + 273$

$$=723\text{K}$$

$$n=\frac{723\times 0.780}{760\times 0.0821\times 723}=0.0125$$

$$\text{No. of moles }=\frac{3.2}{\text{Molecular weight}}=0.0125$$

$$\text{Molecular weight }=\frac{3.2}{0.0125}=256$$

If x atom in one molecule of S_X then molecular weight $=32x=256$

$x=8$

S_8

10. (a)

$$V=\frac{nRT}{P}=\frac{4\times 0.0821\times 295\times 760}{4\times 720}=25.565\text{L}$$

11. (d)

$P_A=2P_B, V_A=2V_A, T_A=2T_B$

$M_A=M_B$

$m_B=X, m_A=?$

$$\frac{P_AV_A}{n_AT_A}=\frac{P_BV_B}{n_AT_B}\Rightarrow\frac{P_AV_AM_A}{m_AT_A}=\frac{P_BV_BM_B}{m_BT_B}$$

$$\frac{2P_B(2V_B)M_B}{m_A(2T_B)}=\frac{P_BV_BM_B}{X(T_B)}\Rightarrow m_A=2\times g$$

12. (a)

$P_1=3\text{atm}$

$T_1=500\text{K}$

$V_1=275\text{L}$

$V_2=200\text{L}$

$P_2=2.50\text{atm}$

$$\frac{P_1V_1}{T_1}=\frac{P_2V_2}{T_2}\Rightarrow T_2=\frac{P_2V_2T_1}{P_1V_1}$$

$$T_2=\frac{2.50\times 200\times 500}{3\times 275}$$

$=303\text{K}$

13. (a)

$$\frac{P_AV_A}{n_AT_A}=\frac{P_{H_2}V_{H_2}}{n_{H_2}T_{H_2}}$$

$P_A=P_{H_2}$

$V_A=V_{H_2}$

$n_AT_A=n_{H_2}T_{H_2}$

$$\frac{m_A}{M_A}T_A=\frac{m_{H_2}}{M_{H_2}}T_{H_2}\Rightarrow M_A=\frac{m_AT_AM_{H_2}}{m_{H_2}T_{H_2}}$$

$$M_A=\frac{5.40\times 300\times 2}{0.14\times 290}=79.8$$

14. (d)

$$PV = nRT$$

$$PV = \frac{m}{M}RT \Rightarrow PM = \frac{m}{v}RT \Rightarrow PM = dRT$$

$$x = \frac{PM}{RT}$$

Value of M is large, density large (at constant P & T)

$$M_{CH_4} = 16, M_{C_2H_2} = 26, M_{C_2H_4} = 28, M_{C_3H_8} = 44$$

15. (d)

$$n_2 = \frac{n_1}{2} \Rightarrow n_1 = 2n_2$$

$$n_1T_1 = n_2T_2 \Rightarrow T_2 = \frac{n_1T_1}{n_2} = \frac{2n_2(300)}{n_2} = 600K$$

$$T_2 = 600 - 273 = 327^\circ C$$

16. (b)

$$n_1T_1 = n_2T_2$$

$$n_2 = \frac{n_1T_1}{T_2} = \frac{n_1 300}{400} = \frac{3}{4}n_1$$

Fraction of molecule of air goes out $\frac{n_1 - \frac{3}{4}n_1}{n_1} = \frac{1}{4}$

17. (a)

$$C_XH_Y + \left(X + \frac{Y}{4}\right)O_2 \longrightarrow XCO_2 + \frac{Y}{2}H_2O$$

0.2 0.8 1

$$\frac{X}{1} = \frac{0.8}{0.2} = 4 \Rightarrow X = 4$$

$$\frac{Y}{2} = \frac{1}{0.2} = 5 \Rightarrow Y = 10$$

C_4H_{10}

18. (d)

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \Rightarrow \frac{P_1V_1}{T_1} = \frac{P_1V_2}{2(2T_1)} \Rightarrow V_2 = 4V_1$$ i.e. four times of initial volume

19. (b)

$$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$$

$$\frac{300V_1}{1(T_1)} = \frac{300V_2}{2(T_1)} \qquad [T_1 = T_2]$$

$$V_2 = 2V_1$$

Now separation removed volume $V_3 = V_1 + V_2 = 3V_1$

$$n_3 = 1 + 2 = 3$$

$$\frac{P_1V_1}{n_1T_1} = \frac{P_3V_3}{n_3T_3}$$

$$\frac{300V_1}{1(T_1)} = \frac{P_3(3V_1)}{3(T_1)} \qquad [T_1 = T_3]$$

$$P_3 = 300\,\text{mm of Hg}$$

20. (c)

$$PV = nRT \Rightarrow PM = dRT \Rightarrow T = \frac{PM}{dR}$$

$$T = \frac{1.12\times10^9\times2}{1.3\times0.0821\times10^3} \qquad \left(d = 1.3g/cc = 1.3\times10^3 g/L\right)$$

$$T = 2\times10^7 K$$

21. (d)

$$PV = nRT \Rightarrow PV = \frac{m}{M}RT \Rightarrow V = \frac{mRT}{PM}$$

The gas which has highest value of M, have the least volume i.e. HI

22. (b)

$PM = dRT$

for same gas $m =$ constant

T=constant

$$\frac{P_1}{d_1} = \frac{P_2}{d_2} \Rightarrow \frac{p_1}{d_1} = \frac{p_2}{2d_1} \qquad [d_2 = 2d_1]$$

$$p_2 = 2P_1 = 2atm$$

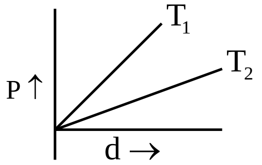
23. (b)

$PM = dRT$

$$d = \frac{PM}{RT}$$

For same gas $\frac{P}{T}$ higher, density higher. i.e. $0^\circ C(273K), 2atm$

24. (a)



$$P = \frac{RT}{M}d$$

For same gas T higher, $\frac{RT}{m}$ higher, slope increases

$$T_1 > T_2$$

25. (c)

Partial pressure will depend upon no. of moles of each gas. As mass of each gas is equal, partial pressure will depend upon relative molecular mass.

26. (c)

Delton's Law of partial pressure

$$P_A = 1\text{atm}, P_T = 1.5\,\text{atm}, m_A = 2\text{gm}, m_B = 3\text{gm}$$

$$P_B = P_T - P_A = 1.5 - 1 = 0.5\text{atm}$$

$$P_A = X_A P_T, P_B = X_B P_T$$

$$\frac{P_A}{P_B} = \frac{X_A}{X_B} = \frac{n_A}{n_B} = \frac{m_A m_B}{m_A m_B} = \frac{1}{0.5} = 2$$

$$\frac{M_A}{M_B} = \frac{2}{2(3)} = \frac{1}{3}$$

27. (a)

$$P_{O_2} = X_{O_2} P_T = 0.21 \times 750$$

$$P_{O_2} = 157.5\text{mm of Hg}$$

28. (c)

$$n_{H_2} = \frac{1}{2}, n_{He} = \frac{4}{4} = 1, n_{H_2} = \frac{7}{28} = \frac{1}{4},\ n_{O_2} = \frac{8}{32} = \frac{1}{4}$$

The gas having highest mole fraction i,e, highest no. of moles, will have highest partial pressure, i.e. He

29. (a)

$$n_{total} = 0.10 + 0.05 + 0.20 + n_{CO_2}$$

$$n_{total} = 0.35 + n_{CO_2}$$

$$PV = n_{total}RT \Rightarrow n_{total} = \frac{PV}{RT}$$

$$0.35 + n_{CO_2} = \frac{1 \times 9.6}{0.0821 \times 300} = 0.389$$

$$n_{CO_2} = 0.389 - 0.35 = 0.039 \approx 0.04$$

30. (b)

Graham's Law

$$\text{rate} = \frac{V}{t} = \frac{K}{\sqrt{M}}$$

$$\frac{t_1}{t_2} = \sqrt{\frac{M_1}{M_2}} \Rightarrow t_{He} = \sqrt{2} \times 5 = 7\,\text{sec}, t_{CO} = \sqrt{14} \times 5 = 18.7\,\text{sec}$$

$$\frac{t_{H_2}}{t_{O_2}} = \sqrt{\frac{M_{H_2}}{M_{O_2}}} = \sqrt{\frac{2}{32}} = \sqrt{\frac{1}{16}} = \frac{1}{4}$$

$$t_{O_2} = 4t_{H_2} = 4 \times 5 = 20\,\text{sec}$$

$$t_{CO_2} = \sqrt{22} \times 5$$

$$= 23.45\,\text{sec}$$

31. (a)

The gases having the same molecular mass diffuse at the same rate

i.e. CO_2 & N_2O

32. (c)

$$\frac{r_1}{r_2}=\frac{n_1}{n_2}\sqrt{\frac{m_2}{m_1}}=\frac{2}{1}\sqrt{\frac{32}{2}}=\frac{2}{1}\times\frac{4}{1}=8$$

33. (c)

The gas having less molecular mass will travel more distance than other

$M_{NH_3}=17$ $M_{HCl}=36.5$

i.e white fumes of NH_4Cl will formed towards HCl and (Point C)

34. (a)

Ratio of molecular mass is large gas can be easily separated

$$\sqrt{\frac{M_{D_2}}{H_2}}=\sqrt{\frac{4}{2}}=\sqrt{2},\sqrt{\frac{CD_4}{CH_4}}=\sqrt{\frac{20}{16}},\sqrt{\frac{C^{14}H_4}{C^{12}H_4}}=\sqrt{\frac{18}{16}}$$

$$\sqrt{\frac{U^{238}F_6}{U^{235}F_6}}=\sqrt{\frac{352}{349}}$$

35. (a)

$$\frac{r_{CH_4}}{r_x}=\sqrt{\frac{M_x}{M_{CH_4}}}=2\Rightarrow\frac{M_x}{M_{CH_4}}=4$$

$$\Rightarrow M_x=4\times16=64$$

36. (a)

Gases having same molecular mass cannot be separated by diffusion.

37. (a)

$$\frac{M_{Br}}{M_{O_2}}=5$$

$$\frac{r_{O_2}}{r_{Br}}=\sqrt{\frac{M_{Br}}{M_{O_2}}}=\sqrt{5}=2.23$$

38. (a)

Moist air diffuse outside and balloon will colapse

39. (c)

$$\frac{r_{SO_2}}{r_x}=\frac{n/20}{n/60}=\sqrt{\frac{m_x}{64}}$$

$$\Rightarrow m_x=\left(\frac{60}{20}\right)^2\times64$$

$\Rightarrow$ (c)

40. (d)

Conceptually inside pressure decreases on steaming hot and when it cool, a vacuum will be created which will help to seal the jars.

41. (c)

$V_{CO} + V_{CO_2} + V_{N_2} = 200 m\ell$

Volume of $CO_2 = x$

Volume of $CO = y$

Volume of $N_2 = 200 - x - y$

$$\begin{array}{llll} & CO + \frac{1}{2}O_2 \longrightarrow CO_2 & & \\ \text{Initial} & y & \frac{y}{z} & \\ \text{Final} & 0 & 0 & y \end{array}$$

Contraction $= \left(y + \frac{y}{2}\right) - y = \frac{y}{2} = 40 m\ell$

$y = 80 m\ell$

Remaining volume $= x + y + 200 - x - y$

$= 200 m\ell$

On passing KOH all CO_2 will be absorbed.

Contraction in volume $= x + y$

$x + y = 100$

$x = 20 m\ell$

$V_{CO_2} = 20 m\ell, V_{CO} = 80 m\ell, V_{N_2} = 100 m\ell$

42. (c)

$$\begin{array}{lllll} & N_xO_y(g) + & yH_2(g) \longrightarrow & yH_2O(\ell) + & \frac{x}{2}N_2(g) \\ \text{Initial} & 10 & 30 & - & 0 \end{array}$$

$\frac{y}{1} = \frac{30}{10} = 3 \qquad \Rightarrow y = 3$

$\frac{x}{2} = \frac{10}{10} = 1 \Rightarrow x = 2$

N_2O_3

43. (a)

$V_{O_2} = x, V_{N_2} = y, V_{CH_4} = z$

$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(\ell)$

For the maximum heat volume of O_2 should be two times of volume of CH_4. And as per given condition volume of N_2 should be four times of volume of O_2.

$$\frac{V_{O_2}}{V_{CH_4}} = \frac{n_{O_2}}{n_{CH_4}} = \frac{x_{O_2}}{x_{CH_4}} = 2$$

$$\frac{V_{N_2}}{V_{O_2}} = \frac{n_{N_2}}{n_{O_2}} = \frac{x_{N_2}}{x_{O_2}} = 4$$

$V_{CH_4} = Z, V_{O_2} = 2Z, V_{N_2} = 8Z$

$$V_{CH_4} = \frac{Z}{11Z} = \frac{1}{11}, X_{O_2} = \frac{2Z}{11Z} = \frac{2}{11}$$

$$X_{N_2} = \frac{8Z}{11Z} = \frac{8}{11}$$

44. (a)

Constant volume & temperature $P_{C_2H_2} = x, P_{C_3H_8} = y$

$$P \propto n$$

$$C_2H_2(g) + \frac{5}{2}O_2(g) \longrightarrow 2CO_2(g) + H_2O(\ell)$$

Initial x $\frac{5}{2}x$ O –

Final O O 2x –

$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$$

Initial y 5y O –

Final O O 3y –

$x + y = 80, 2x + 3y = 230$

$x = 10\,mm, y = 70mm$

45. (c)

By KTG

$E_k = \frac{3}{2}RT = \frac{3}{2}PV$

$\Rightarrow PV = \frac{2}{3}E_k$

$\Rightarrow$ (c)

46. (a)

$KE = \frac{3}{2}RT$

$= \frac{3}{2} \times 2 \times T = 3T$

47. (d)

$T_1 = 273K, T_2 = ?$

$\frac{V_{rms_1}}{V_{rms_2}} = \sqrt{\frac{T_1}{T_2}} = \frac{1}{2}$

$T_2 = 4T_1 = 4 \times 273 = 1092K$

$T_2 = 1092 - 273 = 819^{\circ}C$

48. (b)

$V_{rms}(H_2) = V_{rms}(O_2)$

$\sqrt{\frac{3RT_{H_2}}{M_{H_2}}} = \sqrt{\frac{3RT_{O_2}}{M_{O_2}}} \Rightarrow \frac{T_{H_2}}{M_{H_2}} = \frac{T_{O_2}}{M_{O_2}}$

$T_{H_2} = T_{O_2} \times \frac{M_{H_2}}{M_{O_2}} = 273 \times \frac{2}{32} = 17K$

49. (b)

$K.E. \propto T$

As T doubled K.E. also doubled.

50. (d)

$$v_{rms} \propto \frac{1}{\sqrt{M}} \qquad \text{at constant T}$$

The gas having lowest molecular mass has highest rms speed. i.e CO

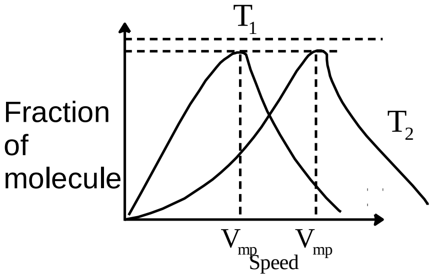
51. (a)

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

$$V_{avg} = \sqrt{\frac{8RT}{\pi M}}$$

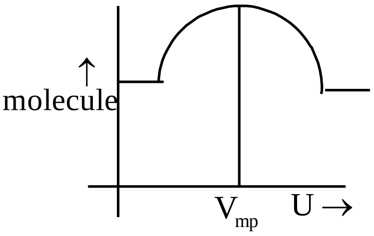
$$\frac{V_{rms}}{V_{avg}} = \sqrt{\frac{3\pi}{8}} = 1.086$$

52. (b)



$T_2 > T_1$ Fraction of molecule has acquired most probable velocity decreases.

53. (a)



As Temperature increases V_{mp} increses.i.e. curve shifts to higher velocity. Pressure & volume doesn't effect the curve.

54. (a)

$$\text{Total KE} = \frac{3}{2}nRT$$

$$x = \frac{3}{2}\frac{N}{N_A}R \times 150$$

$$2x = \frac{3}{2}\frac{N_1}{N_A}R \times 300$$

$$\Rightarrow N = N_1$$

55. (c)

$$\frac{V_{rms}(H_2)}{V_{rms}(O_2)} = \sqrt{\frac{M_{H_2}}{M_{H_2}} \times \frac{T_{H_2}}{T_{O_2}}} = \sqrt{\frac{50}{2} \times \frac{32}{800}} = 1$$

56. (d)

$$V_{mp}=V_0=\sqrt{\frac{2RT}{M}}=\sqrt{\frac{2R\left(t+273\right)}{M_{H_2}}}$$

$$V_{rms}=\sqrt{\frac{3RT}{M}}=\sqrt{\frac{3R\left(2t+273+273\right)}{\frac{M_{H_2}}{2}}}$$

$$=\sqrt{\frac{3R\left(t+273\right)2}{\frac{M_{H_2}}{2}}}=\sqrt{6}V_0$$

57. (a)

$$T_1=27^{\circ}C=300K$$

$$V_{rms},V_{mp},V_{av}\propto\sqrt{T}$$

$$\frac{V_{rms_2}}{V_{rms_1}}=\sqrt{\frac{T_2}{T_1}}$$

$$2=\sqrt{\frac{300+x}{300}}$$

$$4=\frac{300+x}{300}\Rightarrow x=900^{\circ}C$$

58. (b)

With increase in temperature most probable speed increases but fraction of molecules decreases.

59. (d)

I molecules make elastic collisions with each other and with the walls of their container.

II. Average K.E. doesn’t depend upon molecular mass.

III. Molecules of a gas are in constant random motion.

IV. Different molecules have different K.E, but average K.E. of molecules(gas) remains constant at given temperature.

60. (d)

$$\frac{V_{rms}\left(H_2\right)}{V_{rms}\left(CH_4\right)}=\sqrt{\frac{M_{CH_4}}{M_{H_2}}}\text{ at constant temperature}$$

$$\frac{V_{rms}\left(H_2\right)}{V_{rms}\left(CH_4\right)}=\sqrt{\frac{16}{2}}=2.82$$

61. (b)

$$\frac{V_{avg}\left(SO_3\right)}{V_{avg}\left(Ne\right)}=\sqrt{\frac{M_{Ne}}{M_{SO_3}}}=\sqrt{\frac{20}{80}}$$

$$V_{avg}\left(SO_3\right)=\frac{1}{2}V_{avg}\left(Ne\right)$$

62. (c)

Temperature, pressure & volume of both vessel is same i.e same no. of moles and same number of molecule.

K.E. remains constant at constant temperature density is different as mass is different in both flask.

63. (d)

$$\frac{V_{rms}(O_2)}{V_{rms}(CH_4)} = \sqrt{\frac{M_{CH_4}}{M_{O_2}}} = \sqrt{\frac{16}{32}} = \frac{1}{1.41}$$

64. (b)

As kinetic molecular theory of gases pressure rises due to collision of molecule with the container walls, more frequently.

65. (b)

The number of molecular impacts per unit area increases at a higher temperature.

66. (b)

$KE \propto T$

67. (c)

68. (d)

$$U \propto \frac{1}{\sqrt{m}}$$

69. (c)

$$K = \frac{3}{2}PV$$

$$\Rightarrow \frac{K}{V} = \frac{3}{2}P$$

70. (c)

$U \propto \sqrt{T}$

71. (b)

The speed distribution curve becomes sharper and is more peaked at lower temperature.

72. (b)

$Z = 1$ for ideal gas

73. (c)

He has weak attraction forces. i.e. we can neglect a.

$$\left(P + \frac{a}{V_{m^2}}\right)(V_m - b) = RT$$

$$P(V_m - b) = RT$$

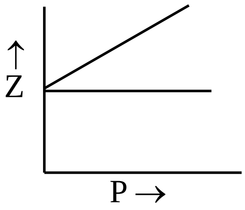
$$PV_m - Pb = RT$$

$$\frac{PV_m}{RT} = \frac{Pb}{RT} \Rightarrow Z = \frac{PV_m}{RT} = 1 + \frac{Pb}{RT}$$

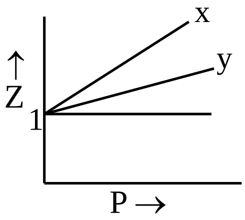
74. (b)

No force of attraction i.e. $a = 0$

$$Z = 1 + \frac{Pb}{RT}$$



75. (a)



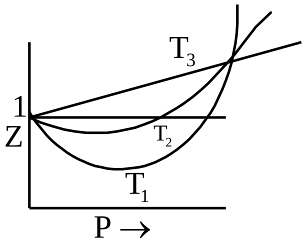
For both He $\&H_2$ no attraction force i.e. $a = 0$

$$Z = 1 + \frac{Pb}{RT}$$

B for H_2 is greater than for He.

$x \rightarrow$ Hydrogen
$y \rightarrow$ Helium

76. (c)



As T increases, Z increases, so graph moves upwards.

$T_3 > T_2 > T_1$

77. (a)

For non-zero value of force of attraction

$$\left(P + \frac{an^2}{V^2}\right)V = nRT$$

$$PV + \frac{an^2}{V} = nRT$$

$$PV = nRT - \frac{n^2a}{V}$$

78. (d)

There is low attraction force in H_2 means least value of ‘a’.

79. (d)

The force of attraction is maximum in the case of NH_3 because of Hydrogen bonding i.e. maximum value of ‘a’.

80. (a)

‘a’ depends on size & shape, but ‘b’ depends onlu upon size of molecule.

81. (b)

The value of ‘a’ higher, gas can be easily liquefied i.e. NH_3

82. (a)

Real gas shows maximum deviation at high pressure & low temperature.

83. (b)

$\frac{a}{V^2}$ term is responsible for intermolecular attraction.

84. (a)

Pressure of real gas is less than the pressure calculated for an ideal gas.

85. (a)

Real gas equation

$$\left(P+\frac{a}{\overline{V}^2}\right)\left(\overline{V}-b\right)=RT$$

$$\left(P+\frac{a}{\overline{V}^2}\right)=\frac{RT}{\overline{V}-b}$$

$$\left(P+\frac{a}{\overline{V}^2}\right)=\frac{RT}{\overline{V}-b}$$

$$P=\frac{RT}{\overline{V}-b}-\frac{a}{\overline{V}^2}$$

$$Z=\frac{P\overline{V}}{RT}=\frac{\overline{V}}{\overline{V}-b}-\frac{a}{\overline{V}RT}$$

86. (b)

$$Z=\frac{PV}{RT}=A+\frac{B}{V}+\frac{C}{V^2}+..........$$

$$A=1, B=\left(b-\frac{a}{RT}\right)$$

Temperature at which gas behave like an ideal gas is Boyle’s temperature.

i.e. $Z=1$ (B,C…….are negligible)

87. (c)
At Boyle’s Temperature real gas behaves like ideal gas for a range of pressure.

88. (c)
At temperature higher than Boyle temperature, $2>1$.

89. (b)

90. (c)
Due to polar nature HCl will have considerable intermolecular force.

91. (c)

$$Z=1+0.34p-\frac{160p}{T}=1$$

$$\Rightarrow T=470K$$

92. (c)

93. (c)

EXERCISE - 1 [B]

1. (d)
Gaseous do not have fixed volume.

2. (c)
Vapour pressure of any liquid depends only on T.

3. (b)
Dalton’s law does not holds for reaching gases.

4. (a)
At sea level pressure is max
So, volume minimum hence density maximum

5. (a)
PV = nRT = k
So slope = 0

6. (d)
Steam distillation is based on partial pressures

7. (d)

$$M_X=16M_{He}=64$$

8. (d)

$$K\propto T$$

9. (b)

$\mathrm{T} \propto \mathrm{P}$

$\mathrm{T_r} = 8\times 300 = 2400\,\mathrm{K} = 2127^{o}\mathrm{C}$

10. (b)

$$\frac{\mathrm{n_f}}{\mathrm{n_i}} = \frac{1}{8}$$

$\mathrm{n} \propto \mathrm{V}$

So, $\frac{\mathrm{V_f}}{\mathrm{V_i}} = \frac{1}{8}$

$\Rightarrow \frac{\mathrm{r_f}}{\mathrm{r_i}} = \frac{1}{2}$

11. (b)

$\mathrm{n_1T_1 = n_2T_2}$

$$\mathrm{n_2 = n_1} \times \frac{300}{750} = 0.4\,\mathrm{n_1}$$

12. (d)

$$\mathrm{d} = \frac{\mathrm{PM}}{\mathrm{RT}}$$

$$\Rightarrow \frac{\mathrm{d_1}}{\mathrm{d_2}} = \frac{800\times 300}{750\times 320} = 1$$

13. (b)

$$\frac{16}{14} = \frac{\mathrm{T_2}}{273} \Rightarrow \mathrm{T_2} = 312\,\mathrm{K} = 39^{o}\mathrm{C}$$

14. (b)

Gaseous state has highest kinetic energy due to least intermolecular forces.

15. (d)

$$\sqrt{\frac{8\mathrm{RT_A}}{\pi \mathrm{M}}} = 2\sqrt{\frac{8\mathrm{RT_B}}{\pi \mathrm{M}}}$$

$\Rightarrow \mathrm{T_A} = 4\mathrm{T_B}$

$$\frac{\mathrm{P_A}}{\mathrm{P_B}} = \frac{\mathrm{T_A}}{\mathrm{T_B}}\frac{\mathrm{V_B}}{\mathrm{V_A}} = 4\times\frac{2}{1} = 8$$

16. (b)

C_1 is most probable speed

So, $C_1 = \sqrt{\frac{2RT}{M}}$

17. (c)

Since, moles of N_2 & O_2 are equal, so on removing pressure will become half.

18. (a)

$P \propto V_{rms}^2$

19. (d)

$V_C = 3b$

20. (d)

'a' depends on intermolecular attraction.

'b' depends on volume of molecules.

21. (d)

At high pressure repulsive forces dominate

22. (c)

Real gas behaves like as an ideal gas at high T & low P.

23. (c)

When repulse forces dominate Z > 1

24. (a)

$$V_{ideal} = \frac{1 \times 0.0821 \times 300}{24}$$

$$= 1.025$$

$$Z = \frac{0.9}{1.025} < 1$$

$\Rightarrow$ Negative deviation

25. (a)

Critical temperature is lesser than Boyle's temperature, so at low to moderate pressure Z < 1. Hence, attractive forces are dominating.

26. (b)

For liquefaction of gases high pressure & low temperature is required.

27. (c)

If Z > 1 repulsive forces dominate hence it is difficult to compress real gas.

28. (b)

At critical point there is no difference between gaseous and liquid state, so meniscus vanishes.

29. (b)

$$T_C = \frac{8a}{27Rb}$$

$$P_C = \frac{a}{27b^2}$$

$$\frac{T_C}{P_C} = \frac{8b}{R} \Rightarrow b = \frac{RT_C}{8P_C}$$

$$V_C = 3b = \frac{3RT_C}{8P_C} = 5\text{ L}$$

30. (b)

At low P, b can be neglected

$$\left(P + \frac{4^2 a}{V^2}\right)(V) = 4RT$$

$$PV+\frac{16a}{V}=4RT$$

$$PV=4\left(RT-\frac{4a}{V}\right)$$

$$\frac{PV}{RT-\frac{4a}{V}}=4$$

31. (a)

According to KTG no forces at on gaseous molecule, hence they move in a straight line between to successive collision.

32. (b)

$$2BCl_3+3H_2\rightarrow 2B+6HCl$$

Moles of B = $\frac{21.6}{10.8}=2$

Moles of H_2 = 3

$$V=\frac{3\times 0.0821\times 273}{1}=67.2\text{ L}$$

33. (c)

$$KE=\frac{3}{2}RT$$

$$\frac{KE_{313\,K}}{KE_{293\,K}}=\frac{313}{293}$$

34. (c)

As temperature is increased the peak of velocity distribution graph shift to a lower height.

35. (d)

$$n_{CH_4}=\frac{x}{16}$$

$$n_{O_2}=\frac{x}{32}$$

$$X_{O_2}=\frac{\frac{x}{32}}{\frac{x}{16}+\frac{x}{32}}=\frac{1}{3}$$

So, $p_{O_2}=\frac{1}{3}P_{total}$

36. (d)

$$n_{H_2O}=\frac{3170\times 10^{-3}}{8.314\times 300}=1.27\times 10^{-3}\text{ mol}$$

37. (a)

The mean free path , $\lambda=\frac{1}{\sqrt{2}\pi a^2 N}$

Or $\lambda \alpha \frac{1}{a^2}$, where $a =$ molecular diameter

$\therefore$ Smaller the molecular diameter, longer the mean free path, Hence, H_2 is the answer.

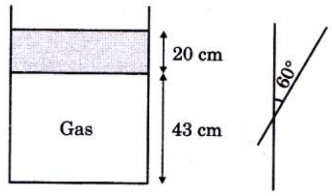
EXERCISE - 1 [C]

1. (48)

$P_0 = 96\text{cm} \qquad P_f = 76 + 20\sin 30^{\circ} = 86$

$96 \times 43 = 86 \times l$

$\Rightarrow l = 48\text{cm}$



2. (5)

$$15 = \frac{P \times 60}{\frac{1}{12} \times 300} \Rightarrow P = 6.25\,\text{atm (Same in both vessels)}$$

$$\frac{10}{n} = \frac{50}{(15 - n)} \Rightarrow n = \frac{15}{6} = 2.5\,\text{moles}$$

3. (9)

$$n_{N_2} = \frac{(1 - 0.04) \times 20}{0.08 \times 300} = 0.05\,\text{moles;}$$

$$P_{N_2} = 1 - 0.04 = 0.96\,\text{atm}$$

$$n_{(H_2 + O_2)} = \frac{0.90 \times 20}{0.08 \times 300} = 0.75$$

$$\underset{\alpha\,\text{moles}}{H_2O} \longrightarrow H_2 + \frac{1}{2}O_2$$

$$\Rightarrow \alpha + \frac{\alpha}{2} = 0.75$$

$$\Rightarrow \alpha = 0.5\,\text{or}\,9\text{g}\,H_2O$$

4. (1327)

$T = 4 \times 400 = 1600\text{K} = 1327\,^{\circ}\text{C}$

5. (3)

$0.2\,\text{L/mol}, Z = 0.75$

6. (4)

$$3 \times \frac{400}{40} = 2 \times \frac{60}{M} \Rightarrow M = 4$$

7. (810)

$P_A = 760 + 90 - 40 = 810$

8. (3)

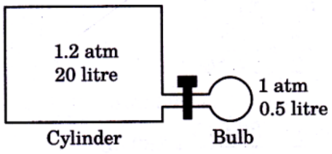
$$5^2 = \frac{4\times 7^2 + 6x^2}{10} \Rightarrow x = 3$$

9. (2)

$$\text{Average KE} = \frac{\frac{3}{2}kT}{1.6\times 10^{-19}}\,eV$$

$$= \frac{1.5\times 1.38\times 10^{-23}\times 300}{1.6\times 10^{-19}}$$

10. (8)



$$\frac{1\times 0.5}{RT}\times x + \frac{1\times 20}{RT} = \frac{1.2\times 20}{RT}$$

11. (800)

$$3b = 8.21; \frac{a}{27b^2} = 3$$

$$b = \frac{8.21}{3}$$

$$\frac{a}{27\times b\times \frac{8.21}{3}} = 3$$

$$\frac{8a}{27Rb} = \frac{3\times 8}{0.0821}\times \frac{8.21}{3}$$

$$= T_C$$

12. (40)

$$h\times 3.4 = 10\times 13.6 \Rightarrow h = 40$$

13. (7)

$$M = \frac{0.0013\times 10^3\times 0.0821\times 273}{1} = 29.13$$

$$x\times 32 + (1-x)\times 28$$

$$\Rightarrow x = \frac{7}{25}$$

14. (8)

$$\frac{r_{H_2}}{r_{O_2}} = \frac{1}{8}\times \frac{32}{2}\sqrt{\frac{32}{2}} = 8$$

15. (3)

$$P_{N_2} = 90 - 63 = 27\,\text{cm of Hg}$$

$$X_{N_2} = \frac{27}{90} = 0.3$$

1. (d)

r.m.s. velocity $V_{rms} = \sqrt{\frac{3RT}{M}}$

i.e., $\frac{V_1}{V_2} = \sqrt{\frac{T_1}{T_2}}$

$\frac{5\times10^4}{10\times10^4} = \frac{1}{2} = \sqrt{\frac{T_1}{T_2}}$

$\therefore T_2 = 4T_1$

2. (d)

Molecules move very fast in all directions in a straight line by colliding with each other but with different velocity.

3. (c)

$C^* : \overline{C} : C = \sqrt{\frac{2RT}{M}} : \sqrt{\frac{8RT}{\pi M}} : \sqrt{\frac{3RT}{M}}$

$= 1 : 1.128 : 1.225$

4. (b)

At low P, b can be neglected.

So, Z = $1 - \frac{a}{VRT}$

5. (b)

Number of moles of $O_2 = \frac{m}{32}$

Number of moles of $N_2 = \frac{4m}{28} = \frac{m}{7}$

$\therefore$ Ratio of moles or molecules $= \frac{m}{32} ; \frac{m}{7} = 7 : 32$

6. (d)

$V_{rms} = \sqrt{\frac{3RT}{M}}$

$V_{rms}(O_2) = V_{rms}(He)$

$\therefore T_{O_2} = \frac{300\times32}{4} = 2400K$

7. (a)

According to Boyle's law

$\frac{V_1}{V_2} = \frac{P_2}{P_1} ; \frac{750}{V_2} = \frac{360}{840}$

$V_2 = 1750 \text{ mL} = 1.750 \text{ L}$

8. (b)

According to Graham's laws of diffusion:

$$\frac{r_1}{r_2}=\sqrt{\frac{d_2}{d_1}} \text{ or } \frac{r_1}{r_2}=\sqrt{\frac{m_2}{m_1}} \qquad \left[\because d=\frac{\text{Mol. wt}}{2}\right]$$

$$\text{Since rate of diffusion }=\frac{\text{Vol. of gas diffused }(V)}{\text{Time taken for diffusion }(t)}$$

$$\therefore\ \frac{r_1}{r_2}=\frac{V_1/t_1}{V_2/t_2} \text{ or } \frac{r_1}{r_2}=\frac{V_1/t_1}{V_2/t_2}\Rightarrow\sqrt{\frac{m_2}{m_1}}$$

$$=\frac{20/60}{V_2/30}\Rightarrow\sqrt{\frac{32}{64}}=\frac{20}{60}\times\frac{30}{V_2}\Rightarrow V_2=14.1$$

9. (a)

$$\text{Given } p=\frac{nRT}{V-nb}-a\left(\frac{n}{V}\right)^2$$

Which can also be written as,

$$\left[p+\frac{n^2a}{V^2}\right](V-nb)=nRT$$

At low pressure and high temperature, the effect of $\frac{a}{V^2}$ and b is negligible, hence $PV=nRT$

10. (c)

According to KTG no intermolecular forces act between gas molecules.

11. (a)

$$C_x H_y+\left(x+\frac{y}{4}\right)O_2\rightarrow x CO_2+\frac{y}{2}H_2 O(\ell)$$

$$15 \text{ ml} \quad 15\left(x+\frac{y}{4}\right)\text{ml} \quad 15x \text{ ml}$$

$$375\times\frac{20}{100}=15\left(x+\frac{y}{4}\right)$$

$$x+\frac{y}{4}=5$$

$$15x+300=345\Rightarrow x=3$$

$$\Rightarrow y=8$$

12. (b)

$$\frac{p_iV}{RT_1}+\frac{p_iV}{RT_1}=\frac{p_fV}{RT_1}+\frac{p_fV}{RT_2}$$

$$p_f=\frac{\frac{2p_i}{T_i}}{\frac{1}{T_1}+\frac{1}{T_2}}=\frac{p_iT_2}{T_1+T_2}$$

13. (a)

$$\text{rms}=\sqrt{\frac{3RT}{M}}$$

$\text{rms for } N_2, u = \sqrt{\frac{3RT}{28}}$

After dissociation, $u' = \sqrt{\frac{3R \times 2T}{14}}$

$\frac{u}{u'} = \sqrt{\frac{1}{4}} = \frac{1}{2}; u' = 2u$

14. (a)

According to van der Waals equation for one mole of gas.

$\left(P + \frac{a}{V^2}\right)(V - b) = RT$

At very high pressure, $P >> \frac{a}{V^2}$

So, $\frac{a}{V^2}$ is negligible.

$P(V - b) = RT$

$PV - Pb = RT$

On dividing RT on both sides

$\therefore Z = 1 + \frac{Pb}{RT}$ compressibility factor.

15. (b)

The real gases show deviation from ideality at low temperature, high pressure and low volume.

16. (c)

$\frac{2 \times M}{R \times 300} = 2 \times \frac{4 \times 28}{R \times 300}$

$M = 112$

17. (c)

From ideal gas equation-

$PV = nRT$

So, $PV = mRT/M; P = mRT/MV$

$P = dRT/M$

$\because$ At constant temperature and pressure , $d \propto M$

$\therefore d_1/d_2 = 17/36.5 : d_1/d_2 = 0.46$

18. (b)

At $27\,^{\circ}C$ or 300 K, number of moles of an ideal gas $= n_1$. At T_2K, number of moles of the ideal gas $= n_2$

Number of moles escaped $= \frac{2n_1}{5}$

$n_2 = n_1 - \frac{2n_1}{5} = \frac{3n_1}{5}$

PV=nRT(Ideal gas equation)

$n \propto \frac{1}{T}; n_1T_1 = n_2T_2$

$$T_2 = \frac{n_1}{n_2} T_1 \Rightarrow T_2 = \frac{n_1}{\frac{3n_1}{5}} \times T_1 = \frac{5}{3} \times 300 = 500K$$

19. (a)

$$V_{mp} = \sqrt{\frac{2RT}{M}}$$

$$\therefore V_{mp} \propto \left(\frac{T}{M}\right)^{\frac{1}{2}}$$

From curve ,

$$(V_{mp})_I < (V_{mp})_{II} < (V_{mp})_{III}$$

$$(V_{mp})_{N_2} \propto \sqrt{\frac{300}{28}}; (V_{mp})_{O_2} \propto \sqrt{\frac{400}{32}}; (V_{mp})_{H_2} \propto \sqrt{\frac{300}{2}}$$

$\therefore (V_{mp})_{N_2} < (V_{mp})_{O_2} < (V_{mp})_{H_2}$ (under given condition)

20. (a)

If values of ‘b’ for two gases are same but values of ‘a’ are different, then the gas having a larger value of’ a’ will occupy lesser volume. Since, it will have larger force of attraction, therefore, lesser distance between its molecules. If values of ‘a’ for two gases are same but values of ‘b’, are different then the smaller value of ‘b’ will occupy lesser volume, therefore, will be more compressible.

21. (a)

Critical temperature $= \frac{8a}{27Rb}$

$$Ar \Rightarrow \frac{a}{b} = 0.4; Ne \Rightarrow \frac{a}{b} = 0.12$$

$$Kr \Rightarrow \frac{a}{b} = 5.1; Xe \Rightarrow \frac{a}{b} = 0.82$$

Value of $\frac{a}{b}$ is highest for Kr. Therefore, Kr has highest value of critical temperature.

22. (b)

Compressibility factor is given by

$$Z = \frac{PV}{RT}$$

$$\therefore \frac{Z_A}{Z_B} = \frac{P_A V_A}{P_B V_B}$$

Given $Z_A = 3Z_B; V_A = 2V_B$

$$\frac{3Z_B}{Z_B} = \frac{P_A \times 2V_B}{P_B \times V_B} \Rightarrow 3 = \frac{P_A}{P_B} \times 2$$

$$2P_A = 3P_B$$

23. (d)

Ideal gas equation: $PV = nRT$

After putting the values, we get

$200 \times 10 = (0.5 + x) \times R \times 1000$ (total no. of moles $= 0.5 + x$)

$$\frac{2000}{1000} = 0.5R + xR \Rightarrow 2 = \left(\frac{1}{2} + x\right)R \Rightarrow \frac{2}{R} = \frac{1}{2} + x$$

$$\Rightarrow x = \frac{4 - R}{2R}$$

24. (a)

Noble gases such as Ne, Ar, Xe and Kr found to deviated from ideal gas behaviour.
Xe gas will exhibit steepest increase in plot of Z *vs* p.
Equation of state is given as:

$$p = \frac{RT}{(V - b)} \Rightarrow p(V - b) = RT$$

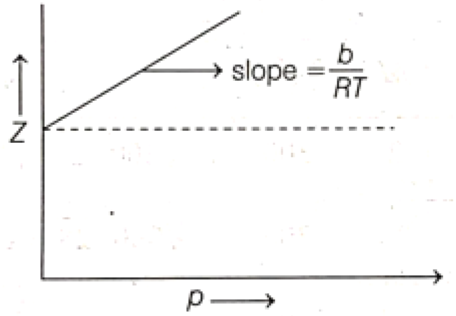
$$pV - pb = RT \Rightarrow pV = RT + pb$$

$$\frac{pV}{RT} = 1 + \frac{pb}{RT}$$

As, $Z = \frac{pV}{RT}$

So, $Z = 1 + \frac{pb}{RT} \Rightarrow y = c + mx$

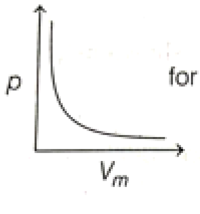
The plot z *vs* p is found to be



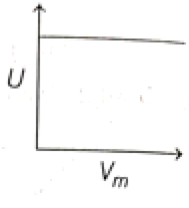
The gas will high value of b will be steepest as slope is directly proportional to b, b is the van der Waals' constant and is equal to four times the actual volume of the gas molecules. Xe has possess the largest atomic volume among the given noble gases (Ne, Kr, Ar).
Hence, it gives the steepest increases in the plot of Z (compression factor) *vs* p.

25. (c)

In isothermal expansion, $pV_m = K$ (constant)
This relation is plotted in graph 'C'
Likewise, $p = \frac{K}{V_m}$
This relation is plotted in graph "A".
Thus graph B and D are incorrect.
For them the correct graphs are:



for graph B and



for graph D

26. (a)

$$P_{gas} = \frac{n_{gas}RT}{V}$$

As n,T and V are constant, so, $P_{H_2} = P_{O_2} = P_{H_2} = 2\text{atm}$

So, $P_{\text{Total}} = P_{H_2} + P_{O_2} + P_{He} = 6\text{atm}$

27. (d)

$V_{\text{rms}} > V_{\text{average}} > V_{\text{mp}}$

$$\sqrt{\frac{3RT}{M}} > \sqrt{\frac{8RT}{\pi M}} > \sqrt{\frac{2RT}{M}}$$

28. (a)

Critical temperature indicates the ease of liquefaction of gas more the critical temp. of gas more intermolecular attractive forces and greater is the ease of liquefaction hence greater is the adsorption.

29. (b)

According to ideal gas equation

$$PV = nRT \Rightarrow PV = \frac{w}{M}RT$$

$$\Rightarrow P = \frac{RT}{M} \times d$$

$\Rightarrow P \propto d$ and $P \propto T$

30. (d)

Mass liquid $= 135 - 40 = 95\text{g}$

Volume of liquid $= \frac{\text{mass}}{\text{density}} = \frac{95}{0.95}\text{mL} = 100\text{mL} = 0.1\text{L}$

Mass of ideal gas $= 40.5 - 40\text{g} = 0.5\text{g}$

$PV = nRT$

$$0.82 \times 0.1 = \left(\frac{0.5}{M}\right) \times 0.082 \times 250 \Rightarrow M = 125$$

31. (a)

For 1 mole of real gas

$PV = ZRT$

From graph PV for real gas is less than PV for ideal gas at point A

$Z < 1$

$$Z = 1 - \frac{a}{V_m RT}$$

32. (a)

Adsorption $\propto$ Vander Waal attraction forces

$Z_c = \frac{3}{8}$ for all real gases

33. (750)

At constant temperature and number of moles

$P_1V_1 = P_2V_2$

$$P_1 = 48 \times 10^{-3}\text{bar}; V_1 = \frac{4}{3}\pi(3)^3; V_2 = \frac{4}{3}\pi(12)^3$$

$$P_2 = \frac{P_1V_1}{V_2} = \frac{48\times10^{-3}\times(3)^3}{(12)^3}$$

$$= \frac{48\times10^{-3}}{64} = 7.5\times10^{-4} = 750\times10^{-6}\,\text{bar}$$

34. (1)

$$P(V_m - b) = RT \Rightarrow PV_m - Pb = RT$$

$$\Rightarrow \frac{PV_m}{RT} = 1 + \frac{Pb}{RT} \Rightarrow Z = 1 + \frac{Pb}{RT}$$

$$\Rightarrow \left(\frac{\partial Z}{\partial P}\right)_T = \frac{b\times1}{RT} \qquad \therefore x = 1$$

35. (26)

$$PV = nRT$$

$$\text{Mass} = \frac{PV}{RT}\times\text{molar mass}$$

$$= \frac{1\times4\times10^6}{0.083\times300}\times16 = 25.7\times10^5\,\text{g} \simeq 26\times10^5\,\text{g}$$

36. (70)

Using: $\frac{P}{T} = \text{Constant}\ \frac{P_1}{T_1} = \frac{P_2}{T_2}$

$$\Rightarrow T_2 = \frac{40\times300}{35} = 342.86\text{K}$$

$$\therefore T_2 = 69.96\,^\circ\text{C} \approx 70\,^\circ\text{C}$$

37. (150)

Number of moles of $CH_4 = \frac{6.4}{16} = 0.4$

Number of moles of $CO_2 = \frac{8.8}{44} = 0.2$

Total number of moles of the mixture $= 0.6$

Now, $P = \frac{nRT}{V} = \frac{0.6\text{mol}\times8.314\text{J mol}^{-1}\text{K}^{-1}\times300\text{K}}{10\text{L}}$

$$= 149.65\text{J}\times\text{L} = \frac{149.65\text{N m}}{10^{-3}\text{m}^3}$$

$$= 149.65\times10^3\,\text{Pa}\left[\because 1\,\text{Pascal} = \frac{\text{N}}{\text{m}^2};1\text{J} = \text{N.m}\right]$$

$$= \frac{149.65\times10^3}{1000}\,\text{kPa} \simeq 150\text{kPa}$$

38. (22)

At 27°C, moist gas pressure,

(p_g°) + v.p. of water =4

Or, $(p_g^\circ)_1 = (4 - 0.4)\,\text{atm} = 3.6\text{atm}$

After doubling the volume at constant $T, \left(p_g^{\circ}\right)_2 = 1.8\,\text{atm}$

$\therefore$ The new pressure of the moist gas $= (1.8 + 0.4)$ atm

$= 2.2 = 22 \times 10^{-1}\text{atm}$

39. (1655)

Moles of $C_3H_8 = \frac{\text{weight}}{\text{Molar mass}} = \frac{11}{44} = 0.25\,\text{moles}$

Assuming ideal gas equation

$PV = nRT$

$\Rightarrow 2 \times 10^6 \times 2 \times 10^{-3} = 0.25 \times 8.3 \times T$

$\Rightarrow T = 1927.710K = 1927.710 - 273.15 = 1654.56^{\circ}C$

40. (152)

Assuming ideal behaviour $pV = nRT$

$PV = \frac{m}{M}RT \Rightarrow M = \frac{m}{v}\frac{RT}{P} = \frac{dRT}{P}$

$760\,\text{mm Hg} \Rightarrow 1\,\text{atm}$

$P = \frac{100}{760}\text{atm}, T = 257 + 273 = 530K, d = 0.46\,\text{gm/L}$

So, $M = \frac{0.46 \times 0.082 \times 530}{100} \times 760 = 151.93\text{g} \approx 152\text{g}$

41. (4)

Using the ideal gas equation $pV = nRT$

$1.5 \times 416 = \frac{100}{M} \times 0.083 \times 300; M = 3.99 \approx 4$

42. (32)

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

$\frac{30}{300} = \frac{P_2}{318} \Rightarrow P_2 = \frac{30}{300} \times 318 = 32$

43. (80)

$p_{\text{Total}} = 25\,\text{bar}; p_{\text{Ne}} = 20\,\text{bar}$

$p_{\text{Ne}} = \chi_{\text{Ne}} \times p_{\text{Total}} \Rightarrow 20 = \chi_{\text{Ne}} \times 25$

$\Rightarrow \chi_{\text{Ne}} = \frac{20}{25} = \frac{4}{5} \Rightarrow \frac{n_{\text{Ne}}}{n_{\text{Total}}} = \frac{4}{5}$

$\Rightarrow \frac{200/20}{n_{\text{Total}}} = \frac{4}{5} \Rightarrow n_{\text{Total}} = 10 \times \frac{5}{4} = \frac{50}{4}$

$\Rightarrow n_{\text{Total}} = \frac{50}{4} \Rightarrow \frac{x}{32} + \frac{200}{20} = \frac{50}{4} = 80\text{g}$

44. (8)

$PV = n_{\text{mix}}RT$

$n_{\text{mix}} = \frac{6 \times 12.5}{0.083 \times 300} \approx 3$

Let mole of $He = x; \text{Mole of } H_2 = 3 - x$

$4x + 2(3 - x) = 10; x = 2\,\text{mol}$

45. (25)

Real gas equation $= P(V - nb) = nRT$

Or, $\dfrac{PV}{nRT} = 1 + \dfrac{Pb}{RT}$ or, $Z = 1 + \dfrac{Pb}{RT}$

When $Z = 2, \dfrac{Pb}{RT} = 1$

Or, $b = \dfrac{RT}{P} = \dfrac{0.083 \times 298}{99} L mol^{-1} = 0.25 L\,mol^{-1}$

$= 25 \times 10^{-2} L\,mol^{-1}$

46. (555)

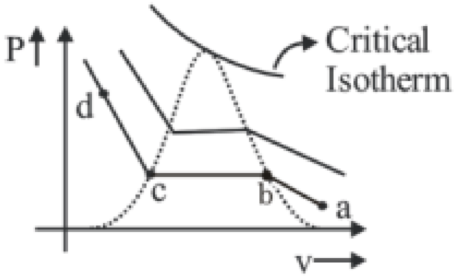
$P_X = \chi P_T$

$$= \frac{\frac{0.6}{20}}{\frac{0.6}{20} + \frac{0.45}{45}} \times 740$$

$P_X = 555\,\text{mm Hg}$

47. (2)

At



(a) → CO_2 exist as gas

(b) → liquefaction of CO_2 starts

(c) → liquefaction ends

(d) → CO_2 exist as liquid.

Between (b) & (c) → liquid and gaseous CO_2 co-exist.

As volume changes from (b) to (c) gas decrease and liquid increases.