**Q1: NTA Test 01 (Single Choice)**

$N_2 + 3H_2 \longrightarrow 2NH_3$

1 mole $N_2$ and 4 moles $H_2$ are taken in 15L flask at $27^{\circ}C$. After complete conversion of $N_2$ into $NH_3$, 5L of $H_2O$ is added. Pressure set up in the flask is (assume water dissolves $NH_3$)

(A) $\frac{3\times0.0821\times300}{15}$ atm

(B) $\frac{2\times0.0821\times300}{10}$ atm

(C) $\frac{1\times0.0821\times300}{15}$ atm

(D) $\frac{1\times0.0821\times300}{10}$ atm

**Q2: NTA Test 02 (Single Choice)**

The reduced temperature $= \theta = \frac{T}{T_C}$

The reduced pressure $= \pi = \frac{P}{P_C}$

The reduced volume $= \phi = \frac{V}{V_C}$

Hence, it can be said that the reduced equation of state may be given as

(A) $\left(\frac{\pi}{3} + \frac{1}{\phi^2}\right)(3\phi - 1) = \frac{8}{3}\theta$

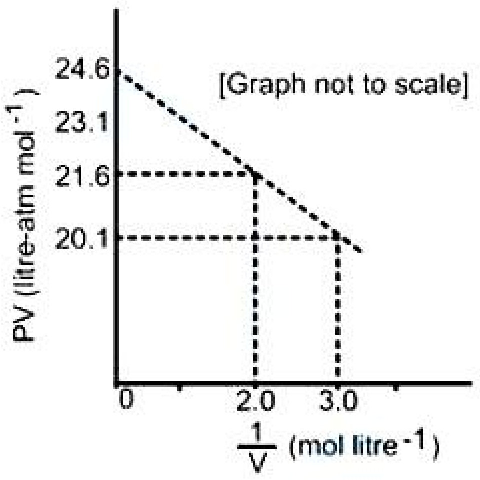
(B) $\left(\frac{\pi}{3} + \frac{1}{\phi}\right)(\phi - 1) = \frac{8}{3}\theta$

(C) $\left(\frac{\pi}{4} + \frac{1}{\phi}\right)(3\theta - 1) = \frac{8}{3}\phi$

(D) $\left(\frac{\pi}{3} + \frac{1}{\phi}\right)(3\phi - 1) = \frac{8}{3}\theta$

**Q3: NTA Test 03 (Single Choice)**

For one mole of a van der Waals when b = 0 and T = 300 K, the PV vs. 1/V plot is shown below. The value of the van der Waals constant a (atm litre$^2$ mol$^{-2}$) is:



(A) 1.0

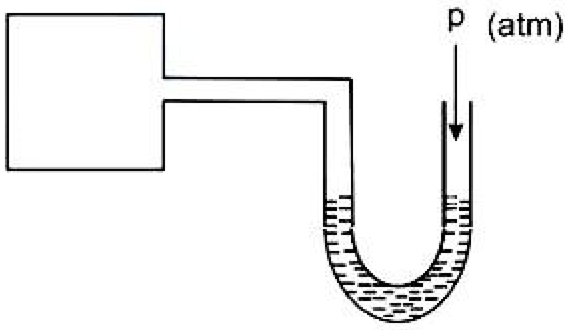
(B) 4.5

(C) 1.5

(D) 3.0

**Q4: NTA Test 04 (Single Choice)**

An open manometer attached to a flask containing ammonia gas have no difference in mercury level initially as shown in diagram. After sparking into the flask, ammonia is partially dissociated as $2NH_3(g) \longrightarrow N_2(g) + 3H_2(g)$. Now it have difference of 18 cm in mercury level in two columns, what is partial pressure of $H_2(g)$ at equilibrium ?



(A) 9 cm of Hg

(B) 18 cm of Hg

(C) 27 cm of Hg

(D) None of these

**Q5: NTA Test 05 (Single Choice)**

According to the kinetic theory of gases, between two successive collisions, a gas molecule travels

(A) In a circular path

(B) In a wavy path

(C) In a straight line path

(D) With an accelerated velocity

**Q6: NTA Test 07 (Numerical)**

Nitrogen gas is kept in an open beaker at 273 K and 1 atm pressure. If the pressure of the surrounding suddenly falls to 0.5 atm and the temperature increases to 546 K, then the percentage of niitrogen remaining in the beaker is mn % of the initial amount. Then the value of m+n is:

**Q7: NTA Test 08 (Single Choice)**

The van der Waal's constant 'b' of a gas is $4\pi \times 10^{-4}\ \mathrm{L/mol}$. How near can the centres of the two molecules approach each other ? [Use : $\mathrm{N_A} = 6 \times 10^{23}$]

(A) $10^{-7}$ m

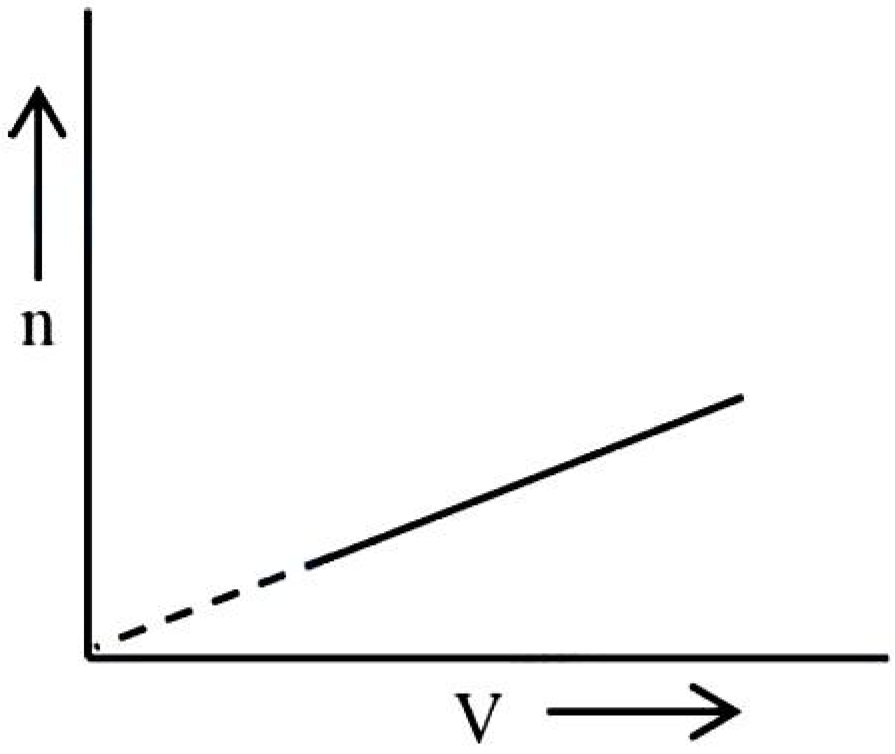
(B) $10^{-10}$ m

(C) $5 \times 10^{-11}$ m

(D) $5 \times 10^{-9}$ m

**Q8: NTA Test 09 (Single Choice)**

For a given one mole of ideal gas kept at 6.5 atm in a container of capacity 2.463 L, the Avogadro proportionality constant for the hypothesis is (see figure)



(A) 0.406

(B) 2.46

(C) 22.4

(D) none of these

**Q9: NTA Test 09 (Numerical)**

One mole of an ideal monoatomic gas is mixed with one mole of an ideal diatomic gas. The molar specific heat of the mixture at constant volume is (in Calories)

**Q10: NTA Test 10 (Single Choice)**

An open vessel at $27^{\circ}$C is heated until 3/8th of the air in it has been expelled. Assuming that the volume remains constant, calculate the temperature at which the vessel was heated

(A) $307^{\circ}$ C

(B) $107^{\circ}$ C

(C) $480^{\circ}$ C

(D) $207^{\circ}$ C

**Q11: NTA Test 12 (Single Choice)**

The rates of diffusion of gases A and B of molecular weight 36 and 64 are in the ratio

(A) 9 : 16

(B) 4 : 3

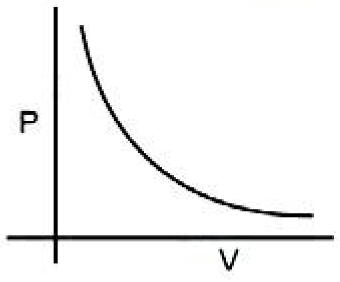
(C) 3 : 4

(D) 16 : 9

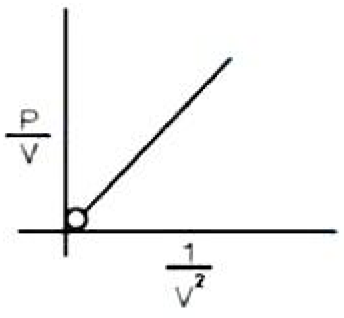
**Q12: NTA Test 13 (Single Choice)**

Which of the following graph represent Boyles law?

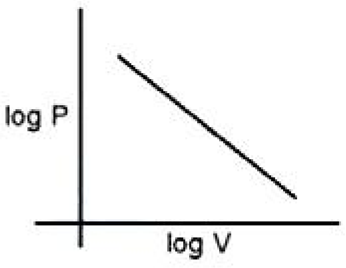
(A)



(B)



(C)



(D) All of these

**Q13: NTA Test 14 (Numerical)**

At STP, 5.6 litre of a gas weighs 60 g. The vapour density of gas is -

**Q14: NTA Test 15 (Numerical)**

Determine how many of the following statements are true at very high pressure for a real gas:

(a) Compressibility factor is greater than 1.

(b) Compressibility factor varies linearly with pressure.

(c) Molar volume occupied by gas is more as compared to ideal gas at similar pressure and temperature.

(d) Gas is less compressible as compare to ideal gas.

(e) Compressibility factor is given by $Z = 1 + \frac{Pb}{RT}$.

**Q15: NTA Test 16 (Single Choice)**

100 ml of $O_2$ (g) effuse from a porous container in 100 sec. 75 ml of unknown gas effuses under the same conditions of temperature and pressure in 150 sec. Calculate vapour density of unknown gas?

(A) 16

(B) 32

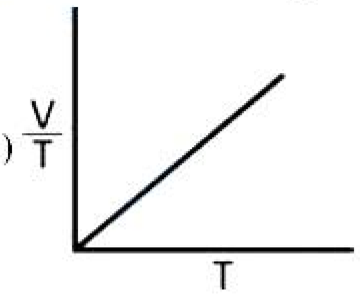
(C) 64

(D) 128

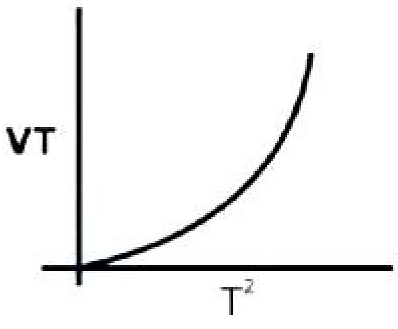
**Q16: NTA Test 17 (Single Choice)**

Which of the following curve is correct for a given amount of an ideal gas at constant pressure?

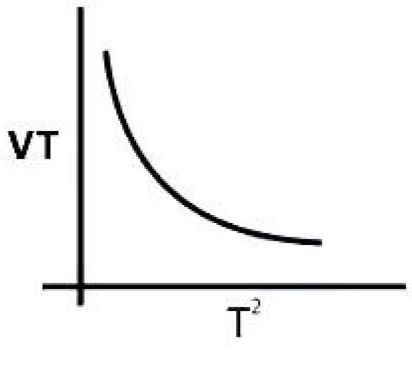
(A)

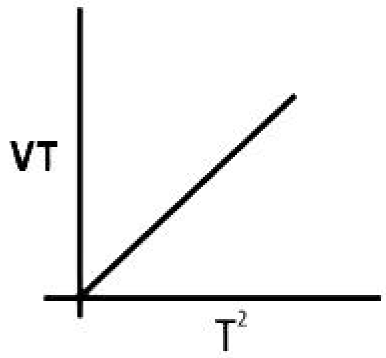


(B)



(D)



(C) 

**Q17: NTA Test 18 (Single Choice)**

At what temperature would $N_2$ molecules have same average speed as CO molecules at 200 K .

(A) $-73^\circ C$

(B) $200^\circ C$

(C) $700^\circ C$

(D) none

**Q18: NTA Test 19 (Single Choice)**

The rate of diffusion of two gases A and B are in the ratio $1:4$ (assume; $P_A = P_B$). In other experiment a mixture contains these gases A and B in the mole ratio $2:3$. The ratio of mole fraction of the gases A and B in the diffused mixture is –

(A) 1 : 6

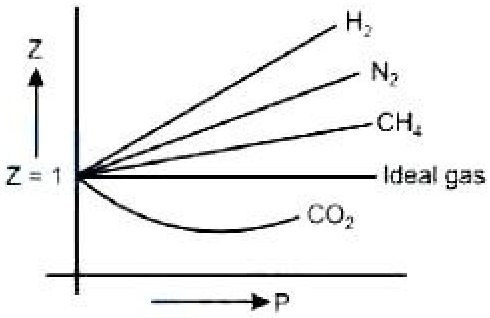
(B) 1 : 12

(C) 1 : 18

(D) 1 : 24

**Q19: NTA Test 20 (Single Choice)**

Consider the graph between compressibility factor Z and pressure P:



The correct increasing order of ease of liquefaction of the gases shown in the above graph is

(A) $H_2 < N_2 < CH_4 < CO_2$

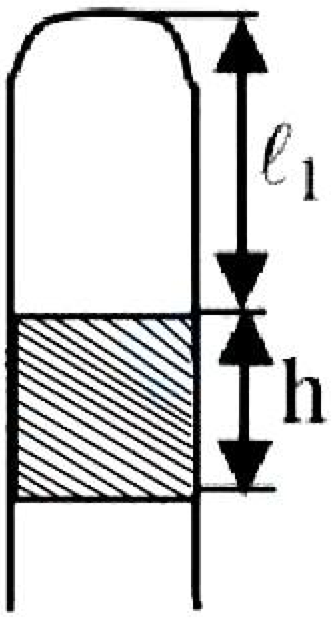
(B) $CO_2 < CH_4 < N_2 < H_2$

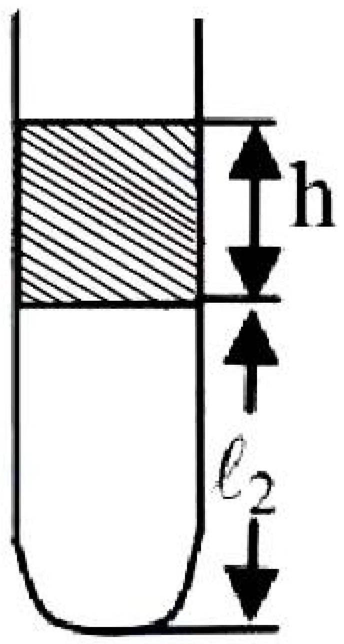
(C) $H_2 < CH_4 < N_2 < CO_2$

(D) $CH_4 < H_2 < N_2 < CO_2$

**Q20: NTA Test 21 (Single Choice)**

An air column closed in a tube sealed at one end by a Hg column having height h . When the tube is placed with open end down, the height of the air column is $l_1$. If the tube is turned so that its open end is at the top, the height of the air column is $l_2$. What is the atmospheric pressure ($P_0$)-





(A) $P_0 = \frac{h(l_1+l_2)}{(l_2-l_1)}$ cm of Hg

(B) $P_0 = \frac{h(l_1-l_2)}{(l_1+l_2)}$ cm of Hg

(C) 76 cm of Hg

(D) $P_0 = \frac{h(l_1+l_2)}{(l_1-l_2)}$ cm of Hg .

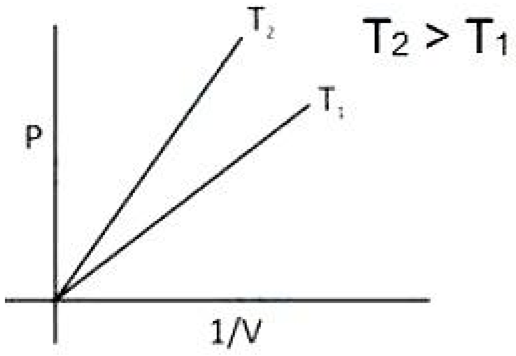
**Q21: NTA Test 22 (Numerical)**

The relative humidity of air is 80% at 27 $^{\circ}$C. .If the aqueous tension at the same temperature is 27 mm of Hg. The partial pressure of water vapour in the air will be (in mm of Hg ).

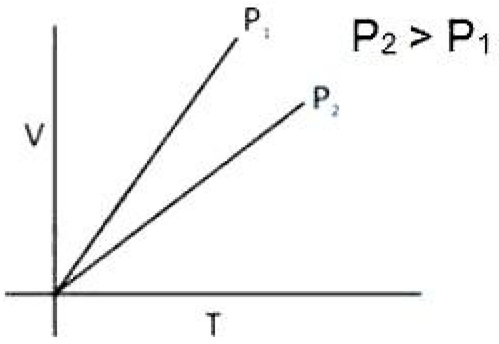
**Q22: NTA Test 24 (Single Choice)**

Which of the following graphs is inconsistent with ideal gas behaviour ?

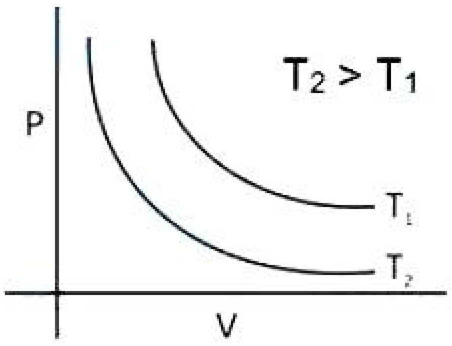
(A)



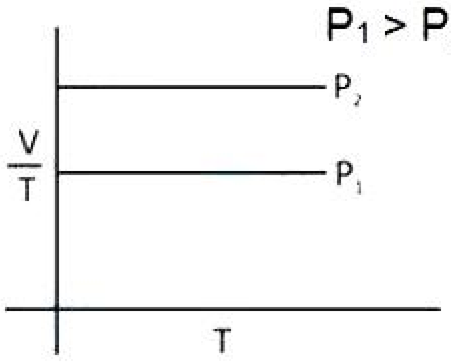
(B)



(C)



(D)



**Q23: NTA Test 26 (Single Choice)**

A balloon filled with oxygen is placed in a tank full of hydrogen gas at the same pressure, is pricked with a sharp pointed needle. The volume of balloon just after the pricking would be

(A) Shrunk

(B) Enlarge

(C) Completely collapsed

(D) remains unchanged in size

**Q24: NTA Test 27 (Single Choice)**

The rms speed of $N_2$ molecules in a gas is u. If the temperature is doubled and the nitrogen molecules dissociate into nitrogen atoms, the rms speed becomes

(A) 2u

(B) 4u

(C) 14u

(D) $\sqrt{2}$u

**Q25: NTA Test 28 (Single Choice)**

Two van der waal's gases have same value of a but different value of b which of the following statement is correct?

(A) The smaller the value of b larger will be compressibility

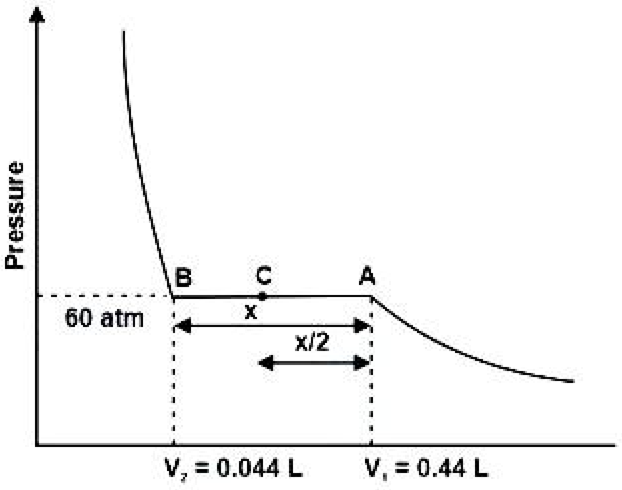
(B) The larger the value of b, larger will be compressibility

(C) Both have same compressibility

(D) All the with smaller value of b will occupy larger volume

**Q26: NTA Test 33 (Single Choice)**

$CO_2$ gas is liquefied at 27$^{\circ}$C . Gas follows the following graph during liquefaction for 1 mole of $CO_2$ .



Then which statement is (are) correct in gaseous phase will

(i) The maximum density of gas is 0.1 gm/ml

(ii) The density of liquid $CO_2$ is 1 g/ml at 60 atm.

(iii) At point C 50% of $CO_2$ is liquefied.

(iv) The compressibility factor of gas at $27^{\circ}C$ is always less than 1.

Which of the above is/are correct

(A) only i

(B) i and ii

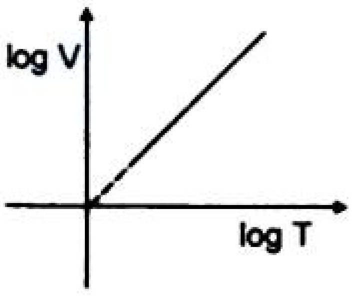
(C) i,ii and iii

(D) all

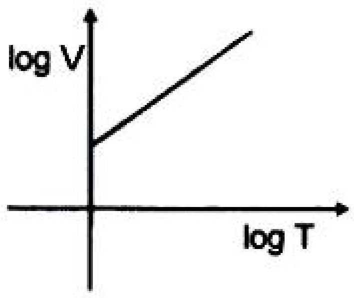
**Q27: NTA Test 34 (Single Choice)**

Which of the following sketches is an isobars (Given: $\frac{nR}{P}>1$ )

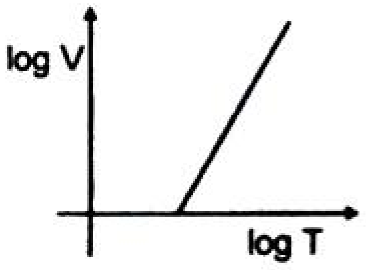
(A)



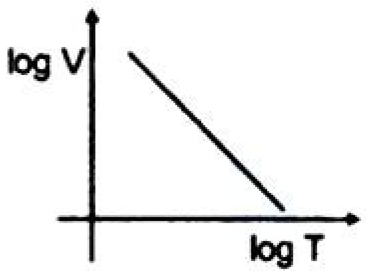
(B)



(C)



(D)



**Q28: NTA Test 35 (Single Choice)**

The van der Waals equation for one mole of a real gas can be written as $\left(P + \frac{a}{V^2}\right)(V - b) = RT$ . For the gases $H_2$ , $NH_3$ , and $CH_4$ , the value of 'a' bar $L^{-2}mol^{-2}$ are 0.2453, 4.170 and 2.253 respectively.

Which of the following can be inferred from the 'a' values?

(A) $NH_3$ can be most easily liquified

(B) $H_2$ can be most easily liquified

(C) value of 'a' for $CH_4$ is less than that of $NH_3$ because it has the lower molar mass

(D) intermolecular forces are the strongest in hydrogen

**Q29: NTA Test 37 (Single Choice)**

If density of vapours of a substance of molar mass 18 gm/mole at 1 atm pressure and 500 K is 0.36 kg $m^{-3}$, then value of Z for the vapours is (Take $R = 0.082$ L atm $mole^{-1}$ $K^{-1}$)

(A) $\frac{41}{50}$

(B) $\frac{50}{41}$

(C) 1.8

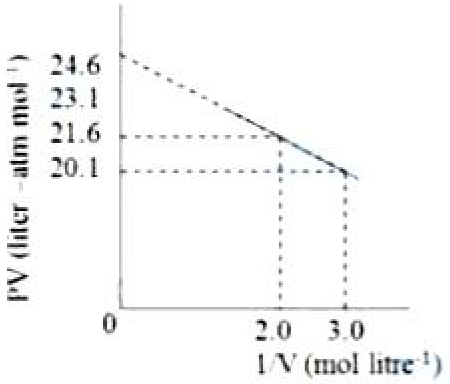
(D) 0.9

**Q30: NTA Test 37 (Numerical)**

To an evacuated vessel with movable piston under external pressure of 1 atm, 0.1 mole of He and 1.0 mole of an unknown compound (vapour pressure 0.68 atm at $0^{o}C$ ) are introduced. Considering ideal gas behaviour, the total volume (in L) of the gas at $0^{o}C$ is close to x L at equilibrium. Calculate the value of x.

**Q31: NTA Test 40 (Single Choice)**

For one mole of a van der Waals gas when b = 0 and T = 300 K, the PV vs. $\frac{1}{V}$ plot is shown below. The value of the van der Waals constant a $\left(\text{atm. litre}^{2}\text{mol}^{-2}\right)$ is



(A) 1.5

(B) 2.5

(C) 1.75

(D) 1.0

**Q32: NTA Test 41 (Numerical)**

The density of $O_2$ is 16 at NTP. At what temperature(in $^{o}$C) its density will be 14? Consider that the pressure remains constant.

**Q33: NTA Test 42 (Single Choice)**

Positive deviation from ideal behaviour takes place because of

(A) molecular interaction between atoms and $\frac{PV}{nR} > 1$

(B) molecular interaction between atoms and $\frac{PV}{nRT} < 1$

(C) finite size of atoms and $\frac{PV}{nRT} > 1$

(D) finite size of atoms and $\frac{PV}{nRT} < 1$

**Q34: NTA Test 45 (Numerical)**

At what temperature (in kelvin) is the rms speed of hydrogen molecules the same as oxygen molecules at 1327°C?

**Q35: NTA Test 46 (Numerical)**

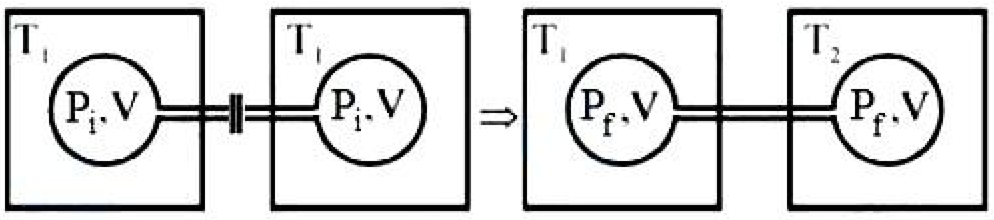
The diffusion coefficient of an ideal gas is proportional to its mean free path and mean speed. The absolute temperature of an ideal gas is increased 4 times and its pressure is increased 2 times. As a result, the diffusion coefficient of this gas increases x times. The value of x is

**Q36: NTA Test 47 (Numerical)**

Calculate the number of hours of service that can be derived at 1 atm, 300 K from an acetylene lamp containing 640 g calcium carbide. Given that the lamp requires 50 L acetylene gas at 1 atm 300 K for one hour. [Take $0.0821 \times 300 = 25$]

**Q37: NTA Test 48 (Single Choice)**

Two closed bulbs of equal volume (V) containing an ideal gas initially at pressure $p_i$ and temperature $T_1$ are connected through a narrow tube negligible volume as shown in the figure below. The temperature of one of the bulbs is then raised to $T_2$ . The final pressure $p_f$



(A) $2p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$

(B) $p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$

(C) $2p_i\left(\frac{T_1}{T_1+T_2}\right)$

(D) $2p_i\left(\frac{T_2}{T_1+T_2}\right)$

# Answer Keys

**Q1:** (D)
**Q2:** (A)
**Q3:** (C)
**Q4:** (C)
**Q5:** (C)
**Q6:** 7.00
**Q7:** (B)
**Q8:** (B)
**Q9:** 4.00

**Q10:** (D)

**Q11:** (B)

**Q12:** (D)

**Q13:** 120

**Q14:** 5

**Q15:** (C)

**Q16:** (C)

**Q17:** (A)

**Q18:** (A)

**Q19:** (A)

**Q20:** (D)

**Q21:** 21.6

**Q22:** (C)

**Q23:** (B)

**Q24:** (A)

**Q25:** (A)

**Q26:** (C)

**Q27:** (B)

**Q28:** (A)

**Q29:** (B)

**Q30:** 7

**Q31:** (A)

**Q32:** 39

**Q33:** (C)

**Q34:** 100

**Q35:** 4

**Q36:** 5

**Q37:** (D)

# Solutions

**Q1: (D)** $\frac{1\times0.0821\times300}{10}$ atm

| | $N_2$ | $+$ | $3H_2$ | $\longrightarrow$ | $2NH_3$ |
|---|---|---|---|---|---|
| Initial mole | 1 | | 4 | | 0 |
| Reacted mole | 1 | | 3 | | |
| Left mole | 0 | | 4-3=1 | | 2 |

$H_2$ left = 1 mol

$NH_3$ formed = 2 mol

But $NH_3$ (g) dissolves in water forming $NH_4OH$ . Residual gas is only $H_2$ which exerts pressure.

Volume $= 15 - 5 = 10$ L (5L occupied by $H_2O$ added)

$\therefore \mathrm{p} = \frac{\mathrm{n}}{\mathrm{V}}\mathrm{RT} = \frac{1\times0.0821\times300}{10}$ atm

**Q2: (A)** $\left(\frac{\pi}{3} + \frac{1}{\phi^2}\right)(3\phi - 1) = \frac{8}{3}\theta$

$\mathrm{P} = \mathrm{P_c}\pi = \left(\frac{\mathrm{a}}{27\mathrm{b}^2}\right)\pi$

$\mathrm{V} = \mathrm{V_c}\phi = (3\mathrm{b})\phi$

$\mathrm{T} = \mathrm{T_c}\theta = \left(\frac{8\mathrm{a}}{27\mathrm{Rb}}\right)\theta$

Hence substituting in the van der Waal's equation

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

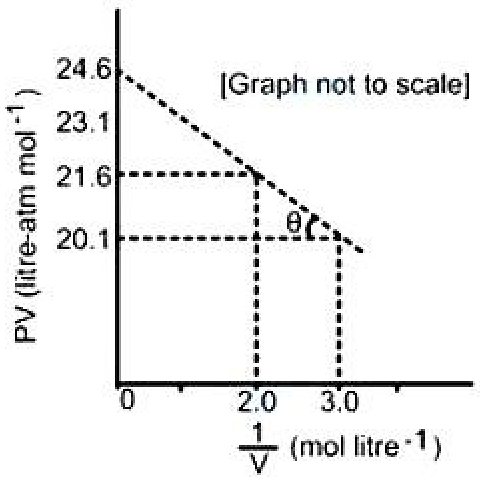
$\Rightarrow \left(\pi + \frac{3}{\phi^2}\right)(3\phi - 1) = 8\theta$

This is reduced state equation

$\left(\pi + \frac{3}{\phi^2}\right)\left(\frac{3\phi}{8\theta} - \frac{1}{8\theta}\right) = 1$

$\left(\frac{\pi}{3} + \frac{1}{\phi^2}\right)(3\phi - 1) = \frac{8}{3}\theta$

**Q3: (C) 1.5**



van der Waals equation for 1 mol of real gas is

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

Given that b = 0

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

$$\therefore\ PV=RT-\frac{a}{V}\qquad \text{........ (i)}$$

Following y = mx + c for the curve PV vs $\frac{1}{V}$

Slope $=-a$

Slope $=\frac{21.6-20.1}{2-3}=-1.5$

$\therefore\ a=1.5$

**Q4: (C)** 27 cm **of** Hg

$$\begin{array}{cccc} 2NH_3\,(g) & \longrightarrow & N_2\,(g) & + & 3H_2 \\ 76-2x & & x & & 3x \end{array}$$

$$76+2x=76+18$$

$$2x=18$$

$$\therefore\qquad x=9$$

$$\therefore\qquad p_{H_2}=3\times 9$$

$$=27\text{ cm of Hg}$$

**Q5: (C) In a straight line path**

According to kinetic theory, the gas molecules are in a state of constant rapid motion in all possible directions colliding in a random manner with one another and with the walls of the container and between two successive collisions, molecules travel in a straight line path but show haphazard motion due to collisions.

**Q6: 7.00**

Let the initial number of moles of nitrogen gas in the beaker $= n_1$

Now, total volume of gas in the beaker will remain constant.
Then, $n \propto \frac{P}{T}$

Therefore,

$\Rightarrow \frac{n_1}{n_2} = \frac{P_1}{P_2} \times \frac{T_1}{T_2}$

$\Rightarrow \frac{n_1}{n_2} = \frac{1}{0.5} \times \frac{546}{273} = 4$

Since, the final moles of nitrogen in the beaker is one-fourth of the initial amount in 25 % of the initial amount.
Therefore, $m = 2, n = 5$ and $m + n = 7$

**Q7: (B)** $10^{-10}$ m
$b = 4 \times \frac{4}{3} \times \pi r^3 \times N_A$ ;

We know that, $1L = 1000\ cm^3$

$4 \times \pi \times 10^{-4} \times 1000 = 4 \times \frac{4}{3} \times \pi \times r^3 \times 6 \times 10^{23}$

$r = 5 \times 10^{-9}$ cm

Distance of closest approach $= 2r$

$= 10^{-8}$ cm or $10^{-10}$ m

**Q8: (B)** 2.46
According to Avogadro hypothesis

$V \propto n$

$V = n\frac{(RT)}{P}$

Proportionality constant $= \frac{RT}{P}$

Using PV = nRT

$\therefore \frac{RT}{P} = \frac{V}{n} = \frac{2.463}{1}$

**Q9: 4.00**

$C_{v,m} = \frac{3}{2}R$ (for monoatomic gas)

$C_{v,m} = \frac{5}{2}R$ (for diatomic gas)

for the mixture, $(C_{v,m})_{mix} = \frac{\frac{3}{2}R \times 1 + \frac{5}{2}R \times 1}{1+1}$

$= 2R$

$\therefore (C_{v,m})_{mix} = 4$ cal

**Q10: (D)** $207^{o}$ C

If $\frac{3^{th}}{8}$ of the air is expelled out then remaining air $= \frac{5}{8}$

In the open vessel volume and pressure are both constant but moles are decreasing

$\therefore \quad n_1T_1 = n_2T_2$

$\therefore \; n_1 \times 300 = \left(\frac{5}{8}n_1\right)T_2$

$\therefore \; T_2 = \frac{8}{5} \times T_1 = \frac{8}{5} \times 300 = 480$ K

$= 480 - 273 = 207^{o}$C

**Q11: (B) 4 : 3**

$\frac{r_A}{r_B} = \sqrt{\frac{M_B}{M_A}} = \sqrt{\frac{64}{36}} = \frac{4}{3}$

$r_A : r_B = 4 : 3.$

**Q12: (D) All of these**

As per Boyles law

$PV = \text{constant}$

$\frac{P}{V} = \text{constant}\ \left(\frac{1}{V^2}\right)$

$\log P = -\log V + \text{lo g}(\text{constant})$

**Q13: 120**

5.6 lit gas weight = 60 gm

22.4 lit gas weight = $\frac{60}{5.6} \times 22.4$ gm

= 240 gm (molecular weight of gas)

Vapour density = $\frac{\text{Molecular weight}}{2} = 120$

**Q14: 5**

At high pressure $Z > 1$ i.e. repulsive forces are relatively dominant, so gas is less compressible.
at high pressure, $a \cong 0$.

**Q15: (C) 64**

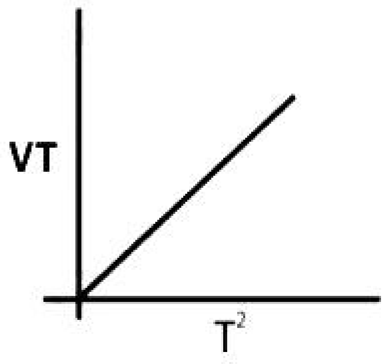
$$\frac{r_{O_2}}{r_{unknown}} = \frac{\frac{v_1}{t_1}}{\frac{v_2}{t_2}} = \sqrt{\frac{M_{unknown}}{M_{O_2}}}$$

$$\Rightarrow \frac{100 \times 150}{100 \times 75} = \sqrt{\frac{M_{unknown}}{32}}$$

$$\Rightarrow M_{unknown} = 128$$

$$\therefore \text{ V.D.} = \frac{128}{2} = 64$$

**Q16: (C)**

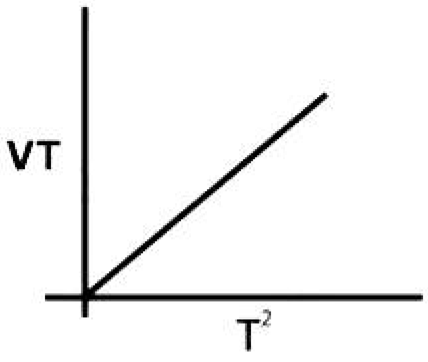


$V \alpha T$

$V = KT$

$VT = KT^2$

$VT = \alpha T^2 = y \alpha x$



**Q17: (A)** $-73^\circ C$

Average speed $= \sqrt{\frac{8RT}{\pi M}}$

Both $N_2$ and CO have same molecular mass, So, for same average speed, temperature should be same

$\therefore$ $T = 200\ K = -73^\circ C$

**Q18: (A) 1 : 6**

$1^{st}$ experiment $\Rightarrow \frac{r_A}{r_B} = \sqrt{\frac{M_B}{M_A}} = \frac{1}{4}$

$2^{nd}$ experiment $\Rightarrow \frac{r_A}{r_B} = \frac{2}{3}\sqrt{\frac{M_B}{M_A}} \left\{\because \frac{r_A}{r_B} = \frac{n_a}{n_B}\right\}$

$= \frac{2}{3} \times \frac{1}{4} = \frac{1}{6}$

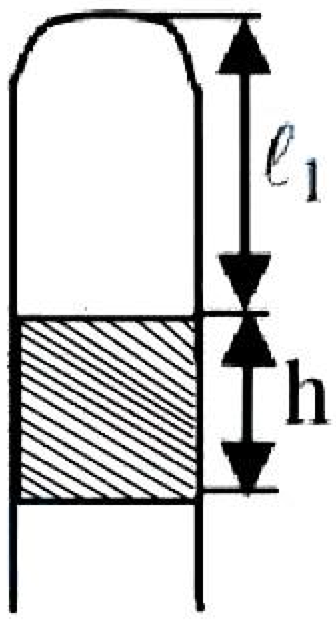
**Q19: (A)** $H_2 < N_2 < CH_4 < CO_2$

$Z < 1$ means, force of attraction dominating i.e., a is considerable, b can be negligible at low temperature and low pressure and liquification is more.

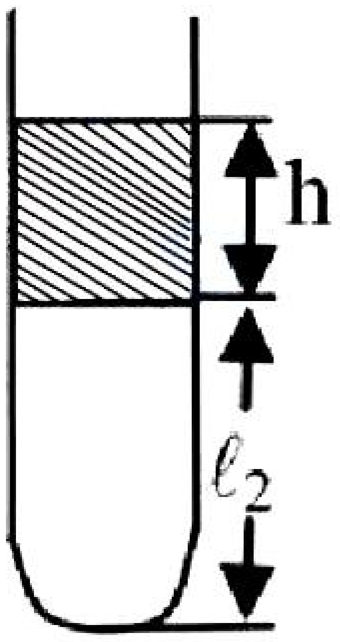
**Q20: (D)** $P_0 = \frac{h(l_1+l_2)}{(l_1-l_2)}$ **cm of Hg .**

Let $P_0$ be the value at atmospheric pressure

(I)



(II)



In case I:

$P_{gas} + h$ cm of Hg $= P_0$ cm of Hg

In case ii

$P_{gas} = P_0$ cm of Hg $+ h$ cm of Hg

By applying Boyle's law between (I) & (II)

$(P_0 - h) \times l_1 = (P_0 + h) \times l_2$

or $P_0 l_1 - hl_1 = P_0 l_2 + hl_2$

or $P_0 \ (l_1 - l_2) = h \ (l_1 + l_2)$

or $P_0 = \frac{h(l_1 + l_2)}{(l_1 - l_2)}$

**Q21: 21.6**

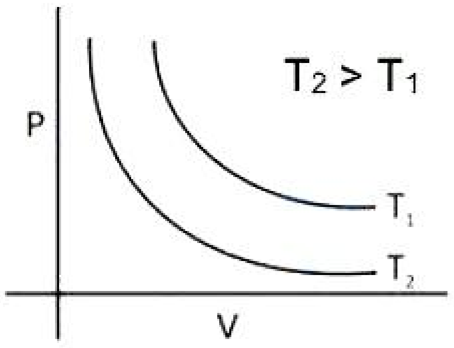
Relative humidity $= \frac{\text{Partial pressure}}{\text{Vapour pressure}} \times 100$

$\Rightarrow \frac{\text{Partial pressure}}{27} \times 100 = 80$

$\Rightarrow$ Partial pressure $= \frac{80 \times 27}{100}$

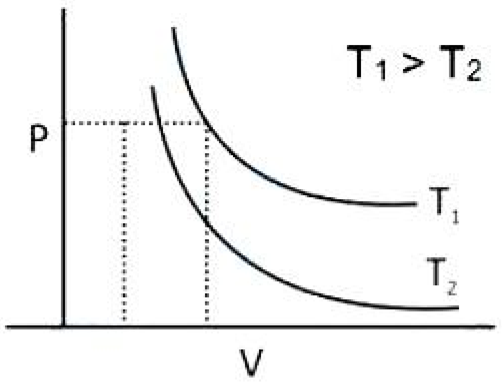
$\therefore$ Partial pressure $= 21.6$ mm of Hg

**Q22: (C)**



$P \propto \frac{1}{V}$

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



**Q23: (B) Enlarge**

According to graham's law of rate of diffusion, the rate of diffusion depends on pressure and molecular weight of the gas.
Rate of diffusion $\propto$ partial pressure
$\propto \frac{1}{\sqrt{M}}$
So According to graham's law of diffusion the rate of diffusion will be higher than the rate of diffusion of oxygen gas, So hydrogen gas will diffuse with a faster rate inside the balloon than oxygen gas will leave the balloon so balloon will enlarge in size.

**Q24: (A)** 2u

$\frac{u_1}{u_2} = \sqrt{\frac{n_1T_1}{n_2T_2}} = \sqrt{\frac{n\times T}{2n\times 2T}} = \sqrt{\frac{1}{4}} = \frac{1}{2}$
$\therefore\ u_2 = 2u_1$
Therefore, If the temperature is doubled and the nitrogen molecules dissociate into nitrogen atoms, the rms speed becomes double.

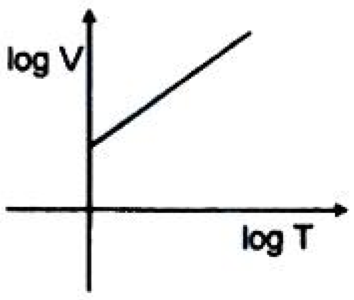
**Q25: (A) The smaller the value of b larger will be compressibility**

Smaller the value of 'b', smaller the volume occupied by molecules so high compressibility.

**Q26: (C) i,ii and iii**

(A) Maximum density of $CO_2$ in gaseous phase will be at point 'A'
Now: $d = \frac{PM}{RT} = \frac{60\times 44}{R\times 300} = 107\ \text{gm/lt} = 0.107\ \text{gm/cc}$
Or $d = \frac{\text{mass of gas}}{\text{Volume of gas}} = \frac{44\ \text{gm}}{440\ \text{cc}} = 0.1$
(B) Density of liquid $CO_2$ at 60 atm (at point B)
At point B there will be only liquid $CO_2$ . So we can find out the density of density of liquid $CO_2$ only at point B.
$d = \frac{M}{V} = \frac{44}{0.044} = 1\ \text{gm/cc}$
(C) at point C the volume will be $\frac{0.44+0.044}{2} \approx 0.22\ \text{L}$
And pressure is same so obviously approx. half of $CO_2$ is liquified
(D) Z can be greater than 1 at 27°C. For example at point 'A' Z is 1.07, So wrong.

**Q27: (B)**



At constant pressure
PV = nRT
$V = \left(\frac{nR}{P}\right)T$
so, $\log V = \log\left(\frac{nR}{P}\right) + \log T$
compare this with $y = mx + c$

**Q28: (A) $NH_3$ can be most easily liquified**

Van der Wall's constant 'a' gives information about force of attraction between gaseous molecules. Higher the value of 'a' higher will be force of attraction, and easier the liquefaction of gas. Order of intermolecular force of attraction = $H_2 < CH_4 < NH_3$

**Q29: (B)** $\frac{50}{41}$
$V_{real} = \frac{\text{molar mass}}{\text{density}} = \frac{18}{0.36}$
$V_{ideal} = \frac{nRT}{P} = \frac{1\times 0.082\times 500}{1}$
So, $Z = \frac{V_{real}}{V_{ideal}} = \frac{50}{0.082\times 500} = \frac{50}{41}$

**Q30: 7**

If external pressure is 1 atm the pressure inside the cylinder will also be equal to 1 atm.
The pressure generated by unknown compound will be fixed and equal to $0.68$ atm, so the pressure generated by He will be $1-0.68 = 0.32$ atm
Now by: $V = \frac{n \times R \times T}{P}$
$V = \frac{0.1 \times 0.082 \times 273}{0.32} = 7\ L$

**Q31: (A) 1.5**

$PV = ZRT$ and $Z = 1 - \frac{a}{ZRT}$

$PV = \left(1 - \frac{a}{VRT}\right)RT$

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

Slope of graph between PV and $\frac{1}{V}$ is -a

$a = \frac{21.6 - 20.1}{3-2} = 1.5$

**Q32: 39**

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

$d_1 T_1 = d_2 T_2$

When p remains constant

$d_1 = 16; d_2 = 14; T_1 = 273\ K,\ T_2 = ?$

$d_1 T_1 = d_2 T_2$

$16 \times 273 = 14 \times T_2$

$T_2 = 312\ K$

$T_2 = 312 - 273 = 39^\circ C$

**Q33: (C) finite size of atoms and $\frac{PV}{nRT} > 1$**

For positive deviation
$\frac{PV}{nRT} > 1$
$PV = nRT + nPb$
$PV/nRT = 1 + Pb/RT$
$PV/nRT > 1.$

**Q34: 100**

$v_{H_2} = v_{O_2}$

$\sqrt{\frac{3RT_{H_2}}{MH_2}} = \sqrt{\frac{3RT_{O_2}}{MO_2}}$

So, $\sqrt{M_{O_2} T_{H_2}} = \sqrt{M_{H_2} T_{O_2}}$

$32 \times T_{H_2} = 2 \times 1600$

$T_{H2} = 2 \times \frac{1600}{32} = 100$

**Q35: 4**

Diffusion coefficient $\propto$ mean free path $\times$ mean speed

$D \propto \bar{i} \times \bar{c}$

But $\bar{i} = \frac{1}{\sqrt{2}\pi\sigma^2} \frac{RT}{PN_0}$

or $\bar{i} \propto \frac{T}{P}$ and $\bar{c} = \sqrt{\frac{8RT}{\pi M}}$

or $\bar{c} \propto \sqrt{\frac{T}{M}}$

So $D \propto \frac{T}{P} . \sqrt{\frac{T}{M}}$ or $D \propto \frac{T^{\frac{3}{2}}}{P\sqrt{M}}$

or $\frac{D_1}{D_2} = \left(\frac{T}{4T}\right)^{\frac{3}{2}} \left(\frac{2P}{P}\right) = \left(\frac{1}{4}\right)^{\frac{3}{2}} \times 2$

$= \left(\frac{1}{2}\right)^3 \times 2 = \frac{1}{4}$

or $D_2 = 4D_1$

**Q36: 5**

$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$

moles of $CaC_2 = \frac{640}{64} = 10$

$\therefore$ moles of $C_2H_2$ formed = 10

$\therefore \quad V_{C_2H_2} = 10 \times 0.0821 \times 300 = 250$ Litres

$\therefore$ number of hours $= \frac{250}{50} = 5$

**Q37: (D)** $2p_i\left(\frac{T_2}{T_1+T_2}\right)$

Initial moles and final moles are equal

$(n_T)_i = (n_T)_f$

$\frac{P_1V}{RT_1} + \frac{P_1V}{RT_1} = \frac{P_fV}{RT_1} + \frac{P_fV}{RT_2}$

$2\frac{P_i}{T_1} = \frac{P_f}{T_1} + \frac{P_f}{T_2}$

$P_f = \frac{2P_iT_2}{T_1+T_2}$