DPP - Daily Practice Problems

Date : ☐ **Start Time :** ☐ **End Time :** ☐

CHEMISTRY

CC05

SYLLABUS : States of Matter

Max. Marks : 74 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 20 Questions divided into 5 sections.
  Section I has **6** MCQs with ONLY 1 Correct Option, **3** marks for each correct answer and **–1** for each incorrect answer.
  Section II has **4** MCQs with ONE or MORE THAN ONE Correct options.
  For each question, marks will be awarded in one of the following categories:
  Full marks: **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  Partial marks: **+1** For darkening a bubble corresponding to each correct option provided NO INCORRECT option is darkened.
  Zero marks: If none of the bubbles is darkened.
  Negative marks: **–2** In all other cases.
  Section III has **4** Single Digit Integer Answer Type Questions, **3** marks for each Correct Answer and 0 marks in all other cases.
  Section IV has Comprehension/Matching Cum-Comprehension Type Questions having **5** MCQs with ONLY ONE correct option, **3** marks for each Correct Answer and 0 marks in all other cases.
  Section V has **2** Matching Type Questions, **2** mark for the correct matching of each row and 0 marks in all other cases.
- You have to evaluate your Response Grids yourself with the help of Solutions.

Section I - Straight Objective Type

This section contains 6 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** is correct.

1. If P_c, V_c and T_c are critical constants, then the value of R will be

(a) $R = \frac{P_c V_c}{T_c}$ (b) $R = \frac{5}{3} \cdot \frac{P_c V_c}{T_c}$

(c) $R = \frac{3}{2} \cdot \frac{P_c V_c}{T_c}$ (d) $R = \frac{8}{3} \frac{P_c V_c}{T_c}$

2. 14 g of N_2 and 36 g of ozone are at the same pressure and temperature . Their volumes will be related as

(a) $2V_{N_2} = 3V_{O_3}$

(b) $3V_{N_2} = 2V_{O_3}$

(c) $3V_{N_2} = 4V_{O_3}$

(d) $4V_{N_2} = 3V_{O_3}$

RESPONSE GRID **1.** ⓐⓑⓒⓓ **2.** ⓐⓑⓒⓓ

3. A perfect gas is found to obey the relation $PV^{3/2}$ = constant. If the gas is compressed to half of its volume at temperature T adiabatically, the final temperature of the gas will be

(a) $2T\sqrt{2}$ (b) 4T (c) $T\sqrt{2}$ (d) 2T

4. When $CO_2(g)$ is passed over red hot coke it partially gets reduced to CO(g). Upon passing 0.5 L of $CO_2(g)$ over red hot coke, the total volume of the gases increased to 700 mL. The composition of the gaseous mixture at STP is

(a) $CO_2 = 300$ mL; CO = 400 mL
(b) $CO_2 = 0.0$ mL; CO = 700 mL
(c) $CO_2 = 200$ mL; CO = 500 mL
(d) $CO_2 = 350$ mL; CO = 350 mL

5. The ratio between most probable velocity, mean velocity and r.m.s velocity is :

(a) $\sqrt{2} : \sqrt{8/\pi} : \sqrt{3}$ (b) $\sqrt{2} : \sqrt{3} : \sqrt{8/\pi}$
(c) $1 : 2 : 3$ (d) $1 : \sqrt{2} : \sqrt{3}$

6. Virial equation of state can be written as follows to express the compressibility factor (*Z*).

$$Z = 1 + \frac{B}{V} + \frac{C}{V^2} + \frac{D}{V^3} + ...$$

The correct relationship for van der Waal's constant '*b*' is

(a) $B = b$ (b) $B = b - \frac{a}{RT}$
(c) $b = D^3$ (d) $b = C^2$

Section II - Multiple Correct Answer Type

This section contains 4 multiple correct answer(s) type questions. Each question has 4 choices (a), (b), (c) and (d), out of which **ONE OR MORE** is/are correct.

7. A car tyre has a volume of 10 litre when inflated. The tyre is inflated to a pressure of 3 atm at 17°C with air. Due to driving the temperature of tyre increases to 47°C. Choose the correct options –

(a) Pressure at this temperature is 2.3103 atm.
(b) 3.1029 L of air should be let out at 1 atm to restore the tyre to 3 atm at 47°C.
(c) Pressure at this temperature is 3.3103 atm.
(d) 2.1029 L of air should be let out at 1 atm to restore the tyre to 3 atm at 47°C.

8. The van der Waal's constants for HCl are 371.843 KPa and $b = 40.8$ $cm^3 mol^{-1}$. Choose the correct options–

(a) The critical pressure is 8.273 MPa
(b) The critical temperature is 224.8 K
(c) The critical volume is 122.4 cm^3
(d) The critical temperature is 324.8 K

9. A gas described by van der Waal's equation –

(a) behave similar to an ideal gas in the limit of large molar volumes
(b) behaves similar to an ideal gas is in limit of large pressures
(c) is characterised by van der Waal's coefficients that are dependent on the identity of the gas but are independent of the temperature.
(d) has the pressure that is lower than the pressure exerted by the same gas behaving ideally

10. Select the correct statements of the following :

(a) Ideal gas can be liquefied by cooling it to a very low temperature and applying a very high pressure
(b) Helium can be liquefied by cooling it to a characteristic temperature and compressing
(c) At ordinary temperatures compressed helium gas get heated up when passed through an orifice into vacuum under adiabatic conditions
(d) At ordinary temperatures hydrogen is less compressible than an ideal gas

Section III - Integer Type

This section contains 4 questions. The answer to each of the questions is a single digit integer ranging from 0 to 9.

11. A 10 L box contains 41.4 g of a mixture of gases C_xH_8 and C_xH_{12}. The total pressure at 44°C in flask is 1.56 atm. Analysis revealed that the gas mixture has 87% total C and 13% total H. Find out the value of *x*.

12. A gas diffuse1/5 times as fast as hydrogen. If its molecular weight is 10y. What will be the value of y?

RESPONSE GRID

3. ⓐⓑⓒⓓ 4. ⓐⓑⓒⓓ 5. ⓐⓑⓒⓓ 6. ⓐⓑⓒⓓ 7. ⓐⓑⓒⓓ
8. ⓐⓑⓒⓓ 9. ⓐⓑⓒⓓ 10. ⓐⓑⓒⓓ 11. ⓪①②③④⑤⑥⑦⑧⑨
12. ⓪①②③④⑤⑥⑦⑧⑨

13. The rate of diffusion of methane at a given temperature is twice that of a gas *X*. If the molecular weight of *X* is 8 y then what will be the value of y?

14. At 400 K, the root mean square (rms) speed of a gas **X** (molecular weight = 40) is equal to the most probable speed of gas **Y** at 60 K. The molecular weight of the gas **Y** is

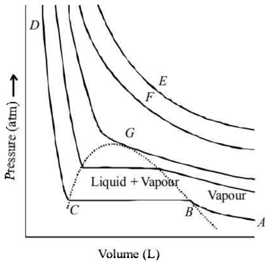
Section IV - Comprehension Type

Directions (Qs. 15-18) : Based upon the given paragraphs, 4 multiple choice questions have to be answered. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** is correct.

PARAGRAPH-1

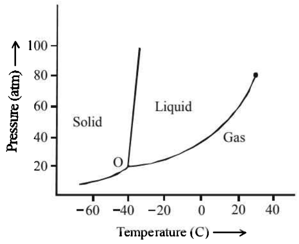
In the Figure-1 below, isotherms of CO_2 at several temperatures near the critical point are shown. At the critical point (critical state), the distinction between the liquid and gaseous states disappears and the density of the gaseous substance is equal to that in the liquid state. For every gas this occurs at specific values of temperature and pressure, called critical temperature and critical pressure respectively. At temperatures and pressures above the critical point value, a gas is said be in a supercritical state. The supercritical fluid has the density and ability to dissolve other substances similar to values expected for liquids.

Figure-2 depicts the phase diagram of CO_2. Various curves in the diagram show the equilibrium between two phases and the areas represent different phases. The point, called triple point, describing the equilibrium between three phases has specific values of temperature and pressure.



Isotherms of CO_2

Figure 1



Phase diagram of CO_2

Figure 2

15. According to Figure-2 what is the critical temperature and pressure of CO_2?

(a) – 42° C and 10 atm

(b) – 38°C and 80 atm

(c) 31.1°C and 75.3 atm

(d) 31.1°C and 1 atm

16. According to Fig.-1, which of the following is correct when CO_2 is compressed at a temperature corresponding to the isotherm ABCD?

(a) Liquefaction of CO_2 is complete at the point *B*

(b) Liquefaction of CO_2 is complete at the point *C*

(c) Volume of CO_2 system remains constant along *BC*

(d) Proportions of liquid and gaseous CO_2 do not change along *BC*.

PARAGRAPH-2

The ideal gas equation, $PV = nRT$ is not obeyed by real gases under certain conditions. The deviation from ideal behaviour was attributed to the fact that P_{ideal} is related to P_{real} by the equation

$$P_{\text{ideal}} = P_{\text{real}} + \frac{an^2}{V^2}$$

In this '*a*' is a measure of intermolecular interaction between gaseous molecules that gives rise to non-ideal behaviour.

Again the volume correction was introduced by taking into account the volume occupied by gaseous molecules and the effective volume is $(V - nb)$, where nb represents the volume occupied by n moles of molecules of real gas.

van der Waals equation of real gases is written as

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

17. The van der Waals equation for real gases will reduce to which one of the following forms under conditions of relatively high pressure?

(a) $PV = RT - Pb$

(b) $PV = RT + Pb$

(c) $PV = RT - \frac{a}{V^2}$

(d) $PV = RT - \frac{a}{V^2}$

RESPONSE GRID	
	13. ⓪①②③④⑤⑥⑦⑧⑨ 14. ⓪①②③④⑤⑥⑦⑧⑨ 15. ⓐⓑⓒⓓ 16. ⓐⓑⓒⓓ 17. ⓐⓑⓒⓓ

18. The van der Waals equation for a gas that has non-zero value of force of attraction between molecules but has the molecules to be point masses, will become

(a) $PV = nRT + nbP$
(b) $P(V - nb) = nRT$
(c) $PV = nRT$
(d) $PV = nRT - \frac{an^2}{V}$

Section V - Matrix-Match Type

This section contains 2 questions. It contains statements given in two columns, which have to be matched. Statements in column I are labelled as A, B, C and D whereas statements in column II are labelled as p, q, r and s. The answers to these questions have to be appropriately bubbled as illustrated in the following example. If the correct matches are A-p, A-r, B-p, B-s, C-r, C-s and D-q, then the correctly bubbled matrix will look like the following:

	p	q	r	s
A	●	○	●	○
B	●	○	○	●
C	○	○	●	●
D	○	●	○	○

19. T_b and T_i are the Boyle's and inversion temperatures respectively for a real gas. Match the following characteristics with appropriate temperatures.

Column I (Gas Characteristics)		**Column II (Temperature)**
(A) Attractive intermolecular forces become dominant over repulsive forces when	p.	$>T_i$
(B) Repulsive forces become dominant	q.	$< T_i$
(C) Gas becomes more or less ideal gas when	r.	Any value of temperature
(D) $\mu_{J.T.}$ for ideal gas is zero at	s.	$= T_b$

20. The van der waal's constants a and b of a real gas are 3.6 L^2 atm mol^{-2} and 0.05 L mol^{-1} respectively. If 200 g of gas (molecular mass 40) is placed in 10 L vessel at 300 K, then match the following:

Column I		**Column II**
(A) Pressure correction (atm)	p.	0.25
(B) Free space for the molecules to move about (L)	q.	0.06
(C) Actual volume occupied by gas molecules (L)	r.	0.9
(D) Effective volume occupied by gas molecules (L)	s.	9.75

RESPONSE GRID	18. ⓐⓑⓒⓓ ; 19. A - ⓟⓠⓡⓢ; B - ⓟⓠⓡⓢ; C - ⓟⓠⓡⓢ; D - ⓟⓠⓡⓢ 20. A - ⓟⓠⓡⓢ; B - ⓟⓠⓡⓢ; C - ⓟⓠⓡⓢ; D - ⓟⓠⓡⓢ

DAILY PRACTICE PROBLEM DPP CHAPTERWISE 5 - CHEMISTRY			
Total Questions	20	Total Marks	74
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	26	Qualifying Score	37
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

DAILY PRACTICE PROBLEMS

CHEMISTRY SOLUTIONS

DPP/CC05

1. **(d)** $R=\frac{PV}{T}$

At critical point $V=V_c$

and $(V-V_c)^3=0$

Expanding this equation, we have

$$V^3-3V_c.V^2+3V_c^2.V-V_c^3=0 \qquad ..(i)$$

The vander waals equation in critical point is

$$V^3-\left(b+\frac{RT_c}{P_c}\right)V^2+\left(\frac{a}{P_c}\right)V-\frac{ab}{P_c}=0 \qquad ...(ii)$$

Comparing (i) and (ii), we get

$$V_c=3b, P_c=\frac{a}{27b^2}, T_c=\frac{8a}{27Rb}$$

Eliminating constants a and b from the values of critical constants, we obtain

$$R=\frac{8P_cV_c}{3T_c}$$

2. **(b)** At the same conditions of T and P, $V \alpha n$

$$n_{N_2}=\frac{14}{28}=\frac{1}{2};\ V_{N_2}\alpha\frac{1}{2} \qquad n_{O_3}=\frac{36}{48}=\frac{3}{4};\ V_{O_3}\alpha\frac{3}{4}$$

Hence, $V_{N_2}/V_{O_3}=\frac{2}{3},\ 3V_{N_2}=2V_{O_3}$

3. **(c)** $PV^{\frac{3}{2}}$ = constant.

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

$\therefore\ \frac{nRT}{V}\times V^{\frac{3}{2}}$ = constant (K)

or, $TV^{\frac{1}{2}}=\frac{K}{nR}$ = K' (constant)

For two states, $T_1V_1^{\frac{1}{2}}=T_2V_2^{\frac{1}{2}}$

$$T_2=T_1\left(\frac{V_1}{V_2}\right)^{\frac{1}{2}}$$

But $V_2=\frac{V_1}{2}$ (given)

$$\therefore\ T_2=T_1\left(\frac{V_1}{\frac{V_1}{2}}\right)^{\frac{1}{2}}=T_1\sqrt{2}$$

4. **(a)** $CO_2+C\longrightarrow 2CO$

Stoichiometry ratio is 1 : 2

AT STP, P = 1 atm, T = 273 K, R = 0.0821

Initial moles of CO_2; $n(CO_2\text{initial})=\frac{PV}{RT}$

$=\frac{1\times0.5}{0.0821\times273}$ = 0.022 mole

In final mixture no. of moles; $n(CO_2/CO$ mixture)

$=\frac{1\times0.7}{0.0821\times273}$ = 0.031

Increase in volume is by = 0.031 – 0.022

= 0.009 mole of gas

Final no. of moles of CO i.e. $n_{(CO\ final)}$

$n_{(CO\ final)}=2n_{(CO2\ initial)}-n_{(CO2\ final)}$

$=2(0.022-n_{(CO2\ final)})$ ...(i)

$n_{(CO\ final)}=0.044-2n_{(CO2\ final)}$ ...(ii)

$\therefore$ Now, $n_{(CO\ final)}+n_{(CO2\ final)}=0.031$

$n_{(CO2\ final)}=0.031-n_{(CO\ final)}$ ...(ii)

Substituting (ii) in eq. (i)

$n_{(CO\ final)}=0.044-2[0.031-n_{(CO\ final)}]$

$n_{(CO\ final)}=0.044-0.062+2n_{(CO\ final)}$

$n_{(CO\ final)}=0.018$ mol.

Volume of CO $=V=\frac{nRT}{P}=\frac{0.018\times0.0821\times273}{1}$

= 0.40 Litre

and volume of CO_2 = 0.7 litre – 0.4 litre

= 0.3 litre

$\therefore$ CO_2 = 300 mL, CO = 400 mL

5. **(a)** Most probable velocity $=\sqrt{\frac{2RT}{M}}$

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

Root mean square velocity $=\sqrt{\frac{3RT}{M}}$

$\therefore$ Most probable velocity : Average velocity : Root mean square velocity

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

6. **(b)** The van der Waals equation is

$$\left(P+\frac{a}{V^2}\right)(V-b)=RT \quad \text{(For one mole)}$$

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

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

Multiplying throughout by molar volume (V) and dividing by RT, we have

$$\frac{PV}{RT}=\frac{V}{V-b}-\frac{a}{RTV} \text{ or } \frac{PV}{RT}=\left(\frac{V-b}{V}\right)^{-1}-\frac{a}{RTV}$$

$$\text{or } \frac{PV}{RT}=\left(1-\frac{b}{V}\right)^{-1}-\frac{a}{RTV}$$

$$\text{or } \frac{PV}{RT}=1+\frac{b}{V}+\frac{b^2}{V^2}+\frac{b^2}{V^3}-\frac{a}{RTV}$$

$$\text{or } \frac{PV}{RT}=1+\left(b-\frac{a}{RT}\right)\times\frac{1}{V}+\frac{b^2}{V^2}+\frac{b^3}{V^3}$$

Comparing this with virial equation we get

$$B=b-\frac{a}{RT}$$

7. **(b, c)** Given $V=10$ litre, $P=3$ atm, $T=290$ K

After driving $V=10$ litre $\qquad P=?$

$$\frac{P_1V_1}{T_1}=\frac{P_2V_2}{T_2} \qquad \therefore V_1=V_2=10 \text{ lit},$$

$$\therefore \frac{P_1}{T_1}=\frac{P_2}{T_2} \text{ or } P_2=\frac{P_1}{T_1}\times T_2$$

$$\text{or } P_2=3\times\frac{320}{290}=3.3103 \text{ atm.}$$

$\therefore$ Pressure of the gas in the tyre at 47°C = 3.3103 atm.

At pressure 3.103 atm, the volume of tyre is 10 lit.

$\therefore$ Volume of tyre at 3 atm pressure

$$=\frac{3.3103\times 10}{3}=11.03433 \text{ lit.}$$

$\therefore$ The volume which is to be reduced at 3 atm pressure

$$=11.03433-10=1.03433 \text{ lit.}$$

$\therefore$ The volume which is to be reduced at 1 atm pressure

$$=\frac{1.03433\times 3}{1}=3.1029 \text{ lit.}$$

$\therefore$ 3.1029 lit of air should be let out at 1 atm to restore the tyre to 3 atm at 47°C.

8. **(a,c,d)** The critical pressure,

$$P_C=\frac{a}{27b^2}=\frac{371.843\times 10^3}{27\times(40.8)^2\times 10^{-6}}$$

$$=\frac{371.843\times 10^9}{27\times(40.8)^2}=8.273\times 10^6 \text{ Pa}=8.273 \text{ MPa}$$

The critical temperature, $T_C=\dfrac{8a}{27Rb}$

$R=8.314$ KPa dm^3 K^{-1} mol^{-1}

$$T_C=\frac{8a}{27Rb}=\frac{8.371.843}{8.314\times 27\times 40.8\times 10^{-3}}$$

$$=324.79=324.8 \text{ K.}$$

The critical volume, $V_C=3b=3\times 40.8=122.4$ cm^3

9. **(a, c)** van der Waal's equation is

$$\left(P+\frac{n^2a}{V^2}\right)(V-nb)=nRT \quad \text{[For n moles of a gas)}$$

a, b are van der Waal's constants

The ideal gas equation is $PV=nRT$ [For n moles of a gas] where P is pressure excerted by ideal gas and V is volume occupied by ideal gas.

In van der Waal's equation the term $\left(P+\dfrac{n^2a}{V^2}\right)$ represents the pressure exerted by the gas and ($V-nb$) the volume occupied by the gas. At low pressure, when the gas occoupies large volume the intermolecular distance between gaseous moleculas is quite large and in such case there is no significant role played by intermolecular forces and thus the gas behaves like an ideal gas thus (a) is correct

NOTE : Under high pressure the intermolecular distance decreases and the intermolecular forces play a significant role and the gas shows a devation from ideal behaviour. Thus (b) is *not* correct.

a, b i.e. the van der Waal's coefficients defined on the nature of gas and are independent of temperature so (c) is correct.

The pressure $\left(P+\dfrac{n^2a}{V}\right)$ is not lower than P so (d) is not correct.

Hence the correct answer is (a, c).

10. **(b,c,d)** (a) An ideal gas cannot be liquefied at any temperature for any pressure. It is due to the absence of intermolecular forces.

(b) Helium, a real gas, can be liquefied by cooling it to critical temperature or below and applying high pressure.

(c) The inversion temperature of helium is much below the room temperature. Hence, it shows heating effect during Joule-Thompson porous plug streaming of the gas at ordinary temperatures.

(d) Compressibility factor $\left(Z=\dfrac{PV}{RT}\right)$ of hydrogen is greater than unity

11. **(5)** Given, $P=1.56$ atm; $V=10$ L

$T=317$ K; $R=0.082$

$$\text{Total moles } (n)=\frac{PV}{RT}=\frac{1.56\times 10}{0.082\times 317}=0.6 \text{ mol}$$

Let C_xH_8 be a mol, therefore moles of $C_xH_{12} = (0.6 - a)$ mol; mass of C in a mol of $C_xH_{12} = 12ax$ g; mass of C in $(0.6 - a)$ mol of $C_xH_{12} = 12 \times (0.6 - a)$ g

$\therefore$ Total mass of C in mixture $= 12ax + 12x(0.6 - a)$ g $= 41.4$ g

$$\% \text{ of } C \text{ in mixture } = \frac{7.2x}{41.4} \times 100$$

Given % of C = 87%

$$\text{or } \frac{720x}{41.4} = 87 \text{ or } x = 5$$

12. **(5)** $r_g = \frac{1}{5} \cdot r_{H_2}$

$$\frac{M_g}{M_{H_2}} = \left[\frac{r_{H_2}}{r_g}\right]^2 = (5)^2 = 25; M_g = 2 \times 25 = 50$$

$10\,y = 50 \Rightarrow y = 5$

13. **(8)** $\frac{r_{CH_4}}{r_x} = 2 = \sqrt{\frac{M_x}{M_{CH_4}}} = \sqrt{\frac{M_x}{16}}$, or $M_x = 64$

$8\,y = 64 \Rightarrow y = 8$

14. **(4)** v_{rms} of X $= \sqrt{\frac{3RT_x}{M_x}}$; v_{mp} of Y $= \sqrt{\frac{2RT_y}{M_y}}$

Given $v_{rms} = v_{mp}$

$$\Rightarrow \sqrt{\frac{3RT_x}{M_x}} = \sqrt{\frac{2RT_y}{M_y}}$$

$$\Rightarrow M_y = \frac{2RT_yM_x}{3RT_x} = \frac{2 \times 60 \times 40}{3 \times 400} = 4$$

15. **(c)** The curve representing the gas-liquid equilibrium ends at the *dark* point, the critical point. Above the temperature corresponding to this point, CO_2 can not be liquefied for any value of pressure. Temperature and pressure corresponding to the *dark* point are T_c and P_c.

16. **(b)** At point B, liquefaction of CO_2 commences and is complete at the point C. Along the line BC the proportion of gas phase of CO_2 decreases and that of liquid phase increases, and hence the volume of the system decreases along the line BC.

17. **(b)** For one mole of real gas, we have

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

Under conditions of high pressure

$$P + \frac{a}{V^2} \approx P$$

$\therefore$ The above equation becomes

$P(V - b) = RT$

or $PV - Pb = RT$

or $PV = RT + Pb$

18. **(d)** Since the value of $b = 0$ in case of molecules to be point masses

$\therefore$ The van der Waals' equation will become

$$\left(P + \frac{an^2}{V^2}\right)(V - 0) = nRT \quad (\because b = 0, \text{ so } nb = 0)$$

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

$$\text{or} \quad PV + \frac{an^2}{V} = nRT \quad \text{or} \quad PV = nRT - \frac{an^2}{V}$$

19. **A-q; B-p, C-s; D-r**

(A) At temperature $< T_i$, $\mu_{JT} = \left[\left(\frac{dT}{dP}\right)_H\right]$ becomes positive, i.e. cooling effect takes place in streaming process. It suggests that the forces between the gas molecules are attractive in nature.

(B) At temperature $> T_i$, μ_{JT} is negative which suggests the existance of repulsive forces between the gas molecules.

(C) At Boyle's temperature and above, a real gas obeys gas laws over a wide range of pressure.

(D) In ideal gas the intermolecular forces do not exist. Hence Joule-Thompson effect is zero.

20. **A-r; B-s; C-q; D-p**

(A) Pressure correction $= \frac{an^2}{V^2}$

$$= \frac{3.6(L^2 atm\, mol^{-2})}{10^2 (L^2)} \times \left(\frac{200}{40}\right)^2 (mol^2) = 0.9 \text{L atm}$$

(B) Free space $= V - nb = 10 - 5 \times 0.05 = 9.75L$

(C) Actual volume of gas molecules

$$= \frac{nb}{4} = \frac{5 \times 0.05}{4} = 0.06L$$

(D) Effective volume of gas molecules

$= nb = 5 \times 0.05 = 0.25L$