JEE Mains 2019 Chapter wise Question Bank

Gaseous State - Questions

Q1

0.5 moles of gas A and x moles of gas B exert a pressure of 200 Pa in a container of volume 10 m^3 at 1000 K. Given R is the gas constant in JK^{-1} mol^{-1}, x is:

(1) $\frac{2R}{4+R}$ (2) $\frac{2R}{4-R}$

(3) $\frac{4+R}{2R}$ (4) $\frac{4-R}{2R}$

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Q2

The volume of gas A is twice than that of gas B. The compressibility factor of gas A thrice than that of gas B at same temperature. The pressures of the gases for equal number of moles are:

(1) $3P_A=2P_B$ (2) $2P_A=3P_B$

(3) $P_A=3P_B$ (4) $P_A=2P_B$

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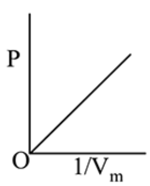
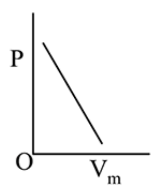
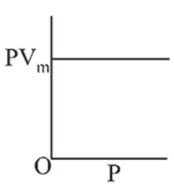
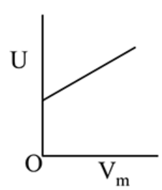
Q3

The combination of plots which does not represent isothermal expansion of an ideal gas is:

(A) 

(B) 

(C) 

(D) 

(1) (B) and (D) (2) (A) and (C)

(3) (B) and (C) (4) (A) and (D)

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Q4

An open vessel at 27°C is heated until two fifth of the air (assumed as an ideal gas) in it has escaped from the vessel. Assuming that the volume of the vessel remains constant, the temperature at which the vessel has been heated is :

(1) 500°C (2) 500 K

(3) 750°C (4) 750 K

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Q5

Consider the van der Waals constants, a and b, for the following gases,

Gas	Ar	Ne	Kr	Xe
a/ (atm dm^6 mol^{-2})	1.3	0.2	5.1	4.1
b/ (10^{-2} dm^3 mol^{-1})	3.2	1.7	1.0	5.0

Which gas is expected to have the highest critical temperature?

(1) Kr (2) Ne (3) Xe (4) Ar

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Q6

At a given temperature T, gases Ne, Ar, Xe and Kr are found to deviate from ideal gas behaviour. Their equation of state is given

as $P = \frac{RT}{V-b}$ at T.

Here, b is the van der Waals constant. Which gas will exhibit steepest increase in the plot of Z (compression factor) vs P?

(1) Xe (2) Kr (3) Ne (4) Ar

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Q7

Consider the following table :

Gas	a/(k Pa dm^{6}mol^{-1})	b/(dm^{3}mol^{-1})
A	642.32	0.05196
B	155.21	0.04136
C	431.91	0.05196
D	155.21	0.4382

a and b are van der waals constants. The correct statement about the gases is :

(1) Gas C will occupy more volume than gas A; gas B will be more compressible than gas D

(2) Gas C will occupy lesser volume than gas A; gas B will be lesser compressible than gas D

(3) Gas C will occupy more volume than gas A; gas B will be lesser compressible than gas D

(4) Gas C will occupy lesser volume than gas A; gas B will be more compressible than gas D

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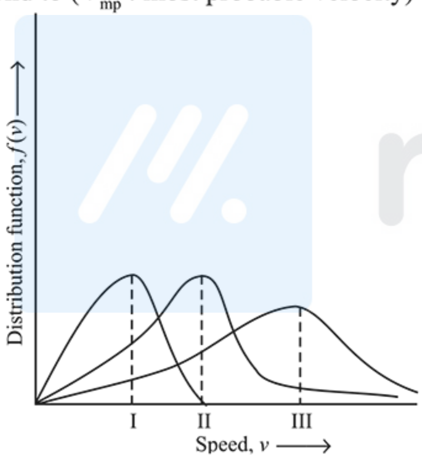
Q8

Points I, II and III in the following plot respectively correspond to (V_{mp} : most probable velocity)



(1) V_{mp} of N_2 (300 K); V_{mp} of O_2 (400 K); V_{mp} of H_2 (300 K)

(2) V_{mp} of O_2 (400 K); V_{mp} of N_2 (300 K); V_{mp} of H_2 (300 K)

(3) V_{mp} of N_2 (300 K); V_{mp} of H_2 (300 K); V_{mp} of O_2 (400 K)

(4) V_{mp} of H_2 (300 K); V_{mp} of N_2 (300 K); V_{mp} of O_2 (400 K)

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Gaseous State – Answers

Q1

$= \sqrt{5(5+2)} = \sqrt{35} = 5.92$ BM

(4) 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 are $0.5 + x$)

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

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Q2

(2) Compressibility factor is given by,

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

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

Given $\quad Z_A = 3Z_B$

$$V_A = 2V_B$$

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

$$3 = \frac{P_A}{P_B} \times 2$$

$$2P_A = 3P_B$$

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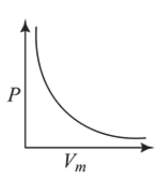
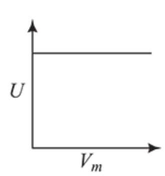
Q3

(1) Isothermal expansion

$PV_m = K$ (graph - C)

$P = \dfrac{K}{V_m}$ (graph - A)





Therefore (B) and (D) are not correct representation.

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Q4

(2) At 27°C or 300 K number of moles of an ideal gas $= n_1$

At T_2 K number of moles of the ideal gas $= n_2$

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

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

$PV = nRT$ (Ideal gas equation)

At constant volume and pressure.

$$n \propto \frac{1}{T};\ n_1 T_1 = n_2 T_2$$

$$T_2 = \frac{n_1}{n_2} T_1;\ T_2 = \frac{n_1}{\frac{3n_1}{5}} \times T_1$$

$$= \frac{5}{3} \times 300 = 500 \text{ K}$$

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Q5

(1) Critical temperature $= \dfrac{8a}{27Rb}$

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

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Q6

(1) $P = \dfrac{RT}{V_m - b}$

$\Rightarrow PV_m - Pb = RT$

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

[Where Z (compressibility factor) = PVm/RT]

Slope of Z vs P curve (straight line) = $\dfrac{b}{RT}$

$\therefore$ Higher the value of b, more steep will be the curve.
Constant 'b' value depends on size of atom or molecule.

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Q7

(1) 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 and, therefore, lesser distance between its moleucles. 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 and, therefore, will be more compressible.

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Q8

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

From curve,

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

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

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

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