PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 34

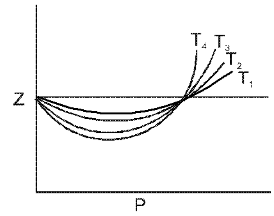
Total Marks : 29

Max. Time : 31 min.

Topic : Gaseous State

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Multiple choice objective ('–1' negative marking) Q.4 to Q.6	(4 marks, 4 min.)	[12, 12]
Subjective Questions ('–1' negative marking) Q.7 to Q.8	(4 marks, 5 min.)	[8, 10]

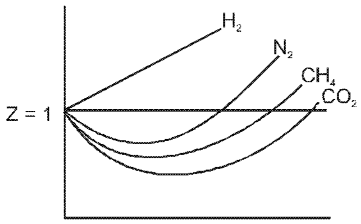
1. Which of the following is correct order of temperature shown in the above graph Z Vs P for the same gas :



(A) $T_4 < T_3 < T_2 < T_1$ (B) $T_1 < T_2 < T_3 < T_4$
(C) $T_1 < T_2 < T_4 < T_3$ (D) $T_3 < T_4 < T_2 < T_1$

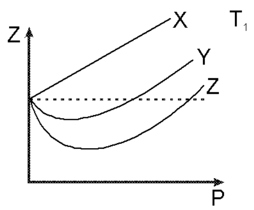
2. A real gas most closely approaches the behaviour of an ideal gas at :
(A) low pressure & low temperature (B) high pressure & high temperature
(C) low pressure & high temperature (D) high pressure & low temperature

3. What is the correct increasing order of liquifiability of the gases shown as in above graph :

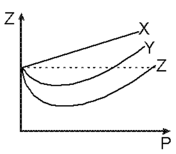


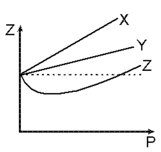
(A) $H_2 < N_2 < CH_4 < CO_2$ (B) $CO_2 < CH_4 < N_2 < H_2$
(C) $H_2 < CH_4 < N_2 < CO_2$ (D) $CH_4 < H_2 < N_2 < CO_2$

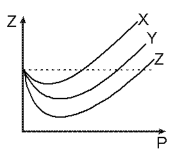
4.* Z vs P graph is plotted for 1 mole of three different gases X, Y and Z at temperature T_1.

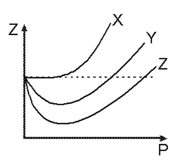


Then, which of the following may be correct if the above plot is made for 1 mole of each gas at T_2 temperature ($T_2 < T_1$) :

(A) 

(B) 

(C) 

(D) 

5.* Which of the following statements regarding compressibility factor (Z) is/are correct :

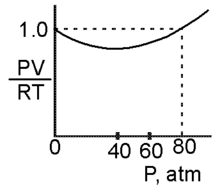
(A) In the lower pressure region, value of Z initially decreases on increasing pressure and then increases, however H_2 and He gases are exception to this.

(B) Z for an ideal gas is greater than one.

(C) Z for a non-ideal gas can be greater than or less than unity depending on temperature and pressure.

(D) When Z < 1, intermolecular attraction dominates over intermolecular repulsion.

6.* The Vander waal's equation of state for a non-ideal gas can be rearranged to give $\frac{PV}{RT} = \frac{V}{V-b} - \frac{a}{VRT}$ for 1 mole of gas. The constants a & b are positive numbers . When applied to H_2 at 80K, the equation gives the curve as shown in the figure. Which one of the following statements is(are) correct :



(A) At 40 atm, the two terms V/(V – b) & a/VRT are equal.

(B) At 80 atm, the two terms V/(V – b) & a/VRT are equal.

(C) At a pressure greater than 80 atm, the term V/(V – b) is greater than a/VRT.

(D) At 60 atm, the term V/(V – b) is smaller than $1+\frac{a}{VRT}$.

7. Compressibility factor (Z) for N_2 at – 23°C and 820 atm pressure is 1.9. Find the number of moles of N_2 gas required to fill a gas cylinder of 95 L capacity under the given conditions.

8. Find the temperature at which the translational kinetic energy of hydrogen atom is equal to the transition energy of electron between $n_1 = 1$ and $n_2 = 2$ levels. (Take : Boltzmann constant $K = 1.36 \times 10^{-23}$ J/K.)

Answer Key

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1.	(A)	2.	(C)	3.	(A)	4.*	(ACD)
5.*	(ACD)	6.*	(CD)	7.	2000	8.	80000 K

Hints & Solutions

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1. $T_4 < T_3 < T_2 < T_1$

2. A real gas behaves idealy under conditions of low pressure and high temperature .

3. Order of Vander waals constant $CO_2 > CH_4 > N_2 > H_2$
$\therefore$ ease of liqufication $CO_2 > CH_4 > N_2 > H_2$

5.* Z for an ideal gas is equal one.

6. Clearly, from the graph at 80 K = $\frac{PV}{RT}$ = 1 and at 60K, Z < 1

7. $Z = \frac{PV}{nRT} \Rightarrow n = \frac{PV}{ZRT}$

8. Translational energy = (3/2) kT
= (3/2) kT = hcR_H ((1/1) – (1/4))

$$= (3/2)\ T = 6.626 \times 10^{-34} \times 2.996 \times 10^{10} \times 109679 \times (3/4)\ \frac{6.02 \times 10^{23}}{8.315}$$

= 118331.1 K
T = 118331.1 × 2/3 = 80000 K.