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CHEMISTRY

DAILY PRACTICE PAPER (DPP)

GASEOUS STATE – FOR REAL GASES

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Unit - Gaseous State **Topic - Real Gases** **DPP - 1**

Objective Problems

01-05 The extent of deviation of real gases from ideal behavior, can be expressed in terms of compressibility factor (Z). Corrected ideal gas equation is written as : PV = nZRT

Where symbols have their usual meaning. The reasons why real gases deviate from ideal behavior can be explained by kinetic theory of gases. For a real gas, compressibility factors (Z) have different values in different pressure zones, but its value is fixed at critical state.

01. Compressibility factor of a real gas at very high temperature and very low pressure, is :

(A) < 1 (B) = 1

(C) > 1 (D) Slightly more than one

02. Compressibility factor (Z) for a real gas at moderately low pressure is given as :

(A) $\frac{PV}{RT}$ (B) $\left[1+\frac{bP}{RT}\right]$

(C) $\left[1-\frac{a}{RTV}\right]$ (D) None of these

03. At critical state, compressibility factor (Z) is equal to :

(A) $\frac{3}{8}$ (B) $\frac{8}{3}$ (C) $\frac{4}{3}$ (D) $\frac{3}{4}$

04. Identify the conditions of pressure and temperature at which a real gas shows maximum deviation from ideality :

(A) 10 atm, 273 K (B) 5 atm, 273 K

(C) 10 atm, 373 K (D) 5 atm, 373 K

05. A real gas can be liquefied by :

(A) First cooling it upto its critical temperature and then applying a minimum pressure over it.

(B) First applying a definite pressure and then cooling it upto its critical temperature.

(C) Decreasing the temperature only.

(D) Increasing the pressure only.

06. The compressibility factor z = $\frac{PV}{nRT}$ of a gas above T = $\frac{a}{Rb}$ will be :

(A) less than unity (B) greater than unity

(C) equal to unity (D) none of these

07. Compressibility constant of an ideal gas is :

(A) 0 (B) 1 (C) 2 (D) 3

08. For a hypothetical gas containing molecules as point masses and having non-zero intermolecular forces, which of the following is correct :

(A) The gas will show positive deviation from ideal behavior.

(B) The compressibility factor $\frac{PV}{nRT}$ >1.

(C) The gas is more compressible than the ideal gas under equivalent conditions.

(D) The gas is difficult to be compressed compared to ideal gas.

09. Amongst the following statements, the correct one is :

(A) The gas can not be compressed below the critical temperature.

(B) Below critical temperature thermal motion of the molecules is slow enough for the intermolecular forces to come into play leading to condensation of the gas.

(C) At critical temperature liquid and gaseous phase can be distinguished.

(D) An ideal gas has a characteristic critical temperature.

10. The Van der Waal's equation for 1 mol of a real gas may be rearranged to give :

$$V_m^3 - \left(b+\frac{RT}{P}\right)V_m^2 - \frac{a}{P}V_m - \frac{ab}{P} = O$$

V_m being the molar volume of the gas, indicate the correct statement amongst the following :

(A) At temperature greater than T_c, there are three values of V_m, one real and two imaginary.

(B) At temperature T_c, the three real values of V_m are identical.

(C) At temperature less than T_c there are three real values of V_m.

(D) All are correct.

11. A real gas most approaches the behaviour of an ideal gas at:

(A) 1 atm and 273 K (B) 0.5 atm and 500 K

(C) 15 atm and 200 K (D) 15 atm and 500 K

12. The compressibility factor $Z = \frac{PV}{RT}$ for 1 mol of a real gas is greater than unity at a pressure of 1 atm and 273.15 K. The molar volume of the gas at STP will be :

(A) less than 22.4 L (B) greater than 22.4 L

(C) equal to 22.4 L (D) none of these

13. The vander Waal's constants for gases A, B and C are as follows :

Gas	a(L^2 atm mol^{-2})	b(L mol^{-1})
A	0.024	0.027
B	4.17	0.037
C	3.59	0.043

Based upon the above data, which of the following statements is correct?

(i) The gas B has the highest critical temperature.

(ii)The gas A has minimum departure from the ideal behavior.

(iii)The gas C has largest molecular volume.

(A) (i) (B) (i) and (ii)

(C) (ii) and (iii) (D) All the three

14. Compressiblility factor for 1 mol of a Van der Waals gas at 0°C and 100 atmospheric pressure is found to be 0.5, the volume of gas molecule is:

(A)2.0224 L (B) 1.4666 L

(C) 0.8542 L (D) 0.1119 L

15. A gas has non–zero value of force of attraction between the molecules but has the molecules to be point masses. The van der Waal's equations for the gas will be :

(A) PV = nRT + nbP (B) P(V – nb) = nRT

(C) PV = nRT (D) $PV = nRT - \frac{an^2}{V}$

16. Van dar Waal's real gas, act as an ideal gas, at which condition?

(A) High temperature, low pressure

(B) Low temperature, high pressure

(C) High temperature, high pressure

(D) Low temperature, low pressure

17. van der Waals equation $\left[P + \frac{a}{V^2}\right](V - b) = RT$ is applicable for:

(A) ideal gas (B) non-ideal gas

(C) both (A) and (B) (D) none of these

18. If V is the volume of one molecule of gas under given conditions, the Vander Waal's constant b is:

(A) 4 V (B) $\frac{4V}{N_0}$ (C) $\frac{N_0}{4V}$ (D) $4VN_0$

19. Which equation shows correct form of Berthelot's equation?

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

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

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

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

20. Positive deviation of real gases from ideal behavior takes place because of :

(A) molecular interactions and $\frac{PV}{nRT} > 1$

(B) molecular interactions and $\frac{PV}{nRT} < 1$

(C) finite size of molecules and $\frac{PV}{nRT} < 1$

(D) finite size of molecules and $\frac{PV}{nRT} > 1$

21. Van der Waals equation for one mol of CO_2 gas at low pressure will

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

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

(C) $P = \frac{RT}{(V-b)}$

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

22. A real gas is expected to be behave non-ideally at

(A) low temperature and low pressure

(B) low temperature and high pressure

(C) high temperature and low pressure

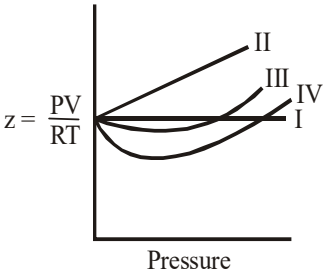
(D) high temperature and high pressure

23. The value of van der Waals constant '***a***' for the gases O_2, N_2, CO_2 and CH_4 are 1.36, 1.39, 3.64 and 2.253 L^2 atm mol^{-2}, respectively. The gas which can be most easily liquefied is

(A) O_2 (B) N_2

(C) CO_2 (D) CH_4

24. For the non-zero volume of molecules having no forces of attraction, the variation of compressibility factor $z = \frac{PV}{RT}$ with pressure is given by the graph :



(A) I (B) II

(C) III (D) IV

25. Which of the following statements is/are correct?
(A) All real gases are less compressible than ideal gas at high pressures
(B) Hydrogen and helium are more compressible than ideal gas for all values of pressure.
(C) Except H_2 and He, the compressibility factor $z = \left(\frac{PV}{nRT}\right) < 1$ for all gases at low pressures.
(D) The compressibility factor of real gases is independent of temperature.

26. The behaviour of real gas is generally depicted by plotting which of the following parameter vs pressure
(A) critical volume (B) density
(C) T_{ideal}/T_{real} (D) V_{real}/V_{ideal}

27. Which of the following gas has highest value of '***a***'?
(A) Ne (B) O_2 (C) Cl_2 (D) N_2

28. In Vander Waals equation of state for a non ideal gas, the term that accounts for intermolecular forces is :
(A) (v - b) (B) RT (C) $\left(P + \frac{a}{v^2}\right)$ (D) $(RT)^{-1}$

29. The temperature at and above which real gases obey the ideal gas laws over wide range of pressure is:
(A) Inversion temperature
(B) Boyle temperature
(C) Critical temperature
(D) Reduced temperature

30. Which of the following is/are the characteristic/s of a real gas?
(a) The molecules attract each other
(b) It shows deviations from the ideal gas law
(c) It obeys the gas law at low temperature and high pressure
(d) The mass of the molecules is negligible
The correct answer is:
(A) a, b (B) b, c (C) c, d (D) a, c

31. At very high pressures the vander Waals equation reduces to:
(A) $pV = RT + pb$ (B*) $p = \frac{RT}{V-b}$
(C) $pV = \frac{aRT}{V^2}$ (D) $pV = RT - \frac{a}{V}$

32. Attractive forces and size effects in a gaseous system can be neglected at:
(A) Low temerature and high pressure
(B) Low temperature
(C) The critical point
(D) Low pressure and high temperature

33. A real gas obeying the vander waal's equation will closely resemble an ideal gas if:
(A) The parameters of a and b are very small
(B) a is large and b is small
(C) a is small but b is large
(D) Both a and b are large

34. The van der waals equation at low pressure may be written as:
$(V)(P + a/V^2) = RT$
The compressibility factor would be
(A) (1-a/RTV) (B) (1-RTV/a)
(C) (1+a/RTV) (D) (1+RTV/a)

35. Van der Waals equation
(A) describes the behaviour of ideal gas
(B) describes the behaviour of real gases
(C) takes into account the effects of intermolecular forces
(D) considers the attractions and repulsions between molecules as negligible

36. The vander waals constant for gases X, Y and Z are as follows:

Gas	a	b
X	4.0	0.027
Y	12.0	0.030
Z	6.0	0.032

(A) The highest critical temperature gas Y
(B) The largest molecular volume gas Z
(C) Most ideal behaviour at STP gas X
(D) None of the above

37. Consider the following statements:
(a) Molecules of different gases have the same kinetic energy at a given temperature
(b) The total kinetic energy for two moles of an ideal gas is equal to 3RT
(c) The ratio of specific heat at constant pressure and the specific heat at constant volume for noble gases is 1.33
(d) The gas with a larger value of the ratio of critical temperature to critical pressure (T_c/P_c) will have larger value of excluded volume "b"
of these statements:

(A) a, b and c are correct
(B) b, c and d are correct
(C) a, c, and d are correct
(D) a, b, and d are correct

38. The term that accounts for intermolecular force in van der Waals' equation for non ideal gas is :

(A) RT (B) V – b

(C) $\left(P + \frac{a}{V^2}\right)$ (D) $[RT]^{-1}$

39. Pressure of real gas is less than the pressure of ideal gas because :

(A) No. of collisions increases
(B) Difinite shape of molecule
(C) K.E. of molecule increases
(D) Inter molecular forces

40. At relatively high pressure, van der waals' equation reduces to

(A) PV = RT (B) $PV = RT + \frac{a}{V}$

(C) PV = RT + Pb (D) $PV = RT - \frac{a}{V^2}$

Subjective Problems

01. Vander Waals constant b of Ar is 3.22×10^{-5} m^3mol^{-1}. Calculate molecular diameter of Ar.

02. Using van der Waal's equation, calculate the constant, 'a' when two mole of a gas confined in a four litre flask exerts a pressure of 11.0 atmospheres at a temperature of 300 K. The value of 'b' is 0.05 $lit.mol^{-1}$.

03. One way of writing the equation of state for real gases is $PV = RT\left[1 + \frac{B}{V} + ...\right]$ where B is a constant. Derive an approximate expression for B in terms of van der Waal's constants a and b.

04. The compression factor (compressibility factor) for 1 mole of a van der Waal's gas at 0°C and 100 atmosphere pressure is found to be 0.5. Assuming that the volume of gas molecule is negligible, calculate the van der Waal's constant a.

05. Calculate the pressure exerted by one mole of CO_2 gas at 273 k, if the Vander Waals constant a = 3.592 dm^6 atm mol^{-2}. Assume that the volume occupied by CO_2 molecules is negligible.

Ans. $P = \left(\frac{22.413}{v} - \frac{3.592}{v^2}\right)$ **atm**

06. The compression factor (compressibility factor) for one mole of a van der Waals gas at 0°C and 100 atmosphere pressure is found to be 0.5. Assuming that the volume of a gas molecule is negligible, calculate the van der waals constant a.

Ans. **a = 1.254 atm litre^2 mol^{-2}**

07. Calculate the molecular diameter of helium from its Vander Waals const. b = 24 mL mol^{-1}.

Ans. **267 pm**

08. Using vander Waals equation, calculate the constant 'a' when two moles of a gas confined in a four litre flask exerts a pressure of 11.0 atm at a temperature of 300 K. The value of 'b' for the gas is 0.05 L mol^{-1}.

Ans. **6.46 L^2 atm mol^{-2}**

09. Is it possible to cool the gas below absolute zero?

10. Why aerated water bottles ar kept under water during summer?

11. Why a liquid boils at lower temperature at the top of a mountain that at sea level?

12. Why are vegetables cooked with difficulty at the top of a mountain?

13. The tyre of an automobile is inflated to a slightly lower pressure in summer than in winter. Explain?

14. "Liquefaction of H_2 and He is very difficult." Explain the statement.

15. Why real gases show ideal behaviour at low pressure?

Que.	01	02	03	04	05
Ans.	**B**	**C**	**D**	**A**	**A**
Que.	06	07	08	09	10
Ans.	**C**	**B**	**C**	**B**	**D**
Que.	11	12	13	14	15
Ans.	**B**	**B**	**D**	**D**	**D**
Que.	16	17	18	19	20
Ans.	**A**	**B**	**D**	**C**	**D**
Que.	21	22	23	24	25
Ans.	**D**	**B**	**B**	**B**	**AC**
Que.	26	27	28	29	30
Ans.	**D**	**C**	**C**	**B**	**A**
Que.	31	32	33	34	35
Ans.	**A**	**D**	**A**	**A**	**BC**
Que.	36	37	38	39	40
Ans.	**B**	**D**	**C**	**D**	**C**

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Thank you for your love and support, we hope you are always being happy and get success in your life, we are happy to see you again.

Regards from Learnaf team