MISCELLANEOUS EXERCISE

Choose the correct options for each of the following questions. Questions marked with * may have more than one correct options.

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

(A) 15 atm and 200 K **(B)** 1 atm and 273 K
(C) 0.5 atm and 500 K **(D)** 15 atm and 500 K

2. At 27°C, hydrogen is leaked through tiny hole into a vessel for 20 minutes. Another unknown gas at the same temperature and pressure as that of H_2 is leaked through the same hole for 20 min. After the effusion of the gases the mixture exerts a pressure of 6 atm. The H_2 content of the mixture is 0.7 moles. If the volume of the container is 3 L, what is the molecular weight of the unknown gas ?

(A) 1088 **(B)** 10.88
(C) 108.8 **(D)** None of these

3. 10 ml of a gaseous organic compound containing C, H and O only was mixed with 100 ml of O_2 and exploded under conditions which allowed the water formed to condense. The volume of the gas after explosion was 90ml. On treatment with NaOH solution, a further contraction in volume of 20 ml was observed. Given the vapour density of the compound as 23, deduce the molecular formula of the compound. All volume measurements were carried out under the same conditions.

(A) C_2H_4O **(B)** C_2H_6O
(C) C_3H_6O **(D)** None of these

4. 5 ml of a gas containing only carbon and hydrogen were mixed with an excess of oxygen (30 ml) and the mixture exploded by means of an electric spark. After the explosion, the volume of the mixed gases remaining was 25 ml. On adding a concentrated solution of potassium hydroxide, the volume further diminished to 15 ml of the residual gas being pure oxygen. All volumes have been reduced to N.T.P. Calculate the molecular formula of the hydrocarbons gas.

(A) C_2H_6 **(B)** C_3H_6
(C) C_2H_4 **(D)** None of these

5. Consider the following statements :
The mean free path of gas molecules
I: decreases with increase in concentration
II: increases with decrease in pressure at constant temperature
III: decreases with increase in molecular size
Which of the above statements are correct?

(A) I, II **(B)** I, III **(C)** II, III **(D)** I, II, III

6. One mole of nitrogen gas at 0.8 atm takes 38 s to effuse through a pinhole, whereas one mole of an unknown compound of xenon with fluorine at 1.6 atm takes 57 s to effuse through the same hole. Calculate the molecular formula of the compound.

(A) XeF_6 **(B)** XeF_2
(C) XeF_4 **(D)** None of these

7. The average velocity of gas molecules is 400 m/sec. Calculate its rms velocity at the same temperature.

(A) 434.1 ms^{-1} **(B)** 368.5 ms^{-1}
(C) 489.9 ms^{-1} **(D)** None of these

8. A graph is plotted between PV_m along Y-axis and P along X-axis, where V_m is the molar volume of a real gas. Find the intercept along Y-axis.

(A) $(RT)^{-1}$ **(B)** RT
(C) 1 **(D)** None of these

9. 1.0 litre of N_2 and 7/8 litre of O_2 at the same temperature and pressure were mixed together. What is the relation between the masses of the two gases in the mixture ?

(A) 1 **(B)** 0.5 **(C)** 2 **(D)** 4

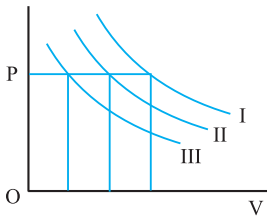
10. The volumes of two vessels at same temperature are in the ratio of 2 : 3. One vessel contains H_2 and other N_2 at 600 mm and 900 mm respectively. The final pressure when they are connected together is : (Assume that N_2 and H_2 react to form NH_3)

(A) 620mm **(B)** 760mm
(C) 780mm **(D)** 800mm

11. The rate of effusion of two gases 'a' and 'b' under identical conditions of temperature and pressure are in the ratio of 2 : 1. What is the ratio of rms velocity of their molecules if T_a and T_b are in the ratio of 2 : 1 ?

(A) 2 : 1 **(B)** $\sqrt{2}$: 1
(C) $2\sqrt{2}$: 1 **(D)** 1 : $\sqrt{2}$

12. I, II, III are three isotherms respectively at T_1, T_2 and T_3. Temperature will be in order :



(A) $T_1 = T_2 = T_3$
(B) $T_1 < T_2 < T_3$
(C) $T_1 > T_2 > T_3$
(D) $T_1 > T_2 = T_3$

13. An evacuated glass vessel weighs 50 gm when empty, 148.0 gm when filled with a liquid of density 0.98 gm ml^{-1} and 50.5 gm when filled with an ideal gas at 760 mm of Hg at 300 K. What is the mol. Wt. of the gas ?

(A) 100 **(B)** 110 **(C)** 122 **(D)** 90

***14.** Which of the following statement is (are) correct ?

(A) The slope of Z vs P at constant temperature for all real gases, is b/RT

(B) The slope of Z vs P at constant temperature for both He and H_2 is b/RT

(C) The slope of Z vs P at low pressure for all real gases, at constant temperature is b/RT

(D) The slope of Z vs P at high pressure and at constant temperature for real gas is –b/RT

15. Which of the following statements is (are) correct for a gas X having molar mass 5g and density 0.3g/litre at 0.5 atmospheric pressure at 300 K ?

(A) The gas "X" will behave ideally

(B) The force of attraction will dominate over the force of repulsion among the gas molecules

(C) The force of repulsion will dominate over the force of attraction among the gas molecules

(D) None of these

16. Under same conditions of temperature and pressure, a hydrocarbon of molecular formula C_nH_{2n-2} was found to diffuse $3\sqrt{3}$ times slower than hydrogen. Find the value of n.

(A) n = 2 **(B)** n = 4
(C) n = 3 **(D)** n = 1

17. At 47°C and 16.0 atm, the molar volume of NH_3 gas is about 10% less than the molar volume of an ideal gas. This is due to :

(A) NH_3 decomposes to N_2 and H_2 at 47°C

(B) The force of attraction between NH_3 molecules is significant at this temperature and pressure

(C) The volume occupies by NH_3 molecules themselves is a significant fraction of the volume of the con tainer at this temperature and pressure

(D) at 16 atm, NH_3 molecules no longer move randomly

***18.** For an ideal gas, under isobaric condition, a graph between log V vs log T :

(A) is linear with unit slope

(B) represents Boyle's Law

(C) represents Charle's Law

(D) represents Gay-Lussac's Law

***19.** A gas described by van der Waals equation :

(A) behaves similar to an ideal gas in the limit of large molar volumes

(B) behaves similar to an ideal gas in the limit of large pressures

(C) is characterised by van der Waals 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 ex erted by the same gas behaving ideally

***20.** At STP, a container has 1 mole of Ar, 2 moles of CO_2, 3 moles of O_2 and 4 moles of N_2. Without changing the total pressure if one mole of O_2 is removed, the partial pressure of O_2 :

(A) is changed by about 26%

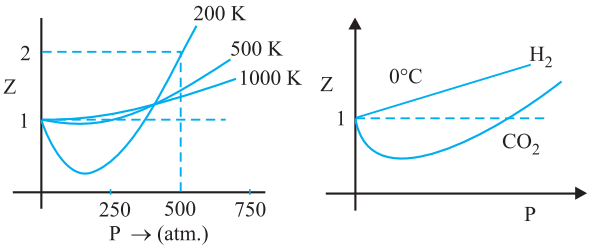
(B) is halved

(C) is unchanged

(D) changed by 33%

For Q.21 - 24

Sketch shows the plot of Z vs P for 1 mol of a hypothetical gas at three distinct temperature.



Boyle's temperature is the temperature at which a gas shows ideal behaviour over a pressure range in the low pressure region. Boyle's temperature $(T_b) = \frac{a}{Rb}$. If a plot is obtained at temperatures well below Boyle's temperature then the curve will show negative deviation, in low pressure region and positive deviation in the high pressure region. Near critical temperature the curve is more likely as CO_2 and the temperature well above critical temperature curve is more like H_2 at (0°C) as shown above. At high pressure suppose all the constant temperature curve varies linearly with pressure according to the following equation :

$$Z = 1 + \frac{Pb}{RT} \; (R = 2 \text{ cal mol}^{-1} \text{ K}^{-1})$$

21. Which of the following is correct :

(A) $\frac{a}{b} < 0.4 \text{ k cal mol}^{-1}$

(B) $0.4 \text{ k cal mol}^{-1} < \frac{a}{b} < 2 \text{ k cal mol}^{-1}$

(C) $\frac{a}{b} > 0.4 \text{ k cal mol}^{-1}$

(D) $\frac{a}{b} = 1 \text{ K cal mol}^{-1}$

22. For 500 K plot the value of Z changes from 2 to 2.2 if pressure is varied from 1000 atm to 1200 atm (high pressure) then the value of b/RT will be :

(A) 10^{-3} atm^{-1} **(B)** $2 \times 10^{-3} \text{ atm}^{-1}$

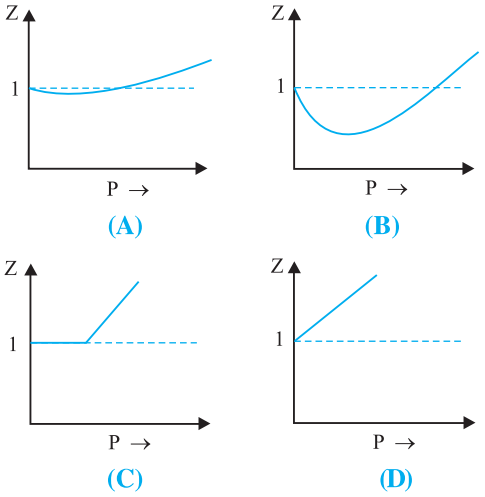
(C) $5 \times 10^{-4} \text{ atm}^{-1}$ **(D)** 10^{-4} atm^{-1}

23. As shown in the figure at 200 K and 500 atm value of compressibility factor is 2 (approx). Then molar volume of the gas at this point will be :

(A) 0.01 L **(B)** 0.09 L

(C) 0.065 L **(D)** 0.657 L

24. Plot at Boyle's temperature for the gas will be :



(A) **(B)** **(C)** **(D)**

ANSWERS TO IN-CHAPTER EXERCISES

A

1.(a) 102 °C **(b)** 220 **(c)** 2.68×10^{10} **2.** 0.4, 2.4×10^{23}, 0.8 **3.** % N_2 = 82.5, % O_2 = 17.5

4.(i) B **(ii)** A **(iii)** A **(iv)** A **(v)** A **(vi)** B **(vii)** A

(viii) BD **(ix)** B **(x)** B **(xi)** C **(xii)** D **(xiii)** B **(xiv)** A

(xv) D

B

1. % CO_2 = 60, % CO = 40 **2.** C_2H_2 **3.** % CH_4 = 65, % C_2H_2 = 35 **4.** % O_2 = 41.67, % CO_2 = 58.33

5.(i) B **(ii)** C **(iii)** C **(iv)** A **(v)** D

C

1.(a) 4 **(b)** 1200 K **(c)** No effect **(d)** No effect

2. C_{rms} = 460.13 m/s, C_{avg} = 429.9 m/s, C_{MP} = 375.9 m/s **3.(a)** 9.84 atm **(b)** 9.32 atm

4.(a) 17.06 **(b)** 1092 **(c)** 4 **5.(i)** B **(ii)** A **(iii)** BCD

(iv) AD **(v)** C **(vi)** D **(vii)** B **(viii)** C **(ix)** A **(x)** D

(xi) D **(xii)** A **(xiii)** A **(xiv)** A **(xv)** C **(xvi)** C **(xvii)** D

ANSWERS TO MISCELLANEOUS EXERCISE

1. C	**2.** A	**3.** B	**4.** C	**5.** D	**6.** A	**7.** A
8. B	**9.** A	**10.** A	**11.** C	**12.** C	**13.** C	**14.** B
15. B	**16.** B	**17.** B	**18.** AC	**19.** ACD	**20.** A	**21.** D
22. A	**23.** C	**24.** A				