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www.askiitians.com
Email: info@askiitians.com
Tel: 1800-2000-838

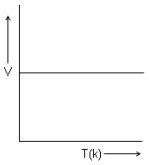
Class: XI
Subject: Chemistry
Topic: States of Matter
No. of Questions: 28

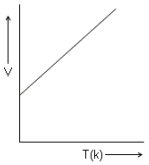
1. Which of the following liquids will exhibit the highest vapour pressure?

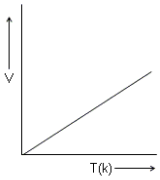
A. $C_2H_5OH(\ell)$
B. $NH_3(\ell)$
C. $HF(\ell)$
D. $H_2O(\ell)$

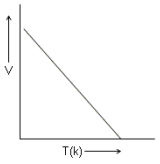
Right Answer Explanation: B
H-bonds in liquid NH_3 are the weakest. Hence, its escaping tendency is the highest and as a result its vapour pressure will be the highest.
The strength of H-bonding is in the order
N ..... H < O.....H < F.....H

2. The correct representation of Charle's law is given in

A. 

B. 

C. 

D. 

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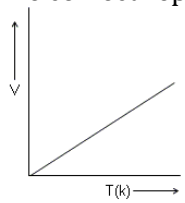
Right Answer Explanation: C
The volume of a given mass of an ideal gas is directly proportional to its temperature on the absolute temperature scale (in Kelvin) if pressure and the amount of gas remain constant; that is, the volume of the gas increases or decreases by the same factor as its temperature.
The correct representation of Charle's law is given in



3. One mole of a gas refers to

A. the number of molecules in one litre of gas
B. the number of molecules in one gram of gas
C. the number of molecules contained in 12 grams of ^{12}C isotope
D. the number of molecules in 22.4 litres of a gas at S.T.P.

Right Answer Explanation: D
One mole of a gas refers to the number of molecules in 22.4 litres of a gas at S.T.P.

4. Which of the following represents the units of Vander Waal's constant 'a'?

A. $L\ mol^{-1}$
B. $atm\ L^2\ mol^{-2}$
C. $L\ atm\ mol^{-1}$
D. $L\ atm\ mol^{-2}$

Right Answer Explanation: B

$\frac{an^2}{V^2} = p$ or $a = \frac{pV^2}{n^2} = atm\ L^2 mol^{-2}$

5. With increase in pressure, the mean free path

A. increases
B. becomes zero
C. decreases
D. remains constant

Right Answer Explanation: C
With increase in pressure, the mean free path decreases.

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6. Which of the following is not heavier than dry air?

A. Moist air
B. SO_2
C. Cl_2
D. None of these

Right Answer Explanation: A
Out of the two gases, the gas with higher vapour density is heavier.
The vapour density of dry air is 14.4, but vapour density of moist air lies between 14.4 and 9.
Hence, moist air is lighter than dry air.

7. In the gas equation PV = nRT, the value of R would depend only on

A. the nature of the gas
B. the volume of the gas
C. constant
D. the units of measurement

Right Answer Explanation: D
The value of R depends on the units of measurement. It has different values in different units.

8. Which of the following is a postulate of kinetic theory of gases?

A. Gases combine in simple ratio
B. There is no attraction between gaseous molecules
C. There is no influence of gravity on gas
D. Atom is indivisible

Right Answer Explanation: C
There is no influence of gravity on gas molecule is a postulate of kinetic theory of gases.

9. Gases become ideal at

A. high temperature and high pressure
B. low pressure and high temperature
C. low temperature and low pressure
D. high pressure and low temperature

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Right Answer Explanation: B
At low pressure and high temperature, the pressure correction and volume correction in Vander walls equation are neglected due to greater volume of gases under these conditions.

10. The KE of gas molecules is equal to

A. $\frac{3RT}{2}$
B. $\frac{2RT}{3}$
C. $\frac{RT}{2}$
D. $\frac{2R}{3}$

Right Answer Explanation: A

The KE of gas molecules is equal to $\frac{3RT}{2}$.

11. The temperature at which real gases obey the ideal gas laws over a wide range of pressure is called

A. Critical temperature
B. Boyle temperature
C. Inversion temperature
D. Reduced temperature

Right Answer Explanation: B
In thermodynamics, the Boyle temperature is the temperature at which a non-ideal gas behaves most like an ideal gas

12. Which gas is most soluble in water?

A. H_2S
B. NH_3
C. SO_2
D. CO_2

Right Answer Explanation: B
Because NH_3 forms hydrogen bond with H_2O.

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13.The van der Waals equation is true for

A. Ideal gas
B. Real gas
C. Gaseous substance
D. None

Right Answer Explanation: B
The van der Waals equation is valid for real gases.

14. Which of the following represents the Avogadro number?

A. The number of molecules present in 1 L of gas at NTP
B. The number of molecules present in 22.4 L of gas at NTP
C. The number of molecules present in 22.4 L of gas at 298 K and 1 atm. pressure
D. The number of molecules present in one mole of gas at any temperature and pressure

Right Answer Explanation: D
The Avogadro number is the number of molecules present in one mole of gas at any temperature and pressure.

15. The mass of 11.2 L of ammonia gas at STP is

A. 8.5 g
B. 85 g
C. 17 g
D. 1.7 g

Right Answer Explanation: A

$$22.4\ \text{L} = 17\ \text{g}$$

$$11.2\ \text{L} = \frac{17}{22.4} \times 11.2 = 8.5\ \text{g}$$

16. Two moles of H-atoms at NTP occupy a volume of

A. 11.2 L
B. 44.8 L
C. 2 L
D. 22.4 L

Right Answer Explanation: B

$\because$ Volume of 1 mol any gas at NTP
$= 22.4L$
$\therefore$ Volume of 2 moles of H_2 gas at NTP
$= 2 \times 22.4L$
$= 44.8\ L$

17. _____ is a collision in which there is no net loss of energy rather, there is transfer of energy.

A. Effusion
B. Elastic collision
C. Magnetic collision
D. Electric collision

Right Answer Explanation: B
An elastic collision is an encounter between two bodies in which the total amount of kinetic energy of all colliding particles is conserved. The net effect of these elastic collisions is that there is a transfer of kinetic energy across the boundary to the particles on the opposite side. The total kinetic energy of the two bodies after the encounter is equal to their total kinetic energy before the encounter.

18. The temperature below which a gas becomes cooler on expansion, is called

A. critical temperature
B. transition temperature
C. inversion temperature
D. Boyle's temperature

Right Answer Explanation: C
The temperature below which a gas becomes cooler on expansion, is called inversion temperature.

19. The rates of diffusion of gases are inversely proportional to the square root of their

A. volumes
B. temperatures
C. pressures
D. molecular masses

Right Answer Explanation: D

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Graham's law of diffusion states that the rates of movement of gases at the same temperature and pressure are inversely proportional to the square roots of their molar masses.

20. Separation of a mixture of gases on the basis of the difference in their rates of diffusion is called

A. hydrolysis
B. atmolysis
C. electrolysis
D. osmosis

Right Answer Explanation: B
Separation of a mixture of gases on the basis of the difference in their rates of diffusion is called atmolysis.

21. A vessel of 120 mL capacity contains a certain amount of gas at 35° C and 1.2 bar pressure. The gas is transferred to another vessel of volume 180 mL at 35 °C What would be its pressure?

Ans: Given, Initial pressure, p_1 = 1.2 bar
Initial, volume, V_1 = 120 mL
Final pressure, V_2 = 180 mL
Since the temperature remains constant, the final pressure (p_2) can be calculated using Boyle's law. According to Boyle's law,

$$p_1V_1 = p_2V_2$$

$$P_2 = \frac{p_1V_1}{V_2}$$

$$= \frac{1.2 \times 120}{180} bar$$

$$= 0.8\, bar$$

Therefore, the pressure would be 0.8 bar.

22. What will be the pressure exerted by a mixture of 3.2 g of methane and 4.4 g of carbon dioxide contained in a 9 dm^3 flask at 27 °C ?
Ans: It is known that, $P=\frac{m}{M}\frac{RT}{V}$

For methane (CH_4), $P_{CH4} = \frac{3.2}{16} \times \frac{8.314 \times 300}{9 \times 10^{-3}} \left[\begin{matrix} Since\ 9\ dm^3 = 9 \times 10^{-3} m^3 \\ 27^oC = 300\ K \end{matrix}\right]$

For carbon dioxide (CO_2),

$P_{CO2} = \frac{4.4}{44} \times \frac{8.314 \times 300}{9 \times 10^{-3}}$

$= 2.771 \times 10^4$ Pa

Total pressure exerted by the mixture can be obtained as:

$P = P_{CH4} + P_{CO2}$

$= (5.543 \times 10^4 + 2.771 \times 10^4)$Pa

$= 8.314 \times 10^4$ Pa

Hence, the total pressure exerted by the mixture is 8.314×10^4 Pa.

23. Calculate the temperature of 4.0 mol of a gas occupying 5 dm^3 at 3.32 bar. (R=0.083 bar dm^3 K^{-1} mol^{-1}).

Ans: Given, n = 4.0 mol v = 5 dm^3 p = 3.32 bar R = 0.083 bar dm^3 K^{-1} mol^{-1}

The temperature (T) can be calculated using the ideal gas equation as:

PV= nRT

$\Rightarrow T = \frac{pV}{nR}$

$= \frac{3.32 \times 5}{4 \times 0.083}$

= 50 K

Hence, the required temperature is 50 K.

24. A mixture of dihydrogen and dioxygen at one bar pressure contains 20% by weight of dihydrogen. Calculate the partial pressure of dihydrogen.

Ans: Let the weight of dihydrogen be 20 g and the weight of dioxygen be 80 g.

Then, the number of moles of dihydrogen, $n_{H2} = \frac{20}{2}$ = 10 moles and the number of moles of dioxygen, $n_{o2} = \frac{80}{32}$ = 2.5 moles

Given, Total pressure of the mixture, p_{total} = 1 bar

Then, partial pressure of dihydrogen,

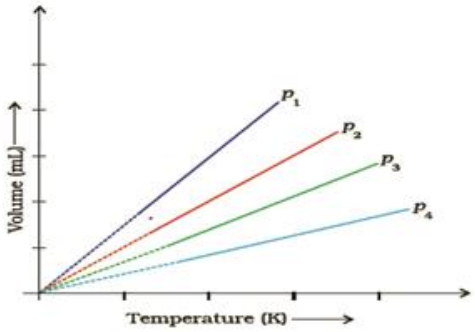
$$P_{H_2} = \frac{n_{H_2}}{n_{H_2} + n_{o_2}} \times P_{total}$$

$$= \frac{10}{10 + 2.5} \times 1$$

$$= 0.8\, bar$$

Hence, the partial pressure of dihydrogen is 0.8 bar.

25. A plot of volume (V) versus temperature (T) for a gas at constant pressure is a straight line passing through the origin. The plots at different values of pressure are shown in Fig. 5.1 Which of the following order of pressure is correct for this gas?



(i) $P_1 > P_2 > P_3 > P_4$
(ii) $P_1 = P_2 = P_3 = P_4$
(iii) $P_1 < P_2 < P_3 < P_4$
(iv) $P_1 < P_2 = P_3 < P_4$

Ans (3)

26. What would be the SI unit for the quantity pV^2T^2/n?

Ans: The SI unit for pressure, P is Nm^{-2}
The SI unit for volume, V is m^3
The SI unit for temperature, T is K.
The SI unit for the number of moles, n is mol.

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Therefore, the SI unit for quantity $\frac{pV^2T^2}{n}$ is given by,

$= \frac{(Nm^{-2})(m^3)^2(K)^2}{mol}$

$=Nm^4 K^2 mol^{-1}$

27. Gases possess characteristic critical temperature which depends upon the magnitude of intermolecular forces between the particles Following are the critical temperatures of some gases.

Gases	H_2	He	O_2	N_2
Critical temperature In Kelvin	33.2	5.3	154.3	126

From the above data what would be the order of liquefaction of these gases? Start writing the order from the gas liquefying first

(i) H_2, He, O_2, N_2
(ii) He, O_2, H_2, N_2
(iii) N_2, O_2, He, H_2
(iv) O_2, N_2, H_2, He

Ans (4)

28. Explain the physical significance of Van der Waals parameters.

Ans: Physical significance of 'a':
'a' is a measure of the magnitude of intermolecular attractive forces within a gas.
Physical significance of 'b':
'b' is a measure of the volume of a gas molecule.