PHYSICS

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KINETIC THEORY OF GASES

Textbook Questions Answers I Multiple Choice Questions

1. A particle of mass m is moving with speed u in a direction which 60° with respect to x - axis. It undergoes elastic collision with the wall. What is the

change in momentum in x and y direction ?

A. $\Delta p_x = -\mathrm{mu}, \Delta p_y = 0$

B. $\Delta p_x = -2\mathrm{mu}, \Delta p_y = 0$

C. $\Delta p_x = 0, \Delta p_y = \mathrm{mu}$

D. $\Delta p_x = \mathrm{mu}, \Delta p_y = 0$

Answer: A

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2. A sample of ideal gas is at equilibrium. Which of the following quantity is zero?

A. rms speed

B. average speed

C. average velocity

D. most probable speed

Answer: C

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3. An ideal gas is maintained at constant pressure. If the temperature of an ideal gas increase from 100K to 1000K then the rms speed of the gas molecules:

A. increases by 5 times

B. increases by $\sqrt{10}$ times

C. remains same

D. increases by 7 times

Answer: B

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4. Two identically sized rooms A and B are connected by an open door. If the room A is air conditioned such that its temperature is 4° lesser than room B, which room has more air in it?

A. Room A

B. Room B

C. Both room has same air

D. Cannot be determined

Answer: A

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5. The average translational kinetic energy of gas molecules depends on

A. number of moles and T

B. only on T

C. P and T

D. P only

Answer: D

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6. If the internal energy of an ideal gas U and volume V are doubled, then the pressure of the gas :

A. doubles

B. remains same

C. halves

D. quadruples

Answer: B

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7. The ratio $\gamma = \frac{C_P}{C_V}$ for a gas mixture consisting of 8 g of helium and 16 g of oxygen is

A. $23/15$

B. $15/23$

C. $27/11$

D. $17/27$

Answer: A::B::C

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8. A container has one mole of monoatomic ideal gas. Each molecule has f degrees of freedom. What is the ratio of $\gamma = \frac{C_P}{C_V}$

A. f

B. $\frac{f}{2}$

C. $\frac{f}{f+2}$

D. $\frac{f+2}{f}$

Answer: D

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9. If the temperature and pressure of a gas is doubled the mean free path of the gas molecules

A. remains same

B. doubled

C. tripled

D. quadrupled

Answer: A

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10. Which of the following shows the correct relationship between the pressure and density of an ideal gas at constant temperature ?

A. 

B. 

C. 

D. 

Answer: D

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11. A sample of gas consists of μ_1 moles of monoatomic molecules, μ_2 moles of diatomic molecules and μ_3 moles of linear triatomic molecules. The gas is kept at high temperature. What is the total number of degrees of freedom?

A. $[3\mu_1 + 7(\mu_2 + \mu_3)]N_A$

B. $[3\mu_1 + 7\mu_2 + 6\mu_3]N_A$

C. $[7\mu_1 + 3(\mu_2 + \mu_3)]N_A$

D. $[3\mu_1 + 6(\mu_2 + \mu_3)]N_A$

Answer: A

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12. If S_P and S_V denote the specific heats of nitrogen gas per unit mass at constant pressure and constant volume respectively, then

A. $s_p - s_V = 28R$

B. $s_p - s_V = R/28$

C. $s_p - s_v = R/14$

D. $s_p - s_v = R$

Answer: B

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13. Which of the following gases will have least rms speed at a given temperature?

A. Hydrogen

B. Nitrogen

C. Oxygen

D. Carbon dioxide

Answer: D

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14. For a given gas molecule at a fixed temperature , the area under the Maxwell - Boltzmann distribution curve is equal to :

A. $\frac{PV}{kT}$

B. $\frac{kT}{PV}$

C. $\frac{P}{NkT}$

D. PV

Answer: A

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15. A particle of mass m is moving with speed u in a direction which 60° with respect to x - axis. It undergoes elastic collision with the wall. What is the change in momentum in x and y direction ?

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Answer: A

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C. average velocity

D. most probable speed

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C. 

D. 

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B. $[3\mu_1 + 7\mu_2 + 6\mu_3]N_A$

C. $[7\mu_1 + 3(\mu_2 + \mu_3)]N_A$

D. $[3\mu_1 + 6(\mu_2 + \mu_3)]N_A$

Answer: A

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B. Nitrogen

C. Oxygen

D. Carbon dioxide

Answer: D

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28. For a given gas molecule at a fixed temperature , the area under the Maxwell - Boltzmann distribution curve is equal to :

A. $\frac{PV}{kT}$

B. $\frac{kT}{PV}$

C. $\frac{P}{NkT}$

D. PV

Answer: A

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Textbook Questions Answers Ii Short Answer Questions

1. What is the microscopic origin of pressure?

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2. What is the microscopic origin of pressure?

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3. Why moon has no atmosphere?

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4. Write the expression for rms speed, average speed and most probable speed of a gas molecule.

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5. What is the relation between the average kinetic energy and pressure?

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6. Define the term degrees of freedom.

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7. State the law of equipartition of energy.

Watch Video Solution

8. Define mean free path and write down its expression.

Watch Video Solution

9. Kinetic theory

Watch Video Solution

10. Deduce Boyle's law based on kinetic theory.

Watch Video Solution

11. State Avogadro's law.

Watch Video Solution

12. List the factors affecting the mean free path.

Watch Video Solution

13. What is the reason for Brownian motion?

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Textbook Questions Answers Iii Long Answer Questions

1. State the postulates of kinetic theory of gases?

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2. Derive the expression pressure exerted by the gas on the walls of the container.

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3. Explain in detail the kinetic interpretation of temperature .

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4. Define the term degrees of freedom.

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5. Derive the ratio of two specific heat capacities of monatomic, diatomic and triatomic molecules.

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6. Explain in detail the Maxwell Boltzmann distribution function.

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7. What is mean free path? Derive an expression for mean free path.

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8. Describe the Brownian motion.

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9. Write down the postulates of kinetic theory of gases.

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10. Gas exerts pressure on the walls of the container

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11. Explain in detail the kinetic interpretation of temperature .

Watch Video Solution

12. Define the term degrees of freedom.

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13. The ratio of specific to molar heat capacity of a body

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14. According to Maxwell Boltzmann distribution of energy

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15. Derive the expression for mean free path the of the gas.

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16. Describe the Brownian motion.

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Textbook Questions Answers Iv Numerical Problems

1. A fresh air is composed of ntirogen $N_2(78\,\%)$ and oxygen $O_2(21\,\%)$. Find the rms speed of N_2 and O_2 at $20^\circ C$.

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2. If the rms speed of methane gas in the Jupiter's atmosphere is $471.8ms^{-1}$, show that the surface temperature of Jupiter is sub-zero.

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3. Calculate the temperature at which the rms velocity of a gas triples its value at S.T.P. $[T_1 = 273K]$

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4. A gas is at temperature $80^\circ C$ and pressure $5 \times 10^{-10} Nm^{-2}$. What is the number of molecules per m^3 if Boltzmann's constant is $1.38 \times 10^{-23} JK^{-1}$

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5. From kinetic theory of gases, show that Moon cannot have atmosphere (Assume $k = 1.38 \times 10^{-23} JK^{-1}, T0^{\circ} C = 273K$).

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6. If 10^{20} oxygen molecules per second strike $4cm^2$ of wall at an angle of 30° with the normal when moving at a speed of $2 \times 10^3 ms^{-1}$, find the pressure exerted on the wall . (mass of 1 atom $= 1.67 \times 10^{-27} kg$)

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7. During an adiabatic process, the the pressure of a mixture of monatomic and diatomic gases is found to be proportional to the cube of the temperature . Find the value of $\gamma = (C_P / C_V)$

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8. Calculate the mean free path of air molecules at STP. The diameter of N_2 and O_2 is about $3 \times 10^{-10} m$

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9. A gas made of a mixture of 2 moles of oxygen and 4 moles of argon at temperature T. Calculate the energy of the gas in terms of RT. Neglect the vibrational modes.

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10. Estimate the total number of air molecules in a room of capacity $25m^3$ at a temperature of $27^\circ C$.

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Other Important Questions Answers I Multiple Choice Questions

1. According to kinetic theory of gases, molecules of a gas behave like .

A. perfectly elastic rigid spheres

B. perfectly elastic non - rigid spheres

C. inelastic spheres

D. inelastic non - rigid spheres

Answer: A

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2. A gas behaves as an ideal gas at :

A. low pressure and high temperature

B. low pressure and low temperature

C. high pressure and high temperature

D. high pressure and low temperature

Answer: A

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3. Select the correct pair from the following parameters.

A. Work and temperature

B. Torque and temperature

C. Torque and volume

D. Pressure and temperature

Answer: D

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4. The mean translational kinetic energy of a perfect gas molecule at the temperature Tk is :

A. k_BT

B. $\frac{3}{2}k_BT$

C. $\frac{1}{2}k_BT$

D. $2K_BT$

Answer: B

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5. The ratio of rotational kinetic energy to the total kinetic energy of a diatomic molecule is :

A. $\frac{3}{5}$

B. $\frac{2}{5}$

C. $\frac{2}{3}$

D. $\frac{5}{2}$

Answer: B

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6. Which one of the following is not an assumption of kinetic theory of gases ?

A. The force of attraction between the molecules is negligible .

B. All molecules have same speed.

C. The volume occupied by the molecules of the gas is negligible.

D. The collision between the molecules are elastic.

Answer: B

7. At 0 K, which of the following properties of a gas will be zero ?

A. Potential energy

B. Kinetic energy

C. Density

D. Vibrational energy

Answer: B

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8. Match the parameters given in column I with the expressions given in column II.

Column I	Column II
1. Pressure of a gas	$(i)\ \frac{KT}{\sqrt{2}}\pi d^2 P$
2. RMS speed of gas molecules	$(ii)\ \sqrt{\frac{2KT}{m}}$
3. Mean free path	$(iii)\ K\frac{T}{\sqrt{3}\pi P^2}$
4. Most probable speed of gas molecules	$(iv)\ \sqrt{\frac{3KT}{m}}$
	$(v)\ \frac{1}{3}mnv^2$
	$(vi)\ \frac{1}{3}KT$

A. 1 - (vi) , 2 - (i) , 3- (iv) , 4 - (ii)

B. 1 - (iii) , 2 - (ii) , 3- (iv) , 4 - (i)

C. 1 - (v) , 2 - (iv) , 3- (iv) , 4 - (i)

D. 1 - (vi) , 2 - (v) , 3- (ii) , 4 - (vi)

Answer: C

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9. Two gases A and B having same pressure P, volume V , and Temperature T are mixed . If mixture has volume and temperature as V ans T respectively. Then pressure of mixture is :

A. 3P

B. P

C. 4P

D. 2P

Answer: D

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10. The adjoining figure shows graph of pressure and volume of a gas at two temperatures T_1 and T_2 . Which of the following inferences is correct ?

A. $T_1 = T_2$

B. $T_1 < T_2$

C. $T_1 > T_2$

D. None of these

Answer: C

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11. At a given temperature , the ratio of kinetic energies of 3 g of hydrogen and 4g of oxygen

A. $1:12$

B. $4:3$

C. $12:1$

D. $3:4$

Answer: C

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12. Which one of the following graphs represents the behaviour of an ideal gas.

A. 

B. 

C. 

D. 

Answer: C

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13. Assertion : For an ideal gaas at constant temperature, the product of the pressure and volume is a constant.

Reason : The mean square velocity of the molecules is inversely proportional to mass.

Select the correct option from the following.

A. Both assertion and reason are true and reason is the correct explanation of the assertion.

B. Both assertion and reason are true but reason is not the correct explanation of the assertion .

C. Both assertion and reason are false

D. Assertion is true but reason is false

Answer: B

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14. A mono atomic gas is suddenly compressed to $\left(\frac{1}{8}\right)^{th}$ of its initial volume adiabatically the ratio of its final pressure to the initial pressure is (Given : the ratio of the specific heats of the given gas to be $5/3$)

A. 16 P

B. $8P$

C. $32P$

D. $24P$

Answer: C

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15. A gas made of a mixture of 2 moles of oxygen and 4 moles of argon at temperature T. Calculate the energy of the gas in terms of RT. Neglect the vibrational modes.

A. 9 RT

B. 4 RT

C. 15 RT

D. 11 RT

Answer: D

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16. A certain mass of an ideal gas having volume V_1 and pressure P_1 at absolute temperature T_1. When it undergoes adiabatic change , its pressure is increased to P_2 and volume is increased to V_2 and temperature is increased to T_2.

If γ is the ratio of two specific heat capacities of the gas $\gamma = \frac{C_P}{C_V}$ then select the incorrect equation from the following.

A. $T_2 = T_1\left(\frac{V_1}{V_2}\right)^{\gamma-1}$

B. $P_2 = P_1\left(\frac{V_1}{V_2}\right)^{\gamma-1}$

C. $P_1V_1 = P_2V_2$

D. $T_2 = T_1\left(\frac{P_1}{P_2}\right)^{\frac{\gamma-1}{\gamma}}$

Answer: C

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17. One mole of an ideal gas $(\gamma = 1.4)$ is compressed adiabatically , so that its temperature is increased from $27^\circ C$ to $35^\circ C$ If R = 8.31 J/K/mole then the change in the internal energy of the gas is :

A. 168 J

B. 166 J

C. 83 J

D. 332 J

Answer: B

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18. Assertion : The air pressure in a tyre of a bus increases during driving.

Reason : The pressure of a given mass of a gas is inversely proportional to its volume.

Choose the correct choice from the following.

A. Both assertion and reason are true and reason is the correct explanation of the assertion.

B. Both assertion and reason are true but reason is not the correct explanation of the assertion .

C. Assertion is true but reason is false

D. Assertion is false but reason is true

Answer: C

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19. Mean free path of a gas molecule is :

A. inversely proportional to diameter of the molecule

B. inversely proportional number of molecules per unit volume

C. directly proportional to the pressure

D. directly proportional to the square root of the absolute temperature.

Answer: B

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20. Root mean square speed of the molecules of ideal gas is V. If pressure is increased two times at constant temperature , then the rms speed will become:

A. V

B. 4V

C. $\frac{V}{2}$

D. 2V

Answer: A

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21. The root mean square velocity of a gas molecule of mass m at a given temperature is proportional to :

A. m

B. m^0

C. $m^{-1/2}$

D. $\sqrt{m}$

Answer: C

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22. Select the odd man out from the following statements.

A. Pressure of a gas P $= \frac{1}{3}nmv^2$

B. Average kinetic energy per molecule is K.e = $\frac{3}{2}KT$

C. For a cyclic process the net heat transferred to the system is equal to the work done by the gas $Q_{\text{net}} = Q_{\text{in}} - Q_{\text{out}} = W$

D. In terms fo kinetic energy pressure of a molecule of a gas

= $\frac{2}{3} \times$ kinetic energy per molecule.

Answer: C

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23. The temperature of H_2 at which the rms velocity of its molecules is seven times the rms velocity of the molecules of nitrogen at 300 K is :

A. 1700 K

B. 2100 K

C. 1050 K

D. 1350 K

Answer: C

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24. The root mean square speed of the molecules of a diatomic gas is V. When the temperature is doubled ,the molecules dissociate into two atoms. The new root mean square speed of the atom is :

A. v

B. 2v

C. $\sqrt{2}v$

D. 4v

Answer: B

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25. At room temperature , the rms speed of the molecules of a centain diatomic gas is found to be 1933 m/s. The gas is :

A. F_2

B. O_2

C. Cl_2

D. H_2

Answer: D

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26. Assertion : The root mean square and most probable speeds of the molecules in a gas are the same.

Reason : The maxwell distribution for the speed to molecules in a gas is symmetrical.

Which one of the following statement is correct ?

A. Both assertion and reason are true and reason is the correct explanation of the assertion.

B. Both assertion and reason are true but reason is not the correct explanation of the assertion .

C. Assertion is true but reason is false

D. Assertion is false and reason is false

Answer: D

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27. The phenomenon of Brownian movement may be taken as evidence of :

A. EMT of radiation

B. corpuscular theory of light

C. photoelectric phenomenon

D. kinetic theory of matter

Answer: D

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28. One mole of a gas occupies 22.4 lit at N.T.P Calculate the difference between two molar specific heates of the gas . J = 4200 J / K cal :

A. 2.378 k cal / kmol K

B. 3.028 k cal / kmol K

C. 1.979 k cal / kmol K

D. 4.569k cal / kmol K

Answer: C

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29. Choose the odd man out.

A. Helium is a monoatomic gas

B. Methane is a polyatomic gas

C. Neon is an inert gas

D. Oxygen is a diatomic gas

Answer: C

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30. Degree of freedom of a polyatomic gas is :

A. ≥ 5

B. ≥ 4

C. > 6

D. ≥ 6

Answer: D

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31. In an adiabatic change, the pressure and temperature of a monoatomic gas are related as $p \times T^C$, where C equals

A. $\frac{5}{2}$

B. $\frac{5}{3}$

C. $\frac{2}{5}$

D. $\frac{3}{5}$

Answer: A

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32. If for a gas $\frac{R}{C_v} = 0.67$, this gas is made up of molecules, which are :

A. mixture of diatomic and polyatomic

B. monoatomic

C. polyatomic

D. diatomic

Answer: B

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33. In the given (V - T) diagram , what is the relation between pressure P_1 and P_2 ?

A. $P_2 > P_1$

B. $P_2 < P_1$

C. $P_2 = P_1$

D. cannot be predicted

Answer: B

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34. Select the correct statement from the following statements.

A. Number of degree of freedom for diatomic molecule is 8

B. Number of degree of freedom for diatomic molecule is 3.

C. Number of degree of freedom for diatomic molecule is 6

D. Number of degree of freedom for diatomic molecule is 7

Answer: B

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35. Select the incorrect statement from the following statements.

A. Pressure of a gas is directly proportional to mean square speed

B. Mean free path of a molecule is inversely Proportional to temperature

C. The value of specific heat capacity of helium gas is $\frac{5}{2}R$

D. Number of degree of freedom for diatomic molecule is 7.

Answer: B

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36. The ratio of the specific heats $\frac{C_P}{C_V} = \gamma$ in terms of degrees of freedom (n) is given by :

A. $\left(1 + \frac{2}{n}\right)$

B. $\left(1 + \frac{n}{3}\right)$

C. $\left(1 + \frac{1}{n}\right)$

D. $\left(1+\frac{n}{2}\right)$

Answer: A

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37. If the pressure in a closed vessel is reduced by drawing out some , the mean free path of the molecules :

A. is increased

B. is decreased

C. increases or decreases according to the nature of gas

D. remains unchanged

Answer: A

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38. If $\gamma = \frac{C_P}{C_V}$ for a gas and R is universal gas constant then select the incorrect pair of the following.

A. For monoatomic molecule $\gamma = \frac{5}{2}R$ and for diatomic molecule $\gamma = \frac{7}{2}R$.

B. For monoatomic molecule $\gamma = \frac{3}{2}R$ and for triatomic linear molecule $\gamma = 1.28$

C. For monoatomic molecule $\gamma = \frac{5}{2}R$ and for triatomic non - linear molecule $\gamma = 1.33$

D. For diatomic molecule $\gamma = \frac{7}{2}R$ and for monoatomic $\gamma = \frac{5}{2}R$.

Answer: B

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39. According to kinetic theory of gases, molecules of a gas behave like .

A. perfectly elastic rigid spheres

B. perfectly elastic non - rigid spheres

C. inelastic spheres

D. inelastic non - rigid spheres

Answer: A

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40. A gas behaves as an ideal gas at :

A. low pressure and high temperature

B. low pressure and low temperature

C. high pressure and high temperature

D. high pressure and low temperature

Answer: A

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41. Select the correct pair from the following parameters.

A. Work and temperature

B. Torque and temperature

C. Torque and volume

D. Pressure and temperature

Answer: D

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42. The mean translational kinetic energy of a perfect gas molecule at the temperature Tk is :

A. k_BT

B. $\frac{3}{2}k_BT$

C. $\frac{1}{2}k_BT$

D. $2K_BT$

Answer: B

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43. The ratio of rotational kinetic energy to the total kinetic energy of a diatomic molecule is :

A. $\frac{3}{5}$

B. $\frac{2}{5}$

C. $\frac{2}{3}$

D. $\frac{5}{2}$

Answer: B

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44. Which one of the following is not an assumption of kinetic theory of gases ?

A. The force of attraction between the molecules is negligible .

B. All molecules have same speed.

C. The volume occupied by the molecules of the gas is negligible.

D. The collision between the molecules are elastic.

Answer: B

45. At 0 K, which of the following properties of a gas will be zero ?

A. Potential energy

B. Kinetic energy

C. Density

D. Vibrational energy

Answer: B

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46. Match the parameters given in column I with the expressions given in column II.

Column I	Column II
1. Pressure of a gas	$(i)\ \frac{KT}{\sqrt{2}}\pi d^2 P$
2. RMS speed of gas molecules	$(ii)\ \sqrt{\frac{2KT}{m}}$
3. Mean free path	$(iii)\ K\frac{T}{\sqrt{3}\pi P^2}$
4. Most probable speed of gas molecules	$(iv)\ \sqrt{\frac{3KT}{m}}$
	$(v)\ \frac{1}{3}mnv^2$
	$(vi)\ \frac{1}{3}KT$

A. 1 - (vi) , 2 - (i) , 3- (iv) , 4 - (ii)

B. 1 - (iii) , 2 - (ii) , 3- (iv) , 4 - (i)

C. 1 - (v) , 2 - (iv) , 3- (i) , 4 - (ii)

D. 1 - (vi) , 2 - (v) , 3- (ii) , 4 - (vi)

Answer: C

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47. Two gases A and B having same pressure P, volume V , and Temperature T are mixed . If mixture has volume and temperature as V ans T respectively. Then pressure of mixture is :

A. 3P

B. P

C. 4P

D. 2P

Answer: D

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48. The adjoining figure shows graph of pressure and volume of a gas at two temperatures T_1 and T_2 . Which of the following inferences is correct ?

A. $T_1 = T_2$

B. $T_1 < T_2$

C. $T_1 > T_2$

D. None of these

Answer: C

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49. At a given temperature , the ratio of kinetic energies of 3 g of hydrogen and 4g of oxygen

A. $1:12$

B. $4:3$

C. $12:1$

D. $3:4$

Answer: C

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50. Which of the following graphs represent the behaviour of an ideal gas ?

A. 

B. 

C. 

D. 

Answer: C

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51. Assertion : For an ideal gas, at constant temperature, the product of the pressure and volume is constant.

Reason : The mean square velocity of the molecules is inversely proportional to mass.

A. Both assertion and reason are true and reason is the correct explanation of the assertion.

B. Both assertion and reason are true but reason is not the correct explanation of the assertion .

C. Both assertion and reason are false

D. Assertion is true but reason is false

Answer: B

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52. A gas with specific heat ratio $\gamma = \frac{5}{3}$ is compressed suddenly to $\frac{1}{8}$ of its initial volume. If the pressure is P, then the final pressure is :

A. 16 P

B. $8P$

C. $32P$

D. $24P$

Answer: C

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53. A gas mixture consists of 2 moles of O_2 and 4 moles of Ar at temperature T. Neglecting all vibrational modes, the total internal energy of the system is :

A. 9 RT

B. 4 RT

C. 15 RT

D. 11 RT

Answer: D

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54. An ideal gas with pressure P, volume V and temperature T is expanded isothermally to a volume 2V and a final pressure P_1 . The same gas is expanded adiabatically to a volume 2V, the final pressure is P_A. In terms of the ratio of the two specific heats for the gas γ , the ratio P_I / P_A is :

A. $T_2 = T_1 \left(\frac{V_1}{V_2} \right)^{\gamma - 1}$

B. $P_2 = P_1 \left(\frac{V_1}{V_2} \right)^{\gamma - 1}$

C. $P_1V_1 = P_2V_2$

D. $T_2 = T_1\left(\frac{P_1}{P_2}\right)^{\frac{\gamma-1}{\gamma}}$

Answer: C

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55. One mole of an ideal gas $(\gamma = 1.4)$ is compressed adiabatically , so that its temperature is increased from $27^\circ C \text{ to } 35^\circ C$ If R = 8.31 J/K/mole then the change in the internal energy of the gas is :

A. 168 J

B. 166 J

C. 83 J

D. 332 J

Answer: B

56. Assertion : The air pressure in a tyre of a bus increases during driving.

Reason : The pressure of a given mass of a gas is inversely proportional to its volume.

Choose the correct choice from the following.

A. Both assertion and reason are true and reason is the correct explanation of the assertion.

B. Both assertion and reason are true but reason is not the correct explanation of the assertion .

C. Assertion is trure but reason is false

D. Assertion is false but reason is true

Answer: C

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57. Mean free path of a gas molecule is :

A. inversely proportional to diameter of the molecule

B. inversely proportional to number to number of molecules per unit volume

C. directly proportional to the pressure

D. directly proportional to the square root of the absolute temperature.

Answer: B

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58. Root mean square speed of the molecules of ideal gas is V. If pressure is increased two times at constant temperature , then the rms speed will become:

A. V

B. 4V

C. $\frac{V}{2}$

D. 2V

Answer: A

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59. The root mean square velocity of a gas molecule of mass m at a given temperature is proportional to :

A. m

B. m^0

C. $m^{-1/2}$

D. $\sqrt{m}$

Answer: C

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60. Select the odd man out from the following statements.

A. Pressure of a gas P $= \frac{1}{3}nmv^2$

B. Average kinetic energy per molecule is K.e = $\frac{3}{2}KT$

C. For a cyclic process the net heat transferred to the system is equal to the work done by the gas $Q_{\text{net}} = Q_{\text{in}} - Q_{\text{out}} = W$

D. In terms fo kinetic energy pressure of a molecule of a gas

= $\frac{2}{3} \times$ kinetic energy per molecule.

Answer: C

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61. The temperature of H_2 at which the rms velocity of its molecules is seven times the rms velocity of the molecules of nitrogen at 300 K is :

A. 1700 K

B. 2100 K

C. 1050 K

D. 1350 K

Answer: C

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62. The root mean square speed of the molecules of a diatomic gas is V. When the temperature is doubled ,the molecules dissociate into two atoms. The new root mean square speed of the atom is :

A. v

B. 2v

C. $\sqrt{2}v$

D. 4v

Answer: B

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63. At room temperature , the rms speed of the molecules of a centain diatomic gas is found to be 1933 m/s. The gas is :

A. F_2

B. O_2

C. Cl_2

D. H_2

Answer: D

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64. Assertion : The root mean square and most probable speeds of the molecules in a gas are the same.

Reason : The maxwell distribution for the speed to molecules in a gas is symmetrical.

Which one of the following statement is correct ?

A. Both assertion and reason are true and reason is the correct explanation of the assertion.

B. Both assertion and reason are true but reason is not the correct explanation of the assertion .

C. Assertion is trure but reason is false

D. Assertion is false but reason is true

Answer: D

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65. The phenomenon of Brownian movement may be taken as evidence of :

A. EMT of radiation

B. corpuscular theory of light

C. photoelectric phenomenon

D. kinetic theory of matter

Answer: D

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66. One mole of a gas occupies 22.4 lit at N.T.P Calculate the difference between two molar specific heates of the gas . J = 4200 J / K cal :

A. 2.378 k cal / kmol K

B. 3.028 k cal / kmol K

C. 1.979 k cal / kmol K

D. 4.569k cal / kmol K

Answer: C

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67. Choose the odd man out.

A. Helium is a monoatomic gas

B. Methane is a polyatomic gas

C. Neon is an inert gas

D. Oxygen is a diatomic gas

Answer: C

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68. Degree of freedom of a polyatomic gas is :

A. ≥ 5

B. ≥ 4

C. > 6

D. ≥ 6

Answer: D

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69. In an adiabatic change, the pressure and temperature of a monoatomic gas are related as $p \times T^C$, where C equals

A. $\frac{5}{2}$

B. $\frac{5}{3}$

C. $\frac{2}{5}$

D. $\frac{3}{5}$

Answer: A

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70. If for a gas $\frac{R}{C_v} = 0.67$, this gas is made up of molecules, which are :

A. mixture of diatomic and polyatomic

B. monoatomic

C. polyatomic

D. diatomic

Answer: B

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71. In the given (V - T) diagram , what is the relation between pressure P_1 and P_2 ?

A. $P_2 > P_1$

B. $P_2 < P_1$

C. $P_2 = P_1$

D. cannot be predicted

Answer: B

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72. Select the correct statement from the following statements.

A. Number of degree of freedom for diatomic molecule is 8

B. Number of degree of freedom for diatomic molecule is 5.

C. Number of degree of freedom for diatomic molecule is 6

D. Number of degree of freedom for diatomic molecule is 7

Answer: B

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73. Select the incorrect statement from the following statements.

A. Pressure of a gas is directly proportional to mean square speed

B. Mean free path of a molecule is inversely Proportional to temperature

C. The value of specific heat capacity of helium gas is $\frac{5}{2}R$

D. Number of degree of freedom for diatomic molecule is 5.

Answer: B

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74. The ratio of the specific heats $\frac{C_P}{C_V} = \gamma$ in terms of degrees of freedom (n) is given by :

A. $\left(1 + \frac{2}{n}\right)$

B. $\left(1 + \frac{n}{3}\right)$

C. $\left(1 + \frac{1}{n}\right)$

D. $\left(1+\frac{n}{2}\right)$

Answer: A

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75. If the pressure in a closed vessel is reduced by drawing out some , the mean free path of the molecules :

A. is increased

B. is decreased

C. increases or decreases according to the nature of gas

D. remains unchanged

Answer: A

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76. If $\gamma = \frac{C_P}{C_V}$ for a gas and R is universal gas constant then select the incorrect pair of the following.

A. For monoatomic molecule $\gamma = \frac{5}{2}R$ and for diatomic molecule $\gamma = \frac{7}{2}R$.

B. For monoatomic molecule $\gamma = \frac{3}{2}R$ and for triatomic linear molecule $\gamma = 4R$

C. For monoatomic molecule $\gamma = \frac{7}{2}R$ and for triatomic non - linear molecule $\gamma = \frac{9R}{2}$.

D. For diatomic molecule $\gamma = \frac{7}{2}R$ and for monoatomic $\gamma = \frac{5}{2}R$.

Answer: B

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Other Important Questions Answers Ii Very Short Answer Questions

1. What is an ideal gas? (or) What is perfect gas?

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2. What is meant by an equation of state ?

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3. At what temperature does all molecular motion cease?

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4. Universal gas constant is

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5. What type of motion is associated with the molecule of a gas?

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6. What is an ideal gas? (or) What is perfect gas?

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7. what is meant by an equation of state ?

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8. At which temperature does all molecular motion cease ?

View Text Solution

9. What is signified by the universal gas constant R ?

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10. What type of motion is associated with the molecule of a gas?

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Other Important Questions Answers Iii Short Answer Questions

1. On the basis of kinetic theory of gases, explain how does a gas exert pressure.

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2. Show that pressure exerted by the gas is two - thirds of average kinetic energy per unit volume of the gas molecules.

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3. What are the characteristics of the ideal gas ?

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4. Define RMS speed.

Watch Video Solution

5. Why there is no hydrogen in earth's atmosphere ?

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6. Define Average speed ?

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7. When an automobile travels for a long distance , the air pressure in the tyres increases slightly . Why ?

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8. What are the factors which effect Brownian motion?

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11. What are the characteristics of the ideal gas ?

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12. Define Root mean square speed .

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15. When an automobile travels for a long distance , the air pressure in the tyres increases slightly . Why ?

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16. What are the factors which effect Brownian motion?

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Other Important Questions Answers Iv Long Answer Questions

1. Derive the relation between pressure and mean kinetic energy.

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2. Explain degrees of freedom with examples.

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3. (i) Find the adiabatic exponent γ for mixture of μ_1 moles of monoatomic gas and μ_2 moles of a diatomic gas at normal temperature.

(ii) An oxygen molecule is travelling in air at 300 K and 1 atm , and the diameter of oxygen molecule is 1.2×10^{-10} m . Calculate the mean free path of oxygen molecule.

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Other Important Questions Answers V Numerical Problems

1. Calculate the kinetic energy per molecule and also rms velocity of a gas at $127^{\circ} C$.

Given $k_B = 1.38 \times 10^{-23} J \text{molecule}^{-1} K^{-1}$ and mass per molecule of the gas $= 6.4 \times 10^{-27}$ kg .

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2. At what temperature will the average velocity of oxygen molecules be sufficient so as to escape from

the earth ? Escape velocity of earth is $11.0 kms^{-1}$ and mass of one molecule of oxygen is 5.34×10^{-26} kg. Boltzmann constant $= 1.38 \times 10^{-23}$ J molecule$^{-1} K^{-1}$.

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3. Calculate the root mean square velocity of a gas of density 1.5 g litre $^{-1}$ at a pressure of $2 \times 10^{6} Nm^{-2}$.

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4. If the mass of each molecule of a gas is halved and speed is doubled , find the ratio of initial and final pressure.

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5. Two perfect gases at temperatures T_1 and T_2 are mixed. There is no loss of energy. Find the temperature of mixture if messes of molecules are m and m and the number of molecules in the gases are n_1 and n_2 respectively.

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6. Four molecules of a gas has speed 2, 4, 6 and 8 kms^{-1} respectively . Calculate their average speed and root mean square speed.

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7. Calculate the rms velocity of oxygen molecules at S.T.P The molecular weight of oxygen is 32.

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8. The rms velocity of hydrogen of S.T.P is u ms^{-1} If the gas is heated at constant pressure till its volume

is three fold ,what will be its final temperature and rms velocity ?

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9. At what temperature is rms velocity of hydrogen molecule equal to that of an oxygen molecule at $47^\circ C$

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10. Calculate the temperature at which rms velocity of SO_2 is the same as that of oxygen at $27^\circ C$

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11. A cylinder of fixed capacity 44.8 litres contains helium gas at standard pressure at temperature . What is the amount of heat need to rest that temperature of the gas by $15.00^{\circ}C$? $\left[R = 8.31 \ \text{J mol}^{-1}K^{-1}\right]$

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12. Calculate the temperature at which rms velocity of a gas is half it's value at $0^{\circ}C$, pressure remaining constant

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13. A gaseous mixture consists of 16g of helium and 16g of oxygen the ratio of two specific heats of the mixture is

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14. Calculate the root mean square speed of smoking practices of mass 5×10^{-17} kg in their Brownian motion in air at S.T.P

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15. A vessel contains one mole of O_2 gas (molar mass 32) at a temperature T. The pressure of the gas 1s.What will be the pressure of one mole of He (molar mass 4) at a temperature 2t in an identical vessel?

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Other Important Questions Answers Vi Conceptual Questions

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2. Why temperature less than $0^{\circ} K$ is not possible ?

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3. What happen when a compressed gas pushed a piston out and expands ?

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