PHYSICS

BOOKS - DHANPAT RAI & CO PHYSICS (HINGLISH)

Kinetic Theory of gases

Exercise

1. State and explain Boyle's law. Represent the law graphically.

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2. State and explain Charle's law.

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3. State and explain (i) Gay lussac's law and (ii) Gas equation. Distinguish clearly between R and r for a gas.

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4. State and derive the perfect or ideal gas equation.

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5. Define universal gas constant. Give its SI and CGS units.

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6. Determine the numerical values of R and k_B

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7. What is an ideal gas? Why do the real gases show deviations from ideal behaviour? Show these deviations graphically.

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8. Air is filled in a bottle and it is corked at $35^{\circ} C$. If the cork can come out at 3 atmospheric pressure, then upto what temperature should the bottle be heated to remove the cork ?

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9. A narrow uniform glass tube contains air enclosed by 15 cm long thread of mercury. When the tube is vertical with open end uppermost, the air column is 30 cm long. When the tube is inverted, the length of air column becomes 45 cm. Calculate the atmospheric pressure.

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10. An open glass tube is immersed in mercury so that a length of $8cm$ of the tube projects above the mercury. The tube is then closed and raised through $44cm$. What length of the tube will be occupied by the air after it has been raised? Given 1 atm $= 76cm$ of Hg.

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11. An empty barometric tube 1 m long is lowered vertically (mouth downwards) into a tank of water. What will be the depth above the water level in the tube, when the water has risen 20 cm inside the tube ? Take atmospheric pressure as 10.4 m column of water.

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12. When a gas filled in a closed vessel is heated through $1^{\circ}C$, its pressure increases by 0.4%. What is the initial temperature of gas ?

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13. Molecular weight of oxygen is 32. At S.T.P., volume of $1g$ of oxygen is $700cm^3$. Find the value of gas constant R.

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14. A $3000cm^3$ tank contains oxygen at $20^\circ C$ and the gauge pressure is $2.5 \times 10^6 Pa$. Find the mass of the oxygen in the tank. Take 1 atm $= 10^5 Pa.$

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15. A vessel of volume $8.0 \times 10^{-3} m^3$ contains an ideal gas at $300K$ and $200KPa$. Calculate the amount of the gas (in moles) leaked assuming that the temperature remains constant.

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16. A vessel of volume $1660 cm^3$ contains 0.1mole of oxygen and 0.2mole of nitrogen. If the temperature of the mixture is $300K$, find its pressure.

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17. A vessel of volume , $V = 5.0$ litre contains $1.4g$ of nitrogen at a temperature $T = 1800K$. Find the pressure of the gas if 30% of its molecules are dissociated into atoms at this temperature.

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18. State the assumptions of the kinetic theory of gases.

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

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20. Derive an expression for pressure exterted by an ideal gas?

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21. Show that the average K.E, of a gas molecule is directly proportional to the temprature of the gas. Hence give the kinetic interpretation of temprature.

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22. Calculate (i) rms velocity and (ii) mean kinetic energy of one gram molecule of hydrogen at STP. Given density of hydrogen at STP is $0.09 kgm^{-3}$.

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23. Calculate the rms velocity of molecules of a gas of density $1.5 g litre^{-1}$ at a pressure of $2 \times 10^6 N/m^2$.

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24. The r.m.s. velocity of the molecules of a gas at S.T.P. is $485.6 ms^{-1}$. Calculate the density of the gas.

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25. Calculate the value of Boltzmann constant k_B, Given $R = 8.3 \times 10^3 J / kg - mol - K$ and Avogadro number, $N = 6.03 \times 10^{26} / kg - mol$.

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26. Kinetic energy of oxygen molecule at $0^\circ C$ is $9.4 \times 10^{-21} J$. Calculate Avogadro's number, when $R = 8.31 J \text{mole}^{-1} K^{-1}$.

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27. Calculate the total K.E. of 1g of nitrogen at $300K$. Molecule weight of nitrogen $= 28$.

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28. Calculate for hydrogen at 27°

(i) KE of one gram mole of the gas

(ii) KE of one gram of the gas

(iii) root mean square velocity of the molecule.

Given, molecule wt. Of hydrogen = 2.

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(ii) KE of one gram of the gas

(iii) root mean square velocity of the molecule.

Given, molecule wt. Of hydrogen = 2.

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31. At what temperature the average value of the kinetic energy of the molecule of a gas will be $1/3$ of the average value of kinetic energy at $27^\circ C$?

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32. If the temperature of air is increased from $27^\circ \rightarrow 227^\circ$, in what ratio will the average kinetic energy of its molecules be increased?

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33. Kinetic theory of gases

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34. Derive Charles's law on the basis of kinetic theory of gases.

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35. Derive Gay Lussac's law on the basis of kinetic theory of gases.

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36. Derive perfect gas equation on the basis of kinetic theory of gases.

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37. Derive Avogadro's law on the basis of kinetic theory of gases.

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38. Deduce Graham's law of diffusion from kinetic theory of gases using experssion for pressure.

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39. Derive Dalton's law of particial pressures on the basis of kinetic theory of gases.

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40. Explain Maxwell distribution of molecular speed with necessary graph.

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41. Define most probable speed, average speed and root mean square speed of a gas. How are they related to each other ?

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42. The velocities of ten particles in ms^{-1} are $0, 2, 3, 4, 4, 4, 5, 5, 6, 9$. Calculate

(i)average speed and

(ii)rms speed

(iii) most probable speed.

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(i)average speed and

(ii)rms speed

(iii) most probable speed.

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44. The velocities of ten molecules of any gas are given $v, 0, 2v, 4v, 3v, 2v, v, 3v, 5v, v$. Calculate their root mean square velocity.

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45. Calculate the rms velocity of the molecules of ammonia at S.T.P. Given molecular weight of ammonia $= 17.$

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46. Show that the rms velocity of O_2 molecule is $\sqrt{2}$ times that of SO_2. Atomic weight of sulphur is 32 and atomic weight of oxygen is 16.

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

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48. Estimate the temperature at which the oxygen molecules will have the same rms velocity as hydrogen molecules at $150^\circ C$. Molecular weight of oxygen is 32 and that of hydrogen is 2.

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49. If root mean sqauare velocity of the molecules of hydrogen at NTP is $1.84 kms^{-1}$, calculate the rms velocity of oxygen molecules at NTP. Molecular weights of hydrogen and oxygen are 2 and 32 respectively.

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50. The density of carbon dioxide gas at $0^{\circ} C$ and at pressure $1.0 \times 10^5 Nm^{-2}$ is $1.98 kgm^{-3}$. Find the rms velocity of its molecules at $0^{\circ} C$

and also at $30^\circ C$, assuming pressure to be constant.

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51. Find the degrees of monoatomic, diatomic and triatomic gas molecules.

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52. According to the law of equipartition of energy, the energy associated with each degree of freedom is :

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53. Using the law of equipartition of energy , detemine the values of C_p, C_V and γ for monoatomic gas.

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54. Using the law of equipartition of energy , detemine the values of C_p, C_V and γ for diatomic gas.

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55. Using the law of equipartition of energy , detemine the values of C_p, C_V and γ for triatomic gas.

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56. Using the law of equipartition of energy , obtain a relation between the degrees of freedom f and the specific heat ratio γ of a polyatomic gas.

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57. Calculate the total number of degree of freedom for a mole of diatomic gas at STP.

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58. Calculate the number of degrees of freedom in $10 cm^3$ of O_2 at N.T.P.

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59. Calculate the number of degree of freedom in 15 c.c. Of nitrogen at N.T.P.?

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60. The specific heat of argon at constant volume is $0.075 kcal kg^{-1} K^{-1}$. Calculate its atomic weight. $Take R = 2 cal mol^{-1} K^{-1}$.

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61. A certain gas possessess 3 degree of freedom corresponding to the translational motion and 2 degrees of freedom corresponding to rotational motion. (i) What is the kinetic energy of translational motion of one such molecule of gas at 300 K ? (ii) If the temperature is raised by $1^\circ C$, what energy must be supplied to the one molecule of the gas. Given Avogadro's number N = $6.023 \times 10^{23} mol^{-1}$ and Boltzmann's constant $k_B = 1.38 \times 10^{-23} Jmo^{-1}K^{-1}$.

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63. How does specific heat of a solid vary with temperature?

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64. What are the different ways of increasing the number of molecules collisions per unit time against the walls of the vessel containing a gas ?

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65. What is an ideal gas ? Explain its main characteristics.

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66. Why do the gases at low temperature and high pressure show large deviations from ideal behaviour ?

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67. On reducing the volume of the gas at constant temperature, the pressure of the gas increases. Explain on kinetic theory.

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68. On driving the scooter for a long time, the air pressure in the tyres slightly increases. Why ?

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69. When a gas is heated, its temperature increases. Explain it on the basis of kinetic theory of gases.

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70. What type of motion is associated with the molecules of a gas ?

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71. On which factors does the average KE of gas molecules depend : nature of gas, its temperature , its volume?

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72. What do you mean by the r.m.s. speed of the molecules of a gas ? Is r.m.s. speed same as the average speed ?

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73. The ratio of vapour densities of two gases at the same temperature is 8:9. Compare the rms velocities of their molecules.

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74. What is the average velocity of the molecules of an ideal gas ?

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75. Given a sample of 1 cm^3 of hydrogen and 1 cm^3 of oxygen both at S.T.P. Which sample has a larger number of molecules ?

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76. At what temperature does all molecular motion cease ? Explain.

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77. Molecular motion ceases at zero kelvin. Explain.

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78. Why temperature less than OK is not possible ?

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79. For an ideal gas, interval energy can only be translational K.E. Why ?

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80. Obtain the dimensional formula for R used in the ideal gas equation, PV = RT.

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81. A box contains equal number of molecules of hydrogen and oxygen. If there is a fine hole in the box, which gas will leak rapidly ? Why ?

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82. If a molecule of krypton is 2.25 times heavier than a molecule of hydrogen, what would be the ratio of their root mean square velocities in a mixture of equal masses of the two gases ?

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83. A sample of an ideal gas occupies a volume V at pressure P and absolute temperature T. The masss of each molecule is m, then the density of the gas is

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84. The volume of vessel A is twice the volume of another vessel B and both of them are filled with the same gas. If the gas in A is at twice the temperature and twice the pressure in comparison to the gas in B, what is the ratio of number of gas molecule in A and B ?

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85. Two gases each at temperature T, volume V and pressure P are mixed such that temperature of mixture is T and volume is V. What will be the pressure of the mixture ?

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86. The total translational kinetic energy of the molecules of a gas having volume V and pressure P is 500 J. What will be the total translational kinetic energy of the molecules of the same gas occupying the suffisame volume V but exerting a pressure 2P ?

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87. Write the equation of state for 16 g of 0_2.

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88. A gas in a vessel is at the pressure P_0. If the masses of all the molecules be made half and their speeds be made double, then find the resultant pressure.

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89. What is evaporation? State the various factors which affect evaporation.

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90. Cooking gas cylinders are kept in a lorry moving with uniform speed. Will there be any effect on temperature of the gas ?

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91. What is curie temperature ? What happens above Curie temperature ?

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92. Equal amounts of heat are supplied to equal masses of helium and oxygen, kept at the same initial temperature. If T_{He} and T_O denote the increase in temperatures of helium and oxygen, then

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93. A gas is filled in a cylinder fitted with a piston at a definite temperature and pressure. Explain on the basis of kinetic theory, the pressure of the gas increases by raising its temperature.

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94. A gas is filled in a cylinder fitted with a piston at a definite temperature and pressure. Explain on the basis of kinetic theory why on pulling the piston out, the pressure of decreases.

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95. There are N molecules of a gas in a containter. If this number is increased to 2N, what will be (i) pressure (ii) total energy (iii) rms speed of the gas ?

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97. There are N molecules of a gas in a containter. If this number is increased to 2N, what will be (i) pressure (ii) total energy (iii) rms speed of the gas ?

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98. Though the velocity of air molecules is nearly $0.5 km / s$, yet the smell of scent spreads at a much slower rate. Why ?

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99. Under what conditions do the real gases obey more strictly the gas equation, PV = RT ? Explain.

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100. (a) When a molecule (or an elastic ball) hits a (massive) wall, it rebounds with the same speed. When a ball hits a massive bat held firmly, the same thing happens However, when the bat is moving towards the ball, the ball rebounds with a different speed. Does the ball move faster or slower?

(b) When gas in a cylinder is compressed by pushing in a piston. Its temperature rises. Guess at an explanation of this in terms of kinetic theory using (a) above

(c) What happens when a compressed gas pushes a piston out and expands. What would you observe?

(d) Sachin Tendulkar uses a heavy cricket bat while playing. Does it help him in any way?

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104. Two rigid boxes containing different ideal gases are placed on a table. Box A contains one mole of nitrogen at temperature T_0, while Box contains one mole of helium at temperature $\left(\frac{7}{3}\right)T_0$. The boxes are then put into thermal contact with each other, and heat flows between them until the gasses reach a common final temperature (ignore the heat capacity of boxes). Then, the final temperature of the gasses, T_f in terms of T_0 is

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105. A vessel is filled with a mixture of two different gases. State with reason (i) will the mean K.E. Per molecule of both the gases be equal ?(ii) Will the root mean square velocities of the molecules be equal (iii) will the pressure be equal ?

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108. Two vessels of the same size are at the same temperature. One of them contains 1 g to H_2 gas, and the other contains 1 g to N_2 gas. Which of the vessels is under greater pressure or and why ?

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109. Two vessels of the same volume and filled with the same gas at the same temperature. If the pressure of the gas in these vessel be in the

ratio 1:2, then state : (i) the ratio of the rms speeds of the molecules, (ii) the ratio of the number of molecules.

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110. Two thermally insulated vessel 1 and 2 are filled with air at temperature $(T_1 T_2)$, $volume(V_1 V_2)$ and pressure $(P_1 P_2)$ respectively. If the valve joining the two vessels is opened, the temperature inside the vessel at equilibrium will be

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111. An insulated container containing monoatomic gas of molar mass s is moving with a velocity v_0. If the container is suddenly stopped, find the change in temperature.

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112. A cubical box of side 1 meter contains helium gas (atomic weight 4) at a pressure of $100N/m^2$. During and observation time of 1 second, an atom travelling with the root-mean-

square speed parallel to one of the edges of the cube, was found to make 500 hits with a particular wall, without any collision with other atoms. Take

$R = \frac{25}{3} Jmo \leq \; - K$ and $k = 1.38 \times 10^{-23} J / K$

(a) Evalute the temperature of the gas.

(b) Evaluate the average kinetic energy per atom.

(c) Evaluate the total mass of helium gas in the box.

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113. A cubical box of side $1m$ contains helium gas (atomic weight 4) at a pressure of $100N/m^2$. During an observation time of $1\sec ond$, an atom travelling with the root - mean - square speed parallel to one of the edges of the cube, was found to make $500hits$ with a particular wall, without any collision with other atoms . Take $R = \frac{25}{3} j/mol - K$ and $k = 1.38 \times 10^{-23} J/K$.

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(c) Evaluate the total mass of helium gas in the box.

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115. The temperature of an ideal gas is increased from 120 K to 480 K. If at 120 K the root mean square velocity of the gas molecules is v, at 480 K it becomes

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116. In a certain region of space there are only 5 molecules per cm^3 of gas on an average. The temperature is $3K$. What is the average pressure of this gas ? .

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117. Two glass bulbs of equal volume are connected by a narrow tube and are filled with a gas at $0^{\circ} C$ and a pressure of 76cm of mercury. One of the bulbs is then placed in melting ice and the other is placed in a water bath maintained at $62^{\circ} C$. What is the new value of the pressure inside the bulbs? The volume of the connecting tube is negligible.

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118. A vessel of volume $2 \times 10^{-2} m^3$ contains a mixture of hydrogen and helium at $47^\circ C$ temperature and $4.15 \times 10^5 N/m^2$ Pressure. The mass of the mixture is $10^{-2} kg$. Calculate the masses of hydrogen and helium in the given mixture.

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119. A thin tube, sealed at both ends, is $100 cm$ long. If lies horizontally, the middle $10 cm$ containing mercury and the two equal containing air at standard atmospheric pressure. If the tube is now turned to a vertical position, by what amount will the mercury be displaced ?

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120. 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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121. N molecules each of mass m of gas A and 2 N molecules each of mass 2m of gas B are contained in the same vessel which is maintined at a temperature T. The mean square of the velocity of the molecules of B type is denoted by v^2 and the mean square of the x-component of the velocity of a tye is denoted by ω^2. What is the ratio of $\omega^2 / v^2 = ?$

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122. Find the number of degrees of freedom for the molecules of a gas for which (a) $C_p = 37.55$

J $mol^{-1}K^{-1}$ in the process, PT = constant.

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123. Estimate the fraction of molecular volume to the actual volume occupied by oxygen gas at STP. Take the diameter of an oxygen molecule to be 3Å.

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124. Molar volume is the volume occupied by 1 mole of any (Ideal) gas at standard temperature and pressure (STP , $0^\circ C$, 1 atmospheric pressure). Show that it is 22.4 litres. Take $R = 8.31 J mol^{-1} K^{-1}$.

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125. An oxygen cylinder of volume 30 litres has an initial gauge pressure of 15 atm. And a temperature of $27^\circ C$. After some oxygen is withdrawn from the cylinder, the gauge pressure drops to 11 atm. And its temperature drops to $17^{\circ} C$. Estimate the mass of oxygen taken out of the cylinder. $\left(R = 8.1 J \text{mole}^{-1} K^{-1}\right.$, molecular mass of $\left. O_2 = 32u\right)$.

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126. An air bubble of volume $1.0 cm^3$ rises from the bottom of a lake 40 m deep at a temperature of $12^{\circ} C$. To what volume does it grow when it reaches the surface which is at a temperature of $35^{\circ} C$?

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127. Estimate the total number of molecules inclusive of oxygen, nitrogen, water vapour and other constituents in a room of capacity $30m^3$ at a temperature of $30^\circ C$ and 1 atmosphere pressure.

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128. Estimate the average thermal energy of a helium atom at room temperature $(27^\circ C)$.

Boltzmann constant $= 1.38 \times 10^{-23} JK^{-1}$

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129. Estimate the average energy of a helium atom at (i) room temperature $(27^{\circ} C)$ (ii) the temperature on the surface of the sun $(6000K)$ and (iii) the temperature of $10^7 K$. Given $k_B = 1.38 \times 10^{-23} J\text{molecule}^{-1} K^{-1}$

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131. Three vessel of equal capacity have gases at the same temperature and pressure. The first vessel contains neon (monoatomic), the second contains chlorine (diatomic), and the third contains uranium hexafluoride (polyatomic). Do the vessels contains equal number of respectice molecules ? Is the root mean square speed of molecules the same in the three cases ? If not, which case is v_{rms} the largest?

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132. Three vessel of equal capacity have gases at the same temperature and pressure. The first vessel contains neon (monoatomic), the second contains chlorine (diatomic), and the third contains uranium hexafluoride (polyatomic). Do

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133. At what temperature is the root mean square speed of an atom in an argon gas cylinder equal to the r.m.s. speed of a helium gas atom at $-20^{\circ}C$? (Atomic mass of Ar = 39.9 u, of He = 4.0 u).

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134. Estimate the mean free path and collision frequency of a nitrogen molecule in a cylinder containing nitrogen at 2 atm and temperature $17^{\circ}C$. Take the radius of a nitrogen molecule to be roughly 1.0Å. Compare the collision time with the time the molecule moves freely between two successive collisions. (Molecular mass of nitrogen = 28.0 u).

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135. A metre long narrow bore held horizontally (and close at one end) contains a 76 cm long mercury thread, which traps a 15 cm column of air. What happens if the tube is held vertically with the open end at the bottom?

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136. From a certain apparatus, the diffusion rate of hydrogen has an average value of $28.7cm^3s^{-1}$. The diffusion of another gas under the same condition is measured to have an average rate of $7.2cm^3s^{-1}$. Identify the gas.

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137. Equal molecules of two gases are in thermal equilibrium. If P_a, P_b and V_a, V_b are their respective pressures and volumes, then which of the following relation is true?

A. $2P_aV_a = P_aV_b$

B. $P_a \neq P_b, V_a = V_b$

C. $P_a / V_a = P_b / V_b$

D. $P_aV_a = P_bV_b$

Answer:

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138. Volume - temperature graph at atmospheric pressure for a monatomic gas (V in m^3 , T in Celsius) is

A.

B.

C.

D.

Answer:

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139. If a given mass of a gas occupies a volume $100 cm^3$ at one atmospheric pressure and a temperature of $100^0 C$. What will be its volume at 4 atmospheric pressure, the temperature being the same?

A. 100cc

B. 400cc

C. 104cc

D. 2.5cc

Answer:

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140. If pressure of a gas contained in a closed vessel is increased by 0.4% when heated by $1^\circ C$, the initial temperature must be

A. 250 K

B. $250^\circ C$

C. 2500 K

D. $25^\circ C$

Answer:

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141. The equation of state for 5 g of oxygen at a pressure P and temperature T, when occupying a volume V, wll be

A. $PV = (5/32)RT$

B. PV = 5RT

C. $PV = (5/2)RT$

D. $PV = (5/16)RT$

Answer:

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142. A 5 g droplet of liquid nitrogen is enclosed in a 50 mL tube which issealed at very low pressure. When the tube is warmed to $35^{\circ}C$ the nitrogen pressure in the tube is (molecular weight of nitrogen = 28 and R =8.3 J/ mol K)

A. $1.01 \times 10^5 N/m^2$

B. $9.13 \times 10^4 N/m^2$

C. $9.13 \times 10^3 N/m^2$

D. $18.26 N/m^2$

Answer:

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143. A gas at one atmosphere and having volume 100 ml is mixed with another gas of equal moles at 0.5 atm and having volume 50 ml in flask of one litre, what is the final pressure ?

A. 0.5 atm

B. 1 atm

C. 0.75 atm

D. 0.125 atm

Answer:

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144. The volume of a gas at $21^{\circ}C$ temperature and 76.8 mm pressure is 1 L. If the density of the gas is 1.2 g/L at NTP, then its mass will he

A. 4 g

B. 4.21 g

C. 1.13 g

D. 10 g

Answer:

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145. Two gases A and B having the same pressure P, volume V and temperature T are mixed. If mixture has volume and temperature as V and T respectively, then the pressure of the mixture will be

A. P

B. 3P

C. 2P

D. 4P

Answer:

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146. A cylinder contained $10kg$of gas at pressure $10^7 \dfrac{N}{m^2}$. The quantity of gas taken out of cylinder if final pressure is $2.5 \times 10^6 N/m^2$ is

(Assume temperature of gas is constant)

A. zero

B. 9.5 kg

C. 7.5 kg

D. 14.2 kg

Answer:

Watch Video Solution

147. Air is filled at $60^\circ C$ in a vessel of open mouth. The vessle is heated to a temperature T so that $1/4th$ of air escapes. Assuming the volume of vessel remaining constant, the value of T is

A. $80^\circ C$

B. $444^\circ C$

C. $333^\circ C$

D. $171^\circ C$

Answer:

Watch Video Solution

148. Gas exerts pressure on the walls of the container because the molecules are –

A. gas has weight

B. gas molecules have momentum

C. gas molecules collide with each other

D. gas molecules collide with tire walls of the container

Answer:

Watch Video Solution

149. The absolute zero is the temperature at which

A. efficiency of engines becomes infinite

B. all liquids freeze

C. molecular motion ceases

D. none of these

Answer:

Watch Video Solution

150. The kinetic energy of 1 g molecule of a gas, at normal temperature and pressure, is

A. 0.56×10^4 J

B. 2.7×10^2 J

C. 1.3×10^2 J

D. 3.4×10^3 J

Answer:

Watch Video Solution

151. The temperature is changed from $27^\circ C$ to $327^\circ C$ Find ratio of K.E. of molecules at two temperatures.

A. $3:2$

B. $2:3$

C. $1:2$

D. $1:3$

Answer:

Watch Video Solution

152. At which of the following temperatures would the molecules of a gas have twice the average kinetic energy they have at $20^\circ C$?

A. $40^\circ C$

B. $80^\circ C$

C. $586^\circ C$

D. $313^\circ C$

Answer:

Watch Video Solution

153. The r.m.s. of speed of a group of 7 gas molecules having speed (6, 4, 2, 0,-2,-4,-6) m/s is

A. 1.5 m/s

B. 3.4 m/s

C. 9 m/s

D. 4 m/s

Answer:

Watch Video Solution

154. The respective speeds of five molecules are 1, 2, 3, 4 and $5 km / s$. The ratio of their rms velocity and the average velocity will be

A. $\sqrt{11} : 3$

B. `3 : sqrt11

C. $1 : 2$

D. $3 : 4$

Answer:

Watch Video Solution

155. If the rms velocity of gas is v , then

A. $v^{-2}T$ = constant

B. v^{-2}/T = constant

C. vT^{-2} = constant

D. v is independent of T

Answer:

Watch Video Solution

156. if average velocity becomes 4 times, then what will be the effect on rms velocity at the temperature?

A. 1.4 times

B. 4 times

C. 3 times

D. 2 times

Answer:

Watch Video Solution

157. The r.m.s. velocity at a temperature is 2 times the r.m.s. velocity at 300 K. What is this temperature ?

A. 900 K

B. 2400 K

C. 600 K

D. 1200 K

Answer:

Watch Video Solution

158. At room temperature $(27^{\circ} C)$ the 'rms' speed of the molecules of a certain diatomic gas is found to be 1920 ms^{-1}. The gas is

A. H_2

B. F_2

C. O_2

D. CI_2

Answer:

Watch Video Solution

159. 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. 2100 K

B. 1700 K

C. 1350K

D. 1050K

Answer:

Watch Video Solution

160. The gas having average speed four times as that of SO_2 (molecular mass 64) is

A. He (molecular mass 64)

B. O_2 (molecular mass 4)

C. H_2 (molecular mass 32)

D. CH_4 (molecular mass 16)

Answer:

Watch Video Solution

161. The temperature of a given mass is increased from $27^\circ C$to $327^\circ C$. The rms velocity of the molecules increases

A. $\sqrt{2}$ times

B. 2 times

C. $2\sqrt{2}$ times

D. 4 times

Answer:

Watch Video Solution

162. The ratio of the vapour densities of two gases at the same temperature is $8:9$. The ratio of the rms velocities of their molecules is

A. $3:2\sqrt{2}$

B. `2sqrt 2 : 3

C. $9:8$

D. $8:9$

Answer:

Watch Video Solution

163. What is the degree of freedom in case of a monoatomic gas?

A. 1

B. 3

C. 5

D. none of these

Answer:

Watch Video Solution

164. If a gas has n degrees of freedom ratio of specific heats of gas is

A. $\frac{1+n}{2}$

B. $1+\frac{1}{n}$

C. $1+\frac{n}{2}$

D. $1+\frac{2}{n}$

Answer:

Watch Video Solution

165. If γ be the ratio of specific heats $(C_p \& C_v)$ for a perfect gas. Find the number of degrees of freedom of a molecules of the gas?

A. $\frac{25}{2}(\gamma - 1)$

B. $\frac{3\gamma - 1}{2\gamma - 1}$

C. $\frac{2}{\gamma - 1}$

D. $\frac{9}{2}(\gamma - 1)$

Answer:

Watch Video Solution

166. Specific heat at constant volume (C_V) and at constant pressure (C_p) of an ideal gas have been reported as shown below. Which of the following sets are most reliable ?

A. $C_V = 5R, C_p = 3R$

B. $C_V = 3R, C_p = 4R$

C. $C_V = 5R, C_p = 7R$

D. $C_V = 3R, C_p = 5R$

Answer:

Watch Video Solution

167. Graph for specific heat at constant volume for a monoatomic gas

A.

B.

C.

D.

Answer:

Watch Video Solution

168. The mean kinetic energy of one mole of gas per degree of

A. $\frac{1}{2}kT$

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

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

D. $\frac{3}{2}RT$

Answer:

Watch Video Solution

169. The gases carbon-monoxide (CO) and nitrogen at the same temperature have kinetic energies E_1 and E_2 respectively. Then

A. $E_1 = E_2$

B. $E_1 > E_2$

C. $E_1 < E_2$

D. E_1 and E_2 cannot be compared

Answer:

Watch Video Solution

170. One mole of monoatomic gas and three moles of diatomic gas are put together in a container. The molar specific heat (in JK^{-1} mol $^{-1}$) at constant volume is (R = 8.3 JK^{-1} mol^{-1})

A. 18.7

B. 18.9

C. 19.2

D. none of these

Answer:

Watch Video Solution

171. How much heat energy in joules must be supplied to 14gms of nitrogen at room temperature to rise its temperature by $40^{\circ} C$ at constant pressure? (Mol. Wt. of $N_2 = 28gm$, R=constant)

A. 50R

B. 60R

C. 70R

D. 80R

Answer:

Watch Video Solution

172. A diatomic gas initially at 18° is compressed adiabatically to one- eighth of its original volume. The temperature after compression will b

A. $18^{\circ} C$

B. $395.4^{\circ} C$

C. $887.4^{\circ} C$

D. $114^{\circ} C$

Answer:

Watch Video Solution

173. A monoatomic gas is suddenly compressed to $1/8$ of its original volume adiabatically. The pressure of gas will change to :

A. 32

B. $\frac{40}{3}$

C. $\frac{24}{5}$

D. 8

Answer:

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174. The phenomenon of Brownian motion is taken as an evidence of

A. kinetic theory of matter

B. EMT of radiation

C. corpusculaar theory of light

D. photoelectric phenomenon

Answer:

Watch Video Solution

175. The mean free path of collision of gas melecules varies with its diameter (d) of the molecules as

A. d^{-1}

B. d^{-2}

C. d^{-3}

D. d^{-4}

Answer:

Watch Video Solution

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

A. is decreased

B. is increased

C. remains unchanged

D. increases or decreases according to the nature of gas

Answer:

Watch Video Solution

177. A gas which obeys the gas laws at all values of temperature and pressure is called ________ .

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178. At _____ pressures and ______ temperatures, some real gases behave like an ideal gas.

Watch Video Solution

179. The graph between pressure P and volume V for a given mass of a gas a fixed temperature T is a _______ .

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180. The gas constant per molecule is called ______ constant and its value in SI is ______ .

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181. Acoording to the kinetic theory of gases, the temperature at which all molecular motion ceases is called ______ .

Watch Video Solution

182. Average straight distance covered between two successive collision of molecules is called......................

Watch Video Solution

183. The average kinetic energy of a gas molecule is ______ proportional to the absolute temperature of the gas.

Watch Video Solution

184. The temperature of a gas is a measure of the average _____ of its molecules.

Watch Video Solution

185. The absolute temperature of a gas is made 4 time its initial value. What will be the change in rms velocity of its molecules ?

Watch Video Solution

186. The ratio of the root mean square speeds of the molecules of an ideal gas at 270 K and 30 K will be ______ .

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187. A gas in a vessel is at the pressure P_0. If the masses of all the molecules be made half and their speeds be made double, then find the resultant pressure.

Watch Video Solution

188. The velocities of three molecules are 3v, 4v and 5v. Calculate their root mean square velocity.

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189. The mass of a molecule of krypton is 2.25 times the mass of a hydrogen molecule. A mixture of equal masses of these gases is enclosed in a vessel. At any given temperature, the ratio of the root mean square velocities of krypton and hydrogen gases will be _____ .

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190. The volume of vessel A is twice the volume of another vessel B and both of them are filled with the same gas. If the gas in A is at twice the temperature and twice the pressure in comparison to the gas in B, what is the ratio of number of gas molecule in A and B ?

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191. One mole any gas occupies a volume of _______ at normal temperature and pressure.

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192. The r.m.s. of gas molecules is directly proportional to the square root of its _______ and

inversely proportional to the square root of its _______.

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193. The speed possessed by the maximum number of molecules in a gas is called ______ .

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194. The ratio $v_{rms} : \bar{v} : v_{mp} =$ ______ .

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195. The total number of independent ways in which the particles of the system can absorb energy is called _____ of the system.

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196. A rigid body has a total of ______ degrees of freedom, _____ for translatory motion and _______ for rotatory motion.

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197. The energy associated with each degree of freedom of a molecule

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198. A diatomic molecule has _______ degree of freedom at moderate temperature and it has ______ degrees of freedom at high temperature.

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199. A non-linear triatomic molecule has ______ degrees of freedom while a linear triatomic molecule has _______ degrees of freedom.

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200. A surface is hit elastically and normally by n bals per unit time, all the balls having the same mass m, and moving with the same velocity v. then the force acting on surface is

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201. Near the room temperature the molar specific heat at constant volume is equal to ________ J $mol^{-1}\ K^{-1}$.

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202. Mean free path of a gas molecule ________ proportional to the mass of gas molecule and ________ proportional to the square of the molecular diameter.

Watch Video Solution

203. Two different gases at the same temperature have the same average kinetic energy.

A. True

B.

C.

D.

Answer:

Watch Video Solution

204. The root-mean square speeds of the molecules of different ideal gases, maintained at the same temperature are the same.

A. True

B.

C.

D.

Answer:

Watch Video Solution

205. Although the velocity of air molecule is nearly 0.5 km/s, yet the smell of scent spreads at a much slower rate. Why?

A. True

B.

C.

D.

Answer:

Watch Video Solution

206. The rms speed of oxygen molecules at a certain temperature T is v. If the temperature is doubled and oxygen gas dissociates into atomic oxygen, then the rms speed

A. True

B.

C.

D.

Answer:

Watch Video Solution

207. On driving the scooter for a long time, the air pressure in the tyres slightly increases. Why ?

A. True

B.

C.

D.

Answer:

Watch Video Solution

208. Rate of diffusion of a gas is independent of the rms speed of its molecules.

A. True

B.

C.

D.

Answer:

Watch Video Solution

209. Real gases obey the gas equation : $PV = nRT$ more correctly at low temperature and high pressure.

A. True

B.

C.

D.

Answer:

Watch Video Solution

210. In the upper atmosphere the kinetic temperature of air is of the order of 1000 K, even then one feels severe cold there.

A. True

B.

C.

D.

Answer:

Watch Video Solution

211. Absolute zero degree temperature is not zero energy temperature.

A. True

B.

C.

D.

Answer:

Watch Video Solution

212. On reducing the volume of the gas at constant temperature, the pressure of the gas increases. Explain on kinetic theory.

A. True

B.

C.

D.

Answer:

Watch Video Solution

213. Three vessel of equal capacity have gases at the same temperature and pressure. The first vessel contains neon (monoatomic), the second contains chlorine (diatomic), and the third contains uranium hexafluoride (polyatomic). Do the vessels contains equal number of respectice molecules ? Is the root mean square speed of molecules the same in the three cases ? If not, which case is v_{rms} the largest?

A. True

B.

C.

D.

Answer:

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214. Which of the following pehnomena gives evidence of the molecule motion ?

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215. What is an equation of state ? Give an example

Watch Video Solution

216. At which temperature does all molecular motion cease ?

Watch Video Solution

217. What is the nature of graph between pressure (P) and volume(V)for a given mass of a gas at a fixed temperature ?

Watch Video Solution

218. What is the nature of graph of P versus (1/V) for a given mass of gas at constant temperature ?

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219. What is the nature of graph of PV versus P for a given mass of a gas at constant temperature?

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220. What is the lowest temperature attainable according to Charles' law ?

Watch Video Solution

221. Who proposed a model for a gas for the kinetic theory of gases?

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222. Equation of state of an ideal gas is

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223. What does universal gas constant R signify?

Watch Video Solution

224. Name the universal gas constant. What is its value in SI unit ?

Watch Video Solution

225. Does the average K.E. per molecule of the gas depend upon the mass of the molecule ?

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226. On which factors does the average KE of gas molecules depend : nature of gas, its temperature , its volume?

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227. What is Boltzman's constant? Give its value.

Watch Video Solution

228. How is the average KE of a gas molecule related to the temperature of the gas ?

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229. The absolute temperature of a gas is made 4 time its initial value. What will be the change in rms velocity of its molecules ?

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230. A body of mass 'M' collides against a wall with a velocity v and retraces its path with the same speed. The change in momentum is (take initial direction of velocity as positive)

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231. At a constant temperature, what is the relation between pressure P and density ρ of gas?

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232. A gas enclosed in a vessel has pressure P, volume V and absolute temperature T, write the formula for number of molecule N of the gas.

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233. What is the value of gas constant in cgs system for 1 gram of helium ?

Watch Video Solution

234. The velocities of three molecules are 3v, 4v and 5v. Calculate their root mean square velocity.

Watch Video Solution

235. What will be the ratio of the root mean square speeds of the molecules of an ideal gas at 270 K and 30 K ?

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236. A mixture of helium and hydrogen gases is filled in a vessel at $30^\circ C$. Compare the rms velocities of molecules of the two gases. Atomic weights of hydrogen and helium are 1 and 4 respectively.

Watch Video Solution

237. Two vessels of the same volume and filled with the same gas at the same temperature. If the pressure of the gas in these vessel be in the ratio 1:2, then state : (i) the ratio of the rms speeds of the molecules, (ii) the ratio of the number of molecules.

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238. Two gases A and B each at temperature T. Pressure P and volume V, are mixed. If the mixture be at the same temperature T and its volume also be V, then what should be its pressure ? Explain.

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239. RELATION BETWEEN SPECIFIC HEAT AND DEGREE OF FREEDOM

Watch Video Solution

240. The mean transitional kinetic energy of a perfect gas molecule at absolute temperature T is (k is the Boltzmann constant)

Watch Video Solution

241. Name the factors on which degrees of freedom of a gas molecule depend.

Watch Video Solution

242. State and prove law of equipartition of energy.

Watch Video Solution

243. Write the values of C_p and C_v for a monoatomicgas

Watch Video Solution

244. Write any four fundamental postulates of the kinetic theory of an ideal gas.

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245. DEVIATION FROM IDEAL BEHAVIOUR

Watch Video Solution

246. RELATION BETWEEN PRESSURE AND KINETIC ENERGY

Watch Video Solution

247. Deduce Graham's law from kinetic gas equation.

Watch Video Solution

248. The Brownian motion is due to :

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249. State four factors on which Brownian motion depends.

Watch Video Solution

250. What is meant by free path of a gas molecule ? On what factors does the mean free path depend ?

Watch Video Solution

251. Dalton's Law of Partial Pressure

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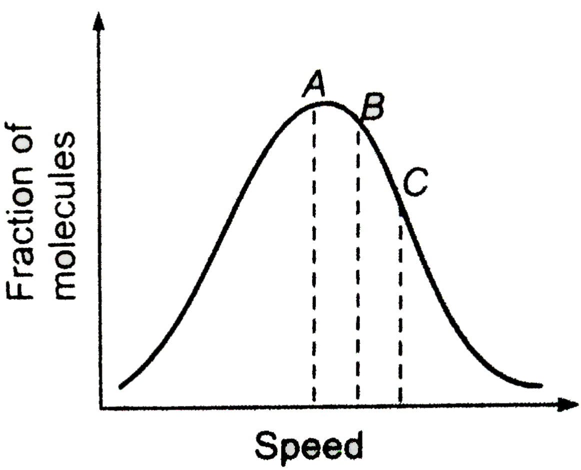
252. At a definit temperature (T), the distribution of speeds is given by the curve. In the curve points A, B and C indicates the speeds corresponding to :



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253. Define most probable speed, average speed and root mean square speed of a gas. How are they related to each other ?

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254. Explain the degrees of freedom for

(i) An atom

(ii) A diatomic molecule.

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255. Obtain an expression for the pressure of an ideal gas from the kinetic theory of an ideal gas.

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256. Deduce Graham's law from kinetic gas equation.

Watch Video Solution

257. Define absolute zero temperature?

Watch Video Solution

258. Obtain the dimensional formula for R used in the ideal gas equation, PV = RT.

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259. The degrees of freedom of a triatomic gas is

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260. According to the law of equipartition of energy, the energy associated with each degree of freedom is :

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261. According to the law of equipartition of energy, internal energy of an ideal gas at a given temperature, is equally distributed in translational and rotational kinetic energies.

Rotational kinetic energy of a monoatomic gas is zero.

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262. State the law of equipartition of energy. Using this law, determine the values of Cp, Cv and y

Watch Video Solution

263. What is meant by free path of a gas molecule ? On what factors does the mean free path depend ?

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264. What do you mean by mean free path ?

Watch Video Solution

265. State the postulates of Kinetic Theory of gases. Explain the pressure exerted by an ideal gas.

Watch Video Solution

266. It P is the pressure and ρ is the density of a gas, then P and ρ are realted as :

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267. State and explain Boyle's law. Represent the law graphically.

Watch Video Solution

268. State and explain (i) Gay lussac's law and (ii) Gas equation. Distinguish clearly between R and r for a gas.

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269. State Gay-Lusaac's law

Watch Video Solution

270. Ideal gas equation strictly obeys gas laws under all conditions of

Watch Video Solution

271. Calculate number of significant digits in Avogadro number if Boltzmann's constant and universal gas constant are $1.38 \times 10^{-23} JK^{-1}$ and $8.314 JK^{-1} mol^{-1}$ respectively

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272. An ideal gas or a perfect gas is that ....the such as ....

Watch Video Solution

273. A gas which obeys all the assumptions of kinetic theory of gases at all conditions of temperatures and pressures is called

Watch Video Solution

274. Pressure exerted by a gas is due to ....against..................................

Watch Video Solution

275. Average kinetic energy of a gas molecule is

Watch Video Solution

276. Explain (i) Boyle's law (ii) Charle's law. Why are they not applicable to real gases in all states ?

Watch Video Solution

277. Which of the following are true for an element ?

(i) Atomic number = number of protons + number of electrons

(ii) Mass number = number of protons + number of neutrons

(iii) Atomic number = number of protons = number of neutrons

(iv) Atomic number = number of protons = number of electrons

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278. We know that gases which donot react chemically intermix irrepective of their nature. This is known as diffusion. The law of gravitation does not apply to diffusion which means that lighter gases can more downward while the hevier ones can move upwards.

(i) State Graham's Law of diffusion.

(ii)Give Its mathemartical form.

(iii) What is the value associated with the phenomenon of diffusion of gases?

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279. To which of the following gaseous mixture, the Dalton's law of partial pressures will not apply ?

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280. AVERAGE SPEED

Watch Video Solution

281. The root mean square speed of gas molecules

Watch Video Solution

282. Most probable speed, average speed and RMS speed are related as -

Watch Video Solution

283. The relation between rms velocity, v_{rms} and the most probable velocity, v_{mp}, of a gas is

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284. What are degrees of freedom?

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285. According to the law of equipartition of energy, the energy associated with each degree of freedom is :

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286. The internal energy of a perfect monoatomic gas is

Watch Video Solution

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

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288. Brownian motion is a/an

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289. A vessel contains 1 mole of O_2 gas (relative molar mass 32) at a temperature T. The pressure of the gas is P. An identical vessel containing one mole of He gas (relative molar mass 4) at temperature 2T has a pressure of

A. $P/8$

B. P

C. 2P

D. 8P

Answer:

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290. The average translational kinetic energy of O_2 (relative molar mass 32) molecules at a particular temperature is 0.048eV. The translational kinetic energy of N_2 (relative molar mass 28) molecules in eV at the same temperature is

A. 0.0015

B. 0.003

C. 0.048

D. 0.768

Answer:

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291. The average translational energy and the rms speed of molecules in a sample of oxygen gas at $300K$ are $6.21 \times 10^{-21} J$ and $484m/s$, respectively. The corresponding values at $600K$ are nearly (assuming ideal gas behaviour)

A. 12.42×10^{-21} J, 968 ms^{-1}

B. 8.78×10^{-21} J, 648 ms^{-1}

C. 6.21×10^{-21} J, 968 ms^{-1}

D. 12.42×10^{-21} J, 684 ms^{-1}

Answer:

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292. A gas mixture consists of 2 moles of oxygen and 4 moles of argon at temperature T. Neglecting all vibrational modes, the total internal energy of the system is

A. 4RT

B. 9RT

C. 11RT

D. 15RT

Answer:

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293. The ratio of the speed of sound in nitrogen gas to that in helium gas, at 300K is

A. $\sqrt{2}/7$

B. $\sqrt{1}/7$

C. $(\sqrt{3})/5$

D. $(\sqrt{6})/5$

Answer:

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294. From the following statements, concerning ideal gas at any given temperature T, select the correct one(s)

(1) The coefficient of volume expansion at constant
pressure is same for all ideal gases

(2) In a gaseous mixture, the average translational kinetic
energy of the molecules of each component is same

(3) The mean free path of molecules increases with the

decrease in pressure

(4) The average translational kinetic energy per molecule of oxygen gas is 3KT (K being Boltzmann constant)

A. The co-efficient of volume expansion at constant pressure is the same for all ideal gase

B. The average translational kinetic energy per molecule of oxygen gas is 3kT, k being Boltzmann constant

C. The mean-free path of molecules increases with increases in the pressure

D. In a gaseous mixture, the average translational kinetic energy of the molecules of each component is different.

Answer:

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295. An ideal gas is expanding such that $PT^2 =$ constant. The coefficient of volume expansion of lthe gas is:

A. $\frac{1}{T}$

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

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

D. $\frac{4}{T}$

Answer:

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296. A real gas behaves like an ideal gas if its

A. Pressure and temperature are both high

B. Pressure is high and temperature is low

C. Pressure and temperature are both low

D. Pressure is low and temperature is high

Answer:

Watch Video Solution

297. A mixture of 2 moles of helium gas ($(a \rightarrow micmass) = 4a.m.u)$ and 1 mole of argon gas $((a \rightarrow micmass) = 40a.m.u)$ is kept at 300K in a container. The ratio of the rms speeds $\left(\frac{v_{rms}(helium)}{(v_{rms}(argon))}\right)$ is

A. 0.32

B. 0.45

C. 2.24

D. 3.16

Answer:

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298. Two moles of ideal helium gas are in a rubber balloon at $30^{\circ} C$. The balloon is fully expandable and can be assumed to require no energy in its expansion. The temperature of the gas in the balloon is slowly changed to $35^{\circ} C$. The amount of heat required in raising the temperature is nearly (take R

$= 8.31 J / mol. K$)

A. 62 J

B. 104 J

C. 124 J

D. 208 J

Answer:

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299. Two non-reactive monoatomic ideal gases have their atomic masses in the ratio $2:3$. The ratio of their partial pressures, when enclosed in a vessel kept at a constant temperature, is $4:3$. The ratio of their densities is

A. $1:4$

B. $1:2$

C. $6:9$

D. $8:9$

Answer:

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300. At room temperature the rms speed of the molecules of a certain diatomic gas is found to be 1920 m/s. The gas is

A. H_2

B. F_2

C. O_2

D. CI_2

Answer:

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301. The temperature of an ideal gas is increased from 120K to 480K. If at 120K the root-mean-squre velocity of the gas molecules is v, at 480K it becomes

A. 4v

B. 2v

C. $v/2$

D. $v/4$

Answer:

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302. Let $\bar{v}$, v_{rms} and v_p respectively denote the mean speed. Root mean square speed, and most probable speed of the molecules in an ideal monoatomic gas at absolute temperature T. The mass of a molecule is m. Then

A. no molecule can have a speed greater than $\sqrt{2} v_{rms}$

B. no molecule can have a speed less than $v_p / \sqrt{2}$

C. $v_p < \bar{v} < v_{rms}$

D. the average kinetic energy of a molecule is $-\frac{3}{4} m v^2 p.$

Answer:

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303. A vessel contains a mixture of one mole of oxygen and two moles of nitrogen at 300K. The ratio of the average rorational kinetic energy per O_2 molecules to that per N_2 molecules is

A. $1:1$

B. $1:2$

C. $2:1$

D. depends on the moment of inertia of the two molecules

Answer:

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304. When an ideal diatomic gas is heated at constant pressure, the fraction of the heat energy supplied which increases the internal energy of the gas is

A. $2/5$

B. $3/5$

C. $3/7$

D. $5/7$

Answer:

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305. If one mole of a monatomic gas $\left(\gamma = \frac{5}{3}\right)$ is mixed with one mole of a diatomic gas $\left(\gamma = \frac{7}{5}\right)$, the value of gamma for mixture is

A. 1.35

B. 1.4

C. 1.5

D. 1.75

Answer:

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306. A given quantity of a ideal gas is at pressure P and absolute temperature T. The isothermal bulk modulus of the gas is

A. $\frac{2}{3}P$

B. P

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

D. $2P$

Answer:

Watch Video Solution

307. Three closed vessels A, B and C are at the same temperature T and contain gases which obey the Maxwellian distribution of velocities. Vessel A contains only O_2, B only N_2 and C a mixture of equal quantities of O_2 and N_2. If the average speed of the O_2 molecules in vessel A is V_1, that of the N_2 molecules in vessel B is V_2, the average speed of the O_2 molecules in vessel C is (where M is the mass of an oxygen molecules)

A. $\frac{v_1 + v_2}{2}$

B. v_1

C. $(v_1 . v_2)^{\frac{1}{2}}$

D. $\sqrt{\frac{3kT}{M}}$

Answer:

Watch Video Solution

308. C_v and C_p denote the molar specific heat capacities of a gas at constant volume and constant pressure, respectively. Then

A. $C_p - C_v$ is larger for a diatomic ideal gas than for a monoatomic ideal gas

B. $C_p + C_v$ is larger for a diatomic ideal gas than for a monoatomic ideal gas

C. C_p // C_v is larger for a diatomic ideal gas than for a monoatomic ideal gas

D. $C_p \cdot C_v$ is larger for a diatomic ideal gas than for a monoatomic ideal gas

Answer:

Watch Video Solution

309. A container of fixed volume has a mixture of a one mole of hydrogen and one mole of helium in equilibrium at temperature T. Assuming the gasses are ideal, the correct statement (s) is (are)

A. The average energy per mole of the gas mixture is 2 RT

B. The ratio of speed of sound in the gas mixture to that in helium gas is $\sqrt{\frac{6}{5}}$

C. The ratio of the rms speed of helium atoms to that of hydrogen molecules is $\frac{1}{2}$

D. The ratio of the rms speed of helium atoms to that of hydrogen molecules is $\frac{1}{\sqrt{2}}$

Answer:

Watch Video Solution

310. A gas is enclosed in a cylinder with a movable frictionless piston. Its initial thermodynamic state at pressure $P_i = 10^5$ Pa and volume $V_i = 10^{-3} m^3$ changes to a final state at $P_f = (1/32) \times 10^5 Pa$ and $V_f = 8 \times 10^{-3} m^3$ in an adiabatic quasi-static process, such that $P^3 V^3 = cons\tan t.$ Consider another thermodynamic process that brings the system form the same initial state to the same final state in two steps: an isobaric expansion at P_i followed by an isochoric (isovolumetric) process at volume V_r. The amount of heat supplied to the system i the two-step process is approximately

A. 112 J

B. 294 J

C. 588 J

D. 813 J

Answer:

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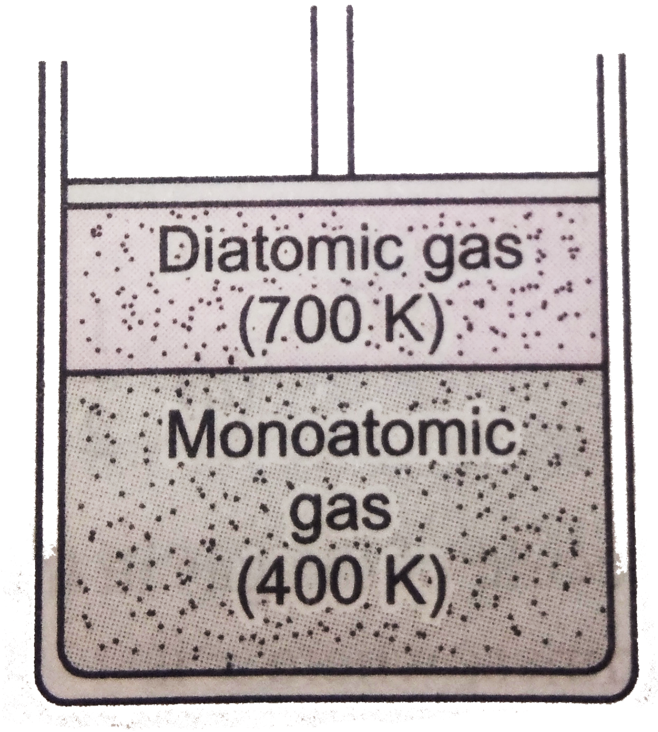
311. In Fig., a container is shown to have a movable (without friction) piston on top. The container and the piston are all made of perfectly insulating material allowing no heat transfer between outside and inside the container. The container is divided into two compartments by a rigid partition made of a thermally conducting material that allows slow transfer of heat. the lower compartment of the container is filled with 2 moles of an ideal monoatomic gas at 700 K and the upper compartment is filled with 2 moles of an ideal diatomic gas at 400 K. the heat capacities per mole of an ideal monoatomic gas are $C_v = \frac{3}{2}R$ and $C_P = \frac{5}{2}R$, and those for an ideal diatomic gas are $C_{ve} = \frac{5}{2}R$ and $C_P = \frac{7}{2}R$.

Consider the partition to be rigidly fixed so that it does not move. when equilibrium is achieved, the final temperature of the gases will be



A. 550K

B. 525K

C. 513K

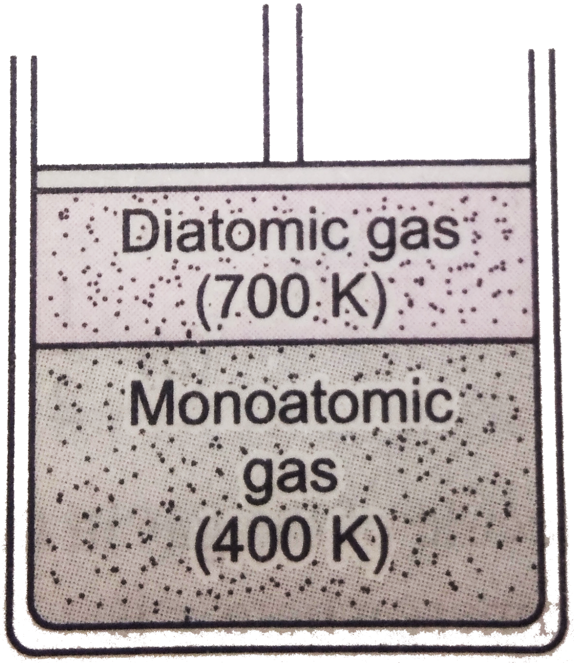
D. 490K

Answer:

Watch Video Solution

312. In Fig., a container is shown to have a movable (without friction) piston on top. The container and the piston are all made of perfectly insulating material allowing no heat transfer between outside and inside the container. The container is divided into two compartments by a rigid partition made of a thermally conducting material that allows slow transfer of heat. the lower compartment of the container is filled with 2 moles of an ideal monoatomic gas at 700 K and the upper compartment is filled with 2 moles of an ideal diatomic gas at 400 K. the heat capacities per mole of an ideal monoatomic gas are $C_v = \frac{3}{2}R$ and $C_P = \frac{5}{2}R$, and those for an ideal diatomic gas are $C_{ve} = \frac{5}{2}R$ and $C_P = \frac{7}{2}R$.

Now consider the partition to be free to move without friction so that the pressure of gases in both compartments is the same. the total work done by the gases till the time they achieve equilibrium will be



A. 250R

B. 200R

C. 100R

D. $-100R$

Answer:

Watch Video Solution

313. Two thermally insulated vessel 1 and 2 are filled with air at temperature $(T_1 T_2)$, $volume(V_1 V_2)$ and pressure $(P_1 P_2)$ respectively. If the valve joining the two vessels is opened, the temperature inside the vessel at equilibrium will be

A. $T_1 + T_2$

B. $\dfrac{T_1 + T_2}{2}$

C. $\dfrac{T_1 + T_2(P_1V_1 + P_2 = V_2)}{P_1V_1T_2 + P_2V_2T_1}$

D. $\dfrac{T_1 + T_2(P_1V_1 + P_2 = V_2)}{P_1V_1T_1 + P_2V_2T_2}$

Answer:

Watch Video Solution

314. An insulated container of gas has two chambers separated by an insulating partition. One of the chambers has volume V_1 and contains ideal gas at pressure P_1 and temperature T_1.The other chamber has volume V_2 and contains ideal gas at pressure P_2 and temperature T_2. If the partition is removed without doing any work on the gas, the final equilibrium temperature of the gas in the container will be

A. $\dfrac{T_1 + T_2(P_1V_1 + P_2 = V_2)}{P_1V_1T_1 + P_2V_2T_2}$

B. $\dfrac{T_1 + T_2(P_1V_1 + P_2 = V_2)}{P_1V_1T_2 + P_2V_2T_1}$

C. $\dfrac{(P_1V_1T_1) + (P_2V_2T_2)}{(P_1V_1) + (P_2V_2)}$

D. $\dfrac{(P_1V_1T_2) + (P_2V_2T_1)}{(P_1V_1) + (P_2V_2)}$

Answer:

Watch Video Solution

315. Cooking gas container are kept in a lorry moving with uniform speed. The temperature of the gas molecules inside will

A. increase

B. decrease

C. remain the same

D. decreases for some, while increases for others

Answer:

Watch Video Solution

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

A. -73 K

B. 3 K

C. 20 K

D. 80 K

Answer:

Watch Video Solution

317. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. The ratio C_P / C_V for the gas is

A. $4/3$

B. 2

C. $5/3$

D. $3/2$

Answer:

Watch Video Solution

318. One mole of ideal monoatomic gas $(\gamma = 5/3)$ is mixed with one mole of diatomic gas $(\gamma = 7/5)$. What is γ for the mixture? γ

Denotes the ratio of specific heat at constant pressure, to that at constant volume

A. $3/2$

B. $23/15$

C. $35/23$

D. $4/3$

Answer:

Watch Video Solution

319. 1 mole of a gas with $\gamma = 7/5$ is mixed with 1 mole of a gas with $\gamma = 5/3$, then the value of γ for the resulting mixture is

A. $7/5$

B. $2/5$

C. $3/2$

D. $12/7$

Answer:

Watch Video Solution

320. A gaseous mixture consists of 16 g of helium and 16 g of oxygen. Find γ for the mixture.

A. 1.4

B. 1.54

C. 1.59

D. 1.62

Answer:

Watch Video Solution

321. The work of 146 kJ is performed in order to compress one kilo mole of a gas adiabatically and in this process the temperature of the gas increases by $7^\circ C$. The gas is $(R = 8.3ml^{-1}Jmol^{-1}K^{-1})$

A. a mixture of monoatomic and diamtomic

B. monoatomic

C. diamtomic

D. triatomic

Answer:

Watch Video Solution

322. One kg of a diatomic gas is at pressure of $8 \times 10^4 N/m^2$. The density of the gas is $4kg/m^3$. What is the energy of the gas due to its thermal motion?

A. $3 \times 10^4 J$

B. $5 \times 10^4 J$

C. $6 \times 0^4 J$

D. $7 \times 10^4 J$

Answer:

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323. Two rigid boxes containing different ideal gases are placed on a table. Box A contains one mole of nitrogen at temperature T_0, while Box contains one mole of helium at temperature $\left(\frac{7}{3}\right)T_0$. The boxes are then put into thermal contact with each other, and heat flows between them until the gasses reach a common final temperature (ignore the heat capacity of boxes).

Then, the final temperature of the gasses, T_f in terms of T_0 is

A. $T_f = \frac{5}{2}T_0$

B. $T_f = \frac{3}{7}T_0$

C. $T_f = \frac{7}{3}T_0$

D. $T_f = \frac{3}{2}T_0$

Answer:

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324. Three perfect gases at absolute temperature T_1, T_2 and T_3 are mixed. The masses f molecules are m_1, m_2 and m_3 and the number of molecules are n_1, n_2 and n_3 respectively. Assuming no loss of energy, the final temperature of the mixture is

A. $\dfrac{T_1 + T_2 + T_3}{3}$

B. (n_1T_1+n_2T_2+n_3T_3)/(n_1+n_2+n_3)`

C. $\dfrac{n_1 T_1^2 + n_2 T_2^2 + n_3 T_3^2}{n_1 T_1 + n_2 T_2 + n_3 T_3}$

D. $\dfrac{n_1^2 T_1^2 + n_2^2 T_2^2 + n_3^2 T_3^2}{n_1 T_1 + n_2 T_2 + n_3 T_3}$

Answer:

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325. A thermally insulated vessel contains an ideal gas of molecular mass M and ratio of specific heats γ. It is moving with speed v and it's suddenly brought to rest. Assuming no heat is lost to the surroundings, Its temperature increases by:

A. $\frac{(\gamma - 1)}{2(\gamma + 2)R} M v^2 K$

B. $\dfrac{(\gamma-1)}{2\gamma R}Mv^2K$

C. $\dfrac{\gamma Mv^2}{2R}K$

D. $\dfrac{(\gamma-1)}{2R}Mv^2K$

Answer:

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326. In an ideal gas at temperature T , the average force that a molecule applies on the walls of a closed container depends on $T \text{as} T^q$. A good estimate for q is :-

A. $\frac{1}{4}$

B. 2

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

D. 1

Answer:

Watch Video Solution

327. Consider a spherical shell of radius R at temperature T. The black body radiation inside it can be considered as an ideal gas of photons with internal energy per unit volume $u = \frac{U}{V} \propto T^4$ and pressure $P = \frac{1}{3}\left(\frac{U}{V}\right)$. If the shell now undergoes an adiabatic expansion the relation between T and R is :

A. $T \propto e^{-r}$

B. $T \propto e^{-3r}$

C. $T \propto \frac{1}{r}$

D. $T \propto \frac{1}{r^3}$

Answer:

Watch Video Solution

328. using euipartion of energy, the specific heat $\left(\text{in} jkg^{-1}K^{-1}\right.$ of aluminium at room temperature can be estimated to be (atomic weigh of aluminium=27)

A. 410

B. 25

C. 1850

D. 925

Answer:

Watch Video Solution

329. Consider an ideal gas confined in an isolated closed chamber. As the gas undergoes an adiabatic expansion, the average time of collision between molecules increase as V^q, where V is the volume of the gas. The value of q is : $\left(\gamma=\frac{C_p}{C_v}\right)$

A. $\frac{3\gamma+5}{6}$

B. (3 gamma-5)/6

C. $\frac{\gamma+1}{2}$

D. $\frac{\gamma-1}{2}$

Answer:

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330. The temperature of an open room of volume $30m^3$ increases from $17^\circ C \rightarrow 27^\circ C$ due to sunshine. The atmospheric pressure in the room remains $1 \times 10^5 Pa$. If n_i and n_f are the number of molecules in the room before and after heating then n_f and n_i will be

A. -1.61×10^{23}

B. 1.38×10^{23}

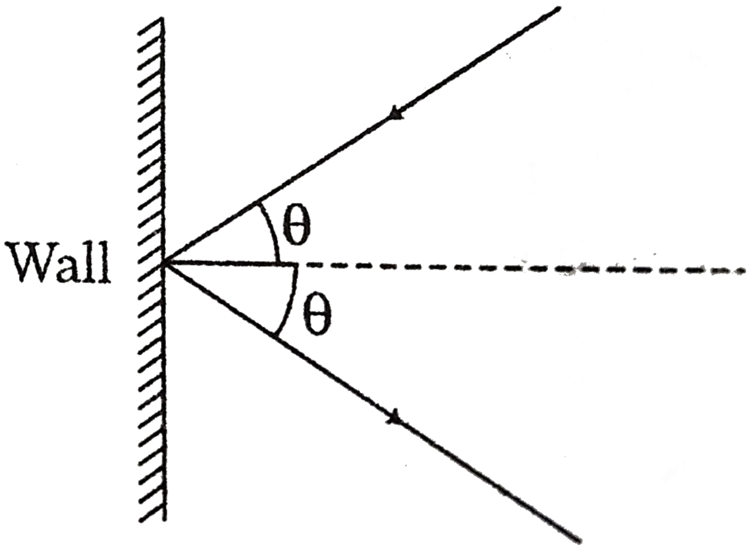
C. 2.5×10^{25}

D. -2.5×10^{25}

Answer:

Watch Video Solution

331. The mass of hydrogen molecule is 3.32×10^{-27} kg. If 10^{23} hydrogen molecules strick per second at 2 cm^2 area of a rigid wall at an angle of 45° from the normal and rebound back with a speed of 1000 ms^{-1}, then the pressure exerted on the wall is



A. $2.35 \times 10^3 \frac{N}{m^2}$

B. $4.70 \times 10^3 \frac{N}{m^2}$

C. $2.35 \times 10^2 \frac{N}{m^2}$

D. $4.70 \times 10^2 \frac{N}{m^2}$

Answer:

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332. According to kinetic theory of gases,

A. inelastic spheres

B. perfectly elastic rigid spheres

C. perfectly elastic non-rigid spheres

D. inelastic non-rigid spheres

Answer:

Watch Video Solution

333. For Boyle's law to be hold good, the gas should be

A. perfect and of constant mass and temperature

B. real and of constant mass and temperature

C. perfect and at constant temperature but variable mass

D. real and at constant temperature but variable mass.

Answer:

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334. Statement-1: A real gas behaves as an ideal gas at high temperature and low pressure .

Statement-2: Liquid state of an ideal gas is impossible.

A. low pressure and high temperature

B. low pressure and low temperature

C. high pressure and low temperature

D. high pressure and high temperature

Answer:

Watch Video Solution

335. A gas in container A is in thermal equilibrium with another gas in container B. Both contain equal masses of the two gases. Which of the following can be true ?

A. $P_A - P_B, V_A + V_B$

B. $P_A \neq P_B, V_A = V_B$

C. $P_A / P_B, V_A / V_B$

D. $P_A P_B, V_A V_B$

Answer:

Watch Video Solution

336. In kinetic theory of gases, a molecule of mass m of an ideal gas collides with a wall of vessel with velocity v. The change in the linear momentum of the molecule is

A. $2mv$

B. mv

C. $-mv$

D. zero

Answer:

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337. 1 mole of H_2 gas in contained in a box of volume V 1.00 m^3 at T =300 K. The gas is heated to a temperature of T= 3000K and the gas gets converted to a gas of hydrogen atoms. The final pressure would be (considering all gases to be ideal)

A. same as the pressure initially

B. 2 times the pressure initially

C. 10 times the pressure initially

D. 20 times the pressure initially

Answer:

Watch Video Solution

338. One mole of gas occupies a volume of 200 mL at 100 mm pressure . What is the volume occupied by two mole of gas at 400 mm pressure and at same temperature ?

A. 50 mL

B. 100 mL

C. 200 mL

D. 400 mL

Answer:

Watch Video Solution

339. A balloon is filled at $27^{\circ}C$ and 1 atm pressure by $500m^3$ He. At-$3^{\circ}C$ and 0.5 atm pressures, the volume of He-gas contained in balloon will be

A. $700m^3$

B. $900m^3$

C. $1000 m^3$

D. $500 m^3$

Answer:

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340. The temperature of a gas is raised while its volume remains constant, the pressure exerted by the gas on the walls of the container increases because its molecules

A. strike the walls with higher velocities

B. strike the walls with large force

C. strike the walls more frequently

D. are in contact with the walls for a shorter time

Answer:

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341. A gas is filled in a container at pressure P_0. If the mass of molecules is halved and their rms speed is doubled, then the resultant pressure would be

A. 4P

B. 2P

C. P

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

Answer:

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342. A jar A is filled with a gas characterised by parameters P,V and T and another jar B with a gas with parameters 2P, $\frac{V}{8}$ and 2T, where the symbols have their usual meaning. The ratio of the number of molecules of jar A to thosej of jar B is

A. $1:1$

B. $1:2$

C. $2:1$

D. $4:1$

Answer:

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343. The absolute zero is the temperature at which

A. all substances exist in solid state

B. water freezes

C. molecular motion ceases

D. none of these

Answer:

Watch Video Solution

344. The average kinetic energy of gas molecule at $27^{\circ} C$ is 6.21×10^{-21} J. Its average kinetic energy at $127^{\circ} C$ will be

A. $52.2 \times 10^{-21} J$

B. $5.22 \times 10^{-21} J$

C. $10.35 \times 10^{-21} J$

D. $11.35 \times 10^{-21} J$

Answer:

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345. When we heat a gas-sample from $27^{\circ} C \rightarrow 327^{\circ} C$, then the initial average kinetic energy of the molecules was E. What will be the average kinetic energy ?

A. 327 E

B. 300 E

C. 2 E

D. $\sqrt{2}E$

Answer:

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346. v_{rms}, v_{av} and v_{mp} are root mean square average and most probable speeds of molecules of a gas obeying Maxwellian velocity distribution. Which of the following statements is correct ?

A. $v_{rms} < v_{av} < v_{mp}$

B. $v_{rms} > v_{av} > v_{mp}$

C. $v_{mp} < v_{rms} < v_{av}$

D. $v_{mp} < v_{rms} < v_{av}$

Answer:

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347. 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. $\frac{v}{2}$

B. v

C. $2v$

D. $4v$

Answer:

Watch Video Solution

348. The heat required to increase the temperature of 4 moles of a monoatomic ideal gas from 273 K to 473 K at constant volume is

A. 200 R

B. 400 R

C. 800 R

D. 1200 R

Answer:

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349. 3 mole of hydrogen is mixed with 1 mole of neon. The molar specific heat at constant pressure is

A. $\frac{9R}{4}$

B. $\frac{9R}{2}$

C. $\frac{13R}{4}$

D. $\frac{13R}{2}$

Answer:

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350. The ratio of the number of moles of a monoatomic to a polyatomic gas in a mixture of the two, behaving as an diatomic gas is :

(vibrational modes of freedom is to be ignored)

A. ge 4`

B. ≥ 5

C. ≥ 6

D. > 6

Answer:

Watch Video Solution

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

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

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

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

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

Answer:

Watch Video Solution

352. Two cylinder having $m_1 g$ and $m_2 g$ of a gas at pressure P_1 and P_2 respectively are put in cummunication with each other, temperature remaining constant. The common pressure reached will be

A. $\dfrac{P_1 P_2 (m_1 + m_2)}{(P_2 m_1 + P_1 m_2)}$

B. `(P_1P_2m_1)/(P_2m_1 + P_1m_2)

C. $\dfrac{m_1 m_2 (P_1 + P_2)}{(P_2 m_1 + P_1 m_2)}$

D. `(m_1m_2P_1)/(P_2m_1 + P_1m_2)

Answer:

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353. A closed vessel explodes at 15 atm pressure if temperature of the vessel is 300 K. At 10 atm pressure, the vessel will explode at the temperature

A. 250 K

B. 420 K

C. 200 K

D. 450 K

Answer:

Watch Video Solution

354. When an ideal diatomic gas is heated at constant pressure the fraction of the heat energy supplied which increases the internal energy of the gas is .

A. $2/5$

B. $3/5$

C. $3/7$

D. $5/7$

Answer:

Watch Video Solution

355. 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.

Watch Video Solution

356. Assertion : The root mean sguar and most probable speed of the molecules in a gas are the same

Reason : The Maxwell distribation for the speed of molecules in a gas is symentrical

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357. Assertion : The ratio C_P / C_v for a diatomic gas is more than that for a monoatomic gas.

Reason : The moleculess of a monoatomic gas have more degrees of freedom than those of a diatomic gas.

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358. Assertion : The ratio C_P / C_v is more for helium gas than for hydrogen gas.

Reason : Atomic mass of helium is more than that of hydrogen.

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359. Assertion : The melting point of ice decreases with increase of pressure

Reason : Ice contract on melting.

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360. Assertion : In pressure-temperature (P-T) phase diagram of water, the slope of the melting curve is found to be negative.

Reason : Ice contracts on melting to water.

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361. Assertion : The molecules of a monatomic gas has three degrees freedom.

Reason : The molecules of a diatomic gas has five degrees of freedom.

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362. According to the law of equipartition of energy, the energy associated with each degree of freedom is :

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363. Free vibrations and forced vibrations.

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364. Assertion : The total translational kinetic energy of all the molecules of a given mass of an ideal gas is 1.5 times the product of its pressure and volume.

Reason : The molecules of gas collide with each other and the velocities of the molecules chane due to the collision.

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365. Assertion : Air pressure in a car tyre increase during driving.

Reason : Absolute zero temperature is not zero energy temperature.

Watch Video Solution

366. At constant volume, temperature is increased. Then

A. collisions on walls will be less

B. number of collisions per unit time will increase

C. collisions will be in straight lines

D. collisions will not change.

Answer:

Watch Video Solution

367. Three containes of the same volume contain three different gases. The masses of the molecules are m_1, m_2 and m_3 and the number of molecules in their respective containers are N_1, N_2 and N_3. The gas pressure in the containers are P_1, P_2 and P_3 respectively. All the gases are now mixed and put in one of the containers. The pressure P of mixture will be

A. $P < (P_1 + P_2 + P_3)$

B. $P = \left(P_1 + P_2 + P_3 \frac{}{3}\right.$

C. $P = P_1 + P_2 + P_3$

D. $P > (P_1 + P_2 = P_3)$

Answer:

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368. From the relation PV = RT, calculate the value of the constant R for one gram mole of an ideal gas (in cal / K)

A. high temperature and high density

B. high temperature and low density

C. low temperature and low density

D. low temperature and high density.

Answer:

Watch Video Solution

369. The equation of state for 5 g of oxygen at a pressure P and temperature T, when occupying a volume V, will be

A. $PV = 5RT/32$

B. $PV = 5RT/16$

C. $PV = 5RT/2$

D. $PV = 5RT$

Answer:

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370. Relation between pressure (P) and average kinetic energy per unit volume of gas (E) is

A. $P = 2E/3$

B. $P = E/3$

C. $P = 3E/2$

D. $P = 3E$

Answer:

Watch Video Solution

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

A. kinetic energy

B. potential energy

C. vibrational energy

D. density.

Answer:

Watch Video Solution

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

A. m^0

B. m

C. $\sqrt{m}$

D. $m^{-\left(\frac{1}{2}\right)}$

Answer:

Watch Video Solution

373. The temperature of an ideal gas is increased from $27^{\circ}C$ to $927^{\circ}C$. The rms speed of its molecules becomes.

A. gets halved

B. gets doubled

C. gets $\sqrt{\frac{927}{27}}$ times the earlier value

D. remains unchanged

Answer:

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374. An ant is moving on a plane horizontal surface. The number of degrees of freedom of the ant will be

A. 1

B. 2

C. 3

D. 6

Answer:

Watch Video Solution

375. The number of degres of freedom of diatomic gas are

A. 2

B. 3

C. 5

D. 6

Answer:

Watch Video Solution

376. The degrees of freedom of a triatomic gas is

A. 1

B. 2

C. 6

D. 8

Answer:

Watch Video Solution

377. A polyatomic gas with (n) degress of freedom has a mean energy per molecule given by.

A. $\frac{nkT}{N}$

B. $\frac{nkT}{2N}$

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

D. $\frac{3kT}{2}$

Answer:

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378. The temperature of ozone in a vessel, is raised by $1^\circ C$ at constant volume. Part of total heat supplied to the gas may be taken as translational and rotational energies. Their respective shares are

A. 60%, 40%

B. 50%, 50%

C. 100%, zero

D. 40%, 60%

Answer:

Watch Video Solution

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

A. diatomic

B. mixture of diatomic and polyatomic

C. monoatomic

D. polyatomic.

Answer:

Watch Video Solution

380. If γ be the ratio of specific heats $(C_p \& C_v)$ for a perfect gas. Find the number of degrees of freedom of a molecules of the gas?

A. $\frac{25(\gamma-1)}{2}$

B. $\frac{9(\gamma-1)}{2}$

C. `(3gamma-1)/(2gamma-1)

D. `2/(gamma-1)

Answer:

Watch Video Solution

381. The value of critical temperature in terms of van der Waals' constants a and b is given by

A. $T_c = \frac{a}{2Rb}$

B. $T_c = \frac{a}{27bR}$

C. $T_c = 8\frac{a}{27Rb}$

D. $\frac{27a}{8RB}$

Answer:

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382. Two vessel separately contains two ideal gases A and B at the same temperature, the pressure of A being twice that of B. under such conditions, the density of A is found to be 1.5 times the density of B. the ratio of molecular weight of A and B is

A. $\frac{1}{2}$

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

C. $\frac{3}{4}$

D. 2

Answer:

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

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

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

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

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

Answer:

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384. The molar specific heats of an ideal gas at constant pressure and volume arc denoted by C_P and C_V respectively. If $\gamma = \frac{C_P}{C_V}$ and R is the universal gas constant, then C_V is equal to

A. $\frac{1+\gamma}{1-\gamma}$

B. $\frac{R}{\gamma - 1}$

C. $\frac{\gamma - 1}{R}$

D. γR

Answer:

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385. The amount of heat energy required to raise the temperature of 1 g of Helium at NTP, from T_1 K to T_2 K is :

A. $\frac{3}{8}N_a k_b (T_2 - T_1)$

B. $\frac{3}{2}N_a k_b (T_2 - T_1)$

C. $\frac{3}{4}N_a k_b (T_2 - T_1)$

D. $\frac{3}{4}N_a k_b \left(\frac{T_2}{T_1}\right)$

Answer:

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386. The mean free path of molecules of a gas (radius r) is inversely proportional to

A. r^3

B. r^2

C. r

D. $\sqrt{r}$

Answer:

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387. A gas mixture consists of 2 moles of O_2 and 3 moles of Ar at temperature T. Neglecting all vibrational modes, the total internal energy of the system is

A. 4 RT

B. 15 RT

C. 9 RT

D. 11 RT

Answer:

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388. The molecules of a given mass of a gas have rms velocity of $200m/sat27^\circ C$ and $1.0 \times 10^5 N/m_2$ pressure. When the temperature and pressure of the gas are respectively $127^\circ C$ and $0.05 \times 10^5 Nm^{-2}$, the rms velocity of its molecules in ms^{-1} is

A. $100\sqrt{2}$

B. $\frac{400}{\sqrt{3}}$

C. (100 sqrt 2)/2

D. 100/3

Answer:

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389. One mole of an ideal monatomic gas undergoes a process described by the equation PV^3= constant. The heat capacity of the gas during this process is

A. $2R$

B. R

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

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

Answer:

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390. A fiven sample of an ideal gas occupise a volume V at a pressure p and sbsoulte temperature T.The mass of each molecule of the gas is m. Which of the following fives the dinsity

of the gas ?

A. $\dfrac{P}{kTV}$

B. mkT

C. $\dfrac{P}{kT}$

D. $\dfrac{Pm}{kT}$

Answer:

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391. At what temperature will the rms speed of oxygen molecules become just sufficient for escaping from the Earth's atmsphere? [Given, mass of oxygen molecule (m) = 2.76×10^{-26} kg, Boltzmann's constant $k_B = 1.38 \times 10^{-23} J \cdot K^{-1}$]

A. $2.508 \times 10^4 K$

B. $1.254 \times 10^4 K$

C. $5.016 \times 10^4 K$

D. $8.360 \times 10^4 K$

Answer:

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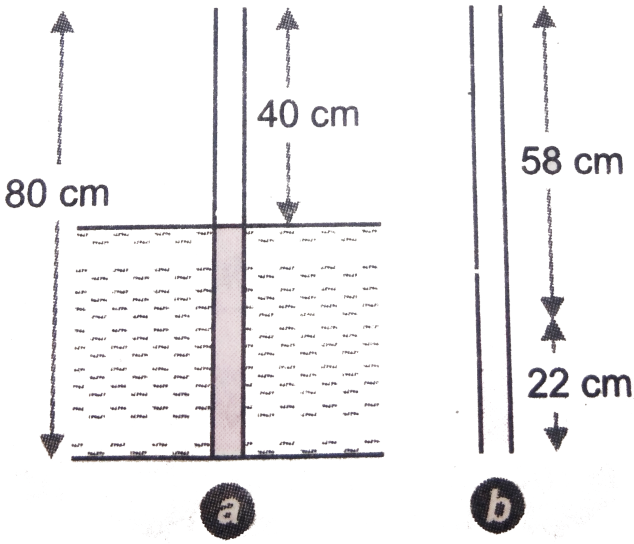
Example

1. A narrow uniform glass tube 80 cm long and open at both ends is half immersed in mercury. Then the top of the tube is closed and it is taken out of mercury. A column of mercury 22 cm long then remains in the tube. What is the atmospheric pressure?



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2. A gas at $27^{\circ}C$ in a cylinder has a volume of 4 litre and pressure $100Nm^{-2}$.

(i) Gas is first compressed at constant

temperature so that the pressure is $150 Nm^{-2}$.

Calculate the change in volume.

(ii) It is then heated at constant volume so that temperature becomes $127^{\circ} C$. Calculate the new pressure.

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3. A gas at $27^{\circ} C$ in a cylinder has a volume of 4 litre and pressure $100 Nm^{-2}$.

(i) Gas is first compressed at constant temperature so that the pressure is $150 Nm^{-2}$.

Calculate the change in volume.

(ii) It is then heated at constant volume so that temperature becomes $127^\circ C$. Calculate the new pressure.

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4. As an air bubble rises from the bottom of a lake to the surface, its volume is doubled. Find the depth of the lake. Take atmospheric pressure = 76 cm of Hg.

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5. Using the ideal gas equation, determine the value of gas constant R. Given that one gram mole of a gas at S.T.P occupies a volume of 22.4 litres

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6. A balloon partially filled with helium has a volume of $30m^3$, at the earth's surface, where pressure is $76cm$ of (Hg) and temperature is $27^\circ C$ What will be the increase in volume of gas if balloon rises to a height, where pressure is $7.6cm$ of Hg and temperature is $-54^\circ C$?

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7. A vessel contains two non-reactive gases neon (monoatomic) and oxygen (diatomic). The ratio of their partial pressures is 3:2. Estimate the ratio of

(i) number of molecules, and

(ii) mass density of neon and oxygen in the vessel.

Atomic mass of neon = 20.2 u, and molecular mass of oxygen = 32.0 u.

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8. A vessel contains two non-reactive gases neon (monoatomic) and oxygen (diatomic). The ratio of their partial pressures is 3:2. Estimate the ratio of

(i) number of molecules, and

(ii) mass density of neon and oxygen in the vessel.

Atomic mass of neon = 20.2 u, and molecular mass of oxygen = 32.0 u.

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9. A closed container of volume $0.02m^3$ contains a mixture of neon and argon gases at a temperature $27^\circ C$ and pressure $1 \times 10^5 Nm^{-1}$ The total mass is 28 and the molar mass of and argon are 20 and 40 respectively find the masses of individual gases in the container assuming then to be ideal .

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10. Calculate the r.m.s. velocity of air molecules at $S.T.P.$ Given density of air at $S.T.P.$ is

$1.296 kgm^{-3}$.

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11. A vessel is filled with a gas at a pressure of 76 cm of mercury at a certain temperature. The mass of the gas is increased by 50% by introducing more gas in the vessel at the same temperature. Find the resultant pressure of the gas.

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12. Calculate the kinetic energy of one mole of argon at $127^{\circ}C$. Given,Boltzmann's constant, $k_B = 1.381 \times 10^{-23} J\text{molecular}^{-1} K^{-1}$.

Avogardro numbe, $N = 6.02 \times 10^{23} \text{mol}^{-1}$

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13. Calculate the KE per molecule and also rms velocity of a gas at $127^{\circ}C$. Given $k = 1.38 \times 10^{-23} J\text{molecule}^{-1} K^{-1}$ and mass of each molecule $= 6.4 \times 10^{-27} kg$.

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14. Calculate the number of molecule in $2 \times 10^{-6} m^3$ of a perfect gas at $27^\circ C$ and at a pressure of 0.01 m of mercury. Mean KE of a molecule at $27^\circ C = 4 \times 10^{-11} J$ and $g = 9.8 m / s^2$.

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15. Calculate the root mean square speed of one gram molecule of hydrogen at S.T.P. Given that the density of hydrogen at S.T.P. Is 0.09kg m^{-3}

and R =8.31 J $mo \leq^{-1} K^{-1}$.

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16. (a) Calculate (i) root-mean-square speed and (ii) the mean energy of 1 mol of hyderogen at STP given that density of hydrogen is $0.09kg/m^3$. (b) Given that the mass of a molecule of hydergen is 3.34×10^{-27} kg, calculate Avogadro's number. (c) Calculate Boltmann's constant.

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17. Calculate Boltzmann's constent.

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18. 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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19. A vessel A contains hydrogen and another vessel B whose volume is twice that of A contains same mass of oxygen at same temperature. Compare

(i) average KE of hydrogen and oxygen molecule.

(ii) root mean square speeds of molecules

(iii) pressure of gases in A and B.

Molecular weight of hydrogen and oxygen are 2 and 32 respectively.

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20. A vessel A contains hydrogen and another vessel B whose volume is twice that of A contains same mass of oxygen at same temperature. Compare

(i) average KE of hydrogen and oxygen molecule.

(ii) root mean square speeds of molecules

(iii) pressure of gases in A and B.

Molecular weight of hydrogen and oxygen are 2 and 32 respectively.

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21. A vessel A contains hydrogen and another vessel B whose volume is twice that of A contains same mass of oxygen at same temperature. Compare

(i) average KE of hydrogen and oxygen molecule.

(ii) root mean square speeds of molecules

(iii) pressure of gases in A and B.

Molecular weight of hydrogen and oxygen are 2 and 32 respectively.

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22. A flask contains argon and chlorine in the ratio 2:1 by mass. The temperature of the mixture is $27^\circ C$. Obtain the ratio of

(i) average kinetic energy per molecule, and

(ii) root mean square speed of the molecules of two gases.

Atomic mass of argon = 39.9 u, Molecular mass of chlorine = 70.9 u.

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23. A flask contains argon and chlorine in the ratio 2:1 by mass. The temperature of the mixture is $27^{\circ} C$. Obtain the ratio of

(i) average kinetic energy per molecule, and

(ii) root mean square speed of the molecules of two gases.

Atomic mass of argon = 39.9 u, Molecular mass of chlorine = 70.9 u.

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24. Two perfect monoatomic gases at absolute temperature T_1 and T_2 are mixed. There is no loss of energy. Find the temperature of the mixture if the number of moles in the gases are n_1 and n_2.

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

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26. If three gas molecules have velocity 0.5, 1 and $2km/s$ respectively, find the ratio of their root mean square speed and average speed.

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27. Calculate the r.m.s. velocity of oxygen molecule at S.T.P. The molcular weight of oxygen is 32.

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28. The rms velocity of hydrogen at 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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29. The rms speed of oxygen molecules at a certain temperature is v. If the temperature is doubled and the oxygen gas dissociates into atomic oxygen, the rms speed would be

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30. At what temperature is the r.m.s velocity of a hydrogen molecule equal to that of an oxygen molecule at $24^\circ C$?

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31. Calculate the temperature at which r.m.s velocity of gas molecules is double its value at $27^\circ C$, pressure of the gas remaining the same.

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32. 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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33. Uranium has two isotopes of masses 235 and 238 units. If both are present in uranium hexa fluoride gas, which would have the larger average speed ? If atomic mass of fluorine is 19 units, estimate the percentage difference in speed at any temperature.

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34. The total number of degrees of freedom possessed by the molecules in $1cm^3$ of H_2 gas at temperature 273 K and 1 atm pressure . Will be

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35. Calculate the internal energy of 1 gram of oxygen at NTP.

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36. Hydrogen is heated in a vessel to a temperature of 10,000K. Let each molecule posses an average energy E_1. A few molecules escape into the atmosphere at 300 K. Due to collisions, their energy changes to E_2. Calculate ratio E_1 / E_2.

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37. The molecular kinetic energy of 1 g of helium (molecular weight 4) at $127^\circ C$ is (Given , R

$= 8.31 J \mathrm{mol}^{-1} K^{-1}$)

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38. How many degrees of freedom are associated with 2 gram of helium at NTP ? Calculate the amount of heat energy required to raise the temp. Of this amount from $27^{\circ} C \rightarrow 127^{\circ} C$. Given Boltzmann constant $k_B = 1.38 \times 10^{-23}$ erg $\mathrm{molecule}^{-1} K^{-1}$ and Avogadro's number $= 6.02 \times 10^{23}$.

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39. Calculate the limiting ratio of the internal energy possessed by helium and hydrogen gases at 10,000K.

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40. 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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41. One mole of a monoatomic gas is mixed with three moles of a diatomic gas. What is the molecular specific heat of mixture at constant volume? $R = 8.31 J mol^{-1} K^{-1}$.

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42. One mole of ideal monoatomic gas $(\gamma = 5/3)$ is mixed with one mole of diatomic gas $(\gamma = 7/5)$. What is γ for the mixture? γ

Denotes the ratio of specific heat at constant pressure, to that at constant volume

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43. A gaseous mixture consists of 16g of helium and 16 g of oxygen. The ratio $\frac{C_p}{C_v}$ of the mixture is

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44. A gaseous mixture enclosed in a vessel consists of one gram mole of a gas A with $\gamma = \left(\frac{5}{3}\right)$ and some amount of gas B with $\gamma = \frac{7}{5}$ at a temperature T.

The gases A and B do not react with each other and are assumed to be ideal. Find the number of gram moles of the gas B if γ for the gaseous mixture is $\left(\frac{19}{13}\right)$.

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45. The density of water is $1000 kgm^{-3}$. The density of water vapour at $100^{\circ} C$ and 1 atmospheric pressure is $0.6 kgm^{-3}$. The volume of a molecule multiplied by the total number gives what is called, molecular volume. Estimate the ratio (or fraction) of the molecular volume to the total volume occupied by the water vapour under the above conditions of temperature and pressure.

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46. The volume of water molecule is

Take, density of wter is $10^3 kgm^{-3}$ and avogadros' number $= 610^{23}\text{mole}^{-1}\Big)$

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47. What is the average distance between atoms (interatomic distance) in water ?

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