PHYSICS

BOOKS - MTG-WBJEE PHYSICS (HINGLISH)

KINETIC THEORY OF GASES

Wb Jee Workout Mcq

1. If f denotes the degree of freedom of a gas, the ratio of two specific heats $\frac{C_P}{C_V}$ is given by

A. $\frac{1}{f}+1$

B. $\frac{2}{f}+1$

C. $\frac{1}{f}-1$

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

Answer: B

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2. According to kinetic theory of gases, which one of the following statement (s) is/are not true?

A. Real gas behave as ideal gas at high temperature and low pressure

B. Liquid state of ideal gas is impossible

C. At any temperature and pressure, ideal gas obeys Boyle's law and Charles' law

D. The molecules of a real gas do not exert any force on one another

Answer: D

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3. The temperature at which the root mean square velocity of a molecules will be double of its value at $100^\circ C$ is

A. $1492^\circ C$

B. $1219^\circ C$

C. $546^\circ C$

D. $273^\circ C$

Answer: B

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4. According to the kinetic theory of gases, the root mean velocity of gas molecules is directly proportional to

A. T

B. $\sqrt{T}$

C. T^2

D. $T^{3/2}$

Answer: B

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5. At absolute zero temperature, the kinetic energy of the molecules

A. becomes zero

B. becomes maximum

C. becomes minimum

D. remains constant

Answer: A

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6. The velocity of molecules of a gas at temperature 120 K is v. At what temperature will the velocity be 2v?

A. 120 K

B. 240 K

C. 480 K

D. 1120 K

Answer: C

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7. Six molecules have speeds 2 units, 5 units, 3 units, 6 units, 3 units and 5 units respectively. The rms speed is

A. 3 units

B. 1.7 units

C. 4.2 units

D. 5 units

Answer: C

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8. The equation of state for n moles of an ideal gas is $PV = nRT$, where R is a constant. The SI unit for R is

A. JK^{-1} per molecule

B. $JK^{-1}mol^{-1}$

C. $Jkg^{-1}K^{-1}$

D. $JK^{-1}g^{-1}$

Answer: B

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9. A closed vessel contains a mixture of two diatomic gases A and B. Molar mass of A is 16 times that of B and mass of gas A contained in the vessel is 2 times that of B. Which of the following statement is incorrect?

A. Average kinetic energy per molecule of A is equal to that of B

B. Root mean square value of translational velocity of B is four times that of A

C. Pressure exerted by B is four times that of exerted by A

D. Number of molecules of B in the cylinder is eight times that of A

Answer: C

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10. According to the kinetic theory of gases, the pressure exerted by a gas on the walls is measured as

A. rate of change of momentum imparted to the walls per second per unit area

B. momentum imparted per second to the walls per unit area

C. change of momentum imparted to the walls per unit area

D. change in momentum per unit volume

Answer: B

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11. A gas has volume V and pressure p. The total translational kinetic energy of all the molecules of the gas is

A. $\frac{3}{2}PV$ only if the gas is monatomic

B. $\frac{3}{2}PV$ only if the gas is diatomic

C. $> \frac{3}{2}PV$ if the gas is diatomic

D. $\frac{3}{2}PV$ in all cases

Answer: D

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12. In a mixture of nitrogen and helium kept at room temperature. As compared to a helium molecule nitrogen molecule hits the wall

A. with greater average speed

B. with smaller average speed

C. with greater average kinetic energy

D. with smaller average kinetic energy

Answer: B

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13. Four container are filled with monatomic ideal gases. For each container, the number of moles, the mass of an individual atom and the rms speed of the atoms are expressed in terms of n, m and v_{rms} respectively. If T_A, T_B, T_C and T_D are their temperature respectively then which one of the options correctly represents the order?

	A	B	C	D
Number of moles	n	$3n$	$2n$	n
Mass	$4m$	m	$3m$	$2m$
rms speed	v_{rms}	$2v_{rms}$	v_{rms}	$2v_{rms}$
Temperature	T_A	T_B	T_C	T_D

A. $T_B = T_C > T_A > T_D$

B. $T_D > T_A > T_C > T_B$

C. $T_D > T_A = T_B > T_C$

D. $T_B > T_C > T_A > T_D$

Answer: C

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14. The average translational kinetic energy of nitrogen gas molecules is 0.02 eV(1 eV = $1.6 \times 10^{-19} J$). Calculate the temperature of the gas. Boltzmann constant $k = 1.38 \times 10^{-28} J/K$.

A. 193.1 K

B. 1011 K

C. 212 K

D. 154.5 K

Answer: D

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15. The rms speed of helium at $24^\circ C$ and 1 atm pressure is $450 ms^{-1}$. Then the rms speed of the helium molecules at $24^\circ C$ and 2 atm pressure is

A. $450ms^{-1}$

B. $1800ms^{-1}$

C. $900ms^{-1}$

D. $750ms^{-1}$

Answer: A

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16. The pressure exerted by an ideal gas at a particular temperature is directly proportional to

A. the mean speed of the gas molecules

B. the mean of the square of the speed of the gas molecules

C. the square of the mean speed of the gas molecules

D. the root mean square speed of the gas molecules

Answer: B

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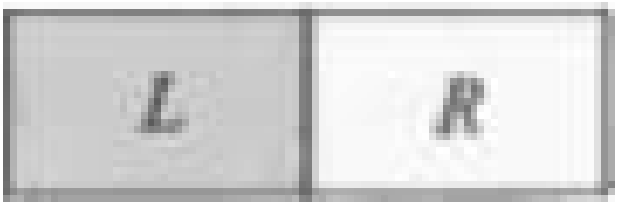
17. A vessel is partitioned in two equal halves by a fixed diathermic separator. Two different ideal gases are filled in left (L) and right (R) halves. The rms speed of the molecules in L part is equal to the mean speed of molecules in the R part. Then the ratio of the mass of a molecule in L part to that of a molecule in R part is



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

B. $\sqrt{\frac{\pi}{4}}$

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

D. $\frac{3\pi}{8}$

Answer: D

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18. One mole ideal monatomic gas is taken at temperature of 300 K. If volume is doubled keeping its pressure constant. The change in the internal energy is

A. 450 R

B. 550 R

C. 650 R

D. 750 R

Answer: A

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19. Internal energy of n_1 moles of hydrogen at temperature T is equal to the internal energy of n_2 moles of helium at temperature 2T. Then the ratio n_1/n_2 is

A. $3/5$

B. $2/3$

C. $6/5$

D. $3/7$

Answer: C

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20. The molecules of an ideal gas have 6 degrees of freedom. The temperature of the gas is T. The average translational kinetic energy of its molecules is

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

B. $\frac{6}{2}kT$

C. kT

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

Answer: A

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21. According to kinetic theory, the molecules

A. repel each other

B. collide with each other elastically

C. move with uniform velocity

D. are massless particles

Answer: B

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22. At room temperature, the rms speed of the molecules of a certain diatomic gas is found to be 1920 m s^{-1}. The gas is

A. H_2

B. F_2

C. O_2

D. Cl_2

Answer: A

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23. 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, then at 480 K, it will be

A. 4v

B. 2v

C. $v/2$

D. $v/4$

Answer: B

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24. Gas at a pressure P_0 is contained in a vessel. If the masses of all the molecules are halved and their speeds are doubled, the resulting pressure P will be equal to

A. $4P_0$

B. $2P_0$

C. P_0

D. $P_0/2$

Answer: B

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25. 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. 4 RT

B. 15 RT

C. 9 RT

D. 11 RT

Answer: D

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26. A fixed mass of a gas expands at constant temperature.

Which property of the gas molecules increases?

A. average number per unit volume

B. average kinetic energy

C. average separation

D. average number of collisions per unit time.

Answer: C

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27. Mean kinetic energy per degree of freedom for gas molecule is

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

B. KT

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

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

Answer: C

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28. For a $\frac{R}{C_V} = 0.67$. This gas is made up of molecules which are

A. diatomic

B. mixture of diatomic and polyatomic molecules

C. monatomic

D. polyatomic

Answer: C

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29. On any planet, the pressure of atmosphere implies (C_{rms} = root mean square velocity of molecules and v_e = escape velocity)

A. $C_{rms} < < v_e$

B. $C_{rms} > v_e$

C. $C_{rms} = v_e$

D. $C_{rms} = 0$

Answer: A

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30. For a gas molecule with 6 degrees of freedom, the law of equipartition of energy gives the relation between the molar specific heat (C_V) and gas constant (R) is

A. $C_V = \frac{R}{2}$

B. $C_V = R$

C. $C_V = 2R$

D. $C_V = 3R$

Answer: D

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31. At what temperature will the rms speed of air molecules be double that of NTP?

A. $519^\circ C$

B. $619^\circ C$

C. $719^\circ C$

D. $819^\circ C$

Answer: D

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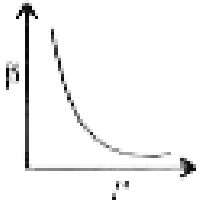
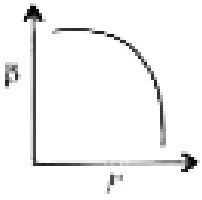
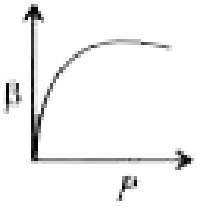
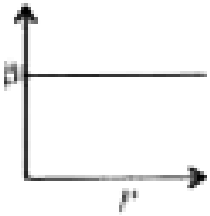
32. Which of the following graphs correctly represents the variation of $\beta = -(dV/dP)/V$ with P for an ideal gas at constant temperature?

A. 

B. 

C. 

D. 

Answer: B

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33. $N(<100)$ molecule of a gas have velocities 1,2,3....N, km/s respectively. Then

A. rms speed and average speed of molecules are same

B. ratio of rms speed to average speed is $\sqrt{\frac{(2N+1)(N+1)}{6N}}$

C. ratio of rms speed to average speed is $\sqrt{\frac{(2N+1)(N+1)}{6}}$

D. ratio of rms speed to average speed of a molecule $\frac{2}{\sqrt{6}}\sqrt{\frac{(2N+1)}{(N+1)}}$

Answer: D

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34. Three closed vessels A, B and C are at the same temperature T and contain gases which obey the Maxwell distribution of speed. 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 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 will be

A. $(v_1 + v_2)/2$

B. v_1

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

D. $v_1/2$

Answer: B

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35. One gram mole of nitrogen at $27^\circ C$ and 1 atm pressure is contained in a vessel and the molecules are moving with their speed. The number of collisions per second which the molecules make with an area of $1m^2$ on the vessel's wall is

A. 2×10^{27}

B. 2×10^{20}

C. 2×10^{10}

D. 2×10^{24}

Answer: A

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36. A cylinder of capacity 20 L is filled with H_2 gas. The total average kinetic energy of translatory motion of its molecules is $1.5 \times 10^5 J$. The pressure of hydrogen in the cylinder is

A. $2 \times 10^6 N/m^2$

B. $3 \times 10^6 N/m^2$

C. $4 \times 10^6 N/m^2$

D. $5 \times 10^6 N/m^2$

Answer: D

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37. Energy of all molecules of a monatomic gas having a volume V and pressure P is $3/2PV$. The total translational kinetic energy of all molecules of a diatomic gas at the same volume and pressure is

A. $1/2PV$

B. $3/2PV$

C. $5/2PV$

D. $3PV$

Answer: C

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38. An ideal gas consists of molecules, each molecule being a linear chain of four atoms. If this gas is heated up to a temperature at which

all degrees of freedom, including vibrational, are excited, the molar specific heat of such a gas at constant volume will be (include vibrational degrees also)

A. $\frac{19R}{2}$

B. $\frac{15R}{2}$

C. $6R$

D. $9R$

Answer: A

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39. Four moles of hydrogen, 2 moles of helium and 1 mole of water vapour form an ideal gas mixture. What is the molr specific heat at constant pressure of mixture?

A. $\frac{16}{7}R$

B. $\frac{7R}{16}$

C. R

D. $\frac{23}{7}R$

Answer: D

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40. 0.014 g of nitrogen is enclosed in a vessel at a temperature of $27^{\circ}C$. How much heat (in J) approximately has to be transferred to the gas to double the rms velocity of its molecules?

A. 930

B. 212

C. 9

D. 6

Answer: C

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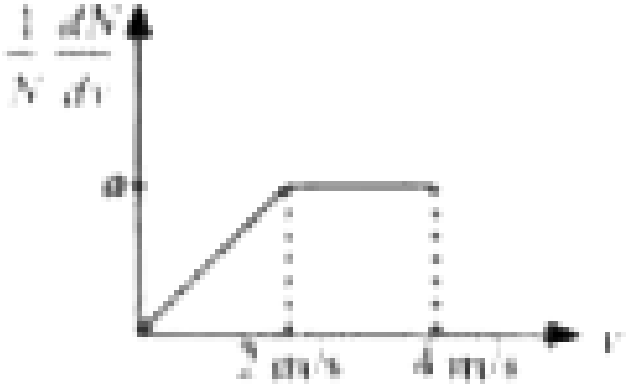
41. The graph show a hypothetical graph of gas molecules. N is the total number of molecules. Find the value of a.



A. $\frac{1}{3}$

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

C. 0

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

Answer: A

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42. For a gas sample with N_0 number of molecules, function N(v) is given by :

$$N(v) = \frac{dN}{dv} = \left(\frac{3N_0}{v_0^3}\right)v^2 \text{ for } 0 < v < v_0 \text{ and } N(v) = 0 \text{ for } v > v_0$$

, where dN is number of molecules in speed range v to $v + dv$. Find the rms speed of the molecules.

A. $\sqrt{\frac{5}{3}}v_0$

B. $\sqrt{\frac{3}{5}}v_0$

C. $\sqrt{\frac{5}{3v_0}}$

D. $\sqrt{\frac{3}{5v_0}}$

Answer: B

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43. Five particles have speeds 1, 2, 3, 4, 5 m/s. The average velocity of the particles is (in m/s)

A. 3

B. 0

C. 2.5

D. data insufficient

Answer: D

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44. The average energy of molecules in a sample of oxygen gas at 300 K are $6.21 \times 10^{-21} J$. The corresponding values at 600 K are

A. $12.12 \times 10^{-21} J$

B. $8.78 \times 10^{-21} J$

C. $6.21 \times 10^{-21} J$

D. $12.42 \times 10^{-21} J$

Answer: D

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45. The heat capacity per mole of water is (R is universal gas constant)

A. 9R

B. 6R

C. 5R

D. 5R

Answer: A

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46. 15 gram of nitrogen is enclosed in a vessel at a temperature of 300 K.

A. Work done is 0 J

B. The amount of heat required to double the root mean square velocity of the molecules of the gas is $1.0016 \times 10^4 J$

C. Change in internal energy of nitrogen gas is $2.03 \times 10^4 J$, it root mean square velocity is doubled

D. All of these

Answer: A::B

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47. A box contains a mixture of H_2 and He gases. Which of the following statements are correct?

A. The average translational kinetic energies of H_2 molecules and He atoms are same

B. The average energies of H_2 molecules and He atoms are same

C. H_2 molecules have greater average energy than that of He atoms

D. The average speed of H_2 molecules and He atoms are same

Answer: A::C

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48. A thermally insulated vessel contains an ideal gas of molecular mass M and ratio o specific heats γ. It is moving with speed v and is suddenly brought to rest. Assuming no heat is lost to surroundings, its temperature increases by

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

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

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

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

Answer: D

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

A. no molecule can have speed greater than v_{rms}

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

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

D. the average kinetic energy of a molecule is $\frac{3}{4}mv(p)^2$

Answer: C::D

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50. Two vessels of the same volume contain the same gas at same temperature. If the pressure in the vessels is in the ratio of 1 : 2, then

A. the ratio of the average kinetic energy is 1 : 2

B. the ratio of the root mean square velocity is 1 : 1

C. the ratio of the average velocity is 1 : 2

D. the ratio of number of molecules is 1 : 2

Answer: B::D

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51. In case of hydrogen and oxygen at N.T.P., which of the following quantities is/are the same?

A. average momentum per molecule

B. average kinetic energy per molecule

C. kinetic energy per unit volume

D. kinetic energy per unit mass

Answer: B::C

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52. The volume of a gas and the number of gas molecules within that volume for four situations are

(1) $2V_0$ and N_0 (2) $3V_0$ and $3N_0$

(3) $8V_0$ and $4N_0$ (4) $3V_0$ and $9N_0$

Which of them has mean free path greatest?

A. 1

B. 2

C. 3

D. 4

Answer: A::C

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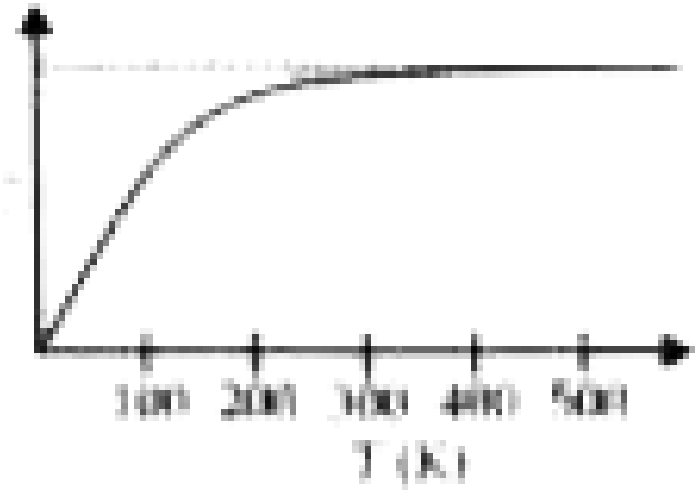
53. The figure shows the variation of specific heat capacity (C) of a solid as a function of temperature (T). The temperature is increased continuously from 0 to 500 K at a constant rate. Ignoring any volume change, the following statements(s) is/are correct to a reasonable

approximation.



A. The rate at which heat is absorbed in the range 0-100 K varies linearly with temperature T

B. Heat absorbed in increasing the temperature from 0-100 K is less than the heat required for increasing the temperature from 400-500 K

C. There is no change in the rate of heat absorption in the range 400-500 K

D. The rate of heat absorption increases in the range 200-300 K

Answer: B::C::D

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54. 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. $C_P . C_V$ is larger for a diatomic ideal gas than for a monoatomic ideal gas

Answer: B::D

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

A. The coefficient of volume expansion at constant pressure is same for all ideal gases

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

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

D. The mean free path of molecules increases with the decrease in pressure

Answer: A::C::D

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Wb Jee Previous Years Questions Mcq

1. The r.m.s. speed of the molecules of a gas at $100^\circ C$ is v. The temperature at which the r.m.s. speed will be $\sqrt{3}v$ is

A. $546^\circ C$

B. $646^\circ C$

C. $746^\circ C$

D. $846^\circ C$

Answer: D

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2. The r.m.s. speed of oxygen is v at a particular temperature. If the temperature is doubled and oxygen molecule dissociate into oxygen

atoms, the r.m.s. speed becomes

A. v

B. $\sqrt{2}v$

C. $2v$

D. $4v$

Answer: C

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3. The perfect gas equation for 4 g of hydrogen gas is

A. $PV = RT$

B. $PV = 2RT$

C. $PV = \frac{1}{2}RT$

D. $PV = 4RT$

Answer: B

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4. If the r.m.s. velocity of hydrogen gas at a certain temperature is c, then the r.m.s. velocity of oxygen gas at the same temperature is

A. $\frac{c}{8}$

B. $\frac{c}{10}$

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

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

Answer: C

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5. Temperature of an ideal gas, initially at $27^\circ C$, is raised by $6^\circ C$. The rms velocity of the gas molecules will

A. increase by nearly 2%

B. decrease by nearly 2%

C. increase by nearly 1%

D. decrease by nearly 1%

Answer: C

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6. What will be the molar specific heat at constant volume of an ideal gas consisting of rigid diatomic molecules?

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

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

C. R

D. $3R$

Answer: B

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7. 3 moles of a mono-atomic gas $(\gamma = 5/3)$ is mixed with 1 mole of a diatomic gas $(\gamma = 7/3)$. The value of γ for the mixture will be

A. $9/11$

B. $11/7$

C. $12/7$

D. $15/7$

Answer:

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