PHYSICS

BOOKS - DISHA PHYSICS (HINGLISH)

KINETIC THEORY OF GASES

Physics

1. $4.0g$ of a gas occupies 22.4 litres at NTP. The specific heat capacity of the gas at constant volume is $5.0JK^{-1}mol^{-1}$. If the speed of sound in this gas at NTP is $952ms^{-1}$. Then the heat capacity at constant pressure is

A. $7.5JK^{-1}mol^{-1}$

B. $7.0JK^{-1}mol^{-1}$

C. $8.5JK^{-1}mol^{-1}$

D. $8.0JK^{-1}mol^{-1}$

Answer:

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2. A fixed mass of gas at constant pressure occupies a volume V. The gas undergoes a rise in temperature so that the root mean square velocity of its molecules is doubled. The new volume will be

A. v/2

B. $V\sqrt{2}$

C. 2V

D. 4V

Answer: D

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

A. 1.62

B. 1.59

C. 1.54

D. 1.4

Answer:

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4. Air is pumped into an automobile tyre's tube up to pressure of $200kPa$ in the morning when the air temperature is $20^{\circ}C$. During the day the temperature rises to $40^{\circ}C$ and the tube expand by 2%. Calculate the pressure of the air in the tube at this temperature.

A. 212kPa

B. 209kPa

C. 206kPa

D. 200kPa

Answer:

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5. Calculate the rms speed of smoke particles of mass $5 \times 10^{-17} kg$ in their Brownian motion in air at NTP. Given $k_B = 1.38 \times 10^{-23} J/K$

A. 1.5m/s

B. 3.0m/s

C. 1.5 cm/s

D. 3cm/s

Answer:

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6. One mole of an ideal gas requires 207J heat to raise the temperature by 10 K, when heated at constant pressure. If the same gas is heated at constant volume to raise the temperature by 10 K, then heat required is [given gas constant. R = 8.3 1/(mol -K)]

A. 198.7 J

B. 29 J

C. 215.3 J

D. 124 J

Answer:

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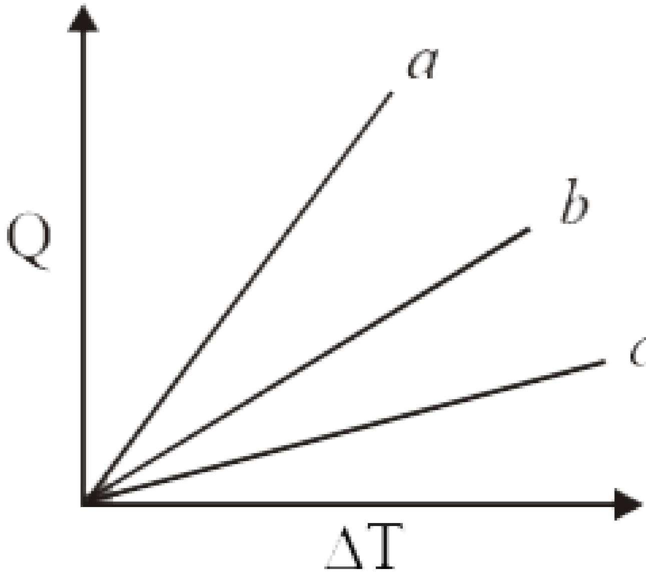
7. Figure shows the variation in temperature (DT) with the amount of heat supplied (Q) in an isobaric process corresponding to a monoatomic (M), diatomic (D) and a polyatomic (P) gas. The initial state of all the gases are the same and the scales for the two axes coincide. Ignoring vibrational degrees of freedom, the lines a, b and c respectively correspond to



A. P.MandD

B. M,DandP

C. P,D and M

D. D,M and P

Answer:

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8. 1 mole of a monatomic and 2 mole of a diatomic gas are mixed. The resulting gas is taken through a process in which molar heat capacity was found 3R. Polytropic constant in the process is

A. $-1/5$

B. $1/5$

C. $2/5$

D. $-2/5$

Answer:

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9. The density of a gas is $6 \times 10^{-2} kg/m^3$ and the root mean square velocity of the gas molecules is 500 m/s. The pressure exerted by the gas on the walls of the vessel is

A. $5 \times 10^3 N / m^2$

B. $1.2 \times 10^{-4} N / m^2$

C. $0.83 \times 10^{-4} N / m^2$

D. $30 N / m^2$

Answer:

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10. The absolute temperature of the gas is increased 3 times. What will be the increases in root mean square velocity of the gas molecules?

A. 3 times

B. 9 times

C. 1/3 times

D. $\sqrt{3}$ times

Answer:

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

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

C. $\frac{3\gamma + 1}{2}$

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

Answer:

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12. 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. $5 \times 10^4 J$

B. $6 \times 10^4 J$

C. $7 \times 10^4 J$

D. $3 \times 10^4 J$

Answer:

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13. 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. $\frac{(\gamma - 1)}{2\gamma R} M v^2 k$

B. $\frac{\gamma m v^2}{2\gamma R} k$

C. $\frac{(\gamma - 1)}{2R} M v^2 k$

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

Answer:

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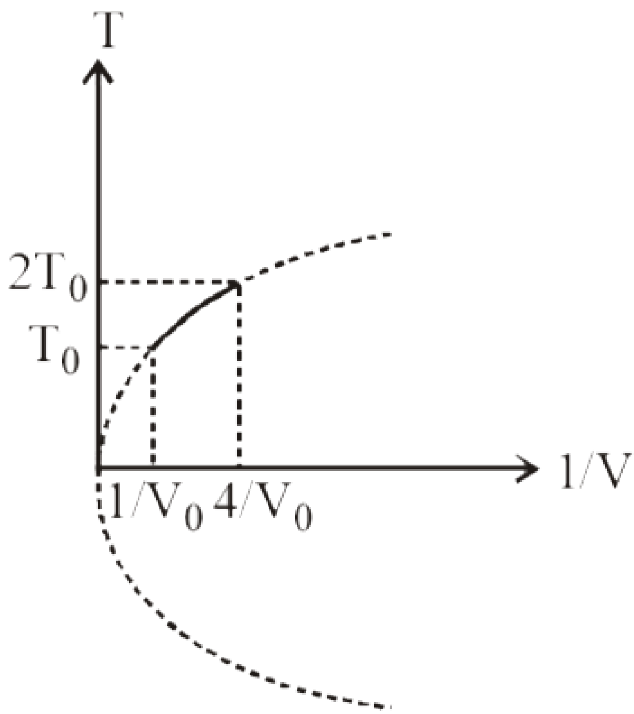
14. Figure shows a parabolic graph between T and 1/V for a mixture of a gases undergoing an adiabatic process. What is the ratio of V_{nms}

of molecules and speed of sound in mixture?



A. $\sqrt{3/2}$

B. $\sqrt{2}$

C. $\sqrt{2/3}$

D. $\sqrt{3}$

Answer:

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15. 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 $\left(R = 8.3ml^{-1}Jmol^{-1}K^{-1}\right)$

A. diatomic

B. triatomic

C. a mixture of monatomic and diatomic

D. monatomic

Answer:

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16. At what temperature is the root mean square velocity of gaseous hydrogen molecules is equal to that of oxygen molecules at $47^{\circ} C$?

A. 40K

B. 80K

C. $-73K$

D. 3K

Answer:

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17. The kinetic theory of gases states that the average squared velocity of molecules varies linearly with the mean molecular weight of the gas. If the root mean square (rms) velocity of oxygen molecules at a certain temperature is 0.5 km/sec. The rms velocity for hydrogen molecules at the same temperature will be :

A. 2km/sec

B. 4km/sec

C. 8km/sec

D. 16km/sec

Answer:

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18. If 2 mol of an ideal monatomic gas at temperature T_0 are mixed with 4 mol of another ideal monatoic gas at temperature $2T_0$ then the temperature of the mixture is

A. $\frac{5}{3}T_0$

B. $\frac{5}{3}T_0$

C. $\frac{4}{3}T_0$

D. $\frac{5}{4}T_0$

Answer:

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19. 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 gas

B. The average translational kinetic energy per molecule of oxygen gas is 3 KT (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 decrease in pressure

Answer:

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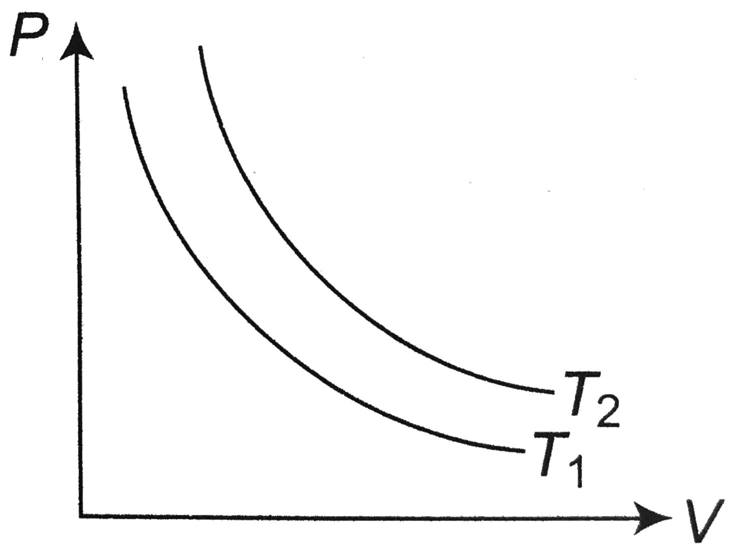
20. Figure shows the pressure P versus volume V graphs for a certains mass of a gas at two constant temperature T_1 and T_2. Which of the following interface is correct?



A. $T_1 > T_2$

B. $T_1 = T_2$

C. $T_1 < T_2$

D. None of these

Answer:

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

B. $100\sqrt{2}$

C. $\frac{100\sqrt{2}}{3}$

D. $\frac{100}{3}$

Answer:

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22. A graph is plotted with PV/T on y-axis and mass of the gas along x-axis for different gases. The graph is

A. a straight line parallel to x-axis for all the gases

B. a straight line passing through origin with a slope having a constant value for all the gases

C. a straight line passing through origin with a slope having different values for different gases

D. a straight line parallel to y-axis for all the gases

Answer:

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23. At identical temperatures, the rms speed of hydrogen molecules is 4 times that for oxygen molecules. In a mixture of these in mass ratio $H_2 : O_2 = 1 : 8$, the rms speed of all molecules in n times the rms speed for O_2 molecules, where n is

A. 3

B. $4/3$

C. $(8/3)^{1/2}$

D. $(11)^{1/2}$

Answer:

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24. Find the expression for the work done by a system undergoing isothermal compression (or expansion) form volume V_1 to V_2 at temperature T_0 for a gas which obeys the van der waals equation of state. $(P + an^2/V^2)(V - bn) = nRT$?

A.

$$nRT \ \log_e\left(\frac{V_2 - n\beta}{v_1 - n\beta}\right) + \alpha n^2\left(\frac{V_1 - V_2}{V_1 V_2}\right)$$

B.

$$nRT \ \log_{10}\left(\frac{V_2 - n\beta}{v_1 - n\beta}\right) + \alpha n^2\left(\frac{V_1 - V_2}{V_1 V_2}\right)$$

C.

$$nRT \ \log_e\left(\frac{V_2 - n\beta}{v_1 - n\beta}\right) + \beta n^2\left(\frac{V_1 - V_2}{V_1 V_2}\right)$$

D.

$$nRT \ \log_e\left(\frac{V_1 - n\beta}{v_2 - n\beta}\right) + \alpha n^2\left(\frac{V_1 V_2}{V_1 - V_2}\right)$$

Answer:

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

B. 2

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

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

Answer:

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26. The temperature of the mixture of one mole of helium and one mole of hydrogen is increased from 0°C to 100°C at constant pressure. The amount of heat delivered will be

A. 600cal

B. 1200 cal

C. 1800cal

D. 3600cal

Answer:

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27. If the intermolecules forces vanish away, the volume occupied by the molecules contained in $4.5kg$ water at stantard temperature and pressure will be given by

A. 5.6litre

B. 4.5 litre

C. 11.2 litre

D. 6.5 litre

Answer:

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28. If the intermolecules forces vanish away, the volume occupied by the molecules contained in $4.5kg$ water at stantard temperature and pressure will be given by

A. 4RT

B. 15RT

C. 9RT

D. 11RT

Answer:

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29. A vessel has 6g of hydrogen at pressure P and temperature 500K. A small hole is made in it so that hydrogen leaks out. How much hydrogen leaks out if the final pressure is P/2 and temperature falls to 300 K ?

A. 2g

B. 3g

C. 4g

D. 1g

Answer:

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30. For a gas if ratio of specific heats at constant pressure and volume is g then value of degrees of freedom is

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

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

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

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

Answer:

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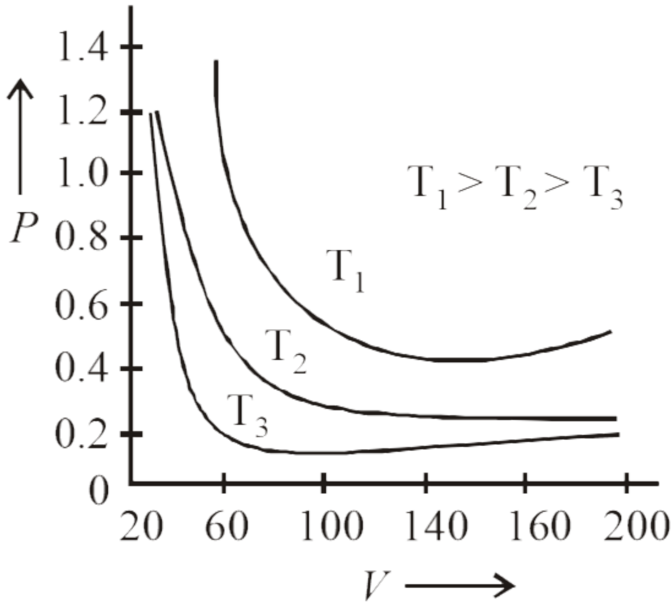
31. The given P-V curve is predicted by



A. Boyle's law

B. Charle's law

C. Avogadro's law

D. Gaylussac's law

Answer:

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32. Three perfect gases at absolute temperature $T_1, T_2,$ and T_3 are mixed. The masses of molecules are n_1, n_2 and n_3 respectively. Assuming to loss of energy, the final temperature of the mixture is:

A. $\dfrac{n_1T_1 + n_2T_2 + n_3T_3}{n_1 + n_2 + n_3}$

B. $\dfrac{n_1T_1^2 + n_2T_2^2 + n_3T_3^3}{n_1T_1 + n_2T_2 + n_3T_3}$

C. $\dfrac{n_1T_1^2 + n_2T_2^2 + n_3T_3^2}{n_1T_1 + n_2T_2 + n_3T_3}$

D. $\dfrac{(T_1 + T_2 + T_3)}{3}$

Answer:

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33. A gas is enclosed in a cube of side l. What will be the change in momentum of the molecule, if it suffers an elastic collision with the plane wall parallel to yz-plane and rebounds with the same velocity ?

$\left[\left(V_x, V_y \& V_z\right)\right.$ initial velocities of the gas molecules]

A. mv_x

B. zero

C. $-mv_x$

D. $-2mv_x$.

Answer:

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34. What will be the ratio of number of molecules of a monoatomic and a diatomic gas in a vessel, if the ratio of their partial pressures is 5 : 3 ?

A. $5:1$

B. $3:1$

C. $5:3$

D. $3:5$

Answer:

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35. 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 $484 m/s$, respectively. The corresponding values at $600K$ are nearly (assuming ideal gas behaviour)

A. $12.42 \times 10^{-21} J, 968 m/s$

B. $8.78 \times 10^{-21} J, 968 m/s$

C. $6.21 \times 10^{-21} J, 968 m/s$

D. $12.42 \times 10^{-21} J, 968 m / s$

Answer:

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36. At $10^{\circ} C$, the value of the density of a fixed mass of an ideal gas divided by its pressure is x. at $110^{\circ} C$, this ratio is

A. x

B. $\frac{383}{283} x$

C. $\frac{10}{110}x$

D. $\frac{283}{383}x$

Answer:

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37. If the potential energy of a gas molecule is $U = \frac{M}{r^6} - \frac{N}{r^{12}}$, M and N being positive constants, then the potential energy at equilibrium must be

A. zero

B. $M^2 / 4N$

C. N^(2)//4M`

D. $MN^2 / 4$

Answer:

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38. Consider a gas with density $'\rho'$ and $\bar{c}$ as the root mean square velocity of its molecules contained in a volume. If the system moves as whole with velocity 'v' , then the pressure exerted by the gas is

A. $\frac{1}{3}\rho\bar{c}^2$

B. $\frac{1}{3}\rho(c+v)^2$

C. $\frac{1}{3}\rho(\bar{c}-v)^2$

D. $\frac{1}{3}\rho\left(c^{-2}-v\right)^2$

Answer:

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39. How is the mean free path (λ) in a gas related to the interatomic distance?

A. λ is 10 times the interatomic distance

B. λ is 100 times the interatomic distance

C. $\lambda$is 1000 times the interatomic distance

D. $\lambda \text{ is} \frac{1}{10}$ times of the interatomic distance

Answer:

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40. Four molecules have speeds $2km/s, 3km/s, 4km/s$ and $5km/s$. The rms speed of these molecules in km/s is

A. $\sqrt{54/4}$

B. $\sqrt{54/2}$

C. 3.5

D. $3\sqrt{3}$

Answer:

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41. If $R =$ universal gas constant, the amount of heat needed to raise the temperature the temperature of $2mol$ of an ideal monatomic gas from $273K$ to $373K$ when no work is done is

A. 100R

B. 150R

C. 300R

D. 500R

Answer:

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42. N molecules, each of mass m of gas A and $2N$ molecules each of mass $2m$ of gas B are containted in the same vessel which is maintained at temperature T. The mean square velocity of molecules of B type is denoted by v^2 and the mean square velocity of A type is denoted by $(\omega)^2$. the ω^2 / v^2 is:

A. 2

B. 1

C. $1/3$

D. $2/3$

Answer:

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43. The root mean square value of the speed of the molecules in a fixed mass of an ideal gas is increased by increasing

A. the volume while keeping the temperature constant

B. the pressure while keeping the volume constant

C. the temperature while keeping the pressure constant

D. the pressure while keeping the temperature constant

Answer:

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44. P-V diagram of a diatomic gas is a straight line passing through origin. The molar heat capacity of the gas in the process will be

A. 4R

B. 2.5R

C. 3R

D. $\frac{4R}{3}$

Answer:

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45. For a gas, difference between two specific heats is 5000 J/ mole°C. If the ratio of specific heats is 1.6, the two specific heats in J/mole-°C are

A. $C_p = 1.33 \times 10^4, C_v = 2.66 \times 10^4$

B. $C_p = 13.3 \times 10^4, C_v = 8.33 \times 10^3$

C. $C_p = 1.33 \times 10^4, C_v = 8.33 \times 10^3$

D. $C_p = 2.6 \times 10^4, C_v = 8.33 \times 10^4$

Answer:

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