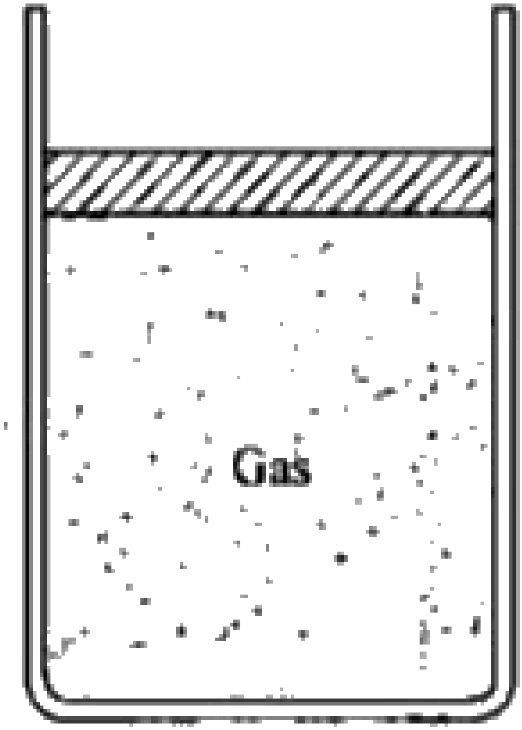
PHYSICS

BOOKS - GK PUBLICATIONS PHYSICS (HINGLISH)

Kinetic Theory of Gases and Gas Laws

Illustrative Example

1. A cylindrical container is shown in figure-2.7 in which a gas is enclosed. Its initial volume is Vand temperature is T. As no external pressure is applied on the light piston shown, gas pressure must be equal to the atmospheric pressure. If gas temperature is doubled, find its final volume. In its final state if piston is clamped and temperature is again doubled, find the final pressure of the gas.



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2. 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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3. Two closed containers of equal volume of air are initially at 1.05×10^5 Pa, and 300 K temperature. If the containers are connected by a narrow tube and one container is maintained at 300 K temperature and other at 400 K temperature. Find the final pressure in the containers.

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4. Equal masses of air are sealed in two vessels, one of volume V_0 and the other of volume $2V_0$. If the first vessel is maintained at a temperature $300K$ and the other at $600K$, find the ratio of the pressures in the two vessels.

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5. A glass container encloses a gas a pressure of 8×10^5 pa and 300 K temperature. The container walls can bear a maximum pressure of 10^6 Pa. If the temperature of container is gradually increased, find the temperature at which the container will break.

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6. Find the minimum attainable pressure of one mole of an ideal gas. If during its expansion its temperature and volume are related as $T = T_0 + \alpha V^2$ where $T_0 \& \alpha$ are positive constants

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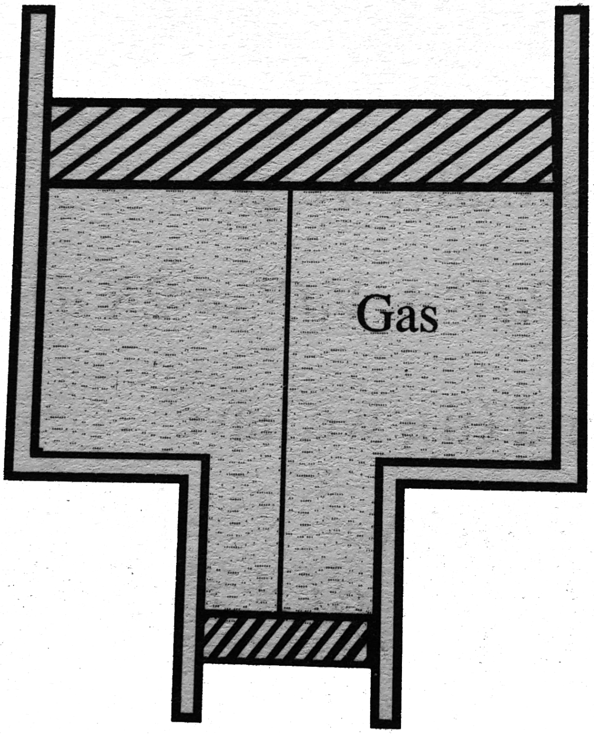
7. A smooth vertical tube having two different cross sections is open from both the ends but closed by two sliding pistions as shown in Fig. and tied with an inextensible string. One mole of an ideal gas is enclosed between the piston The difference in cross-sectional areas of the two pistons is given ΔS. The masses of piston are m_1 and m_2 for larger and smaller one, respectively. Find the temperature by which tube is raised so that the pistons will be displaced by a distance l. Take atmospheric pressure equal to P_0



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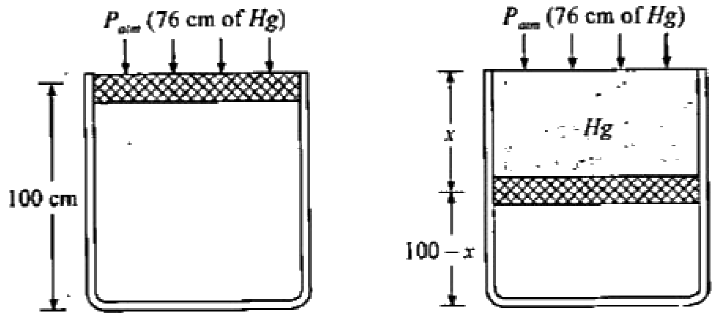
8. A vertical cylinder of height 100 cm contains air at a constant temperature and its top is closed by a frictionless piston at atmospheric pressure (76 cm of Hg) asshown in figure-2.12. If mercury is slowly poured on the piston, due to its weight airis compressed. Find the maximum height of the mercury column which can be put on the piston.



(a) (b)

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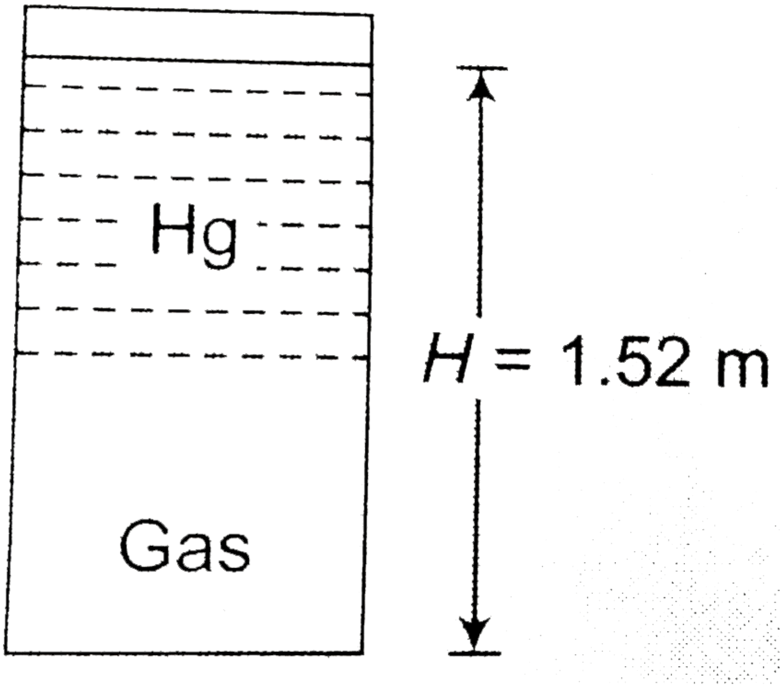
9. A vertical hollow cylinder of height $1.52m$ is fitted with a movable piston of negligible mass and thickness. The lower half portion of the cylinder contains an ideal gas and the upper half is filled with mercury. The cylinder is initially at $300K$. When the temperature is raised half of the mercury comes out of the cylinder. Find this temperature assuming the thermal expansion of the mercury to be negligible.



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10. A tall cylindrical vessel with gaseous nitrogen is located in a uniform gravitational field in which the free-fall acceleration is equal to g. The temperature of the nitrogen varies along the height h so that its density is the same throught the volume. find the temperature gradient dT / dh.

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11. An open glass tube is immersed in mercury in such a way that a lenth of 8cm extends above the mercury level. The open end of the tube is then closed and sealed and the tube is raised vertically up by additional 46cm. What will be length of the air column above mercury in the tube now?

(Atmosphere pressure =76cm of Hg)

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12. A uniform tube closed at one end, contains a pellet of mercury $10cm$ long. When the tube is kept vertically with the closed-end upward, the length of the air column trapped is $20cm$. Find the length of the air column trapped when the tube is inverted so that the closed-end goes down. Atmospheric pressure $= 75 cm$ of mercury.

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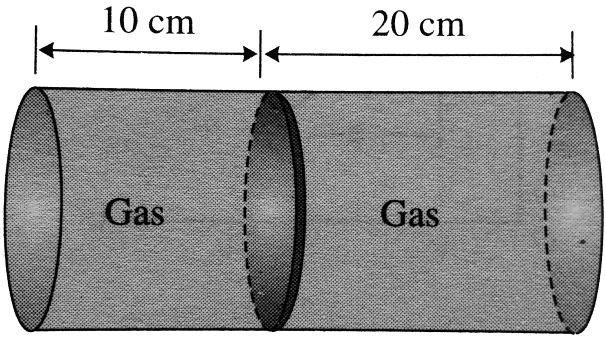
13. Fig. shows a horzontal cylindrical container of length $30 cm$, which is partitioned by a tight-fiting separator. The separator is diathermic but conductws heat very slowly. Initially the separator is the state shown in the figure. The temperature of left part of cylinder is $100 K$ and that on right part is $400 K$. Initially the separator is in equilibrium. As heat is conducted from right to left part, of separator after a long when gases on the two

displacement of separator after a long when gases on the two parts of cylinder are in thermal equilibrium.



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14. (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 $0.09 kg/m^3$. (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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15. Given that the mass of a molecule of hydrogen is 3.34×10^{-27} kg. Calculate Avogadro's number.

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16. Calculate Boltzmann's constant.

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17. Calculate the number of molecules in 1 cm^3 of an ideal gas at $27^\circ C$ and a pressure of 10 mm of mercury. Mean kinetic energy of a molecule at $27^\circ C$ is 4×10^{-14} erg, the density of mercury is 13.6 gm/c.c.

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18. A parallel beam of nitrogen molecules moving with velocity $v = 400ms^{-1}$ imprings on a wall at an angle $\theta = 30^\circ$ to its normal. The concentration of molecules in the beam is $n = 9 \times 10^{18} cm^{-3}$. Find the pressure exerted by the beam on the wall, assuming that collisions are perfectly elastic.

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19. Calculate the temperature at which rms velocity of a gas molecule is same as that of a molecule of another gas at $47^\circ C$. Molecular weight of first and secon gases are 64 and 32 respectively.

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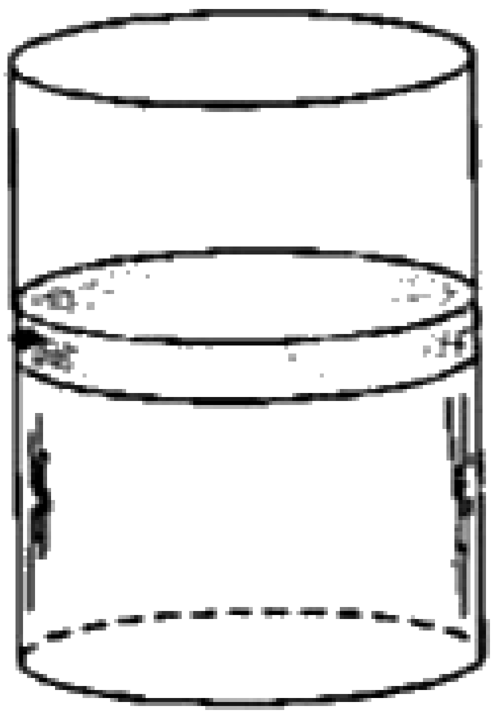
20. Figure-2.28 shows a cylindrical container which is divided in two equal parts by a clamped diathermic piston. Different ideal gases are filled in the two parts. It is found that the rms speed of molecules in the lower part is equal to the mean speed of molecules in the upper part. Find the ratio ofmass of molecule of gas in lower part to that of the gas in upper part.



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21. In a closed container of volume $10^{-3}m^3$, O_2 gas is filled at temperature 400 K and pressure 1.5 atm. A small hole is made in the container from which gas leaks out to pen atmosphere. After some time the temperature and pressure of container become equals to that of surrounding. Find the mass of gas that leaks out from the container. (Atmospheric temperature = 300 K)

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22. In a certain region of outer space there are only 100 molecules per cm^3 on an average. The temperature there is about 3 K. What is the average pressure of this very dilute gas.

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23. One gram mole of oxygen at $27^\circ C$ and one atmospheric pressure is enclosed in a vessel. Assuming the molecules to be moving with v_{rms}, find the number of collisions per second which the molecules make against one square metre of the vessel wall.

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24. Calculate (a) the average kinetic energy of translation of an oxygen molecule at $27^\circ C$ (b) the total kinetic energy of an oxygen molecule at $27^\circ C$ (c) the total kinetic energy in joule of one mole of oxygen at 27°. Given Avogadro's number $= 6.02 \times 10^{23}$ and Boltzmann's constant $= 1.38 \times 10^{-23} J/(mol - K)$.

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25. Calculate (a) the average kinetic energy of translation of an oxygen molecule at $27^\circ C$ (b) the total kinetic energy of an oxygen molecule at $27^\circ C$ (c) the total kinetic energy in joule of one mole of oxygen at 27°. Given Avogadro's number $= 6.02 \times 10^{23}$ and Boltzmann's constant $= 1.38 \times 10^{-23} J/(mol - K)$.

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26. Calculate (a) the average kinetic energy of translation of an oxygen molecule at $27^\circ C$ (b) the total kinetic energy of an oxygen molecule at $27^\circ C$ (c) the total kinetic energy in joule of one mole of oxygen at 27°. Given Avogadro's number $= 6.02 \times 10^{23}$ and Boltzmann's constant $= 1.38 \times 10^{-23} J/(mol - K)$.

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27. A mass M = 15 g of nitrogen is enclosed in a vessel at temperature T = 300 K. What amount of heat has to be transferred to the gas to increase the root-mean-square velocity of molecules 2 times ?

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28. 1 gm of helium having rms velocity of molecules 100 m/s and 4 gm of oxygen having rms velocity of molecules 1000 m/s are mixed in a container which is thermally isolated. What are the rms velocities of helium and oxygen molecules after equilibrium is attained ?

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29. A cubical vessel of side 1 m contains one mole of nitrogen at a temperature of 300 K. If the molecuels are assuming to move with the rms velocity

find the number of collisions per second which the molecules may make with the wall of the vessel

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30. A cubical vessel of side 1 m contains one mole of nitrogen at a temperature of 300 K. If the molecuels are assuming to move with the rms velocity

further if the vessel now thermally insulated moved with a constant speed v and then suddenly stopped and this results in rise of temperature by $2^\circ C$, find v.

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31. As adiabatic vessel contains $n_1 = 3$ mole of diatomic gas. Moment of inertia of each molecule is $I = 2.76 \times 10^{-46} kgm^2$ and root-mean-square angular velocity is $\omega_0 = 5 \times 10^{12} rad / s$. Another adiabatic vessel contains $n_2 = 5$ mole of a monatomic gas at a temperature $470K$. Assume gases to be ideal, calculate root-mean-square angular velocity of diatomic molecules when the two vessels are connected by a thin tube of negligible volume. Boltzmann constant $k = 1.38 \times 10^{-23} J / : \text{molecule}$.

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Discussion Question

1. Two balloons of the same volume are filled wi t.h gases at the same pressure, one with hydrogen and the other with helium. Which of the two has the greater buoyancy (including the weight of the bag) and what is the ratio of buoyancies?

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2. Why is the climate of coastal cities milder than that of cities in the midst of large land areas?

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3. What would happen if we take a barometer to the bottom of a swimming pool ? What would happen if we take it to the moon ?

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4. It is advisable to measure the tyre pressures in a car before going for a long drive. What difference would it make if the pressure were measured after driving several miles at speed.

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5. In an open room at atmospheric pressure, the total kinetic energy of all the air molecules is more when the room is warm than the total kinetic energy of the molecules in the same room when it is cool. Justify this statement.

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6. Some potatoes are put in container with water. If pressure in the container is reduced, potatoes will cook faster.

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7. Why does food cook faster in a pressure cooker than in boiling water?

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8. In the ideal gas equation, could Celsius temperature be used instead of Kelvin if an appropriate numerical value of the gas constant R is used,?

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9. "Desert areas often have exceptionally large day-night temperature variations" Comment on this statement.

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10. Helium gas found in nature is a mixture of two isotopes having atomic weights 3 and 4, which atom move faster on average and why?

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11. When two gases are mixed and if they are in thermal equilibrium, they must have the same average molecular speed. Justify this statement.

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12. When we open a gas tap for a few seconds, the sound of escaping gas is heard first but the smell of gas comes later. Why?

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13. A flask is closed by a stop valve. The valve allows only those air molecules that are moving faster than a certain speed to move out of the flask and allows only air molecules that are moving slower than that speed to enter the flask from outside. What effect would this filter have on the temperature of the air in the flask.

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14. If a gas is made up entirely of free electrons. Would the temperature of such a gas rise, fall or remains same if it undergoes free expansion.

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15. An ideal diatomic gas, without vibrations loses heat to a system in a process. Is the resulting decrease in the internal energy of the gas greater if the loss occurs in isochoric process or in isobaric process.

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16. We know the mechanical energy of a body is a frame dependent property. Is temperature of a substance is also a frame dependent property.

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17. While gas from a cooking gas cylinder is used, the pressure does not fall appreciably till the last few minutes. Why?

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18. What we can say about the specific heat of a boiling water or melting ice.

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Conceptual Mcqs Single Option Correct

1. The following four gases are at the same temperature. In which gas do the molecules have the maximum root mean square speed?

A. Hydrogen

B. Oxygen

C. Nitrogen

D. Carbon dioxide

Answer:

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2. Cooking vegetables and other food in a pressure cooker saves time and fuel because :

A. Under increased pressure, water can be made to boil at a temperature much higher than $100^{\circ} C$

B. Under increased pressure, water can be made to boil at a temperature much lower than $100^{\circ} C$

C. Heat losses are reduced to a minimum

D. Condensation of steam is prevented

Answer:

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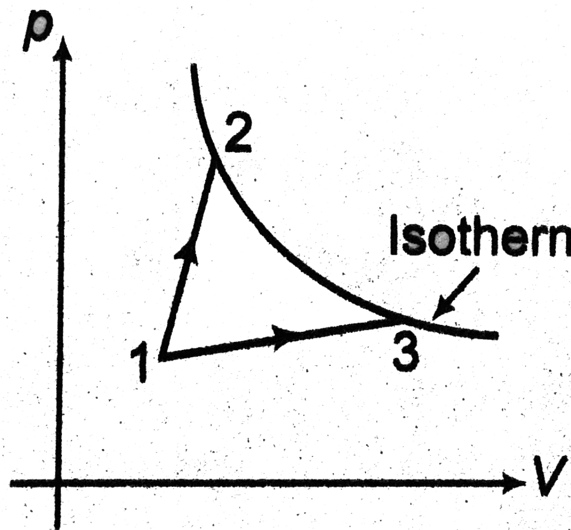
3. A gas takes part in two processes in which it is heated from the same initial state 1 to the same final temperature. The processes are shown on the p-V diagram by the straight lines 1-3 and 1-2. 2 and 3 are the points on the same isothermal curve. Q_1 and Q_2 are the heat transfer along the two processes. Then,



A. $Q_1 = Q_2$

B. $Q_1 < Q_2$

C. $Q_1 > Q_2$

D. insufficient data

Answer:

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4. If water at $0^\circ C$ kept in a container with an open top, is placed a large evacuated chamber,

A. All the water will vaporize

B. All the water will freeze

C. Part of the water will vaporize and the rest will freeze

D. Ice, water and water vapour will be formed and reach equilibrium at the triple point

Answer:

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5. Which of the following is correct for the molecules of a gas in thermal equilibrium ?

A. All have the same speed

B. Molecules have different speed distribution of which average remain constant

C. They have a certain constant average speed

D. They do not collide with one another

Answer:

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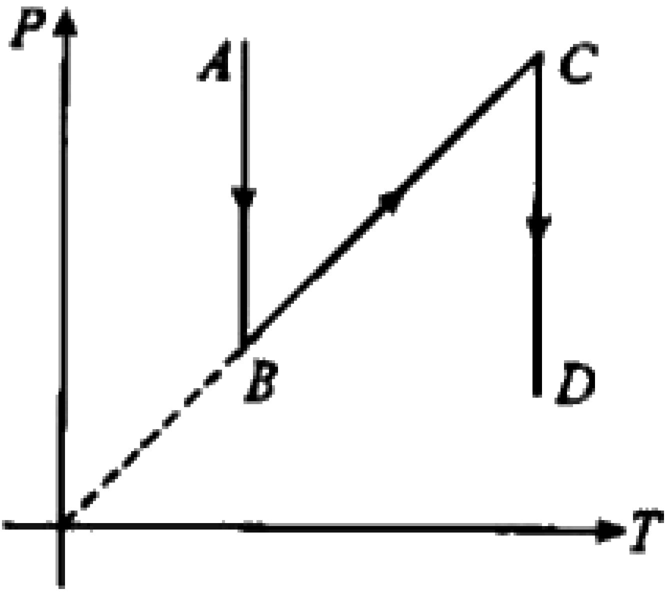
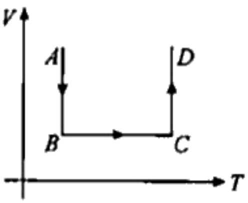
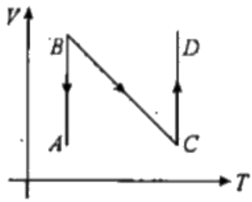
6. P-T diagram is shown below then choose the corresponding V-T diagram

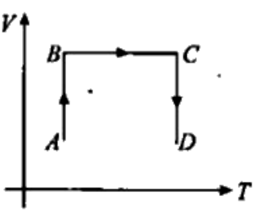




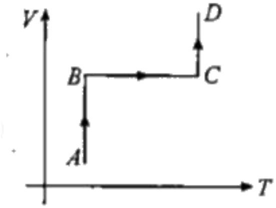
A.



B.



C.

D. 

Answer:

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7. E_0 and E_n respectively represent the average kinetic energy of a molecule of oxygen and hydrogen. If the two gases are at the same temperature, which of the following statements is true?

A. $E_0 > E_h$

B. $E_0 = E_n$

C. $E_0 < E_h$

D. Nothing can be said about the magnitude of E_0 and E_h as the information given is insufficient

Answer:

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8. When an ideal gas is compressed isothermally then its pressure increase because:

A. Its potential energy increases

B. Its kinetic energy increases and molecules move apart

C. Its number of collisions per unit area with walls of container increases

D. Molecular energy increases

Answer:

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9. 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. $(v_1 + v_2) / 2$

B. v_t

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

D. $\sqrt{2kT / M}$

Answer:

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10. The pressure p of a gas is plotted against its absolute temperature T for two different constant volumes, V_1 and V_2 when $V_1 > V_2$, the

A. The curve for V_1 has greater slope than the curve for V_2

B. The curve for V_2 has greater slope than the curve for V_1

C. The curves must intersect at some point other than T=0

D. The curves have the same slope and do not intersect

Answer:

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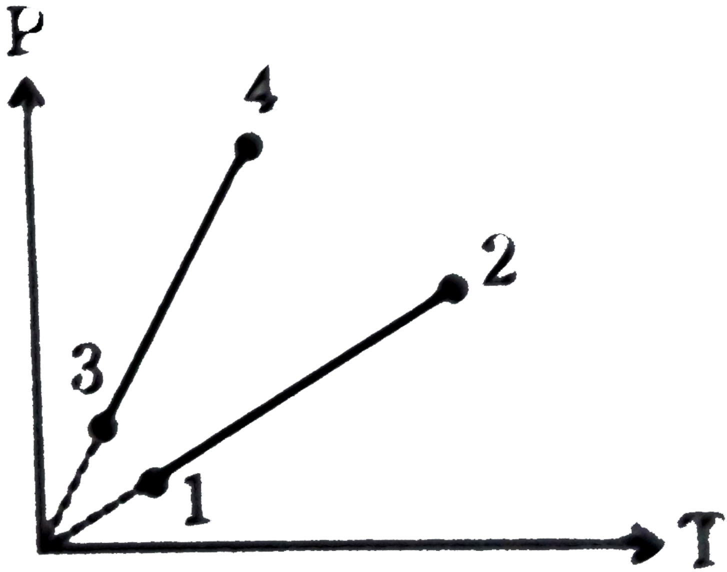
11. Pressure versus temperature graph of an ideal gas of equal number of moles of different volumes is plotted as shown in figure. Choose the correct alternatives.



A. $V_1 = V_2, V_3 = V_4$ and $V_2 > V_3$

B. $V_1 = V_2, V_3 = V_4$ and $V_2 < V_3$

C. $V_1 = V_2 = V_3 = V_4$

D. $V_4 > V_3 > V_2 > V_1$

Answer:

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12. A gas is contained in a metallic cylinder fitted with a piston.The piston is suddenly moved in to compress the gas and is maintained at this position. As time passes the pressure of the gas in the cylinder

A. Increases

B. Decreases

C. Remains constant

D. Increases or decreases depending on the nature of the gas

Answer:

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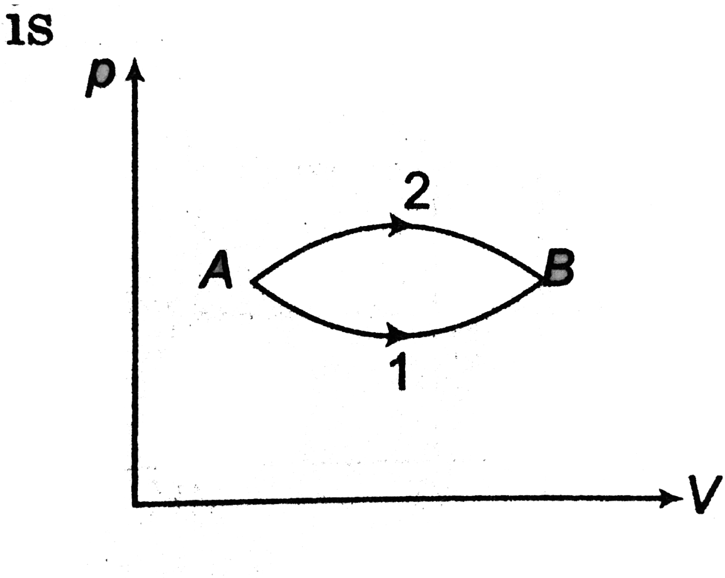
13. The figure shows two paths for the change of state of a gas from A to B. The ratio of molar heat capacities in path 1 and path 2 is



A. > 1

B. < 1

C. 1

D. Data insufficient

Answer:

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14. 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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15. A volume V of air saturated with water vapour experts a pressure P. Pressure of saturated vapour is P_0. If the volume is made $V/2$ isothermally, the final pressure will be

A. More than 2p

B. Less than 2p

C. Equal to 2p

D. Equal top

Answer:

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16. Two samples A and B are initially kept in the same state. The sample A is expanded through an adiabatic process and the sample B through an isothermal process. The final volumes of the samples are the same .The final pressures in A and B are p_A and P_B respectively.

A. $p_A > p_B$

B. $p_A = p_B$

C. $p_A < p_B$

D. The relation between p_A and p_B can not be deduced.

Answer:

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17. A gas has molar heat capacity $C = 24.9 J mol^{-1}{}' K^{-1}$ in the process $P^2 T$ = constant. Then (R=8.3 J/mol k)

A. Gas is monoatomic

B. Gas is diatomic

C. Gas is triatomic

D. Atomicity of gas is 4

Answer:

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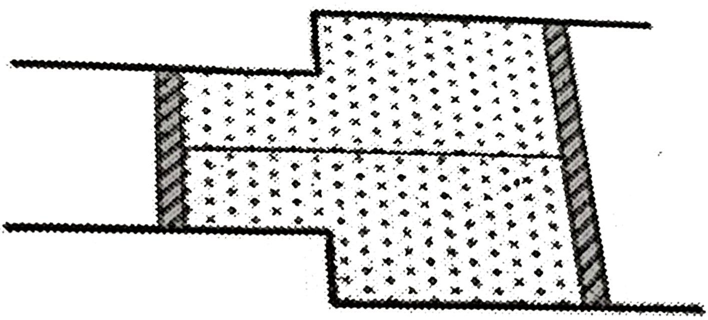
18. A horizontal cylinder has two sections of unequal cross - sections, in which two pistons can move freely. The pistons are joined by a string, Some gas is trapped between the pistons. If this gas is heated the pistons will



A. Move to the left

B. Move to the right

C. Remain stationary

D. Either (A) or (B) depending on the initial pressure of the gas

Answer:

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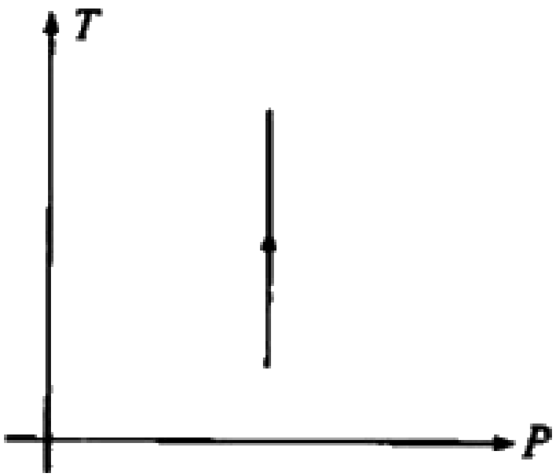
19. Pressure versus temperature graph of an ideal gas are as shown in figure-2.39. Choose the wrong statement



A. Given process is isobaric

B. Density of gas is constant

C. Volume of gas is increasing

D. None of these

Answer:

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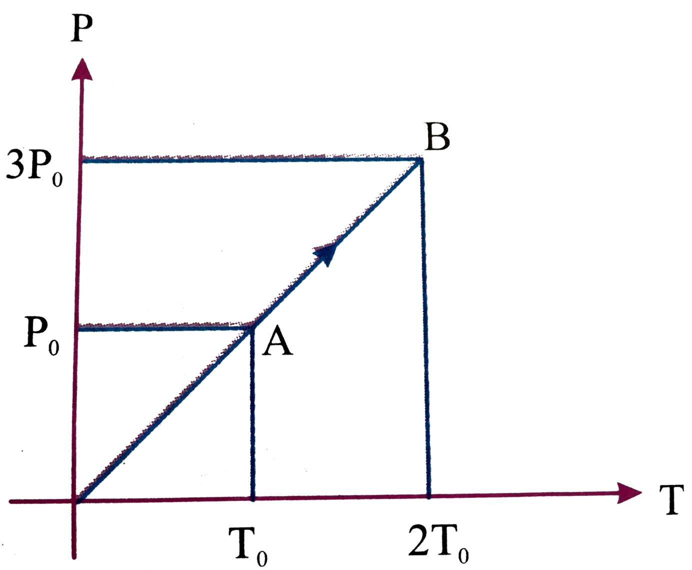
20. Pressure versus temperature graph of an ideal gas is shown in figure. Density of the gas at point A is ρ_0. Density at B will be



A. $\frac{3}{4}\rho_0$

B. $\frac{3}{2}\rho_0$

C. $\frac{4}{3}\rho_0$

D. $2\rho_0$

Answer:

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21. The quantity $\frac{pV}{kt}$ represents

A. Number of moles of the gas

B. Total mass of the gas

C. Number of molecules in the gas

D. Density of the gas

Answer:

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22. The equation of state for a real gas such as hydrogen, oxygen, etc. is called the Van der Waal's equation which reads

$$\left(P + \frac{a}{V^2}\right)(V - b) = nRT,$$

where a and b are constants of the gas. The dimensional formula of constant a is :

A. $\mathrm{M\,L^5T^{-2}}$

B. $\mathrm{M\,L^5T^{-1}}$

C. $\mathrm{M\,L^{-1}T^{-1}}$

D. a being a constant, is dimensionless

Answer:

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23. A stationary vertical cylindrical container of very large height filled with a gas of molar mass M at constant Temperature. The pressure at the bottom is P_1 and at the top is P_2. If the acceleration due to gravity is assumed to be constant for the whole cylinder, which is equal to g. Then the height of the cylinder is :

A. $\frac{RT}{Mg}\ln\left(\frac{P_1}{P_2}\right)$

B. $\frac{RT}{2Mg}\ln\left(\frac{P_1}{P_2}\right)$

C. $\frac{2RT}{Mg}\ln\left(\frac{P_1}{P_2}\right)$

D. $\frac{RT}{3Mg}\ln\left(\frac{P_1}{P_2}\right)$

Answer:

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24. The coefficient of linear expansion of an in homogeneous rod change linearly from α_1 to α_2 from one end to the other end of the rod. The effective coefficient of linear expansion of rod is

A. $\alpha_1 + \alpha_2$

B. $\dfrac{\alpha_1 + \alpha_2}{2}$

C. $\sqrt{\alpha_1 \alpha_2}$

D. $\alpha_1 - \alpha_2$

Answer:

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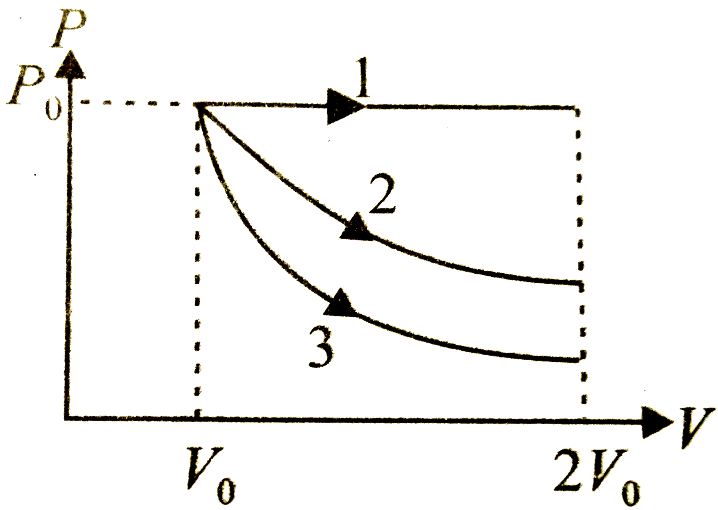
25. A gas is expanded form volume $V_0 \rightarrow 2V_0$ under three different processes as shown in the figure . Process 1 is isobaric process process 2 is isothermal and and process 3 is adiabatic .

Let $\Delta U_1, \Delta U_2$ and ΔU_3 be the change in internal energy of the gs in these three processes then



A. $\Delta U_1 > \Delta U_2 > \Delta U_3$

B. $\Delta U_1 < \Delta U_2 < \Delta U_3$

C. $\Delta U_2 < \Delta U_1 < \Delta U_3$

D. $\Delta U_2 < \Delta U_3 < \Delta U_1$

Answer:

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26. Some of the thermodynamic parameters are state variables while some are process variables. Some grouping of the parameters are given. Choose the correct one.

A.

State variables	:	Temperature, No of moles
Process variables	:	Internal energy, work done by the gas.

B.

State variables	:	Volume, Temperature
Process variables	:	Internal energy, work done by the gas.

C.

State variables	:	Work done by the gas, heat rejected by the gas
Process variables	:	Temperature, volume.

D.

State variables	:	Internal energy, volume
Process variables	:	Work done by the gas, heat absorbed by the gas.

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Answer:

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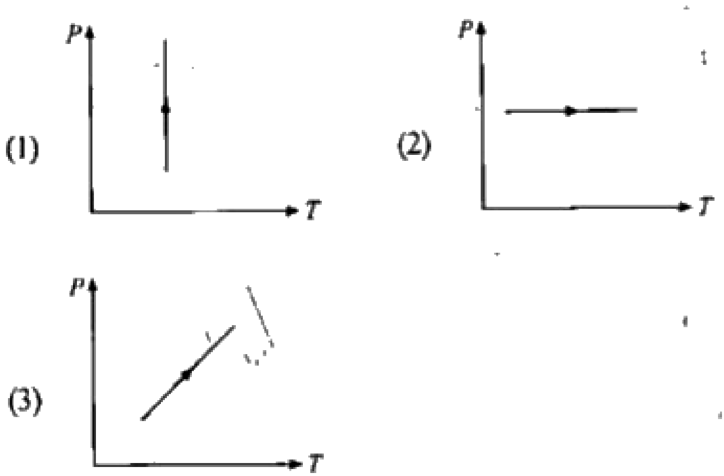
27. P-T graphs of an ideal gas are as shown in figures-2.42 below.

Choose the wrong statement from the options given:



A. Density of gas is increasing in graph (1)

B. Density of gas decreasing in graph (2)

C. Density of gas is constant in graph (3)

D. None of the above

Answer:

Watch Video Solution

Numerical Mcqs Single Options Correct

1. One mole of O_2 gas having a volume equal to 22.4 litres at $0^\circ C$ and 1 atmospheric pressure is compressed isothermally so that its volume reduces to 11.2 litres. The work done in this process is

A. 1672.5J

B. 1728 J

C. -1728 J

D. -1570 J

Answer:

Watch Video Solution

2. If k is the Boltzmann constant, the average translational kinetic energy of a gas molecules at absolute temperature T is:

A. k T/2

B. 3 k T/4

C. k T

D. 3 k T/2

Answer:

Watch Video Solution

3. The mass of an oxygen molecule is about 16 times that of a hydrogen molecule. At room temperature the 'rms' speed of oxygen molecules is v. the 'rms' speed of the hydrogen molecules at the same temperature will be

A. v/16

B. v/4

C. 4 v

D. 16 v

Answer:

Watch Video Solution

4. The average kinetic energy of H_2 molecules at $300K$ is E at the same temperature the average kinetic energy of O_2 molecules is :

A. E/16

B. E/4

C. E

D. 4E

Answer:

Watch Video Solution

5. A jar.contains gas G_1 ar pressure p, volume V and temperature T. Another jar contains gas G_2 at pressure 2p, volume V/2 and temperature 2T. What is the ratio of the number of molecules of G_1 to that of G_2?

A. 1

B. 2

C. 3

D. 4

Answer:

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6. 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. $\frac{3}{2}T_0$

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

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

Answer:

Watch Video Solution

7. 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:

Watch Video Solution

8. The equation of state of gas is given $\left(P+\frac{aT^2}{V}\right)V^c=(RT+b)$ where a, b, c and R are constant. The isotherms can be represented by $P=AV^m-BV^n$, where A and B depend only on temperature and

A. $m=-c, n=-1$

B. m=c, n=1

C. $m=-c, n=1$

D. $m=c, n=-1$

Answer:

Watch Video Solution

9. The rms speed of hydrogen at $27^{\circ}C$ is v. What will be the rms speed of oxygen at 300 K ?

A. 4 v

B. 2 v

C. v/2

D. v/4

Answer:

Watch Video Solution

10. Same volumes of hydrogen and oxygen at the same temperature and pressure are mixed together so that the volume of the mixture is same as the initial volume of the either gas. If the initial pressure be p, then the pressure of the mixture will be :

A. 4p

B. 2p

C. p/2

D. p/4

Answer:

Watch Video Solution

11. 2 m^3 of hydrogen and 2 m^3 of oxygen are at the same temperature. If the pressure of hydrogen be p, then that of oxygen will be:

A. 2p

B. 4p

C. 8p

D. 1p

Answer:

Watch Video Solution

12. The mean rotational kinetic energy of a diatomic molecule at temperature T is :

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

B. kT

C. 2 kT

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

Answer:

Watch Video Solution

13. One mole of an ideal gas undergoes a process in which $T = T_0 + aV^3$, where T_0 and a are positive constants and V is molar volume. The volume for which pressure with be minimum is

A. $\left(\frac{T_0}{2a}\right)^{1/3}$

B. $\left(\frac{T_0}{3a}\right)^{1/3}$

C. $\left(\frac{a}{(2T_0)^{2/3}}\right.$

D. $\left(\frac{a}{3T_0}\right)^{2/3}$

Answer:

Watch Video Solution

14. In the above question, maximum pressure attainable is

A. $\frac{3}{4}\left(a^{5/3}R^{2/3}T_0^{2/3}\right)2^{1/3}$

B. $\frac{3}{2}\left(a^{2/3}RT_0^{2/3}\right)3^{1/2}$

C. $\frac{3}{2}\left(a^{1/2}R^{2/3}T_0^{3/4}\right)4^{1/3}$

D. $\frac{3}{2}\left(a^{1/3}RT_0^{2/3}\right)2^{1/3}$

Answer:

Watch Video Solution

15. Each molecule of a gas has F degrees of freedom . The ratio $\frac{C_p}{C_V} = \gamma$ for the gas is

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

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

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

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

Answer:

Watch Video Solution

16. Gas at a pressure P_0 in contained as a vessel. If the masses of all the molecules are halved and their speeds are doubles. The resulting pressure P will be equal to

A. $4P_0$

B. $2P_0$

C. P_0

D. $\frac{P_0}{2}$

Answer:

Watch Video Solution

17. The root mean square speed of the molecules of an enclosed gas is 'v'. What will be the root mean square speed if the pressure is doubled, the temperature remaining the same?

A. v/2

B. v

C. 2 v

D. 4 v

Answer:

Watch Video Solution

18. Two containers of equal volume contain the same gas at pressure P_1 and P_2 and absolute temperature T_1 and T_2, respectively. On joining the vessels, the gas reaches a common pressure P and common temperature T. The ratio P/T is equal to

A. $\frac{p_1}{T_1} + \frac{p_2}{T_2}$

B. $\frac{1}{2}\left[\frac{p_1}{T_1} + \frac{p_2}{T_2}\right]$

C. $\dfrac{p_1T_2 + p_2T_1}{T_1 + T_2}$

D. $\dfrac{p_1T_2 - p_2T_1}{T_1 - T_2}$

Answer:

Watch Video Solution

19. The mean square speed of the molecules of a gas at absolute temperature T is proportional to

A. 1/T

B. $\sqrt{T}$

C. T

D. T^2

Answer:

Watch Video Solution

20. A mono atomic gas initially at $27^\circ C$ is compressed adiabatically to one eighth of its original volume. The temperature after compression will be

A. $27^\circ C$

B. $300^\circ C$

C. $327^\circ C$

D. None of the above

Answer:

Watch Video Solution

21. Three moles of oxygen ar mixed with two moles of helium. What will be the ratio of specific heats at constant pressure and constant volume for the mixture ?

A. 1.67

B. 1.5

C. 1.4

D. None of the above

Answer:

Watch Video Solution

22. The weight of a person is 60 kg . If he gets 10 calories of heat through food and the efficiency of his body is 28% , then upto what height he can climb? Take g = $10ms^{-2}$

A. 100m

B. 196m

C. 400m

D. 1000 m

Answer:

Watch Video Solution

23. Two idential container joined by a small pipe initially contain the same gas at pressure p_0 and absolute temperature T_0. One container is now maintained at the same temperature while the other is heated to $2T_0$. The common pressure of the gas

A. $\frac{3}{2}p_0$

B. $\frac{4}{3}p_0$

C. $\frac{5}{3}p_0$

D. $2p_0$

Answer:

Watch Video Solution

24. In the previous question let V_0 be the volume of each container. All other details remain the same. The number of moles of gas in the container at temperature $2T_0$ will be

A. $\frac{p_0 V_0}{2RT_0}$

B. $\frac{p_0 V_0}{RT_0}$

C. $\frac{2p_0 V_0}{3RT_0}$

D. $\frac{p_0 V_0}{3RT_0}$

Answer:

Watch Video Solution

25. Four molecules of ags have speeds 1,2,3 and 4 km/s.The volue of the root mean square speed of the gas molecules is

A. $\frac{1}{2}\sqrt{15}$ km s^{-1}

B. $\frac{1}{2}\sqrt{10}$ km s^{-1}

C. 2.5 km s^{-1}

D. $\sqrt{15/2}$ km s^{-1}

Answer:

Watch Video Solution

26. The average kinetic energy of a molecule of a gas at absolute temperature T is proportional to

A. 1/T

B. $\sqrt{T}$

C. T

D. T^2

Answer:

Watch Video Solution

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

A. J $kg^{-1}K^{-1}$

B. J $g^{-1}K^{-1}$

C. J $K^{-1}mol^{-1}$

D. J K^{-1} per molecule

Answer:

Watch Video Solution

28. The reading of a barometer containing some air above the mercury column is 73cm while that of a correct one is 76cm. If the tube of the faulty barometer is pushed down into mercury until volume of air in it is reduced to half, the reading shown by it will be:

A. 70 cm

B. 72 cm

C. 74 cm

D. 76 cm

Answer:

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Advance Mcqs With One Or More Options Correct

1. Three identical adiabatic containers A, B and C Contain helium, neon and oxygen respectively at equal pressure. The gases are pushed to half their original volumes.

A. The final temperature in the three containers will be the same.

B. The final pressures in the three containers will be the same.

C. The pressure of helium and neon will be the same but that of oxygen will be different.

D. The temperature of helium and neon will be the same but that of oxygen will be different.

Answer:

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2. 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 statements are correct ?

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 eight times of that exerted by A

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

Answer:

Watch Video Solution

3. Consider the quantity $\frac{MkT}{pV}$ of an ideal gas where M is the mass of the gas. It depends on the

A. Temperature of the gas

B. Volume of the gas

C. Pressure of the gas

D. Nature of the gas

Answer:

Watch Video Solution

4. Which of the following quantities is independent of the nature of the gas at same temperature ?

A. The number of molecules in 1 mole

B. The number of molecules in equal volume

C. The translational kinetic energy of 1 mole

D. The kinetic energy of unit mass

Answer:

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5. During an experiment, an ideal gas is found to obey a condition $\frac{p^2}{\rho} = \text{constant}$. ($\rho$ = density of the gas). The gas is initially at temperature (T), pressure (p) and density ρ. The gas expands such that density changes to $\rho/2$.

A. The pressure of the gas changes to $\sqrt{2}$ P

B. The temperature of the gas changes to $\sqrt{2}T$

C. The graph of the above process on the P-T diagram is parabola

D. The graph of the above process on the P-T diagram is hyperbola

Answer:

Watch Video Solution

6. Pick the correct statement (s) :

A. The rms translational speed for all ideal-gas molecules at the same temperature is not the same but it depends on the mass.

B. Each particle in a gas has average translational kinetic energy and the equation $\frac{1}{2}mv^2\_(rms) = \frac{3}{2}kT$ establishes the relationship between the average translational kinetic energy per particle and temperature of an ideal gas. It can be concluded that single particle has a temperature.

C. Temperature of an ideal gas is doubled from $100^\circ C$ to $200^\circ C$. The average kinetic energy of each particle is also doubled.

D. It is possible for both the pressure and volume of a monoatomic ideal gas to change simultaneously without causing the internal energy of the gas to change.

Answer:

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7. 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:

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8. A gas in container A is in thermal equilibrium with another gas in container B, both contain equal masses of the two gases in the respective containers. Which of the follow- ing can be true

(1) $P_A = P_B, V_A \neq P_B V_B$

(2) $P_A V_B = P_B V_B$

(3) $P_A \neq P_B, V_A = V_B$

(4) $\dfrac{P_A}{V_A} = \dfrac{P_B}{V_B}$

A. $P_A V_A = P_B V_B$

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

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

D. $\dfrac{P_A}{V_A} = \dfrac{P_B}{V_B}$

Answer:

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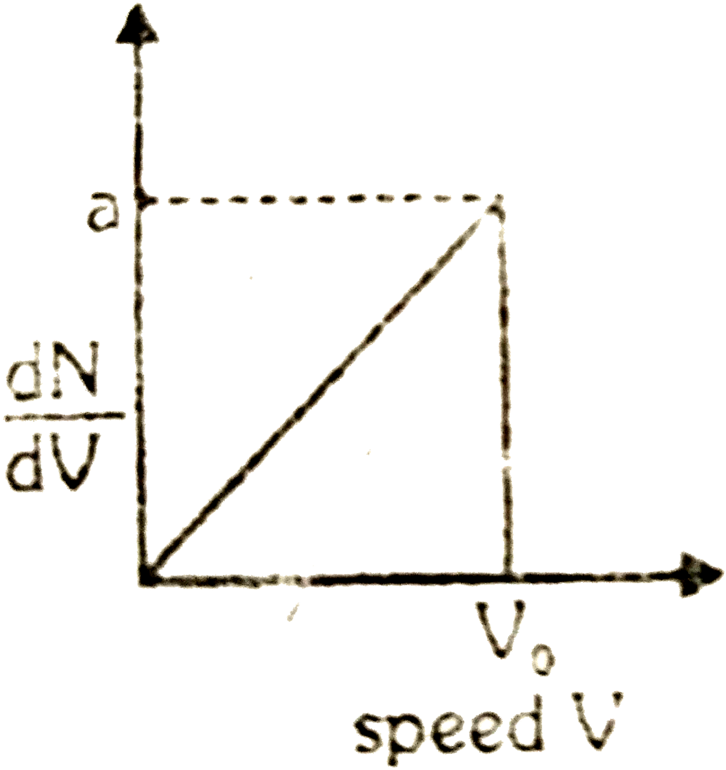
9. Graph shows a hypothetical speed distribution for a sample of N gas particle :- (for$V > V_0, \dfrac{dN}{dV} = 0$)



A. The value of V_0 is 2N.

B. The ratio V_{avg}/V_0 is equal to 2/3.

C. The ratio V_{rms}/V_0 is equal to $\frac{1}{\sqrt{2}}$

D. Three fourth of the total particle has a speed between $0.5V_0$ and V_0.

Answer:

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10. A piston of mass m can move without friction in a uniform closed cylinder at one end. A gas is enclosed in it. For this situation mark the correct statement(s)

A. Pressure of the gas will be equal to that of the surrounding if axis is not horizontal

B. Pressure of the gas may be equal to that of surrounding if axis of the cylinder is not horizontal

C. Pressure of the gas may be less than that of surrounding if axis of the cylinder is not horizontal

D. Pressure of the gas cannot be less than that of the surrounding, if axis of the cylinder is not horizontal

Answer:

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11. 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 statements are correct ?

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 eight times of that exerted by A

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

Answer:

Watch Video Solution

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

A. Pressure keeping the volume constant

B. Pressure keeping the temperature constant

C. Temperature keeping the volume constant

D. Temperature keeping the pressure constant

Answer:

Watch Video Solution

13. Two tanks of equal volumes contain equal masses of hydrogen and helium at the same temperature. Then :

A. The pressure of hydrogen is half that of helium

B. The pressure of hydrogen is double that of helium

C. The translational kinetic energy of all the molecules of hydrogen is double of that of all the molecules of helium

D. The total kinetic energy of all the molecules of hydrogen is more than double of that of all the molecules of helium

Answer:

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14. Consider a collision between an oxygen molecule and a hydrogen molecule in a mixture of oxygen and hydrogen kept at room temperature. Which of the following are possible?

A. The kinetic energies of both the molecules increase.

B. The kinetic energies of both the molecules decrease.

C. The kinetic energy of the oxygen molecule increases and that of the hydrogen molecules decreases.

D. The kinetic energy of the hydrogen molecules increases and that of the oxygen molecule decreases.

Answer:

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15. An ideal gas can be expanded form an initial state to a certain volume through two different processes $PV^2 =$ constant and (ii) $P = KV^2$ where K is a positive constant. Then

A. Final temperature in (i) will be greater than in (ii)

B. Final temperature in (ii) will be greater than in (i)

C. Total heat given to the gas in (i) case is greater than in (ii)

D. Total heat given to the gas in (ii) case is greater than in (i)

Answer:

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1. An electron tube was sealed off during manufacture at a pressure of 1.2×10^{-7} mm of mercury at $27^\circ C$. Its volume is 100 cm^3. The number of molecules that remain in the tube is

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2. The mass of hydrogen molecule is $3.23 \times 10^{-27} Kg$. If 10^{23} hydrogen molecules strike $2cm^2$ of a wall per second at an angle of 45° with the normal when moving with a speed of $10^5 cms^{-1}$, what pressure do they exert on the wall ? Assume collision to be elastic.

Watch Video Solution

3. A lamp of voume 50 cc was sealed off during manufacture at a pressure 0.1 newton per square metre at $27^\circ C$. Calculate the mass of the gas enclosed in the lamp. Molecular weight of the gas $= 10$ and $R = 8.3 J mol^{-1} K^{-1}$

Watch Video Solution

4. An electric bulb of volume $250 cm^3$ was sealed off during manufacture at a pressure of 10^{-3} mm of Hg at $27^{\circ} C$. Find the number of molecules in the bulb. Given, Boltzmann constant $= 1.38 \times 10^{-16} \text{erg molecule}^{-1} \hat{} (\circ) C^{-1}$.

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5. Calculate the kinetic energy of translation of the molecules of $20 g$ of CO_2 at $27^{\circ} C$.

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6. A cubic box of volume $8.0 \times 10^{-3} m^3$ is filled with air at atmospheric pressure at $20^\circ C$. The box is closed and heated to $150^\circ C$. What is the net force on each side of the box?

View Text Solution

7. Calculate the number of molecules/m^3 in an ideal gas at STP.

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8. The lowest pressure attainable using the best available vacuum techniques is about $10^{-12} N/m^2$. At such a pressure, how many molecules are there per cm^3 at $0^\circ C$?

Watch Video Solution

9. In outer space the density of matter is about one atom per cm^3, mainly hydrogen atoms, and the temperature is about 3.6K. Calculate the average speed of these hydrogen atoms, and the pressure (in atmospheres).

Watch Video Solution

10. Calculate the density of oxygen at STP using the ideal gas law.

Watch Video Solution

11. A tank contains 28.0 kg of O_2 gas at a gauge pressure of 6.80 atm. If the oxygen is replaced by helium, how many kg of the latter will be needed to produce a gauge pressure of 8.25 atm ?

Watch Video Solution

12. A house has a volume of $600m^3$.

What is the total mass of air inside the house at $0^\circ C$?

Watch Video Solution

13. A house has a volume of $600m^3$.

If the temperature rises to $25^\circ C$, what mass of air enters or leaves the house?

Watch Video Solution

14. A tire is filled with air at $15^\circ C$ to a gauge pressure of 1.9×10^5 Pa. If the tire reaches a temperature of $40^\circ C$, what fraction of the original air must be removed if the original pressure of 1.9×10^5 Pa is to be maintained ?

Watch Video Solution

15. An electric bulb of volume $250cm^3$ was sealed off during manufacture at a pressure of 10^{-3} mm of Hg at $27^\circ C$. Find the number of molecules in the bulb. Given, Boltzmann constant $= 1.38 \times 10^{-16} \text{erg molecule}^{-1} \hat{} (\circ) C^{-1}$.

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16. A column of mercury of 10cm length is contained in the middle of a narrow horizontal 1m long tube which is closed at both the ends. Both the halves of the tube contain air at a pressure of 76 cm of mercury. By what distance will the column of mercury be displaced if the tube is held vertically?

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17. Two cylinder having m_1g and m_2g 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

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18. In a toy truck the volume of its tyre tube is 2000 cm^3 in which air is filled at a pressure of $2 \times 10^5 \frac{N}{m^2}$. When the tube gets punctured, its volume reduces to $500cm^3$. Find the number of moles of air leaked out in the puncture. Given that the atmospheric pressure is $1 \times 10^5 \frac{N}{m^2}$ and atmospheric temperature is $27^\circ C$.

View Text Solution

19. Show that the volume thermal expansion coefficient for an ideal gas at constant pressure is $\frac{1}{T}$.

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20. The temperature of a room of volume Vrise from T_1 to T_2. How much will the mass of the air in the room changes if the atmospheric pressure is p_0. The molecular weight of the air is M.

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21. When the bulb of a constant volume air thermometer is immersed in ice, the mercury level in the open tube is 15 cm higher than the fixed index. When the bulb is immersed in boiling water the difference in the two levels increases to 48.3 cm. When the bulb is immersed in a hot liquid, the difference in levels decreases to 21 cm. What is the temperature of the hot liquid ?

View Text Solution

22. The pressure in a helium gas cylinder is initially 30 atmospheres. After many balloons have been blown up, the pressure has decreased to 6 atm. What fraction of the original gas remains in the cylinder ?

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23. A beam of particles, each of mass m_0 and speed v, is directed along the xaxis. The beam strikes an area I mm square, with 1×10^{15} particles striking per second. Find the pressure on the area due to the beam if the particles stick to the area when they hit. Evaluate for an electron beam in a television tube, where $m_0 = 9.11 \times 10^{-31}$ kg and $v = 8 \times 10^7$ m/s.

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24. A cylinder of length $42cm$ is divided into chambers of equal volumes and each half contains a gas of equal mass at temperature $27^\circ C$. The separator is a frictionless piston of insulating material. Calculate the distance by which the piston will be displacement if the temperature of one half is increaded to $57^\circ C$.

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25. Two identical vessels are connected by a tube with a valve letting the gas pass from one vessel into the other if the pressure difference is ΔP. Initially there was a vacuum in one vessel while the other contained ideal gas at a temperature T_1 and pressure P_1 Then both vessels were heated to a temperature T_2. Up to what value will the pressure in the first vessel (which had vaccum initially) increase?

View Text Solution

26. A chamber of volume V is evacuated by a pump whose evacuation rate equals C. How soon will the pressure in the chamber decrease by $\eta(\eta > 1)$?

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27. A vertical cylinder closed from both ends is equipped with an easily moving piston dividing the volume into two parts, each containing one mole of air. In equilibrium at $T_0 = 300K$ the volume of the upper part is $\eta = 4.0$ times greater than that of the lower part. At what temperature will the ratio of these volumes be equal to $\eta' = 3.0$?

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28. Suppose the pressure p and the density ρ of air are related as $p/\rho^n = const$ regardless of height (n is a constant here). Find the corresponding temperature gradient.

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29. 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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30. Under standard conditions the density of the helium and nitrogen mixture equals $\rho = 0.60g/1$. Find the concentration of helium atoms in the given mixture.

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31. A glass bulb of volume 100 cm^3 is connected by a narrow tube of negligible volume to another bulb of volume 300cm^3. The apparatus is filled with air at a pressure of 76 cm of mercury and a temperatureof 12°C, andthensealed. The smaller bulb is then immersedin melting ice whilst the larger bulb is placed in boiling water.Calculate the fraction of the total mass of air in the larger bulb, ignoring the expansion of the bulbs.

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32. A cylinder of length $42cm$ is divided into chambers of equal volumes and each half contains a gas of equal mass at temperature $27^{\circ} C$. The separator is a frictionless piston of insulating material. Calculate the distance by which the piston will be displacement if the temperature of one half is increaded to $57^{\circ} C$.

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33. Compute the temperature at which the rms speed is equal to the speed of escape from the surface of the earth for hydrogen and for oxygen. The temperature of the uper atmosphere is about 10000 K. Would you expect to find a lot of hydrogen there or a lot of oxygen ?

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34. A spherical vessel of radius r = 5 cm contains hydrogen (H_2) at a temperature T=300 K and pressure$p = 10^5$ Pa. How many molecules collide on the vessel in 1 s ?

Watch Video Solution

35. Air at 273 K and 1 atm pressure contains 2.70 $\times 10^{25}$ molecules per cubic metre. How many molecules per cubic metre will there be at a place where the temperature is 223 K and the pressure is $1.33 \times 10^{-4} Nm^{-2} (1atm = 1.01 \times 10^5 Nm^{-2})$

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36. Let us assume that air is under standard conditions close to the Earth's surface. Presuming that the temperature and the molar mass of air are independent of height, find the air pressure at the height $5.0km$ over the surface and in a mine at the depth $5.0km$ below the surface.

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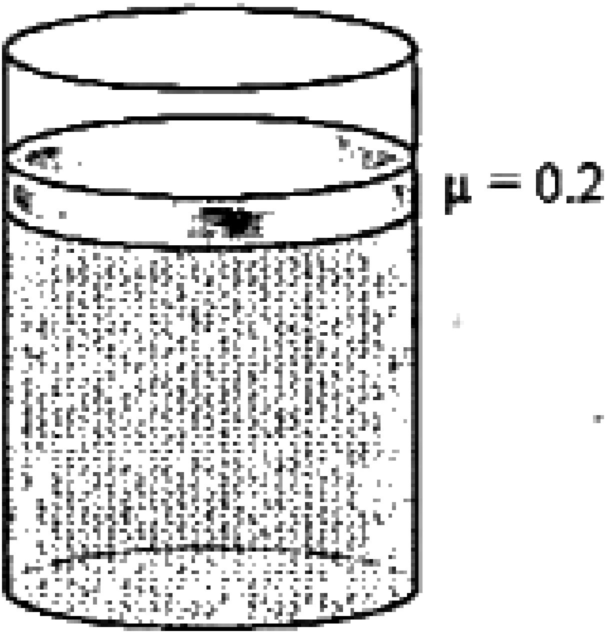
37. A cylindrical tube ofuniform cross sectional area A is fitted with two frictionless pistons, as shown in figure-2.46. The pistons are connected to each other by a metallic wire. Initially the pressure of the gas is equal to atmospheric pressure P_0 and temperature isT^0. If the temperature of the gas is increased to $2T_0$, find the tension in the wire.

Watch Video Solution

38. Figure-2.47 shows a cylindrical container of radius 5cm and a piston is fitted in it to enclose a length of 20 cm in it.The cylinder contains an ideal gas at a pressure of 1 atmosphere and 300 K temperature.The cylinder is slowly heated and it is found that the piston starts displacing when the gas temperature reaches 600 K. It is given that the friction coefficient between the piston sidesand the container wall is 0.2. Find the normal force acting between piston sides and the container wall per unit length ofits circumference.



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39. A planet of mass M and radius a is surrounding by an atmosphere of constant density consisting of a gas of molar mass μ. Find the temperature T of the atmosphere on the surface of the planet if the height of the atmosphere is h $< \, <$ a.

View Text Solution

40. One mole of a gas at standard temperatureand pressure (STP corresponds to 7=273 K and $\rho = 1.01 \times 10^5$ Pa) occupies a volume of 22.5 /. Suppose the container is in the shape of a cube, (a) Determine the length of the cube edge, (b) What force is exerted by the gas on each face ofthe container ?

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41. If a sking diver fills his lungs to full capacity of 5.5 L when 12 below the surface to what volume would his lungs expand If he quciky rose to the surface ? Is this advisable ?

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42. An air bubble at the bottom of a lake 16 m deep has a volume of $1.10 cm^3$. If the temperature at the bottom is 5.5° and at the top is is $17.0^\circ C$, what is the volume of the bubble just befor it reaches the surface ?

View Text Solution

43. A vessel of volume V contains a mixture of hydrogen and helium a ta temperature T and pressure p. The mass of the mixture is equal to m . Find the ratio of the mass of hydroge to that of helium in the given mixture . Take molar masses hydrogen and helium ot be M_1 and M_2 respectively .

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44. The density of argon is $1.6kgm^{-3}$ at $27^{\circ}C$ and at a pressure of 75cm of mercury . What is the mass of the argon in an electric bulb of volume $100cm^3$ if the pressure inside is 75cm of mercury when the average temperature of the gas is $150^{\circ}C$?

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45. A closed container of volume $0.02m^3$contains a mixture of neon and argon gases, at a temperature of $27^{\circ}C$ and pressure of $1 \times 10^5 Nm^{-2}$. The total mass of the mixture is 28g. If the molar masses of neon and argon are $20 \text{ and } 40gmol^{-1}$ respectively, find the masses of the individual gasses in the container assuming them to be ideal (Universal gas constant $R = 8.314J/mol - K$).

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46. A20 cm long cylindrical test tube is inverted and pushed verticallydown into water. When the closed end is at the water surface, how high has the water risen inside the tube ?

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47. A piece of dry ice , CO_2 is placed in a test tube , which is then sealed off. If the mass of dry ice is 0.36 g and the sealed test tube has a volume of $20cm^3$, what is the final pressure of the CO_2 in the tube if all the CO_2 vaporise and reached thermal equilibrium with the surrounding at $27^\circ C$?

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48. Two vessel of volumes 5 and 3 litres contain air at pressure of 3 and 7 atmospheres, respectively . What will be the resultant pressure when they are conncected through a small - bore tube ? Assume that the temperature remains constant throughout .

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49. At the top of mountain , a thernomete reads $7^{\circ}C$ and a barometer readas 70 cm of Hg . At the bottom of the mountain , they read $27^{\circ}C$ and 76 cm of Hg . Calculate the ration the density of the air at the top with that at the bottom.

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50. A thin - walled cylinder of mass (m), height (h) and cross-sectional area (A) is filled with a gas and floats on the surface of water. As a result of leakage from the lower part of the cylinder, the depth of its submergence has increased byΔh. Find the initial pressure p_1 of the gas in the cylinder if the atmospheric pressure is p_0 and the temperature remains constant.

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51. A thin tube of uniform cross-section is sealed at both ends. It lies horizontally, the middle 5 cm containing mercury and the two equal end containing air at the same pressure P. When the tube is held at an angle of 60° with the vetical direction, the length of the air column above and below the mercury column are 46 cm and 44.5 cm respectively. Calculate the pressure P in centimeters of mercury. (The temperature of the system is kept at $30^\circ C$).

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52. 20 g of helium (M = 4) in a cylinder under a piston are transferred infinitely slowly form a state of volume $V_1 = 0.032m^2$

and pressure $p_1 = 4.1$ atm to a state of volume $V_2 = 0.009 m^3$ and $p_2 = 15.5$ atm. What maximum temperature will the gas reach if the prssure decrease linearly with volume ?

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53. In a high altitude cosmic station on a mountain at an altitude of 3250 mabovesealevel,calculatethepressureofair at this station. Take the temperature of the air constant and equal to $5^\circ C$. The mass of one kilomole of air is 29 kg /kmole and the pressure at sea level is 760 of mercury .

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54. A vessel of volume V contains ideal gas at the temperature $T0^\circ C$. After a portion of the gas the been let out , the pressure in the vessel decreased by Δp (the temperature remaining constant). . Find the mass ofthe re.leased gas.The gas density under the noraml conditions ρ

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55. Find the pressure in an air bubble of diamter d = $4.0 \mu m$ located in weather at a depth h= 50 m . The atmospheric pressure has the standard valueP_0.

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56. The mass of a 250 cm^3 flask is 287 mg more when it is filled with an unknown gas than when it is evacuated. When the flask is filled, the gas is at $20^\circ C$ and 1.00×10^5 Pa. What is the molecular mass of the gas molecules.

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57. Both limbs of a 'U' tube are of equal length. One of the limbs is sealed and contains a column of 28 cm of air at atmospheric pressure. The air is separated from the atmosphere by mercury. What will be the height of air in the sealed limb, if the other limb is now filled to the top with mercury ? Atmospheric pressure is 76 cm of mercury.

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58. A glass tube sealed at one end and containing a quantity of air is immersed in mercury until the sealed end is 10 cm from the surface of mercury. At $0^\circ C$ the level of mercury in the tube is 5 cm above the level of mercury in the vessel. The length of the tube is 15 cm. To what temperature should the air in the tube be raised as to fill the tube completely? The atmospheric pressure is 75 cm of Hg. Neglect any change in the level of mercury in the vessel.

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59. A column of mercury of 10cm length is contained in the middle of a narrow horizontal 1m long tube which is closed at both the ends. Both the halves of the tube contain air at a pressure of 76 cm of mercury. By what distance will the column of mercury be displaced if the tube is held vertically?

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60. Modern vacuum pumps permit to pressures down to $p = 4.10^{-15} atm$ to be reached at room temperatures. Assuming that the gas exhausted is nitrogen, find the number of its molecules per $1 cm^3$ and the mean distance between them at this pressure.

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61. The diameter of an air-bubble formed at the bottom of a pond is $d = 4\mu m$, when the bubble rises to the surface, its diameter increases $n = 1.1$ times. If expansion of air bubble is assumed to be isothermal and atmospheric pressure to be standard. How deep the pond at the spot is [surface tension of water $0.075\frac{N}{m}$]

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62. Determine the gas temperature at which

(a) the root mean square velocity of hydrogen molecules exceeds their most probable velocity by $\Delta v = 400 m / s$,

(b) the velocity distribution function $F(v)$ for the oxygen molecules will have the maximum value at the velocity $v = 420 m / s$.

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63. Determine the gas temperature at which

(a) the root mean square velocity of hydrogen molecules exceeds their most probable velocity by $\Delta v = 400 m / s$,

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64. At what temperature of a nitrogen and oxygen mixture do the most probable velocities of nitrogen and oxygen molecules differ by $\Delta v = 30 m / s$?

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