Single Correct Answer Type:

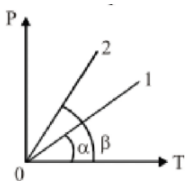
1. A gaseous mixture consists of 16g of helium and 16g of oxygen. The ratio C_p / C_v of the mixture is:

(A) 1.62 (B) 2.12 (C) 1.96 (D) 2.67

2. Consider the lung capacity to be $500\,cm^3$ and the pressure thereing to be equivalent of 761 mm of Hg; estimate the number of molecules per breath.

(A) 2.62×10^{18} (B) 1.06×10^{18} (C) 2×10^{19} (D) 1.19×10^{19}

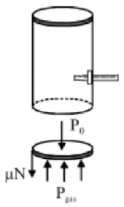
3. A certain mass of a gas was heated in a constant volume vessel; its P-T curve 3 is 1; similarly another mass of the gas was heated in the same vessel; its P-T curve is 2. If $\tan\beta = 2\tan\alpha$, what is the ratio of masses of gas in the two experiments?



(A) $\frac{1}{2}$ (B) $\frac{2}{3}$

(C) $\frac{2}{5}$ (D) $\frac{6}{7}$

4. Figure shown a cylindrical tube of radius r and l, fitted with a cork. The friction coefficient between the cork and the tube is μ. The tube contains an ideal gas at temperature T, and atmospheric pressure P_0. The tube is slowly heated; the cork pipe out when temperature is doubled. What is normal force per unit length exerted by the cork on the periphery of tube? Assume uniform temperature throughout gas any instant.



(A) $\frac{P_0 A}{4\pi r\mu}$ (B) $\frac{P_0 A}{2\pi r\mu}$

(C) $\frac{P_0 A}{2r\mu}$ (D) $\frac{P_0 A}{\mu r\pi}$

5. Calculate the rms speed of nitrogen at STP (pressure = 1 atm an temperature = $0^\circ C$). The density of nitrogen in these conditions is $1.25\,kg/m^3$.

(A) 283 m/s (B) 800 m/s (C) 490 m/s (D) 680 m/s

6. A barometer tube contains a mixture of air and saturated water vapour in the space above the mercury column. It reads 70 cm when the actual atmospheric pressure is 76 cm of mercury. The saturation vapour pressure at room temperature is 1.0 cm of mercury. The tube is now lowered in the reservoir till space above the mercury column is reduced to half its original volume. Find the reading of the barometer. Assume that the temperature remains constant.

(A) 65 cm (B) 70 cm (C) 82 cm (D) 87 cm

7. The temperature of an ideal gas consisting of rigid diatomic molecules is $T = 300K$. Calculate the angular root mean square velocity of a rotating molecules if its moment of inertial is equal to $I = 2.1\times10^{-39}\,g.cm^2$

(A) $6.99\times10^{11}\,rad/s$ (B) $3.26\times10^{12}\,rad/s$ (C) $4.39\times10^{11}\,rad/s$ (D) $6.3\times10^{12}\,rad/s$

8. Calculate the pressure of Hydrogen in a cylinder of capacity 10 L given that the total kinetic energy of translation is 7.5×10^3 J . What is the total kinetic energy of molecules in the cylinder?

(1 atm pressure = $10^5\,N/m^2$)

(A) 12,500 J (B) 8,960 J (C) 6210 J (D) 16,200 J

9. Find the number of Hydrogen molecules in $1\,cm^3$ if the pressure is 200 mm Hg and the root mean square velocity of hydrogen is 2400 m/s in these conditions.

(A) 3.92×10^{18} (B) 4.17×10^{18} (C) 6.16×10^{19} (D) 5.67×10^{19}

10. What is the energy of the rotational motion of the molecules contained in 1 Kg of nitrogen at a temperature of $7°C$?

(A) 6.2×10^4 J (B) 0.639×10^5 J (C) 8.3×10^4 J (D) 9.279×10^5 J

11. A vessel A with a capacity of $V_1 = 3\,\ell t$ contains gas at a pressure of $P_1 = 2\,atm$ and a vessel B with a capacity of $V_2 = 4\,\ell t$ contains the same gas at a pressure of 1 atm. The temperature is $0°C$ in A and $27°C$ in B. What will be the pressure in the vessels if they are connected by a tube?

(A) 1.43 atm (B) 1.92 atm (C) 2.16 atm (D) 2.92 atm

12. A vertical cylindrical tank 1m high has its top end closed by a tightly fitted frictionless piston of negligible weight. The air inside the cylinder is at an absolute pressure of 1 atm. The piston is depressed by pouring mercury on it very slowly. How far will the piston descend before mercury spills over the top of cylinder? The temperature of the air inside the cylinder is maintained constant.

(A) 16 cm (B) 18 cm (C) 21 cm (D) 24 cm

13. A vessel containing 1 gm of oxygen at a pressure of 10 atm and a temperature of $47°C$. It is found that because of a leak, the pressure drops to 5/8 th of its original value and the temperature falls to $27°C$. Find the volume of the vessel.

(A) 0.082 L (B) 0.07 L (C) 0.018 L (D) 0.03 L

14. A bulb A of $500\,cm^3$ is joined by a narrow tube of another bulb B of $250\,cm^3$ and the whole system is initially filled with air at S.T.P. and sealed. If the temperature of the bulb A is now raised to $100°C$ and that of B is kept constant, find:

(a) the new pressure in the system

(b) mass of air which is transferred from one bulb to another during heating

(density of air at S.T.P. = 1.29 g/l)

(A) a) 1.22 atm b) 0.9291 g (B) a) 1.22 atm b) 0.0709 g (C) a) 2.16 atm b) 0.9291 g (D) a) 2.16 atm b) 0.0709 g

15. A thin tube sealed at both ends, is 100 cm long. It lies horizontally, the middle 0.1 m containing mercury and the two ends containing air at standard atmospheric pressure. If the tube is turned to a vertical position, by what amount will the mercury be displaced?

(A) 1.2 cm (B) 1.45 cm (C) 2.42 cm (D) 2.95 cm

16. What will be the ratio of number of a mono atomic and 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

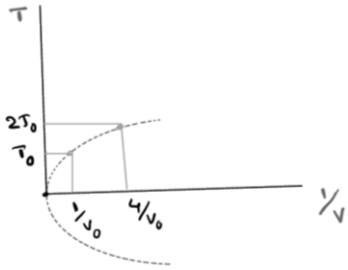
17. An ideal gas is found to obey an additional law $VP^2 = \text{constant}$. The gas is initially at temperature T and volume V. When it expands to 2V, the temperature becomes

(A) $\frac{T}{\sqrt{2}}$ (B) 2T (C) $2T\sqrt{2}$ (D) 4T

18. N(<100) molecules of gas have velocities 1, 2, 3.....N km/s respectively. Then the ratio of rms speed and average speed is

(A) 1 (B) $\frac{\sqrt{(2N+1)(N+1)}}{6N}$ (C) $\frac{\sqrt{(2N+1)(N+1)}}{6}$ (D) $2\sqrt{\frac{2N+1}{6(N+1)}}$

19. Fig shows a parabolic graph T and $\frac{1}{V}$ for a mixture of a gas undergoing an adiabatic process. What is the ratio of V_{rms} of molecules and speed of sound in mixture is?



(A) $\sqrt{\frac{3}{2}}$ (B) $\sqrt{2}$

(C) $\sqrt{\frac{2}{3}}$ (D) $\sqrt{3}$

20. The maximum attainable temperature of ideal gas in the process $P = P_0 - \alpha V^2$, where P_0 and α are +ve constants

(A) $\frac{2P_0}{3nR}\left(\frac{P_0}{3\alpha}\right)^{1/2}$ (B) $\frac{P_0}{2nR}\left(\frac{2P_0}{3\alpha}\right)^{1/2}$ (C) $\frac{2nR}{P_0}\left(\frac{2P_0}{3\alpha}\right)^{1/2}$ (D) $\frac{2P_0}{nR}\left(\frac{P_0}{2\alpha}\right)^{1/2}$

Numerical based:

21. Both limbs of a 'U' tube are of equal length. One of the limbs is sealed and the tube contains a column of 28 cm of air at atmospheric pressure. The air is separated from the atmosphere by mercury. Height of air in the sealed limb, will be approximately $3\times x$ centimetre if the other limb is now filled to the top with mercury Atmospheric pressure is 76 cm of mercury. Value of 'x' is?

22. The diameter of a gas bubble formed at the bottom of a pond is $d = 4.0\mu m$. When the bubble rises to the surface its diameter increases to n = 1.1 times. Depth of pond is 'x' meter. The nearest integer to 'x' is
(The atmospheric pressure is taken 10 m of water column, the gas expansion is assumed to be isothermal)

23. The average degrees of freedom per molecule of a gas are 6. The gas performs 25 J of work in a process when it is expanded at constant pressure. Amount of heat absorbed by the gas is $25\times x$. Value of 'x' is

24. An ideal gas which undergoes through a process $V = aT^2$; starting at T_0 and ends at $2T_0$. 'a' is a constant. The molar heat capacity of the gas if it is monoatomic is $\frac{n}{2}R$; What is n?

25. Calculate the pressure $\left(\text{in } 10^5 \text{ N/m}^2\right)$ exerted by a mixture of 8 g of oxygen, 14 g of nitrogen, and 22 g of carbon dioxide in a container of 30 litres at a temperature of $27°C$.

KEY

1.	A	2.	D	3.	A	4.	B	5.	C
6.	A	7.	D	8.	A	9.	B	10.	C
11.	A	12.	D	13.	A	14.	B	15.	D
16.	C	17.	A	18.	D	19.	B	20.	A
21.	7	22.	3	23.	4	24.	7	25.	3