KINETIC THEORY OF GASES

1. On colliding in a closed container the gas molecules **[RPET 2003]**

(a) Transfer momentum to the walls (b) Momentum becomes zero

(c) Move in opposite directions (d) Perform Brownian motion

2. The relation between the gas pressure P and average kinetic energy per unit volume E is **[CBSE PMT 1993; UPSEAT 2000; RPMT 2000; RPET 2001; MP PET 2003]**

(a) $P = \frac{1}{2}E$ (b) $P = E$ (c) $P = \frac{3}{2}E$ (d) $P = \frac{2}{3}E$

3. Kinetic theory of gases provide a base for **[AIEEE 2002]**

(a) Charle's law (b) Boyle's law

(c) Charle's and Boyle's law (d) None of these

4. At constant volume, temperature is increased. Then **[CBSE PMT 1993; JIPMER 2000]**

(a) Collision on walls will be less (b) Number of collisions per unit time will increase

(c) Collisions will be in straight line (d) Collisions will not change

5. Kinetic theory of gases was put forward by **[RPMT 1999]**

(a) Einstein (b) Newton (c) Maxwell (d) Raman

6. Which of the following statements about kinetic theory of gases is wrong **[AMU 1995]**

(a) The molecules of a gas are in continuous random motion

(b) The molecules continuously undergo inelastic collisions

(c) The molecules do not interact with each other except during collisions

(d) The collisions amongst the molecules are of short duration

7. The pressure exerted by the gas on the walls of the container because **[CPMT 1972]**

(a) It loses kinetic energy

(b) It sticks with the walls

(c) On collision with the walls there is a change in momentum

(d) It is accelerated towards the walls

8. In kinetic theory of gases, a molecule of mass m of an ideal gas collides with a wall of vessel with velocity V. The change in the linear momentum of the molecule is **[AIIMS 1997]**

(a) 2 mV (b) mV (c) – mV (d) Zero

9. Consider a gas with density ρ 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 **[BHU 1994]**

(a) $\frac{1}{3}\rho \bar{c}^2$ (b) $\frac{1}{3}\rho(\bar{c}+v)^2$ (c) $\frac{1}{3}\rho(\bar{c}-v)^2$ (d) $\frac{1}{3}\rho(\bar{c}^2-v)^2$

10. The kinetic energy of a perfect gas is 60 joules and its volume is 3 litres, then its pressure will be

(a) $2\times10^4\ N/m^2$ (b) $4\times10^4\ N/m^2$ (c) $\frac{4}{3}\times10^4\ N/m^2$ (d) $\frac{2}{3}\times10^4\ N/m^2$

11. The mass of a gas molecule is 4×10^{-30} kg. If 10^{23} molecules strike per second at $4\ m^2$ area with a velocity $10^7\ m/s$, then the pressure exerted on the surface will be

(a) 1 Pascal (b) 3 Pascal (c) 2 Pascal (d) 4 Pascal

12. Equal number of molecules of hydrogen and oxygen are contained in a vessel at one atmospheric pressure. The ratio of the collision frequency of hydrogen molecules to that of oxygen molecules on the container walls will be

(a) 4 : 1 (b) 1 : 4 (c) 1 : 16 (d) 16 : 1

Problems based on Ideal gas equation

▶ Basic level

13. In the relation $n = \frac{PV}{RT}$, n = **[RPET 2003]**

(a) Number of molecules (b) Atomic number (c) Mass number (d) Number of moles

14. A balloon contains $1500\,m^3$ of helium at 27°C and 4 atmospheric pressure. The volume of helium at –3°C temperature and 2 atmospheric pressure will be **[BHU 2002]**

(a) $1500\,m^3$ (b) $1700\,m^3$ (c) $1900\,m^3$ (d) $2700\,m^3$

15. One litre of helium gas at a pressure 76 cm of Hg and temperature 27° is heated till its pressure and volume are doubled. The final temperature attained by the gas is **[CPMT 2000]**

(a) 927°C (b) 900°C (c) 627°C (d) 327°C

16. The pressure and temperature of an ideal gas in a closed vessel are 720 pka and 40°C respectively. If $\frac{1}{4}$th of the gas is released from the vessel and the temperature of the remaining gas is raised to 353°C, the final pressure of the gas is **[EAMCET (Med.) 2000]**

(a) 1440 kPa (b) 1080 kPa (c) 720 kPa (d) 540 kPa

17. A vessels is filled with an ideal gas at a pressure of 10 atmospheres and temperature 27°C. Half of the mass of the gas is removed from the vessel and temperature of the remaining gas is increased to 87°C. The pressure of the gas in the vessel will be **[EAMCET (Engg.) 2000]**

(a) 5 atm (b) 6 atm (c) 7 atm (d) 8 atm

18. S.I. unit of universal gas constant is **[MNR 1988; MP PMT 1994; UPSEAT 1999]**

(a) cal / °C (b) J/mol (c) $J\,mol^{-1}\,K^{-1}$ (d) J/kg

19. The product of the pressure and volume of an ideal gas is **[Manipal MEE 1995]**

(a) A constant (b) Approx. equal to the universal gas constant

(c) Directly proportional to its temperature (d) Inversely proportional to its temperature

20. A sample of an ideal gas occupies a volume V at a pressure P and absolute temperature T, the mass of each molecule is m. The expression for the density of gas is [K = Boltzmann's constant] **[EAMCET 1988; MP PMT 1994]**

(a) mKT (b) P/KT (c) P/KTV (d) Pm/KT

21. The gas equation $\frac{PV}{T}$ = constant is true for a constant mass of an ideal gas undergoing **[MP PET 1992]**

(a) Isothermal change (b) Adiabatic change (c) Isobaric change (d) Any type of change

22. A box contains n molecules of a gas. How will the pressure of the gas be effected, if the number of molecules is made 2n **[MP PMT/PET 1988]**

(a) Pressure will decrease (b) Pressure will remain unchanged

(c) Pressure will be doubles (d) Pressure will become three times

23. An ideal gas at 1 atmospheric pressure and 273K has 22.4 litre of volume. This is heated to 546K and then by applying pressure its volume is reduced to 4.48 litre, then the resulting pressure will be **[MP PET 1989]**

(a) 20 atms (b) 10 atms (c) 5 atms (d) 2.5 atms

24. At 100K and 0.1 atmospheric pressure, the volume of helium gas is 10 litres. If volume and pressure are doubled, its temperature will change to **[MP PMT 1986]**

(a) 400 K (b) 127 K (c) 200 K (d) 25 K

25. The molecular weights of O_2 and N_2 are 32 and 28 respectively. At 15°C, the pressure of 1gm O_2 will be the same as that of 1gm N_2 in the same bottle at the temperature **[MP PMT 1985]**

(a) – 21°C (b) 13°C (c) 15°C (d) 56.4°V

26. The air density at Mount Everest is less than that at the sea level. It is found by mountaineers that for one trip lasting a few hours, the extra oxygen needed by them corresponds to 30,000 cc at sea level (pressure 1 atmosphere, temperature 27°C). Everest is – 73°C and that the oxygen cylinder has capacity of 5.2 litre, the pressure at which O_2 be filled (at site) in cylinder is **[MNR 1978]**

(a) 3.86 atm (b) 5.00 atm (c) 5.77 atm (d) 1 atm

27. In order to double the separation between the molecules (keeping temperature fixed), the final pressure must be made how many times the initial pressure

(a) Halved (b) 1/4th (c) 1/8th (d) 1/16th

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

(a) P/8 (b) P (c) 2P (d) 8P

29. The volume of gas at pressure $21\times10^4\ N/m^2$ and temperature 27°C is 83 litres. If R = 8.3 J/mol/K, then the quantity of gas in gm-mole will be

(a) 15 (b) 42 (c) 7 (d) 14

30. A gas at absolute temperature 300K has pressure $= 4\times10^{-10}\ N/m^2$. Boltzmann constant $= k = 1.38\times10^{-23}\ J/K$. The number of molecules per cm^3 is of the order of

(a) 100 (b) 10^5 (c) 10^8 (d) 10^{11}

31. The size of container B is double that of A and gas in B is at double the temperature and pressure than that in A. The ratio of molecules in the two containers will then be

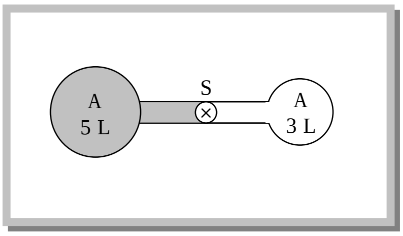
(a) $\frac{N_B}{N_A}=\frac{1}{1}$ (b) $\frac{N_B}{N_A}=\frac{2}{1}$ (c) $\frac{N_B}{N_A}=\frac{4}{1}$ (d) $\frac{N_B}{N_A}=\frac{1}{2}$

32. A gas is enclosed in a vessel at a constant temperature at a pressure of 2.5 atmospheres an volume 4 litre. Due to a leak in the vessel after some time the pressure is reduced to 2 atmosphere. As a result, the

(a) 20% of the gas has escaped out (b) 25% of the gas has escaped out

(c) 20% of the gas remains in the vessel (d) 25% of the gas remains in the vessel

33. A vessel A of volume 5 litre has a gas at pressure of 80 cm column of Hg. This is joined to another evacuated vessel B of volume 3 litre. If now the stopcock S is opened and the aperture is maintained at constant temperature then the common pressure will become



(a) 80 cm of Hg

(b) 50 cm of Hg

(c) 30 cm of Hg

(d) None of these

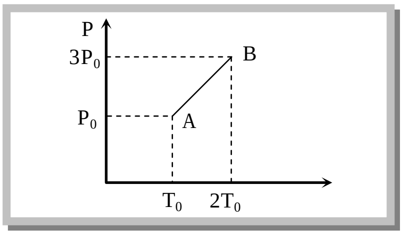
34. Inside a cylinder, closed at both ends, is a movable piston. On one side of the piston is a mass m of a gas, and on the other side a mass 2m of the same gas. What fraction of volume of the cylinder will be occupied by the larger mass of the gas when the piston is in equilibrium ? The temperature is the same throughout

(a) 1/4 (b) 1/2 (c) 2/3 (d) 1/3

35. A vessel has 6g of oxygen at pressure P and temperature 400 K. A small hole is made in it so that O_2 leaks out. How much O_2 leaks out if the final pressure is P/2 and temperature 300 K

(a) 5g (b) 4g (c) 2g (d) 3g

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



(a) $\frac{3}{4}\rho_0$

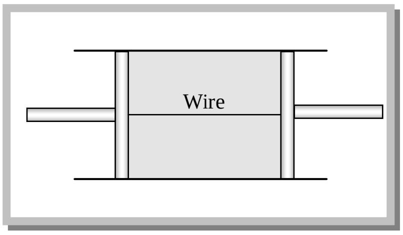
(b) $\frac{3}{2}\rho_0$

(c) $\frac{4}{3}\rho_0$

(d) $2\rho_0$

Advance level

37. A cylindrical tube of uniform cross-sectional area A is fitted with two air tight frictionless pistons. The pistons are connected to each other by a metallic wire. Initially the pressure of the gas is P_0 and temperature is T_0. Atmospheric pressure is also P_0. Now the temperature of the gas is increased to $2T_0$, then tension in the wire will be



(a) $2P_0A$

(b) P_0A

(c) $\frac{P_0A}{2}$

(d) $4P_0A$

38. One mole of an ideal gas undergoes a process $P = \frac{P_0}{1+\left(\frac{V_0}{V}\right)^2}$. Here P_0 and V_0 are constants. Change in temperature of the gas when volume is changed from $V = V_0$ to $V = 2V_0$ is

(a) $-\frac{2P_0V_0}{5R}$ (b) $\frac{11P_0V_0}{10R}$ (c) $-\frac{5P_0V_0}{4R}$ (d) P_0V_0

Problems based on Vander Waal gas equation

39. Every gas (real gas) behaves as an ideal gas **[CPMT 1997; RPMT 2000; MP PET 2001]**

(a) At high temperature and low pressure (b) At low temperature and high pressure

(c) At normal temperature and pressure (d) None of these

40. Triple point temperature for water is nearly

(a) 273.16 K (b) 373.16 K (c) 100°C (d) 444.6°C

41. The vapour of a substance behaves as a gas **[CPMT 1987]**

(a) Below critical temperature (b) Above critical temperature

(c) At 100°C (d) At 1000°C

42. Critical temperature is that temperature **[RPET 1987]**

(a) Above which the gas cannot be liquified only by increasing pressure

(b) Above which the gas can be liquified only by increasing pressure

(c) Below which a gas cannot be liquified only by increasing pressure

(d) None of these

43. It is possible for a substance to coexist in all three phases in equilibrium, when the substance is at **[MP PET 1985]**

(a) Boyle temperature (b) Critical temperature (c) Triple point (d) Dew point

44. The constant 'a' in the equation $\left(P + n^2\frac{a}{V^2}\right)(V - nb) = nRT$ for a real gas has unit of

(a) $N-m^{-4}$ (b) $N-m^{-2}$ (c) $N-m^2$ (d) $N-m^4$

45. The deviation of gases from the behaviour of ideal gas is due to

(a) Colourless molecules (b) Covalent bonding of molecules

(c) Attraction of molecules (d) Absolute scale

46. The liquefaction of ideal gas is possible

(a) Only at low temperature (b) Only at high temperature

(c) Only at very low temperature (d) None of these

Problems based on Various speeds

47. For a gas at temperature T the root-mean square velocity v_{rms}, the most probable speed v_{rmp}, and the average speed v_{av} obey the relationship **[MP PET 2003]**

(a) $v_{av} > v_{rms} > v_{mp}$ (b) $v_{rms} > v_{av} > v_{mp}$ (c) $v_{mp} > v_{av} > v_{rms}$ (d) $v_{mp} > v_{rms} > v_{av}$

48. The rms speed of gas molecules is given by **[MNR 1995; MP PET 2001]**

(a) $2.5\sqrt{\frac{RT}{M}}$ (b) $1.73\sqrt{\frac{RT}{M}}$ (c) $2.5\sqrt{\frac{M}{RT}}$ (d) $1.73\sqrt{\frac{M}{RT}}$

49. At a given temperature if V_{rms} is the root mean square velocity of the molecules of a gas and V_s the velocity of sound in it, then these are related as $\left(\gamma = \frac{C_P}{C_v}\right)$ **[CPMT 1983, Bhiar CMEET 1995; MP PMT 2001; MP PET 2002]**

(a) $V_{rms} = V_s$ (b) $V_{rms} = \sqrt{\frac{3}{\gamma}} \times V_s$ (c) $V_{rms} = \sqrt{\frac{\gamma}{3}} \times V_s$ (d) $V_{rms} = \left(\frac{3}{\gamma}\right) \times V_s$

50. On any planet, the presence of atmosphere implies (C_{rms} = root mean square velocity of molecules and V_e = escape velocity) **[RPMT 1996; JIPMER 2000]**

(a) $C_{rms} << V_e$ (b) $C_{rms} > V_e$ (c) $C_{rms} = V_e$ (d) $C_{rms} = 0$

51. To what temperature should the hydrogen at room temperature (27°C) be heated at constant pressure so that the rms velocity of its molecules become double of its previous value **[MP PMT 2001]**

(a) 1200°C (b) 927°C (c) 600°C (d) 108°C

52. At a given temperature the ratio of rms velocities of hydrogen molecule and helium atom will be **[AMU (Engg.) 2000]**

(a) $\sqrt{2} : 1$ (b) $1 : \sqrt{2}$ (c) 1 : 2 (d) 2 : 1

53. If the molecular weight of two gases are M_1 and M_2, then at a temperature the ratio of root mean square velocity v_1 and v_2 will be **[MP PMT 1989, 96; DPMT 2001]**

(a) $\sqrt{\frac{M_1}{M_2}}$ (b) $\sqrt{\frac{M_2}{M_1}}$ (c) $\sqrt{\frac{M_1+M_2}{M_1-M_2}}$ (d) $\sqrt{\frac{M_1-M_2}{M_1+M_2}}$

54. According to the kinetic theory of gases, at absolute temperature **[CBSE PMT 1990; AIIMS 1998]**

(a) Water freezes (b) Liquid helium freezes
(c) Molecular motion stops (d) Liquid hydrogen freezes

55. The temperature of an ideal gas is increased from 27°C to 927°C. The root mean square speed of its molecules becomes **[NCERT 1983; CBSE PMT 1994]**

(a) Twice (b) Half (c) Four times (d) One-fourth

56. At what temperature the molecules of nitrogen will have the same rms velocity as the molecules of oxygen at 127°C **[MP PMT 1994]**

(a) 77°C (b) 350°C (c) 273°C (d) 457°C

57. The root mean square velocity of a gas molecule of mass m at a given temperature is proportional to **[CBSE PMT 1990]**

(a) m^0 (b) m (c) $\sqrt{m}$ (d) $\frac{1}{\sqrt{m}}$

58. A gas is allowed to expand isothermally. The root mean square velocity of the molecules **[MP PMT 1986]**

(a) Will increase (b) Will decrease
(c) Will remain unchanged (d) Depends on the other factors

59. The total momentum of the molecules of 1 gm mol of a gas in a container at rest of 300 K is

(a) $2 \times \sqrt{3R \times 300} gm \times cm/sec$ (b) $2 \times 3 \times R \times 300 gm \times cm/sec$
(c) $1 \times \sqrt{3R \times 300} gm \times cm/sec$ (d) Zero

60. If the respective velocities of three molecules of a gas are $\sqrt{7}, 4$ and 5 km/sec., then their rms velocity in km/sec will be

(a) $\frac{2+\sqrt{7}}{3}$ (b) $\frac{4}{\sqrt{3}}$ (c) 4 (d) $4\sqrt{3}$

61. The rms velocity of molecules of a gas at temperature T is v_{rms}. Then the root mean square of the component of velocity in any one particular direction will be

(a) $v_{rms}/\sqrt{3}$ (b) $\sqrt{3}\,v_{rms}$ (c) $v_{rms}/3$ (d) $3v_{rms}$

Problems based on Kinetic energy

62. If a piston is pushed rapidly into a container of gas, what will happen to the kinetic energy of the molecules of gas and to the temperature of the gas **[JIPMER 2002]**

(a) Both will increase

(b) Kinetic energy increases but the temperature remains unchanged

(c) Kinetic energy increases while the temperature decreases

(d) Kinetic energy is unchanged while the temperature increases

63. A sealed container with negligible coefficient volumetric expansion contains helium (a monoatomic gas). When it is heated from 300 K to 600 K, the average K.E. of helium atoms is **[NCERT 1980; DPMT 2002]**

(a) Halved (b) Unchanged (c) Doubled (d) Increased by factor $\sqrt{2}$

64. At 0 K which of the following properties of a gas will be zero **[CBSE PMT 1996]**

(a) Kinetic energy (b) Potential energy (c) Vibrational energy (d) Density

65. The ratio of mean kinetic energy of hydrogen and oxygen at a given temperature is

[NCERT 1981; MP PET 1989, 99; MP PMT 1994, 2000, 03; Pb. PMT 2000]

(a) 1 : 16 (b) 1 : 8 (c) 1 : 4 (d) 1 : 1

66. The average kinetic energy of a gas molecule at 27°C is 6.21×10^{-21} J . Its average kinetic energy at 127°C will be

[MP PMT/PET 1998; AIIMS 1999]

(a) 52.2×10^{-21} J (b) 5.22×10^{-21} J (c) 10.35×10^{-21} J (d) 11.35×10^{-21} J

67. At 27°C temperature, the kinetic energy of an ideal gas is E_1 . If the temperature is increased to 327°C, the kinetic energy would be

[MP PMT 1996]

(a) $2E_1$ (b) $\frac{1}{2}E_1$ (c) $\sqrt{2}E_1$ (d) $\frac{1}{\sqrt{2}}E_1$

68. The kinetic energy per gm mol for a diatomic gas at room temperature is **[MP PET 1991]**

(a) 3 RT (b) $\frac{5}{2}$RT (c) $\frac{3}{2}$RT (d) $\frac{1}{2}$RT

69. The ratio of mean kinetic energy of hydrogen and nitrogen at temperature 300 K and 450 K respectively is **[MP PET 1990]**

(a) 3 : 2 (b) 2 : 3 (c) 2 : 21 (d) 4 : 9

70. If the volume of a gas is doubled at constant pressure, the average translational kinetic energy of its molecules will

(a) Be doubled (b) Remain same (c) Increase by a factor $\sqrt{2}$ (d) Become four times

Problems based on Boyle's law

71. A graph is drawn for a given mass of a gas at constant temperature between PV and P. the curve will be **[CPMT 2002]**

(a) Parabola (b) Straight line inclined at an angle of 45°

(c) Straight line parallel to axis of P (d) Straight line parallel to PV axis

72. The relationship between pressure and the density of a gas expressed by Boyle's law, P = KD holds true **[JIPMER 2002]**

(a) For any gas under any conditions (b) For some gases under any conditions

(c) Only if the temperature is kept constant (d) Only if the density is constant

73. Boyle's law holds for an ideal gas during **[AFMC 1994; KCET 1999]**

(a) Isobaric changes (b) Isothermal changes (c) Isochoric changes (d) Isotonic changes

74. At a given temperature, the pressure of an ideal gas of density ρ is proportional to **[MP PMT 1999]**

(a) $\frac{1}{\rho^2}$ (b) $\frac{1}{\rho}$ (c) ρ^2 (d) ρ

75. For Boyle's law to hold the gas should be **[CPMT 1978]**

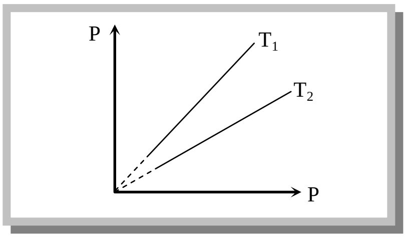
(a) Perfect and of constant mass and temperature (b) Real and of constant mass and temperature

(c) Perfect and at constant temperature but variable mass (d) Real and at constant temperature but variable mass

76. By what percentage should the pressure of a given mass of a gas be increased so as to decrease its volume by 10% at a constant temperature

(a) 8.1% (b) 9.1% (c) 10.1% (d) 11.1%

77. The figure shows graphs of pressure versus density for an ideal gas at two temperatures T_1 and T_2



(a) $T_1 > T_2$

(b) $T_1 = T_2$

(c) $T_1 < T_2$

(d) Nothing can be predicted

Problems based on Charle's law

78. Volume of gas become four times if **[RPET 2001]**

(a) Temperature become four times at constant pressure (b) Temperature become one fourth at constant pressure

(c) Temperature becomes two times at constant pressure (d) Temperature becomes half at constant pressure

79. A perfect gas at 27°C is heated at constant pressure so as to triple its volume. The temperature of the gas will be **[MP PET 1991]**

(a) 81°C (b) 900°C (c) 627°C (d) 450°C

80. 4 moles of an ideal gas is at 0°C. At constant pressure it is heated to double its volume, then its final temperature will be **[MP PET 1990]**

(a) 0°C (b) 273°C (c) 546°C (d) 136.5°C

81. The volume of a gas at 20°C is 200 ml. if the temperature is reduced to –20°C at constant pressure, its volume will be **[MP PET 1986]**

(a) 172.6 ml (b) 17.26 ml (c) 192.7 ml (d) 19.27 ml

82. A litre of an ideal gas at 27°C is heated at a constant pressure to 297°C. Then the final volume is approximately **[NCERT 1974]**

(a) 1.2 litres (b) 1.9 litres (c) 19 litres (d) 2.4 litres

Problems based on Gay Lussac's law

83. A gas at the temperature 250 K is contained in a closed vessel. If the gas is heated through 1K, then the percentage increase in its pressure will be **[KCET (Engg./Med.) 2001]**

(a) 0.4% (b) 0.2% (c) 0.1% (d) 0.8%

84. The temperature of a gas at pressure P and volume V is 27°C. Keeping its volume constant if its temperature is raised to 927°C, then its pressure will be **[MP PMT 1985]**

(a) 2P (b) 3P (c) 4P (d) 6P

85. Consider a 1 cc sample of air at absolute temperature T_0 at sea level and another 1cc sample of air at a height where the pressure is one-third atmosphere. The absolute temperature T of the sample at that height is **[NCERT 1980]**

(a) Equal to $T_0 / 3$ (b) Equal to $3 / T_0$

(c) Equal to T_0 (d) Cannot be determined in terms of T_0 from the above data

Problems based on Avogadro's law

86. At N.T.P., sample of equal volume of chlorine and oxygen is taken. Now ratio of number of molecules **[RPET 2000]**

(a) 1 : 1 (b) 32 : 27 (c) 2 : 1 (d) 16 : 14

87. If Avogadro's number is 6×10^{23}, then approximate number of molecules in 1 cm^3 of water will be

(a) 1×10^{23} (b) 6×10^{23} (c) 22.4×10^{23} (d) $(1/3) \times 10^{23}$

88. The number of molecules per cc of a gas at STP is

(a) 2.68×10^{17} (b) 2.68×10^{19} (c) 6×10^{23} (d) $22400 \times 6 \times 10^{23}$

89. The residual pressure of a vessel at 27°C is $1 \times 10^{-11}\ N/m^2$. The number of molecules per cc in this vessel is nearly

(a) 2400 (b) 2.4×10^{6} (c) $10^{-11} \times 6 \times 10^{23}$ (d) $2.68 \times 10^{19} \times 10^{-11}$

Problems based on Grahms law

90. The rate of diffusion is **[AIIMS 1998]**

(a) Faster in solids than in liquids and gases (b) Faster in liquids than in solids and gases

(c) Equal to solids, liquids and gases (d) Faster in gases than in liquids and solids

91. Ratio of rate of diffusion of H_2 gas and O_2 gas is 1 : 4. Ratio of their molecular weights is **[CPMT 1995]**

(a) 16 : 1 (b) 4 : 1 (c) 1 : 16 (d) 1 : 4

Problems based on Dalton's law

▶ Basic level

92. Three containers of the same volume contain three different gases. The masses of the molecules are m_1, m_2 and m_3 and the number of molecules in their respective containers are N_1, N_2 and N_3. The gas pressure in the containers are P_1, P_2 and P_3 respectively. All the gases are now mixed and put in one of the containers. The pressure P of mixture will be **[CBSE PMT 1992]**

(a) $P < (P_1 + P_2 + P_3)$ (b) $P = \frac{(P_1 + P_2 + P_3)}{3}$ (c) $P = P_1 + P_2 + P_3$ (d) $P > (P_1 + P_2 + P_3)$

93. The pressure and temperature of two different gases is P and T having the volume V for each. They are mixed keeping the same volume and temperature, the pressure of the mixture will be **[NCERT 1978]**

(a) P/2 (b) P (c) 2P (d) 4P

94. A container encloses two ideal gases. Two moles of the first gas are present, with molar mass M_1. Molecules of the second gas have a molar mass $M_2 = 3M_1$, and 0.5 mole of this gas is present. The fraction of total pressure attributable to the second gas is

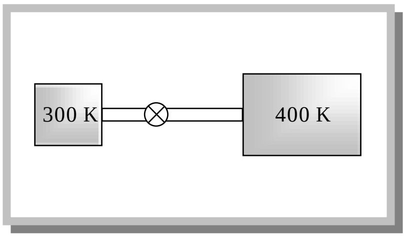
(a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) $\frac{1}{5}$ (d) $\frac{1}{4}$

▶▶ Advance level

95. A container of volume 20 litre is filled with a mixture of H_2 and He at 20°C. The pressure is 2 atm. If the mass of mixture is 5 gm, then the ratio of masses of H_2 and He is

(a) 0.46 (b) 0.61 (c) 0.75 (d) 0.80

96. A contains an ideal gas at a pressure of 5.0×10^5 Pa and at a temperature 300 K. it is connected by a thin tube to container B with four times the volume of A. B contains the same ideal gas at a pressure of 1.0×10^5 Pa and at a temperature of 400 K. the connecting valve is opened. The final pressure of the system is



(a) 200 kPa

(b) 100 kPa

(c) 350 kPa

(d) 250 kPa

Problems based on Law of equipartition of energy

97. Mean kinetic energy per degree of freedom of gas molecules is **[MP PET 1995; RPET 1999; 2001, 2003]**

(a) $\frac{3}{2}KT$ (b) KT (c) $\frac{1}{2}KT$ (d) $\frac{3}{2}RT$

98. The translatory kinetic energy of a gas per gm is **[DPMT 2002]**

(a) $\frac{3}{2}\frac{RT}{N}$ (b) $\frac{3}{2}\frac{RT}{M}$ (c) $\frac{3}{2}RT$ (d) $\frac{3}{2}NKT$

99. A monoatomic gas molecule has **[DCE 1999]**

(a) Three degrees of freedom (b) Four degrees of freedom

(c) Five degrees of freedom (d) Six degrees of freedom

100. The degrees of freedom of a triatomic gas is **[CBSE 1999]**

(a) 2 (b) 4 (c) 6 (d) 8

101. The kinetic energy, due to translational motion, of most of the molecules of an ideal gas at absolute temperature T is **[Roorkee 1994]**

(a) kT (b) k/T (c) T/k (d) 1/kT

102. The number of translational degrees of freedom for a diatomic gas is **[CBSE PMT 1993]**

(a) 2 (b) 3 (c) 5 (d) 6

103. A polyatomic gas with n degrees of freedom has a mean energy per molecule given by **[CBSE PMT 1992]**

(a) nkT / N_A (b) $nkT / 2N_A$ (c) nkT/2 (d) 3kT/2

104. 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 monoatomic (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

Problems based on Mean free path

105. If the pressure in a closed vessel is reduced by drawing out some gas, the mean free path of the molecules **[CPMT 1973]**

(a) Is decreased (b) Is increased

(c) Remains unchanged (d) Increases or decreases according to the nature of the gas

106. The correct relation connecting C_{rms}, λ and collision frequency NC is

(a) $N_c = \frac{C_{rms}}{\lambda}$ (b) $N_c = \frac{\lambda}{C_{rms}}$ (c) $N_c = \lambda C_{rms}$ (d) $N_c = \lambda^2 C_{rms}$

107. The mean free path of gas molecules depends on (d = molecular diameter)

(a) d (b) d^2 (c) d^{-2} (d) d^{-1}

108. Mean free path of the molecules of a gas depends on absolute temperature T as

(a) T (b) T^{-1} (c) T^2 (d) T^4

Problems based on Specific heat

▶ Basic level

109. Universal gas constant is **[Orissa JEE 2003]**

(a) C_P / C_v (b) $C_p - C_v$ (c) $C_p + C_v$ (d) C_v / C_p

110. The specific heat of an ideal gas is **[CPMT 1983; RPMT 1999; CPMT 2002]**

(a) Proportional to T (b) Proportional to T^2 (c) Proportional to T^3 (d) Independent of T

111. If the degree of freedom of a gas are f, then the ratio of two specific heats C_p / C_v is given by **[MP PMT 1990; MP PET 1995; BHU 1997; MP PMT 2001]**

(a) $\frac{2}{f}+1$ (b) $1-\frac{2}{f}$ (c) $1+\frac{1}{f}$ (d) $1-\frac{1}{f}$

112. The value of C_v for one mole of neon gas is **[MP PMT 2000]**

(a) $\frac{1}{2}R$ (b) $\frac{3}{2}R$ (c) $\frac{5}{2}R$ (d) $\frac{7}{2}R$

113. The specific heat of a gas at constant pressure is greater than that of the same gas at constant volume because **[UPSEAT 2000]**

(a) At constant pressure work is done in expanding the gas against constant external pressure

(b) At constant volume work is done when pressure increases

(c) The molecular agitation increases at constant pressure

(d) The molecular agitation decreases at constant volume

114. The specific heat of 1 mole of an ideal gas at constant pressure (C_p) and at constant volume (C_v) which is correct **[UPSEAT 2000]**

(a) C_p of hydrogen gas is $\frac{5}{2}R$ (b) C_v of hydrogen gas is $\frac{7}{2}R$

(c) H_2 has very small values of C_p and C_v (d) $C_p - C_v = 1.99 \text{cal/mole} - K$ for H_2

115. In gases of diatomic molecules, the ratio of the two specific heats of gases C_p / C_v is **[EAMCET (Med) 1995]**

(a) 1.66 (b) 1.40 (c) 1.33 (d) 1.00

116. When an ideal monoatomic gas is heated at constant pressure, the fraction of heat energy supplied which increases the internal energy of the gas is **[AIIMS 1995]**

(a) $\frac{2}{5}$ (b) $\frac{3}{5}$ (c) $\frac{3}{7}$ (d) $\frac{3}{4}$

117. If R is gas constant and C_p and C_v are specific heats for a solid per mole, then for the solids **[CPMT 1977]**

(a) $C_p - C_v = R$ (b) $C_p - C_v << R$ (c) $C_p - C_v = 0$ (d) $C_p - C_v$ is negative

118. When two moles of oxygen is heated from 0°C to 10°C at constant volume, its internal energy changes by 420 J. What is the molar specific heat of oxygen at constant volume

(a) 5.75 J-K^{-1} mol^{-1} (b) 10.5 J-K^{-1} mol^{-1} (c) 21 J-K^{-1} mol^{-1} (d) 42 J-K^{-1} mol^{-1}

119. If U represents the internal energy of one mole of a gas and T is the absolute temperature, then the molar specific heat of the gas at constant pressure is

(a) $\frac{dU}{dT}$ (b) $\frac{dU}{dT}+R$ (c) $\frac{dU}{dT}-R$ (d) $R-\frac{dU}{dT}$

▶▶ Advance level

120. The ratio of specific heat of a gas at constant pressure to that at constant volume is γ. The change in internal energy of a mass of gas when the volume changes from V to 2V at constant pressure P is

(a) $\frac{R}{\gamma - 1}$ (b) PV (c) $\frac{PV}{\gamma - 1}$ (d) $\frac{\gamma PV}{\gamma - 1}$

121. A sample of ideal gas (γ = 1.4) is heated at constant pressure. If an amount of 100 J heat is supplied to the gas, the work done by the gas is

(a) 42.12 J (b) 56.28 J (c) 28.57J (d) 36.23 J

Problems based on Mixture

122. If one mole of a monoatomic gas $(\gamma = 5/3)$ is mixed with one mole of diatomic gas $(\gamma = 7/5)$, the value of γ for the mixture is

[IIT-JEE 1986; RPMT 1996; AIEEE 2002]

(a) 1.40 (b) 1.50 (c) 1.53 (d) 3.07

123. A gaseous mixture contains equal number of hydrogen and nitrogen molecules. Specific heat measurements on this mixture at temperatures below 150 K would indicate that the value of γ (ratio of specific heats) for this mixture is **[SCRA 1998]**

(a) 3/2 (b) 4/3 (c) 5/3 (d) 7/5

124. Two ideal gases at temperature T_1 and T_2 are mixed. There is no loss of energy. If the masses of molecules of the two gases are m_1 and m_2 and number of their molecules are n_1 and n_2 respectively, the temperature of mixture will be

(a) $\frac{T_1 + T_2}{n_1 + n_2}$ (b) $\frac{T_1}{n_1} + \frac{T_2}{n_2}$ (c) $\frac{n_2T_1 + n_1T_2}{n_1 + n_2}$ (d) $\frac{n_1T_1 + n_2T_2}{n_1 + n_2}$

125. Two moles of a monoatomic gas are mixed with one mole of a diatomic gas. The γ for mixture is

(a) $\frac{5}{3}$ (b) $\frac{7}{5}$ (c) $\frac{4}{3}$ (d) $\frac{17}{11}$

126. A mixture of n_1 moles of monoatomic gas and n_2 moles of diatomic gas has $\gamma = 1.5$, then

(a) $n_1 = 2n_2$ (b) $2n_1 = n_2$ (c) $n_1 = n_2$ (d) $2n_1 = 3n_2$