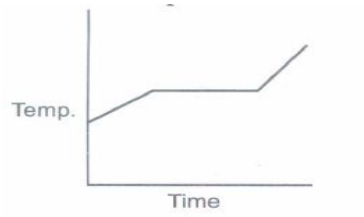
# Ravi Maths Tuition Centre

**Time : 1 Mins** **BEHAVIOUR OF PERFECT GAS AND KINETIC ENERGY 1** **Marks : 510**

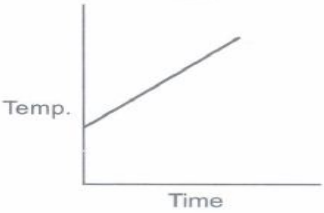
1. The internal energy of one gram of helium at 100 K and one atmospheric pressure is:
   a) 100 J b) 1200 J c) 300 J d) 500 J
2. Amonoatomic gas at a pressure P, having a volume V expands isothermally to a volume 2 V and then adiabatically to a volume 16 V. The final pressure of the gas is: (take $\gamma$ = 5/3)
   a) 64 P b) 32 P c) P/64 d) 16 P
3. At what temperature is the root mean square velocity of gaseous hydrogen molecules is equal to that of oxygen molecules at $47^0$C :
   a) 20 K b) 80 K c) -73 K d) 3 K
4. The equation of state for 5 g of oxygen at a pressure P and temperature 7, when occupying a volume V, will be:
   a) PV = (5/16) RT b) PV = (5/32) RT c) PV = 5 RT d) PV = (5/2) RT
5. At what temperature is the root mean square speed of an atom in an argon gas cylinder equal to the rms speed ofa helium gas atom at -20°C? (Atomic mass of Ar = 39 u and He = 400 u)
   a) $2.52 \times 10^3$ K b) $2.52 \times 10^2$ K c) $4.03 \times 10^3$ K d) $4.03 \times 10^2$ K
6. The mean free path for a gas, with molecular diameter d and number density n can be expressed as:
   a) $\frac{1}{\sqrt{2}n^2\pi^2d^2}$ b) $\frac{1}{\sqrt{2}n\pi d}$ c) $\frac{1}{\sqrt{2}n\pi d^2}$ d) $\frac{1}{\sqrt{2}n^2\pi d^2}$
7. A gas is filled in a cylinder. Its temperature is increased by 20% on kelvin scale and volume is reduced to 90%. How much percentage of the gas has to leak for pressure to remain constant?
   a) 20% b) 25% c) 30% d) 40%
8. **Assertion:** For a mixture of non reactive ideal gases, the total pressure gets contribution from each gas in the mixture.
   **Reason:** In equilibrium, the average kinetic energy of the molecules of different gases will be equal.

a)
If both assertion and reason are true and reason is the correct explanation of assertion.
b)
If both assertion and reason are true but reason is not the correct explanation of assertion.
c) If assertion is true but reason is false. d) If both assertion and reason are false.

9. 1 mole of $H_2$ gas is contained in a box of volume V = 1.00 $m^3$ at T = 300 K. The gas is heated to a temperature of T = 3000 K and the gas gets converted to a gas of hydrogen atoms. The final pressure would be (considering all gases to be ideal)
   a) same as the pressure initially b) 2 times the pressure initially
   c) 10 times the pressure initially d) 20 times the pressure initially
10. The volume of water molecule is (Take, density of water is $10^3$ kg $m^3$ and avogadros number = $6 \times 10^{23}$ $mole^{-1}$)
    a) $3 \times 10^{-28}$ $m^3$ b) $3 \times 10^{-29}$ $m^3$ c) $1.5 \times 10^{-28}$ $m^3$ d) $1.5 \times 10^{-29}$ $m^3$
11. Liquid oxygen at 50 K is heated to 300 K at constant pressure of 1 atm. The rate of heating is constant. Which one of the following graphs represents the variation of temperature with time?

a) 

b) 

c) 

d) 


12. An insulated container containing monatomic gas of molar mass m moving with a velocity $v_o$, If the container is suddenly stopped. The change in temperature is
    a) $\frac{mv_0^2}{2R}$ b) $\frac{mv_0^2}{3R}$ c) $\frac{R}{mv_0^2}$ d) $\frac{3mv_0^2}{2R}$
13. The equation of state, corresponding to 8g of $O_2$ is:
    a) PV = 8RT b) PV = RT/4 c) PV = RT d) PV = RT/2
14. Pressure of a gas at constant volume is proportional to
    a) total internal energy of the gas b) average kinetic energy of the molecules
    c) average potential energy of the molecules d) total energy of the gas
15. At constant volume, temperature is increased then:
    a) Collision on walls will be less b) Number of collisions per unit time will increase
    c) Collisions will be in straight lines d) Collisions will not change.
16. Three moles of oxygen are mixed with two moles of helium. What will be the ratio of specific heats at constant pressure and constant volume for the mixture?
    a) 2.5 b) 3.5 c) 1.5 d) 1

17. A sample of an ideal gas occupies a volume V at pressure P and absolute temperature T. The mass of each molecule is m, then the density of the gas is

    a) mKT  b) $\frac{pm}{KT}$  c) $\frac{P}{Km}$  d) $\frac{P}{KT}$

18. N molecules, each of mass m, of gas A and 2 N molecules, each of mass 2 m, of gas B are contained in the same vessel which maintained at a temperature T. the mean square of the velocity of molecules of B type is denoted by $v^2$ and the mean square of the X component of the velocity of A type is denoted by $\omega^2$, then ($\omega^2$/ $v^2$) is:

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

19. **Assertion :** In case of collision of gas molecules in a given amount of gas, total kinetic energy is conserved.

    **Reason :** All collisions of the gas molecules in a given amount of gas are elastic.

    a)

    If both assertion and reason are true and reason is the correct explanation of assertion.

    b)

    If both assertion and reason are true but reason is not the correct explanation of assertion.

    c) If assertion is true but reason is false.  d) If both assertion and reason are false.

20. A gas mixture consists of 2 moles of $O_2$ and 4 moles of Ar at temperature T. Neglecting all vibrational modes, the total internal energy of the system is

    a) 15 RT  b) 9 RT  c) 11 RT  d) 4 RT

21. If three molecules have velocities 0.5 km $s^{-1}$, 1 km $s^{-1}$ and 2 km $s^{-1}$, the ratio of the rms speed and average speed is:

    a) 2.15  b) 1.13  c) 0.53  d) 3.96

22. A vessel contains two non-reactive gases neon (monatomic) and oxygen (diatomic). The ratio of their partial pressures is 3 : 2. The ratio of number of molecules is

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

23. A cubic vessel (with faces horizontal + vertical) contains an ideal gas at NTP. The vessel is being carried by a rocket which is moving at a speed of 500 m/s in vertical direction. The pressure of the gas inside the vessel as observed by us on the ground.

    a) remains the same because 500 m/s is very much smaller than $V_{rms}$ of the gas

    b)

    remains the same because motion of the vessel as a whole does not affect the relative motion of the gas molecules and the walls

    c)

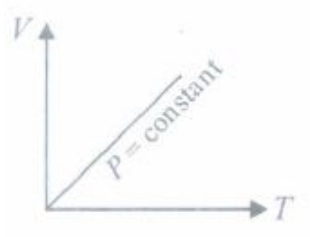
    will increase by a factor equal to $\left[V_{rms}^2 + (500)^2\right] / V_{rms}^2$ ,where $V_{rms}$ was the original rms mean square velocity of the gas

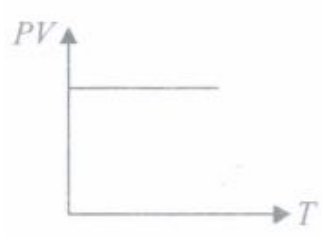
    d) will be different on the top wall and bottom wall of the vessel.

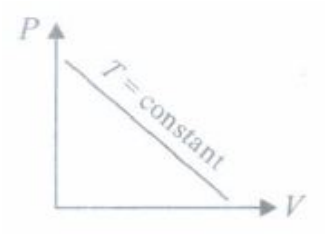
24. The average kinetic energy of $O_2$ at a particular temperatures is 0.768 eV. The average kinetic energy of $N_2$ molecules in eV at the same temperature is

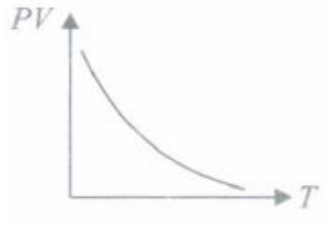
a) 0.0015 b) 0.0030 c) 0.048 d) 0.768

25. If a given mass of gas occupies a volume of 10 cc at 1 atmospheric pressure and temperature of 100°C (373.15K). What will be its volume at 4 atmospheric pressure the temperature being the same?
    a) 100 cc b) 400 cc c) 2.5 cc d) 104 cc
26. Which of the following graphs represent the behaviour of an ideal gas?

a) 

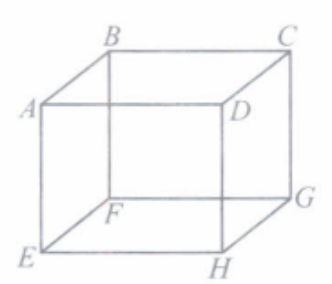

b) 


c) 


d) 


27. One mole of an ideal monoatomic gas requires 207 J heat to raise the temperature by 10 K when heated at constant pressure. If the same gas is heated at constant volume to raise the temperature by the same 10 K, the heat required is:
    [Given the gas constant R = 8.3 J/mol.K]
    a) 198.7 J b) 29 J c) 215.3 J d) 124 J
28. A gas at 300 K has pressure $4 \times 10^{-10}$ N $m^{-2}$. If $k_B = 1.38 \times 10^{-23}$ J $K^{-l}$, the number of molecules per $cm^3$ is of the order of
    a) $10^3$ b) $10^5$ c) $10^6$ d) $10^9$
29. If for a gas $(R/C_v) = 0.67$ this gas is made up of molecules which are:
    a) Diatomic b) Mixture of diatomic and polyatomic c) Monoatomic d) Polyatomic
30. N molecules each of mass m of gas A and 2N molecules each of mass 2m of gas B are contained in the vessel which is maintained at a temperature T. The mean square of velocity of the molecules of B type is denoted by $v^2$ and the mean square of the x-component of the velocity of A type is denoted by $w^2$. The ratio of $w^2$: $v^2$ is
    a) 3: 2 b) 1: 3 c) 2: 3 d) 1: 1
31. **Assertion:** Molecules of air in a room do not all fall and settle on the ground due to gravity.
    **Reason:** Air molecules move with high speed and there is incessant collision of air molecules.
    a)
    If both assertion and reason are true and reason is the correct explanation of assertion.
    b)
    If both assertion and reason are true but reason is not the correct explanation of assertion.
    c) If assertion is true but reason is false. d) If both assertion and reason are false

32. 1 mole of an ideal gas iscontained in a cubical volume V, A BCDEFGH at 300 K as shown in figure. One face of the cube (EFGH) is made up of a material which totally absorbs any gas molecule incident on it. At any given time,




a) the pressure on EFGH would be zero b) the pressure on all the faces will be equal
c) the pressure of EFGH would be double the pressure on ABCD
d) the pressure on EFGH would be half that on ABCD.

33. Which one of the following is not an assumption of kinetic theory of gases?
a) The volume occupied by the molecules of the gas is negligible
b) The force of attraction between the molecules is negligible.
c) The collision between the molecules are elastic. d) All molecules have same speed.

34. If pressure of a gas contained in a closed vessel is increased by 0.4% when heated by $1^0$C, the initial temperature must be:
a) 250 K b) $250^0$C c) 2500 K d) $25^0$C

35. 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 :
a) P/2 b) P c) 2P d) 4P

36. Ratio specific heats of monoatomic molecule is:
a) $\gamma$=5/3 b) $\gamma$=3/5 c) $\gamma$=4/3 d) $\gamma$=2/3

37. The heat capacity per mole of water is (R is universal gas constant)
a) 9R b) $\frac{9}{2}R$ c) 6R d) 5R

38. The average thermal energy for a mono-atomic gas is : ($k_B$ is Boltzmann constant and T, absolute temperature)
a) $\frac{7}{2}\mathrm{k_B T}$ b) $\frac{1}{2}\mathrm{k_B T}$ c) $\frac{3}{2}\mathrm{k_B T}$ d) $\frac{5}{2}\mathrm{k_B T}$

39. When an ideal gas is compressed adiabatically, its temperature rises the molecules on the average have more kinetic energy than before. The kinetic energy increases
a) because of collisions with moving parts of the wall only.
b) because of collisions with the entire wall.
c) because the molecules gets accelerated in their motion inside the volume.
d) because the redistribution of energy amongst the molecules.

40. If $C_p$ and $C_v$ denoted the specific heats of unit mass of nitrogen at constant pressure and volume respectively, then

a) $C_p - C_v = \frac{R}{28}$ b) $C_p - C_v = \frac{R}{7}$ c) $C_P - C_v = \frac{R}{14}$ d) $C_P$-$C_V$=R

41. Temperature of an ideal gas is T K and average kinetic energy is E = 2.07 x $10^{-23}$ T Joule/molecule. Number of molecules in 1 litre gas at S.T.P. will be:
a) 2.68 x $10^{22}$ b) 2.68 x $10^{25}$ c) 2.68 x $10^{28}$ d) 1.68 x $10^{22}$

42. If $C_p$ and $C_v$ denote the specific heats (per unit mass) of an ideal gas of molecular weight M, then: where R is the molar gas constant
a) $C_p$-$C_v$ = $R/M^2$ b) $C_p$-$C_v$ = R c) $C_p$-$C_v$ = R/M d) $C_p$-$C_v$ = M/R

43. A gas is filled in a container at pressure $P_o$' If the mass of molecules is halved and their rms speed is doubled, then the resultant pressure would be
a) $2P_o$ b) $4P_o$ c) $\frac{P_0}{4}$ d) $\frac{P_0}{2}$

44. The temperature of 5 mole of a gas which was held at constant volume was changed from 100°C to $120^0$C. The change in internal energy was found to be 80 J. The total heat capacity of the gas at constant volume will be equal to:
a) 8 $JK^{-1}$ b) 0.8 $JK^{-1}$ c) 4 $JK^{-1}$ d) 0.4 $JK^{-1}$

45. 0.014 kg of nitrogen is enclosed in a vessel at a temperature of 27°C. At which temperature the rms velocity of nitrogen gas is twice its the rms velocity at 27°C?
a) 1200 K b) 600 K c) 300 K d) 150 K

46. Pressure versus temperature graph of an ideal gas of equal number of moles of different volumes are plotted as shown in figure. Choose the correct alternative.
a) $V_1 = V_2 = V_3$ = Vol b) $V_4 > V_3 > V_2 > V_1$ c) $V_1 = V_2$; $V_3 = V_4$ and $V_2 > V_3$
d) $V_1 = V_2$, $V_3 = V_4$ and $V_2 < V_3$

47. 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 these containers. The pressure P of the mixture will be:
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) $P > (P_1 + P_2 + P_3)$

48. 22 gm of $CO_2$ at $27^0$C is mixed with 16 gm of $O_2$ at $37^0$C. The temperature of the mixture is :
a) $32^0$C b) $27^0$C c) $37^0$C d) $30.5^0$C

49. A disc of radius 2 m and mass 100 kg rolls on a horizontal floor. Its centre of mass has speed of 20 cm/s. How much work is needed to stop it?
a) 30 KJ b) 2 J c) 1 J d) 3 J

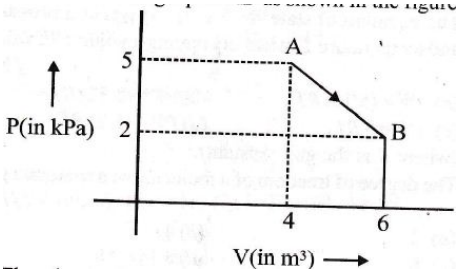
50. A cylinder contains 10 kg of gas at a pressure of $10^7$ N $m^{-2}$. The quantity of gas taken out of the cylinder, if final pressure is 2.5 x $10^6$ N $m^{-2}$ is
a) 9.5 kg b) 7.5 kg c) 14.2 kg d) zero

51. From a certain apparatus, the diffusion rate of hydrogen has an average value of 28.7 $cm^3\ s^{-1}$. The diffusion of another gas under the same conditions is measured to have an average rate of 7.2 $cm^3\ s^{-1}$. The gas is
    a) Nitrogen  b) Helium  c) Argon  d) Oxygen

52. The average energy per molecule of a triatomic gas at room temperature T is
    a) 3kT  b) $\frac{1}{2}kt$  c) $\frac{3}{2}kT$  d) $\frac{5}{2}kT$

53. A cylinder contains hydrogen gas at pressure of 249 kPa and temperature $27^\circ\mathrm{C}$. Its density is: $\left(\mathrm{R} = 8.3\ \mathrm{J\ mol^{-1}\ K^{-1}}\right)$
    a) $0.02\ \mathrm{kg/m^3}$  b) $0.5\ \mathrm{kg/m^3}$  c) $0.2\ \mathrm{kg/m^3}$  d) $0.1\ \mathrm{kg/m^3}$

54. One mole of an ideal diatomic gas undergoes a transition from A to B along a path AB as shown in the figure.




    The change in internal energy of the gas during the transition is:
    a) -20 KJ  b) 20 J  c) -12 KJ  d) 20 KJ

55. In a certain region of space there are only 5 gaseous molecules per em" on an average. The temperature there is 3 K The pressure of this gas is
    ($k_B$ = 1.38 X $10^{-23}$ J $mol^{-1}$ $K^{-1}$)
    a) 20.7 x $10^{-16}$ N $m^{-2}$  b) 20.7 x $10^{-17}$ N $m^{-2}$  c) 10.7 x $10^{-16}$ N $m^{-2}$
    d) 10.7 x $10^{-17}$ N $m^{-2}$

56. An air bubble of volume 1.0 cm- rises from the bottom of a lake 40 m deep at a temperature of 12°C. To what volume does it grow when it reaches the surface, which is of a temperature of 35 °C ?
    a) 10.6 x $10^{-6}$ $m^3$  b) 5.3 x $10^{-6}$ $m^3$  c) 2.8 x $10^{-6}$ $m^3$  d) 15.6 x $10^{-6}$ $m^3$

57. According to kinetic theory of gases, at absolute zero temperature:
    a) Water freezes  b) Liquid helium freezes  c) Molecular motion stops
    d) Liquid hydrogen freezes

58. Ten small planes are flying at a speed of 150 km $h^{-1}$ in total darkness in an air space that is 20 x 20 x 1.5 $km^3$, in volume. You are in one of the planes, flying at random within this space with no way of knowing where the other planes are. On the average about how long a time will elapse between near collision with your plane. Assume for this rough computation that a safety region around the plane can be approximated by a sphere of radius 10m.
    a) 125h  b) 220h  c) 432h  d) 225h

59. For a certain gas, the ratio of specific heats is given to be g = 1.5. For this gas:
    a) $C_V = 3\mathrm{R/J}$  b) $C_p = 3\mathrm{R/J}$  c) $C_p = 5\mathrm{R/J}$  d) $C_V = 5\mathrm{R/J}$

60. A thin tube of uniform cross-section is sealed at both ends. When it lies horizontally, the middle 5 cm length contains mercury and the two equal ends contain air at the same pressure P. When the tube is held at an angle of 60° with the vertical, then the lengths of the air columns above and below the mercury column are 46 cm and 44.5 cm respectively. Calculate the pressure P in cm of mercury. The temperature of the system is kept at 30°C.
    a) 75.4  b) 45.8  c) 67.5  d) 89.3
61. Two specific heats of a perfect gas are related by :
    a) $C_p - C_v = R/J$  b) $C_p - C_v = J$  c) $C_p - C_v = RJ$  d) $C_p + 1/C_v = 2.4$ cal
62. The molecules of a given mass of a gas have r.m.s velocity of 200 m/s at $27^0$C and 1.0 x $10^5$ N/m$^2$ pressure. When the temperature and pressure of the gas are respectively 127°C and 0.05 x $10^5$Nm$^{-2}$, the rms velocity of its molecules in ms$^{-1}$ is
    a) 100/3  b) $100\sqrt{2}$  c) $400\sqrt{3}$  d) $100\sqrt{2/3}$
63. Cooking gas containers are kept in a lorry moving with uniform speed. The temperature of the gas molecules inside wil
    a) increase  b) decrease  c) remains the same
    d) decrease for some and increase for others
64. The ratio of the molar heat capacities of a diatomic gas at constant pressure to that at constant volume is
    a) $\frac{7}{5}$  b) $\frac{3}{2}$  c) $\frac{3}{5}$  d) $\frac{5}{2}$
65. The pressure of a gas is raised from 27°C to 927°C. The root mean square speed is:
    a) $\sqrt{(927/27)}$ times the earlier value  b) Remain the same  c) Get halved
    d) Get doubled
66. Calculate the means free path of nitrogen molecule at 27°C when pressure is 1.0 atm. Given, diameter of nitrogen molecule = 1.5 Å, $k_B$ = 1.38 x $10^{-23}$ J K$^{-1}$. If the average speed of nitrogen molecule is 675 ms$^{-1}$. The time taken by the molecule between two successive collisions is
    a) 0.6ns  b) O.4ns  c) 0.8ns  d) O.3ns
67. The molecules of a given mass of a gas have root mean square speeds of 100 ms$^{-1}$ at 27°C and 1 atmospheric pressure. The root mean square speeds of the molecules of the gas at 127°C and 2 atmospheric pressure is
    a) $\frac{200}{\sqrt{3}}$  b) $\frac{100}{\sqrt{3}}$  c) $\frac{400}{3}$  d) $\frac{200}{3}$
68. A cylinder of fixed capacity 44.8 litres contains helium gas at standard temperature and pressure. What is the amount of heat needed to raise the temperature of the gas in the cylinder by 15°C ? (R = 8.31 J mol$^{-1}$ K$^{-l}$)
    a) 265 J  b) 310.10 J  c) 373.95 J  d) 387.97 J

69. Two cylinders A and B of equal capacity are connected to each other via a stop cock. The contains an ideal gas at standard temperature and pressure. B is completely evacuated. The entire system is thermally insulated. The stop cock is suddenly opened. The process is:

a) Isobaric b) Isothermal c) Adiabatic d) Isochoric

70. One kg of a diatomic gas is at a pressure of $8 \times 10^4$ $m^{-2}$. The density of the gas is 4 kg $m^{-3}$. The energy of the gas due to its thermal motion is:

a) $3 \times 10^4$ J b) $5 \times 10^4$ J c) $6 \times 10^4$ J d) $7 \times 10^4$ J

71. **Assertion:** The ratio of specific heat of a gas at constant pressure and specific heat at constant volume for a diatomic gas is more than that for a monoatomic gas.
**Reason :** The molecules of a mono atomic gas have more degree of freedom than those of a diatomic gas.

a)
If both assertion and reason are true and reason is the correct explanation of assertion.

b)
If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false. d) If both assertion and reason are false.

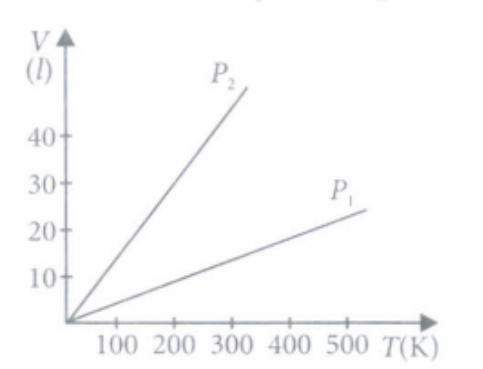
72. The equation of state corresponding to 8 g of $O_2$ is:

a) PV = 8RT b) PV = RT/4 c) PV = RT d) PV = RT/2

73. Molecular motion shows itself as

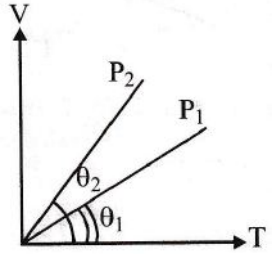
a) temperature b) internal energy c) friction d) viscosity

74. Volume versus temperature graphs for a given mass of an ideal gas are shown in figure at two different values of constant pressure. What can be inferred about relation between $P_1$ and $P_2$?




a) $P_1 > P_2$ b) $P_1 = P_2$ c) $P_12$ d) data is insufficient

75. In the given (V-T) diagram, what is the relation between pressure $P_1$ and $P_2$?




a) $P_2 > P_1$ b) $P_2 < P_1$ c) Cannot be predicted d) $P_2 = P_1$

76. **Assertion:** Average kinetic energy per molecule of any ideal monoatomic gas is $\frac{3}{2}k_BT$
**Reason :** Average kinetic energy depends only on temperature and is independent of the nature of the gas.
a)
If both assertion and reason are true and reason is the correct explanation of assertion.
b)
If both assertion and reason are true but reason is not the correct explanation of assertion.
c) If assertion is true but reason is false. d) If both assertion and reason are false.

77. At $10^o$ C the value of the density of a fixed mass of an ideal gas divided by its pressure is x. At $110^o$'C this ratio is:
a) x b) $\frac{383}{283}x$ c) $\frac{10}{110}x$ d) $\frac{283}{383}x$

78. According to equipartition law of energy each particle in a system of particles have thermal energy E equal to
a) $E=k_BT$ b) $E=\frac{1}{2}k_BT$ c) $E=3k_BT$ d) $E=\frac{3}{2}k_BT$

79. The temperature of an ideal gas is increased from 120 K to 480 K. If at 120 K, the rms velocity of the gas molecules is $v_{rms}$, then at 480 K, it becomes
a) $4v_{rms}$ b) $2\ v_{rms}$ c) $\frac{v_{rms}}{2}$ d) $\frac{v_{rms}}{4}$

80. For hydrogen gas $C_p - C_v = a$, and for oxygen gas $C_p - C_v = b$, so that relation between a and b given by:
a) a=16 b b) 16a=b c) a=b d) a=4b

81. A perfect gas at 27°C is heated at constant pressure to $327^0$C. If original volume of gas at 27°C is V then volume at 327° C is:
a) V b) 3V c) 2V d) V/2

82. Increase in temperature of a gas filled in a container would lead to:
a) Increase in its kinetic energy b) Decrease in its pressure
c) Decrease in intermolecular distance d) Increase in its mass

83. **Assertion:** Specific heat of a gas at constant pressure is greater than its specific heat at constant volume.
**Reason:** At constant pressure, some heat is spent in expansion of the gas.
a)
If both assertion and reason are true and reason is the correct explanation of assertion.
b)
If both assertion and reason are true but reason is not the correct explanation of assertion.
c) If assertion is true but reason is false. d) If both assertion and reason are false.

84. One half mole each of nitrogen, oxygen and carbon dioxide are mixed in enclosure of volume 5 litres and temperature 27°C. The pressure exerted by mixture is (R = 8.31 J rnol$^{-1}$ K$^{-1}$)
a) 7.48 x $10^5$ N m$^{-2}$ b) 5 x $10^5$ N m$^{-2}$ c) 6 x $10^5$ N m$^{-2}$ d) 3 x $10^5$ N m$^{-2}$

85. The diameter of an oxygen molecule is 3 A. The ratio of molecular volume to the actual volume occupied by the oxygen gas at STP is:
a) 2 x $10^{-4}$ b) 1 x $10^{-4}$ c) 1.5 x $10^{-4}$ d) 4 x $10^{-4}$

86. One mole of an ideal monatomic gas at temperature $T_o$ expands slowly according to the law $\frac{P}{V}$ = constant. If the final temperature is 2 $T_o$ heat supplied to the gas is
a) $2RT_0$ b) $RT_0$ c) $\frac{3}{2}RT_0$ d) $\frac{1}{2}RT_0$

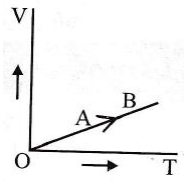
87. A balloon contains 1500 m$^3$ of helium at 27°C and 4 atmospheric pressure. The volume of helium at -3 °C temperature and 2 atmospheric pressure will be
a) 1500 m$^3$ b) 1700 m$^3$ c) 1900 m$^3$ d) 2700 m$^3$

88. The degree of freedom of a molecule of a triatomic gas is:
a) 2 b) 4 c) 6 d) 8

89. At what temperature is the rms velocity of hydrogen molecule equal to that of an oxygen molecule at 47°C?
a) 10 K b) 20 K c) 30 K d) 40 K

90. A vessel is filled with a gas at a pressure of 76 cm of mercury at a certain temperature. The mass of the gas is increased by 50% by introducing more gas in the vessel at the same temperature. The resultant pressure of the gas is:
a) 76 cm of mercury b) 108 cm of mercury c) 112 cm of mercury
d) 114 cm of mercury

91. The volume (V) of a monoatomic gas varies with its temperature (T), as shown in the graph. The ratio of work done by the gas, to the heat absorbed by it, when it undergoes a change from state A to state B, is:




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

92. The ratio of specific heats $C_p/C_v = \gamma$ in terms of degree of freedom (n) is given by:
a) (1+n/3) b) (1+2/n) c) (1+n/2) d) (1+ 1/n)

93. The temperature of a gas is raised from 27$^0$C to 927$^0$C. The root mean square speed:
a) $(\sqrt{927/27})$ times the earlier value b) Gets halved c) Remains the same
d) Gets doubled

94. The ratio of the specific heats $\frac{C_p}{C_v} = \gamma$ in terms of degrees of freedom (n) is given by:
a) $\left(1+\frac{n}{3}\right)$ b) $\left(1+\frac{2}{n}\right)$ c) $\left(1+\frac{n}{2}\right)$ d) $\left(1+\frac{1}{n}\right)$

95. Two identical containers A and B with frictionless pistons contain the same ideal gas at the same temperature and the same volume V. The mass of the gas in A is mA and that in B is $m_B$' The gas in each cylinder is now allowed to expand isothermally to the same final volume 2 V. The changes in the pressure in A and B are found to be Δp and 1.5 Δp, respectively. Then
    a) $4m_A=9m_B$  b) $2m_A=3m_B$  c) $3m_A=2m_B$  d) $9m_A=4m_B$
96. 1 mole of a gas with $\gamma = \frac{7}{5}$ is mixed with 1 mole of gas with $\gamma = \frac{5}{3}$ the value of y of the resulting mixture of.
    a) $\frac{7}{5}$  b) $\frac{2}{5}$  c) $\frac{3}{2}$  d) $\frac{12}{7}$
97. Two moles of a gas A at 27°C mixed with a 3 moles of gas at 37°C. If both are monatomic ideal gases, what will be the temperature of the mixture?
    a) 66 °C  b) 11 °C  c) 22°C  d) 33 °C
98. Two mole of oxygen is mixed with eight mole of helium. The effective specific heat of the mixture at constant volume is
    a) 1.3R  b) 1.4R  c) 1.7R  d) 1.9R
99. A real gas behaves like an ideal gas if its
    a) both pressure and temperature are high  b) both pressure and temperature are low
    c) pressure is high and temperature is low  d) pressure is low and temperature is high
100. The equation of state for 5 g of oxygen at a pressure P and temperature T, when occupying a volume V, will be
    (where R is the gas constant)
    a) PV = (5/32)RT  b) PV = 5RT  c) PV = (5/2)RT  d) PV = (5/16)RT
101. An inflated rubber balloon contains one mole of an ideal gas, has a pressure P,volume V and temperature T. If the temperature rises to 1.1 T, and the volume is increased to 1.05 V, the final pressure will be
    a) 1.1 P  b) P  c) less than P  d) between P and 1.1 P
102. The kinetic theory of gases gives the formula $PV = \frac{1}{3}Nmv^{-2}$ for the pressure P exerted by a gas enclosed in a volume V. The term Nm represents
    a) the mass of a mole of the gas  b) the mass of the gas present in the volume V
    c) the average mass of one molecule of the gas
    d) the total number of molecules present in volume V
103. **Assertion:** Each vibrational mode gives two degrees of freedom.
    **Reason :** By law of equipartition of energy, the energy for each degree of freedom in thermal equilibrium is $2k_BT$.

a)
If both assertion and reason are true and reason is the correct explanation of assertion.
b)
If both assertion and reason are true but reason is not the correct explanation of assertion.
c) If assertion is true but reason is false. d) If both assertion and reason are false.

104. The r.m.s. velocity of the molecules in the sample of helium is $5/7^{th}$ that of the molecules in the sample of hydrogen. If the temperature of the hydrogen sample is $0^0$C that of helium is :
a) $0^0$C b) $0^0$K c) $273^0$C d) $100^0$C

105. A molecule of a gas has six degrees of freedom. Then the molar specific heat of the gas at constant volume is:
a) $\frac{R}{2}$ b) R c) $\frac{3R}{2}$ d) 3R

106. Consider a rectangular block of wood moving with a velocity Vo in a gas at temperature T and mass density p. Assume the velocity is along x-axis and the area of cross-section of the block perpendicular to $V_o$ is A. The drag force on the block is (where m is the mass of the gas molecule.)
a) $4\rho A v_0\sqrt{\frac{kT}{m}}$ b) $2\rho A v_0\sqrt{\frac{kT}{3m}}$ c) $\frac{\rho A}{2v_0}\sqrt{\frac{kT}{m}}$ d) $\frac{v_0}{\rho A}\sqrt{\frac{kT}{2m}}$

107. A gaseous mixture enclosed in a vessel contains 1 g mole of a gas A (with y = 5/3) and another gas B (with γ = 7/5) at a temperature T. The gases A and B do not react with each other and assumed to be ideal. The number of gram moles of B, if Y for the gaseous mixture is 19/13 is
a) 2 b) 12 c) 16 d) 8

108. A vessel of volume V contains a mixture of 1 mole of hydrogen and 1 mole of oxygen (both considered as ideal). Let $f_1(v)dv$ denote the fraction of molecules with speed between *v* and (v + dv) with $f_2(v)dv$, similarly for oxygen. Then
a) $f_1(v) + f_2(v) = f(v)$ obeys the Maxwell's distribution law
b) $f_1(v)$,$f_2(v)$ will obey the Maxwell's disribution law separately
c) Neither $f_1(v)$ nor $f_2(v)$ will obey the Maxwell's distribution law
d) $f_2(v)$ and $f_1(v)$ will be the same

109. If a gas has n degrees of freedom ratio of specific heats of gas is
a) $\frac{1+n}{2}$ b) $1+\frac{1}{n}$ c) $1+\frac{n}{2}$ d) $1+\frac{2}{n}$

110. If the pressure and the volume of certain quantity of ideal gas are halved, then its temperature
a) is doubled b) becomes one-fourth c) remains constant d) become four times

111. When a block of iron floats in mercury at $0^0$C, fraction $k_1$ of its volume is submerged, while at the temperature 60° C, a fraction $k_2$ is seen to be submerged. If the coefficient of volume expansion of iron $\gamma_{Fe}$ and that of mercury is $\gamma_{Hg}$, then the ratio $k_1/k_2$ can be

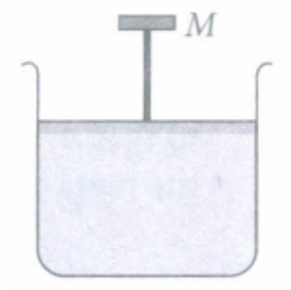
expressed as

a) $(1+60\gamma_{Fe})/(1+60\gamma_{Hg})$ b) $\frac{1-60\gamma_{Fe}}{1+60\gamma_{Hg}}$ c) $\frac{1+60\gamma_{Fe}}{1-60\gamma_{Fe}}$ d) $\frac{1+60\gamma_{Hg}}{1+60\gamma_{Fe}}$

112. The root mean square speed of smoke particles each of mass 5 x $10^{-17}$ kg in their Brownian motion in air at N.T.P is:

a) 3 x $10^{-2}$ $ms^{-1}$ b) 1.5 x $10^{-2}$ m $s^{-1}$ c) 3 x $10^{-3}$ m $s^{-1}$ d) 1.5 x $10^{-3}$ m $s^{-1}$

113. A cylinder containing an ideal gas is in vertical position and has a piston of mass M that is able to move up or down without friction. If the temperature is increased,




a) both P and V of the gas will change

b) only P will increase according to Charle's law. c) V will change but not P

d) V will change but not P

114. **Assertion:** The ratio of rms speed and average speed of a gas molecules at a given temperature is $\sqrt{3} : \sqrt{8/\pi}$

**Reason:** $c_{rms} > c_{av}$ .

a)

If both assertion and reason are true and reason is the correct explanation of assertion.

b)

If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false. d) If both assertion and reason are false.

115. In a vessel, the gas is at a pressure P. If the mass of all the molecules is halved and their speed is doubled, then the resultant pressure will be:

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

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

a) 2 g b) 3 g c) 4 g d) 1 g

117. Relation between pressure (P) and energy (E) of a gas is:

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

118. The temperature of an ideal gas is increased from 27°C to $927^0$C. The root mean square speed of its molecules becomes:

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

119. **Assertion:** The root mean square and most probable speeds of the molecules in a gas are the same.
**Reason:** The Maxwell distribution for the speed of molecules in a gas is symmetrical.
a)
If both assertion and reason are true and reason is the correct explanation of assertion.
b)
If both assertion and reason are true but reason is not the correct explanation of assertion.
c) If assertion is true but reason is false. d) If both assertion and reason are false.

120. A polyatomic gas with z degrees of freedom has a mean energy per molecule given by:
a) $\frac{nkT}{N}$ b) $\frac{nkT}{2N}$ c) $\frac{nkT}{2}$ d) $\frac{3kT}{2}$

121. When the temperature of a gas filled in a closed vessel is increased by 1°C, its pressure increases by 0.4 percent. The initial temperature of gas was
a) 250°C b) 25°C c) 250 K d) 25 K

122. The temperature of an ideal gas is increased from 27°C to 127°C, then percentage increase in $v_{rms}$ is
a) 37% b) 11% c) 33% d) 15.5%

123. The volume of vessel A is twice the volume of another vessel B, and both of them are filled with the same gas. If the gas in A is at twice the temperature and twice the pressure in comparison to the gas in B, then the ratio of the gas molecules in A to that of B is
a) $\frac{1}{2}$ b) $\frac{2}{1}$ c) $\frac{3}{2}$ d) $\frac{2}{3}$

124. Boyle's law is applicable for an
a) adiabatic process b) isothermal process c) isobaric process d) isochoric process

125. A vessel containing 1 mole of $0_2$ 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) $\frac{P}{8}$ b) P c) 2P d) 8P

126. The kinetic energy of 1g molecule of a gas, at normal temperature and pressure, is:
a) 0.56 x $10^4$ J b) 2.7 x $10^2$ J c) 1.3 x $10^2$ J d) 3.4 x $10^3$ J

127. A gas is taken in a sealed container at 300K it is heated at constant volume to a temperature 600 K the mean KE. of its molecules is :
a) Halved b) Doubled c) Tripled d) Quadrupled

128. Two chamber containing $m_1$ and $m_2$ grams of a gas at pressures $P_l$ and $P_2$ respectively are put In communication with each other, temperature remaining constant. The common pressure reached will be
a) $\frac{P_1 P_2 (m_1 + m_2)}{P_2 m_1 + P_1 m_2}$ b) $\frac{P_1 P_2 m_1}{P_2 m_1 + P_1 m_2}$ c) $\frac{m_1 m_2 (P_1 + P_2)}{P_2 m_1 + P_1 m_2}$ d) $\frac{m_1 m_2 P_2}{P_2 m_1 + P_1 m_2}$

129. The number of translational degrees of freedom for a diatomic gas is:
a) 2 b) 3 c) 5 d) 6

130. A gas has molar heat capacity C = 37.55 J mole$^{-1}$, K$^{-1}$ in the process PT = constant. The number of degrees of freedom of the molecules of the gas.
a) 6 b) 3 c) 1 d) 5

131. Two containers A and B are partly filled with water and closed. The volume of A is twice that of B and it contains half the amount of water in B. If both are at the same temperature, the water vapour in the containers will have pressure in the ratio of:
a) 1: 2 b) 1: 1 c) 2: 1 d) 4: 1

132. **Assertion:** In a mixture of gases at a fixed temperature, the heavier molecule has the lower average speed.
**Reason :** Temperature of a gas is a measure of the average kinetic energy of a molecule.
a)
If both assertion and reason are true and reason is the correct explanation of assertion.
b)
If both assertion and reason are true but reason is not the correct explanation of assertion.
c) If assertion is true but reason is false. d) If both assertion and reason are false.

133. At 0 K, which of the following properties of a gas will be zero?
a) Kinetic energy b) Potential energy c) Density d) Mass

134. 1/2 mole of helium is contained in a container at STP How much heat energy is needed to double the pressure of the gas, (volume is constant) heat capacity of gas is 3 J s' K$^{-1}$
a) 1436 J b) 736 J c) 1638 J d) 5698 J

135. The amount of heat energy required to raise the temperature of 1 g of Helium at NTP, from $T_1$K to $T_2$K is:
a) $\frac{3}{2}N_a k_B (T_2 - T_1)$ b) $\frac{3}{4}N_a k_B (T_2 - T_1)$ c) $\frac{3}{4}N_a k_B \frac{T_2}{T_1}$
d) $\frac{3}{8}N_a k_B (T_2 - T_1)$

136. The mean free path of molecules of a gas (radius 'r') is inversely proportional to:
a) $r^3$ b) $r^2$ c) r d) $\sqrt{r}$

137. If $C_s$ be the velocity of sound in air and C be the r.m.s velocity, then:
a) $C_s < C$ b) $C_s = C$ c) $C_s = C(\gamma/3)^{1/2}$ d) None of these

138. A litre of an ideal gas at 27°C is heated at a constant pressure to 297$^0$C. Then the final volume is approximately:
a) 1.2 litres b) 1.9 litres c) 19 litres d) 2.4 litres