STATES OF MATTER

CHEMISTRY

Single Correct Answer Type

1. Select incorrect statement
   a) The properties of liquid crystals are intermediate between liquids and solids
   b) Surface tension of a liquid is maximum at critical temperature
   c) Viscosity decreases with increases in temperature
   d) CO_2 and H_2O show the unusual properties of supercritical fluids
2. The relation between molecular weight (M) and vapour density (VD) is:
   a) $M = 2.5 \times \text{VD}$ b) $M = 2 \times \text{VD}$ c) $M = 0.5 \times \text{VD}$ d) $M = \text{VD}$
3. Analysis shows that an oxide ore of nickel has formula $Ni_{0.98}O_{1.00}$. The percentage of nickel as Ni^{3+} ions is nearly
   a) 2 b) 96 c) 4 d) 98
4. In the calcium fluoride structure, the coordination number of the cation and anion are respectively
   a) 4, 4 b) 6, 6 c) 4, 8 d) 8, 4
5. In deriving the kinetic equation we make use of the root mean square speed of the molecules which is:
   a) The average speed of molecules
   b) The most probable speed of molecules
   c) The square root of the average of the square of the speed of the molecules
   d) The most accurate form in which speed can be used in the calculations
6. Bravais lattices are of
   a) 8 types b) 9 types c) 12 types d) 14 types
7. One poise is equal to:
   a) 1 dyne sec^{-2} cm b) 1 dyne sec cm^{-2} c) 1 dyne sec^{-1} cm^{-2} d) 1 dyne sec^{-1} cm^{-1}
8. The rate of diffusion of hydrogen is about
   a) One half that of helium
   b) 1.4 times that of helium
   c) Twice that of helium
   d) Four times that of helium
9. The pressure of 2 moles of ammonia at 27° when its volume is 5 L according to van der Waals' equation is (Given, $a = 4.17, b = 0.3711$)
   a) 10.33 atm b) 9.33 atm c) 9.74 atm d) 9.2 atm
10. The gases in the liquid form are held together by a weak attraction among the molecules, called as:
    a) Nuclear attraction
    b) Bond attraction
    c) Van der Waals' attraction
    d) Gravitational attraction
11. The value of the molar gas constant is
    a) 8.3145×10^3 J (g mol)$^{-1}$ K^{-1}
    b) 1.987 cal mol K^{-1}
    c) 0.083145×10^3 dm^3 bar mol^{-1} K^{-1}
    d) 0.083145 dm^3 bar mol^{-1} K^{-1}
12. For hydrogen gas $C_p - C_v = a$, and for oxygen gas $C_p - C_v = b$, so the relation between a and b is:
    a) $a = 16b$ b) $16a = b$ c) $a = 4b$ d) $a = b$
13. The solid NaCl is a bad conductor of electricity since
    a) In solid NaCl, there is no velocity of ions
    b) In solid NaCl, there are no ions
    c) In solid NaCl, there are no electrons
    d) Solid NaCl is covalent
14. A gas deviates from ideal behaviour at a high pressure because its molecules
    a) Attract one another
    b) Show the Tyndall effect

c) Have kinetic energy

d) Are bound by covalent bonds

15. A closed vessel contains equal numbers of O_2 and H_2 molecules at same T. Which of the following is not true?
a) The average speed of the hydrogen molecules is greater
b) The hydrogen molecules strike the walls of the vessel more often
c) The average kinetic energy of the two gases is the same
d) The weight of H_2 is the same as the weight of oxygen
16. Two identical cylinders contain helium at 2.5 atm and argon at 1 atm respectively. if both the gases are filled in one of the cylinders, the pressure would be:
a) 3.5 atm b) 1.75 atm c) 1.5 atm d) 1 atm
17. NH_3 and HCl gas are introduced simultaneously from the two ends of a long tube. A white ring of NH_4Cl appears first
a) Nearer to the HCl end
b) At the centre of the tube
c) Throughout the tube
d) Nearer to the NH_3 end
18. The molecular weight of O_2 and SO_2 are 32 and 64 respectively. If one litre of O_2 at 15°C and 759 mm pressure contains N molecules, the number of molecules in two litre of SO_2 under the same conditions of temperature and pressure will be:
a) $N/2$ b) N c) $2N$ d) $4N$
19. The pressure of a real gas is less than the pressure of an ideal gas because of
a) Increases in the number of collisions
b) Finite size of the molecules
c) Increase in the kinetic energy
d) Intermolecular forces
20. 32 g of O_2, 2 g of H_2 and 28 g of N_2 at STP occupy separately a volume of
a) 1 L b) 2 L c) 22.4 L d) 2.24 L
21. At what temperature is the rms speed of hydrogen molecules the same as that of oxygen molecules at 1327°C?
a) 173 K b) 100 K c) 400 K d) 523 K
22. Mark out the wrong expression
a) Boyle's temperature $T_B = \frac{b}{aR}$
b) Critical pressure $p_c = \frac{a}{27b^2}$
c) Critical temperature, $T_c = \frac{8a}{27Rb}$
d) Critical volume $V_c = 3b$
23. Which is true statement?
a) All liquid have concave meniscus
b) All liquid have convex meniscus
c) Mercury has convex and other liquids have concave meniscus
d) Mercury has concave and other liquids have convex meniscus
24. If Z is the number of atoms in the unit cell that represents the closest packing sequence..... $ABC\ ABC$ ..... , the number of tetrahedral voids in the unit cell is equal to
a) Z b) $2Z$ c) $\frac{Z}{2}$ d) $\frac{Z}{4}$
25. A Dewar flask is usually used to:
a) Measure the amount of liquid
b) Measure known volumes of a gas
c) Store distilled water
d) Store liquid air
26. What is the coordination number of sodium in Na_2O?
a) 2 b) 4 c) 6 d) 8
27. For a given crystal, the lattice parameter 'a' is 318 pm. The d-spacing for a (III) plane is
a) 318 pm b) 184 pm c) 390 pm d) 225 pm
28. Select correct statement(s)
a) The standard boiling temperature is the temperature at which the vapour pressure of the substance is 1 bar

b) The normal boiling temperature is the temperature at which the vapour pressure of the substance is 1 atm

c) Substances for which $T > T_c$ and $p > p_c$ are called super critical fluids

d) All the above are correct statements

29. The ratio of Boyle's temperature and critical temperature for a gas is:
a) 8/27 b) 27/8 c) ½ d) 2/1

30. Positive deviation from ideal behaviour takes place because of
a) Molecular interaction between atoms and $pV/nRT > 1$
b) Molecular interaction between atoms and $pV/nRT < 1$
c) Finite size of atoms and $pV/nRT > 1$
d) Finite size of atoms and $pV/nRT < 1$

31. a and b are van der Waals' constants for gases. Chlorine is more easily liquefied than ethane because
a) a and b for $Cl_2 > a$ and b for C_2H_6
b) a and b for $Cl_2 < a$ and b for C_2H_6
c) a for $Cl_2 > a$ for C_2H_6 but b for $Cl_2 > b$ for C_2H_6
d) a for $Cl_2 > a$ for C_2H_6 but b for $Cl_2 < b$ for C_2H_6

32. Longest mean free path under similar conditions of P and T stands for:
a) N_2 b) O_2 c) H_2 d) Cl_2

33. Ferrous oxide has a cubic structure and each edge of the unit cell is 5.0 Å. Assuming density of the oxide as $4.0 g/cm^{-3}$ then the number of Fe^{2+} and O^{2-} ions present in each unit cell will be
a) Two Fe^{2+} and four O^{2-}
b) Three Fe^{2+} and three O^{2-}
c) four Fe^{2+} and two O^{2-}
d) four Fe^{2+} and four O^{2-}

34. Which one of the following is correct about surface tension (ST) and viscosity (η)?
a) Both decrease with temperature
b) Both increase with temperature
c) ST increases and η decreases
d) ST decreases and η increases

35. In which of the following crystals alternate tetrahedral voids are occupied?
a) NaCl b) CaF_2 c) Na_2O d) ZnS

36. For an ideal gas, number of mol per litre in terms of its pressure p, temperature T and gas constant R is
a) pT/R b) pRT c) p/RT d) RT/p

37. For a gas $(R/C_v) = 0.67$, the gas is made up of molecules which are:
a) Monoatomic b) Diatomic c) Polyatomic d) Mixture of gases

38. As the speed of molecules increases, the number of collisions per second:
a) Decreases b) Increases c) Does not change d) None of these

39. To an evacuated vessel with movable piston under external pressure of 1 atm, 0.1 mole of He and 1.0 mole of an unknown compound (vapour pressure 0.68 atm at0°C) are introduced. Considering the ideal gas behaviour, the total volume (in litre) of the gases at 0°C is close to
a) 3 b) 5 c) 7 d) 9

40. A closed vessel contains equal number of nitrogen and oxygen molecules at a pressure of P mm. If nitrogen is removed from the system, then the pressure will be:
a) P b) $2P$ c) $P/2$ d) P^2

41. The molar volume of CO_2 is maximum at
a) NTP b) 0°C and 2.0 atm c) 127°C and 1 atm d) 273°C and 2 atm

42. An example of a metallic crystalline solid is
a) P b) Si c) W d) C

43. The density of neon will be highest at
a) STP b) 0°C, 2 atm c) 273°C, 1 atm d) 273°C, 2 atm

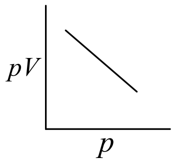
44. A 4 : 1 mixture of helium and methane is contained in a vessel at 10 bar pressure. Due to a hole in the vessel, the gas mixture leaks out. The composition of mixture effusing out initially is
a) 8 : 1 b) 8 : 3 c) 4 : 1 d) 1 : 1

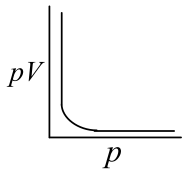
45. Which of the following set of variables give a straight line with a negative slope when plotted?
(p = apour pressure, T = temperature in K)

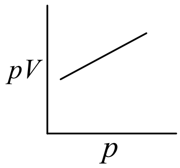
y −axis	x −axis

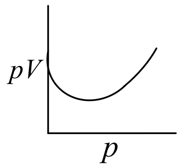
a) p T b) $\log_{10} p$ T c) $\log_{10} p$ $\frac{1}{T}$ d) $\log_{10} p$ $\log_{10} \frac{1}{T}$

46. Volume occupied by 3.01×10^{23} molecules of acetylene at NTP is:
a) 22.4 litre b) 11.2 litre c) 1.12 litre d) 2.24 litre
47. According to Charles' law:
a) $(\partial V/\partial T)_P = K$ b) $(\partial V/\partial T)_P = -K$ c) $(\partial V/\partial T)_P = -K/T$ d) None of these
48. Which of the following is a Boyle's plot at very low pressure?

a) 

b) 

c) 

d) 

49. Gases X, Y, Z, P and Q have the van der Waals' constants a and b (in CGS units) as shown below

	X	Y	Z	P	Q
a	6	6	20	0.05	30
b	0.025	0.15	0.1	0.02	0.2

The gas with the highest critical temperature is
a) P b) Q c) Y d) Z
50. At what temperature will be total kinetic energy (KE) of 0.30 mole of He be the same as the total KE of 0.40 mole of Ar at 400 K ?
a) 400 K b) 373 K c) 533 K d) 300 K
51. At constant temperature, in the given mass of an ideal gas
a) The ratio of pressure and volume always remains constants
b) Volume always remains constant
c) Pressure always remains constant
d) The product of pressure and volume always remains constant
52. At what temperature will the volume of a gas at 0°C double itself, pressure remaining constant?
a) −546°C b) 273 K c) 546°C d) 546 K
53. Which of the following is non-crystalline solid?
a) NaCl b) CsCl c) CaF_2 d) Glass
54. The ratio of close packed atoms to tetrahedral holes in cubic close packing is
a) 1:1 b) 1:2 c) 1:3 d) 2:1
55. Which of the following statement is not true?
a) The pressure of a gas is due to collision of the gas molecules with the walls of the container.
b) The molecular velocity of any gas is proportional to the square root of the absolute temperature.
c) The rate of diffusion of a gas is directly proportional to the density of the gas at constant pressure.
d) Kinetic energy of an ideal gas is directly proportional to the absolute temperature.
56. When air is blown to balloon (at constant temperature) its pressure and volume both increases. This violates:
a) Boyle's law b) Charles' law c) Gas law d) None of these
57. The joule Thomson coefficient is zero at
a) Absolute temperature b) Critical temperature
c) Inversion temperature d) Below 0°C
58. The rms velocity of molecules of a gas of density 4 kg m^{-3} and pressure 1.2×10^5 Nm^{-2} is
a) 300 ms^{-1} b) 900 ms^{-1} c) 120 ms^{-1} d) 600 ms^{-1}

59. The rms speed of hydrogen is $\sqrt{7}$ times the rms speed of nitrogen. If T is the temperature of the gas, then

a) $T_{H_2} = T_{N_2}$ b) $T_{H_2} > T_{N_2}$

c) $T_{H_2} < T_{N_2}$ d) $T_{H_2} = \sqrt{7T_{N_2}}$

60. The most unsymmetrical crystal system is

a) hexagonal b) Triclinic c) Cubic d) orthorhombic

61. If the rms speed of a gaseous molecule is x ms^{-1} at a pressure p atm, then what will be the rms speed at a pressure $2p$ atm and constant temperature?

a) x b) $2x$ c) $4x$ d) $x/4$

62. A 2.24 litre cylinder containing O_2 gas at 27°C and 2 atm is found to develop a leakage. When the leakage was repaired, the pressure dropped to 100 cm of Hg at 27°C. The number of mole of gas escaped out during leakage is:

a) 0.06 b) 0.05 c) 0.07 d) 0.08

63. Avogadro's number is the number of molecules present at NTP in:

a) 1 mL of gas b) 1 litre of gas c) 22.4 litre of gas d) 22.4 mL of gas

64. The ratio of rate of diffusion of helium and methane under identical conditions of pressure and temperature is:

a) 4 b) 2 c) 1 d) 0.5

65. At what temperature will be rate of effusion of N_2 be 1.625 times the rate of effusion of SO_2 at 500°C ?

a) 273 K b) 893 K c) 110 K d) 173 K

66. When a sample of gas is compressed at constant temperature from 15 atm to 60 atm, its volume changes from76 cm^3 to 20.5 cm^3. Which of the following statements are possible explanations of this behaviour?

1. The gas behaves non-ideally
2. The gas dimerises
3. The gas is absorbed into the vessel walls

a) 1, 2, and 3 b) 1 and 2 only c) 2 and 3 only d) 1 only

67. The root mean square velocity of a gas is double when the temperature is

a) Increased four times b) Increased two times

c) Reduced to half d) Reduced to one fourth

68. A flask is of a capacity one litre. What volume of air will escape out from it on heating from 27°C to 37°C? Assume pressure constant:

a) 1.033 litre b) 33.3 mL c) 33.3 litre d) None of these

69. The correct statement in the following is

a) The ionic crystal of AgBr has Schottky defect

b) The coordination number of Na^+ ion in NaCl is 4

c) In ionic compounds having Frenkel defect, the ratio $\frac{r_+}{r_-}$ is high

d) The unit cell having crystal parameters, $a = b \neq c, \alpha = \beta = 90°, \gamma = 120°$ is hexagonal

70. An element occurring in the bcc structure has 12.08×10^{23} unit cells. The total number of atoms of the element in these cells will be

a) 6.04×10^{23} b) 12.08×10^{23} c) 24.16×10^{23} d) 36.18×10^{23}

71. An ideal gas expands according to $PV =$ constant. On expansion, the temperature of gas:

a) Will rise

b) Will drop

c) Will remain constant

d) Cannot be determined because the external pressure is not known

72. The temperature at which the second virial coefficient of a real gas is zero is called:

a) Critical temperature b) Eutectic point c) Boiling point d) Boyle's temperature

73. Total energy of one mole of an ideal gas (monoatomic) at 27°C is:

a) 600 cal b) 900 cal c) 800 cal d) 300 cal

74. KE of one mole of He at 0°C is:

a) 819.0 cal b) 84.43 cal c) 8.143 cal d) None of these

75. At lower temperatures, all gases except H_2 and He show:
a) Negative deviation
b) Positive deviation
c) Positive and negative deviation
d) None of the above

76. For a real gas, deviations from ideal gas behaviour are maximum at:
a) $-10°C$ and 5.0 atm b) $-10°C$ and 2.0 atm c) 0°C and 1.0 atm d) 100°C and 2.0 atm

77. Effect of temperature on viscosity is given by
a) Hole theory b) Arrhenius theory c) Adsorption theory d) Collision theory

78. In a closed flask of 5 L, 1.0 g of H_2 is heated from 300 to 600 K. Which statement is not correct?
a) Pressure of the gas increases
b) The rate of collision increases
c) The number of mole of gas increases
d) The energy of gaseous molecules increases

79. If latent heat of vaporization is L at boiling point T(K) then entropy of vaporisation is
a) LT b) LT^{-1} c) TL^{-1} d) None of these

80. Equal volumes of two gases are kept in separate containers at the same temperature and pressure. Then:
a) Masses of the two gases are same
b) Molecular structure of two gases would be similar
c) The two gases contain the same number of molecules
d) The two gases, if allowed to diffuse would do so at the same rate

81. 300 mL of a gas at 27°C is cooled to $-3°C$ at constant pressure. The final volume is
a) 350 L b) 270 mL c) 540 mL d) 135 mL

82. Which one of the following will give a linear plot at constant pressure?
a) $T \; vs \frac{1}{V}$ b) $V \; vs \frac{1}{T}$ c) $V \; vs \; T$ d) None of these

83. When gases are heated from 20°C to 40°C at constant pressure, the volume:
a) Increase by the same magnitude
b) Become double
c) Increase in the ratio of their molecule masses
d) Increase but to different extent

84. In which one of the following does the given amount of chlorine exert the least pressure in a vessel of capacity 1 dm^3 at 273 K?
a) 0.0355g
b) 0.071
c) 6.023×10^{21} molecules
d) 0.02 moles

85. A crystalline solid
a) Changes abruptly from solid to liquid when heated
b) Has no definite melting point
c) Has an irregular three-dimensional arrangements
d) Undergoes deformation of its geometry easily

86. $H_2O(l) \xrightleftharpoons{1 \text{ atm}} H_2O(g), \Delta H_{vap} = 10 \text{ kcal mol}^{-1}$. If pressure is increased
a) Steam is liquefied
b) b.p. of H_2O is elevated
c) Both (a) and (b)
d) None of these

87. At NTP, 5.6 litre of a gas weighs 8 g. The vapour density of the gas is:
a) 32 b) 40 c) 16 d) 8

88. Which of the following will increase with the increase in temperature?
a) Surface tension b) Viscosity c) Molality d) Vapour pressure

89. The condition of SATP refers for:
a) 25°C and 2 atm b) 25°C and 1 atm c) 0°C and 2 atm d) 25°C and 1 bar

90. The equation, $\left[P_r + \frac{3}{V_r^2}\right][3V_r - 1] = 8T_r$:

a) Is equation for law of corresponding states.
b) States that under similar conditions of reduced pressure (P_r) and reduced temperature (T_r) gases possess same reduced volume (V_r)
c) Provides better results at boiling point of two liquids
d) All of the above

91. The compressibility of a gas is less than unity as STP. Therefore,
a) $v_m > 22.4$ L b) $v_m < 22.4$ L c) $v_m = 11.2$ L d) $v_m = 44.8$ L

92. If the pressure is halved and absolute temperature doubled the volume of the gas will be:
a) 4 b) 2 c) Same d) 8

93. Which form of matter is highly compressible?
a) Solid b) Liquid c) Gas d) Colloidal

94. Two sealed containers of the same capacity and at the same T are filled with 44 g of H_2 gas in one and 44 g of CO_2 in other. If the P of CO_2 is 1 atm in other, the P of H_2 in its container will be:
a) 1 atm b) Zero c) 22 atm d) 44 atm

95. Vapour pressure increases with increase in
a) Concentration of solution containing non-volatile solute
b) Temperature up to boiling point
c) Temperature up to triple point
d) Altitude of the concerned place of boiling

96. An alloy of Cu, Ag and Au is found to have Cu forming the simple cubic close packed lattice. If the Ag atoms occupy the face centres and Au is present at the body centre, the formula of the alloy will be
a) Cu_4Ag_4Au b) $CuAg_3Au$ c) CuAgCu d) Cu_4Ag_2Au

97. The root mean square speed of the molecules of diatomic gas is u. When the temperature is doubled, the molecules dissociates into two atoms. The new rms speed of the atom is:
a) $\sqrt{2}u$ b) u c) $2u$ d) $4u$

98. The kinetic energy of molecules at constant temperature in gaseous state is:
a) More than those in the liquid state
b) Less than those in the liquid state
c) Equal to those in the liquid state
d) None of the above

99. At a constant pressure, what should be the percentage increase in the temperature in Kelvin for a 10% increase in volume?
a) 10% b) 20% c) 5% d) 50%

100. A mixture of helium and argon contains 3 mole of He for every 2 mole of Ar. The partial pressure of argon is:
a) 2/3 the total pressure
b) 1/3 the total pressure
c) 2/5 the total pressure
d) 1/5 the total pressure

101. Boyle's law is applicable in:
a) Isobaric process b) Isochoric process c) Isothermal process d) Adiabatic process

102. Which defect causes decreases in the density of crystal?
a) Frenkel b) Schottky c) Interstitial d) F-centre

103. A perfect gas of a given mass is heated first in a small vessel and then in a large vessel, such that their volume remains unchanged. The P-T curves are:
a) Parabolic with same curvature
b) Parabolic with different curvatures
c) Linear with same slope
d) Linear with different slopes

104. The three states of matter are solid, liquid and gas. Which of the following statements is/ are true about

them?
a) Gases and liquids have viscosity as a common property
b) The molecules in all the three states posses random translational motion
c) Gases cannot be converted into solids without passing through the liquid phase
d) Solids and liquids have vapour pressure as a common property

105. The kinetic theory of gases predicts that total kinetic energy of a gaseous assembly depends on
a) Pressure of the gas
b) Temperature of the gas
c) Volume of the gas
d) Pressure, volume and temperature of the gas

106. If two moles of a ideal gas at 546 K occupy volume 44.8 L, then pressure must be
a) 2 atm b) 3 atm c) 4 atm d) 1 atm

107. What is kinetic energy of 1 g of O_2 at 47°C?
a) 1.24×10^2 J b) 2.24×10^2 J c) 1.24×10^3 J d) 3.24×10^2 J

108. If volume containing gas is compressed to half, how many moles of gas remained in the vessel?
a) Just double b) Just half c) Same d) More than double

109. At constant volume, the pressure of a monoatomic gas depends upon:
a) Thickness of the walls of the container
b) The absolute temperature
c) The atomic number of the element
d) The number of valency electrons

110. If two moles of an ideal gas at 246 K occupy a volume of 44.8 L, the pressure must be
a) 4 atm b) 2 atm c) 8 atm d) 6 atm

111. Example of unit cell with crystallographic dimensions, $a \neq b \neq c, \alpha = \gamma = 90°, \beta \neq 90°$, is
a) Calcite b) rhombic sulphur c) Graphite d) Monoclinic sulphur

112. The unit of van der Waals' constant $'a'$ is:
a) atm litre^2 mol^2 b) dyne cm^4 mol^{-2} c) newton m^4 mol^{-2} d) All of these

113. Use of hot air balloons in sports and meteorological observations is an application of:
a) Boyle's law b) Newtonic law c) Charles' law d) Brown's law

114. The circulation of blood in human body supplies O_2 and releases CO_2. The concentration of O_2 and CO_2 is variable but on the average, 100 mL blood contains 0.02 g of O_2 and 0.08 g CO_2. The volume of O_2 and CO_2 at 1 atm and body temperature 37°C, assuming 10 litre blood in human body is:
a) 2 litre, 4 litre b) 1.5 litre, 4.5 litre c) 1.59 litre, 4.62 litre d) 3.82 litre, 4.62 litre

115. If the distance between Na^+ and Cl^- ions in NaCl crystal is 'a' pm what is the length of the cell edge?
a) $4a$ pm b) $\frac{a}{4}$ pm c) $2a$ pm d) $\frac{a}{2}$ pm

116. Normal temperature and pressure (NTP) of gases refers to:
a) 273 K and 760 mm Hg
b) 273°C and 760 mm Hg
c) 273 K and 76 mm Hg
d) 273°C and 76 mm Hg

117. $CuSO_4 aq.$ absorbs:
a) NH_3 b) H_2S c) PH_3 d) All of these

118. Under which of the following conditions, van der Waals' gas approaches ideal behaviour?
a) Extremely lower pressure
b) Low temperature
c) High pressure
d) Low product of pV

119. The compressibility factor of an ideal gas is
a) 1 b) 2 c) 4 d) 0

120. A vessel has two equal compartments A and B containing H_2 and O_2 respectively, each at 1 atm pressure. If the wall separating the compartment is removed, the pressure:
a) Will remain unchanged in A and B
b) Will increase in A and decrease in B
c) Will decrease in A and increase in B

d) Will increase in both A and B

121. Quartz is a crystalline variety of
a) Silica b) Silicon c) Silicon carbide d) Sodium silicate

122. A sample of gas at 35°C and 1 atmospheric pressure occupies a volume of 3.75 litre. At what temperature should the gas be kept, if it is required to reduce the volume to 3.0 litre at the same pressure?
a) −26.6°C b) 0°C c) 3.98°C d) 28°C

123. Air at sea level is dense. This is a practical application of:
a) Boyle's law b) Charles' law c) Avogadro's law d) Dalton's law

124. The strength of van der Waals' forces increases with:
a) Increase in molecular size
b) Increase in the number of electrons in the molecule
c) Increases in molecular weight
d) All of the above

125. The vacant space in the bcc unit cell is
a) 23% b) 26% c) 32% d) None of these

126. Pressure remaining constant, the volume of a given sample of gas at 127°C will be doubled at:
a) 254°C b) 527°C c) 400 K d) 800°C

127. The numerical value of $'a'$ the van der Waals' constant is maximum for:
a) NH_3 b) H_2 c) O_2 d) He

128. To which of the following gaseous mixtures is Dalton's law not applicable?
a) $Ne + He + SO_2$ b) $NH_3 + HCl + HBr$ c) $O_2 + N_2 + CO_2$ d) $N_2 + H_2 + O_2$

129. At critical temperature of a liquid, surface tension is
a) Zero b) Infinite
c) Varies liquid to liquid d) Can't be measured

130. The rms speed of hydrogen is $\sqrt{7}$ times the rms speed of nitrogen. If T is the temperature of the gas, then
a) $T_{H_2} = T_{N_2}$ b) $T_{H_2} > T_{N_2}$ c) $T_{H_2} < T_{N_2}$ d) $T_{H_2} = \sqrt{7}T_{N_2}$

131. Equal masses of nitrogen and ethylene are mixed in an empty container at 27°C. The total pressure exerted by the gaseous mixture is 1 atm. The partial pressure exerted by ethylene gas is :
a) 0.67 atm b) 0.33 atm c) 0.50 atm d) 0.20 atm

132. At a constant temperature what should be the percentage increase in pressure for a 5% decrease in the volume of gas?
a) 5% b) 10% c) 5.26% d) 4.26%

133. At 27°C a gas was compressed to half its volume. To what temperature must it be heated so that it occupies the original volume? (P = constant)
a) 54°C b) 600°C c) 327 K d) 327°C

134. A solid is made of two elements X and Z. The atoms Z are in ccp arrangement while the atom X occupy all the tetrahedral sites. What is the formula of the compound?
a) XZ b) XZ_2 c) X_2Z d) X_2Z_3

135. For cubic coordination, the value of radius ratio is
a) 0.000 − 0.225 b) 0.225 − 0.414 c) 0.414 − 0.732 d) 0.732 − 1.000

136. An example of fluorite structure is
a) NaF b) $AlCl_3$ c) SrF_2 d) SiF_4

137. Clausius-Clapeyron equation is
a) $\frac{d \log p}{dT} = \frac{\Delta H_{vap}}{2.303\, RT^2}$ b) $\log p = \log A - \frac{\Delta H_{vap}}{2.303\, RT}$
c) Both (a) and (b) d) None of the above

138. The concept of critical temperature for a gas was given by:
a) Andrew b) Boyle c) Charles d) None of these

139. Correct gas equation is
a) $\frac{p_1T_1}{V_1} = \frac{p_2T_2}{V_2}$ b) $\frac{V_1T_2}{p_1} = \frac{V_2T_1}{p_2}$ c) $\frac{p_1V_1}{p_2V_2} = \frac{T_1}{T_2}$ d) $\frac{V_1V_2}{T_1T_2} = p_1p_2$

140. The edge of unit cell of fcc Xe crystal is 620 pm. The radius of Xe atom is
a) 189.37 pm b) 209.87 pm c) 219.25 pm d) 235.16 pm
141. The following is not a function of an impurity present in a crystal
a) Establishing thermal equilibrium b) Having tendency to diffuse
c) Contributing to scattering d) Introducing new electronic energy levels
142. Which one of the following statements is not true about the effect of an increase in temperature on the distribution of molecular speeds in a gas?
a) The area under the distribution curve remains the same as under the lower temperature
b) The distribution becomes broader
c) The fraction of the molecules with the most probable speed increases
d) The most probable speed increases
143. Identify the pair of gases that have equal rates of diffusion
a) CO, NO b) N_2O, CO c) N_2O, CO_2 d) CO_2, NO_2
144. Oxygen gas is collected by downward displacement of water in a jar. The level of water inside the jar is adjusted to the height of water outside the jar. When the adjustment is made, the pressure exerted by the oxygen is:
a) Equal to the atmospheric pressure
b) Equal to the vapour pressure of oxygen at that temperature
c) Equal to atmospheric pressure plus aqueous tension at that temperature
d) Equal to atmospheric pressure minus aqueous tension at that temperature
145. The maximum radius of sphere that can be fitted in the octahedral hole of cubical closed packing of sphere of radius r is
a) 0.732 r b) 0.414 r c) 0.225 r d) 0.155 r
146. The root mean square velocity of a gas is doubled when temperature is
a) Increased four times b) Increased two times
c) Reduced to half d) Reduced to one fourth
147. Assume that air is 21% oxygen and 79% nitrogen by volume. If the barometric pressure is 740 mm, the partial pressure of oxygen is closest to which one of the following?
a) 155.4 mm b) 310 mm c) 580 mm d) 740 mm
148. A and B are two identical vessels. A contains 15 g of ethane at 298 K and 1 atm. The vessel B contains 75 g gas X_2 at the same temperature and pressure. The vapour density of X_2 is:
a) 75 b) 150 c) 37.5 d) 300
149. Which gas contains larger number of molecules?
a) 4 g of H_2O b) 2 g of marsh gas c) 4 g of PCl_5 d) 2 g of phoszene
150. A gas is found to have formula $[CO]_x$. Its VD is 70. The value of x must be:
a) 3 b) 5 c) 6 d) 2.5
151. Which one of the following metal oxides is antiferromagnetic in nature?
a) MnO_2 b) VO_2 c) TiO_2 d) CrO_2
152. If 1 litre of a gas A at 600 mm and 0.5 litre of gas B at 800 mm are taken in a 2 litre bulb. The resulting pressure is:
a) 1500 mm b) 1000 mm c) 2000 mm d) 500 mm
153. Which of the following gases would have the highest rms speed at 0°C ?
a) O_3 b) CO_2 c) SO_3 d) CO
154. Which statement violates the assumptions of the kinetic theory of gases?
a) Gases consist of large number of small particles called molecules
b) The molecules are at rest
c) The molecules possess random and chaotic motion
d) There is no attraction between the molecules
155. Space lattice of CaF_2 is
a) fcc b) Bcc c) hcp d) simple cubic

156. In zinc blende structure, the coordination number of Zn^{2+} ion is

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

157. At 27°C, 500 mL of helium diffuses in 30 min. What is the time (in hours) taken for 1000 mL of SO_2 to diffuse under same experimental conditions?

a) 240 b) 3 c) 2 d) 4

158. Indicate which of the following statements is correct?

a) At constant temperature, the KE of all gas molecules will be the same
b) At constant temperature, the KE of different molecules will be different
c) At constant temperature, the KE will be greater for heavier gas molecules
d) At constant temperature, the KE will be less for heavier gas molecules

159. Which of the following represents total kinetic energy of one mole of gas?

a) $1/2\ RT$ b) $3/2\ RT$ c) $(C_p - C_V)\ RT$ d) $2/3\ RT$

160. Gay-Lussac's law of gaseous volumes is derived from:

a) Law of reciprocal proportions
b) Law of multiple proportions
c) Experimental observations
d) None of the above

161. The ratio of average speed of an oxygen molecule to the rms, speed of a nitrogen molecule at the same temperature is:

a) $\left(\frac{3\pi}{7}\right)^{1/2}$ b) $\left(\frac{7}{3\pi}\right)^{1/2}$ c) $\left(\frac{3}{7\pi}\right)^{1/2}$ d) $\left(\frac{7\pi}{3}\right)^{1/2}$

162. The following is a method to determine the surface tension of liquids

a) Single capillary method b) Refractometric method
c) Polarimetric method d) Boiling point method

163. Which phrase would be incorrect to use?

a) A molecule of an element
b) An atom of an element
c) A molecule of a compound
d) None of the above

164. In which of the following substances the carbon atom is arranged in a regular tetrahedral structure?

a) Diamond b) Benzene c) Graphite d) Carbon black

165. In two separate bulbs containing ideal gases A and B respectively, the density of gas A is twice that of gas B while molecular weight of gas A is half that of gas B at the same temperature, pressure ratio P_A/P_B will be:

a) ¼ b) ½ c) 4 d) 1

166. A, B and C are ideal gases. Their molecular weights are 2, 4 and 28 respectively. The rate of diffusion of these gases follow the order

a) $C > A > B$ b) $C > B > A$ c) $A = B$ d) $A > L$

167. 4.0 g of argon has pressure P and temperature T K in a vessel. On keeping the vessel at 50° higher temperature, 0.8 g of argon was given out to maintain the pressure P. The original temperature was:

a) 73 K b) 100 K c) 200 K d) 510 K

168. The inversion temperature (T_i) for a gas is given by:

a) $\frac{a}{Rb}$ b) $\frac{2a}{Rb}$ c) $\frac{Rb}{a}$ d) $\frac{2Rb}{a}$

169. The van der Waals' equation for real gas is:

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

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

c) $P = \frac{nRT}{V - nb} - \frac{an^2}{V^2}$

d) All of the above

170. Amorphous solids are

a) Supercooled liquids
b) solid substances
c) Liquids
d) Substances with definite m.p.

171. The temperature of 20 L of nitrogen was increased from 10 K to 30 K at a constant pressure. Change in volume will be

a) 20 L
b) 40 L
c) 60 L
d) 80 L

172. A flask of methane (CH_4) was weighed. Methane was then pushed out and the flask again weighed when filled with oxygen at the same temperature and pressure. The mass of oxygen would be:

a) The same as the methane
b) Half of the methane
c) Double of that of methane
d) Negligible in comparison to that of methane

173. When a solid vaporizes directly without melting, it is known as:

a) Evaporation
b) Sublimation
c) Sedimentation
d) Saponification

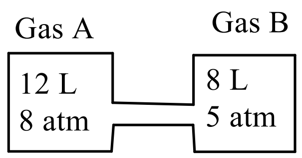
174. For an ionic crystal of the general formula AX and coordination number 6, the value of radius ratio will be

a) in between 0.732 and 0.414
b) in between 0.414 and 0.225
c) less than 0.225
d) greater than 0.732

175. A gas at 298 K is shifted from a vessel of 250 cm^3 capacity to that of 1 L capacity. The pressure of the gas will

a) Becomes four times
b) Becomes doubled
c) Decrease by one-fourth
d) Decrease by half

176. Two vessels containing gases A and B are interconnected as shown in the figure. The stopper is opened, the gases are allowed to mix homogeneously. The partial pressures of A and B in the mixture will be, respectively



a) 8 and 5 atm
b) 9.6 and 4 atm
c) 4.8 and 2 atm
d) 6.4 and 4 atm

177. Different gases at the same temperature have same

a) Pressure
b) Number of moles
c) Volume
d) Average kinetic energy

178. Certain crystals produces electric signals on application of pressure. This phenomena is called

a) Ferroelectricity
b) Ferrielectricity
c) Pyroelectricity
d) Piezoelectricity

179. If air contains N_2 and O_2 in volume ratio 4 : 1. The average vapour density of air is:

a) 14.5
b) 16.5
c) 14.4
d) 29.0

180. In face centred cubic unit cell edge length is

a) $2r$
b) $\frac{\sqrt{3}}{2}r$
c) $\frac{4}{\sqrt{3}}r$
d) $\frac{4}{\sqrt{2}}r$

181. When an ideal gas undergoes unrestricted expansion, no cooling takes place because the molecules:

a) Exert no attractive forces on each other
b) Do work equal to loss of KE
c) Collide without loss of energy
d) Are above the inversion temperature

182. If volume of a given mass of gas at constant T, becomes three times, the pressure will be:

a) $3P$
b) $P/3$
c) $9P$
d) P

183. The relationship between P_c, V_c and T_c is:

a) $P_cV_c = RT$
b) $P_cV_c = 3RT_c$
c) $P_cV_c = \frac{3}{5}RT_c$
d) $P_cV_c = \frac{3}{8}RT_c$

184. The rms speed of gas molecules at a temperature 27 K and pressure 1.5 bar is 1×10^4 cm/sec. If both

temperature and pressure are raised three times, the rms speed of the gas will be:

a) 9×10^4cm/sec b) 3×10^4cm/sec c) 1×10^4cm/sec d) $\approx 1 \times 10^4$cm/sec

185. The number of equidistance oppositely charged ions in a sodium chloride crystal is

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

186. Equal volumes of two gases which don't react together are confined in separate vessels. Their pressure is 100 mm and 300 mm of Hg respectively. If the two vessels are joined together, then what will be the pressure of the resulting mixture? (Temperature remains constant)

a) 400 mm b) $\sqrt{400}$ mm c) 300 mm d) 200 mm

187. The mean free path (λ) of a gas sample is given by:

a) $\lambda = \sqrt{2}\,\pi\sigma^2 N$ b) $\lambda = \frac{1}{\sqrt{2}\,\pi\sigma^2 N}$ c) $\lambda = \sqrt{2}\,\pi u\sigma^2 N$ d) None of these

188. Which of the following is ferroelectric compound?

a) $BaTiO_3$ b) Pb_2O_3 c) $PbZrO_3$ d) $K_4[Fe(CN)_6]$

189.

Gas	CO	CH_4	HCl	SO_2
Critical temp, T_c(K)	134	190	324	430

In the context of given values of critical temperature, the greater ease of liquefication is of

a) SO_2 b) HCl c) CH_4 d) CO

190. The unit of van der Waal's constant $'b'$ is:

a) $cm^3\ mol^{-1}$ b) litre mol^{-1} c) $m^3\ mol^{-1}$ d) All of these

191. The number of atoms in 100 g of an fcc crystal with density $d = 10 g/cm^3$ and cell edge equal to 100 pm, is equal to

a) 1×10^{25} b) 2×10^{25} c) 3×10^{25} d) 4×10^{25}

192. Which of the following pair of gases contain the same number of molecules?

a) 16 g O_2, 14g N_2 b) 8g O_2, 22g N_2 c) 28g N_2, 22g CO_2 d) 32g O_2, 32g N_2

193. Two closed vessels of equal volume containing air at pressure p_1 and temperature T_1 are connected to each other through a narrow tube. If the temperature in one of the vessels is now maintained at T_1 and that in the other at T_2, what will be the pressure in the vessels?

a) $\frac{2p_1T_1}{T_1 + T_2}$ b) $\frac{T_1}{2p_1T_2}$ c) $\frac{2p_1T_2}{T_1 + T_2}$ d) $\frac{2p_1}{T_1 + T_2}$

194. In case of hydrogen and helium the van der Waals' forces are:

a) Strong b) Very strong c) Weak d) None of these

195. The volume of ammonia obtained by the complete combination of 10 mL of N_2 and 30 mL of H_2 is:

a) 20 mL b) 40 mL c) 30 mL d) 10 mL

196. If the value of ionic radius ratio $\left(\frac{r_c}{r_a}\right)$ is 0.52 in an ionic compound, the geometrical arrangement of ions in crystal is

a) Planar b) Pyramidal c) Tetrahedral d) Octahedral

197. The constituent particles of a solid have

a) Rotatory motion only b) Vibratory motion only

c) Translatory motion only d) All of these

198. At relatively high pressure, van der Waals' equation reduces to:

a) $PV = RT$ b) $PV = RT + a/V$ c) $PV = RT + Pb$ d) $PV = RT - a/V^2$

199. Crystals can be classified into…. basic crystal lattices

a) 3 b) 7 c) 6 d) 14

200. Which type of solid crystals will conduct heat and electricity?

a) Ionic b) Covalent c) Molecular d) Metallic

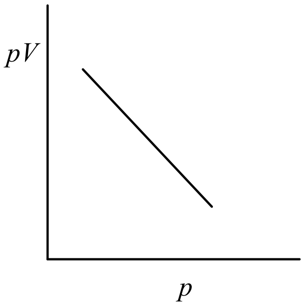
201. One atmosphere is numerically equal to approximately:

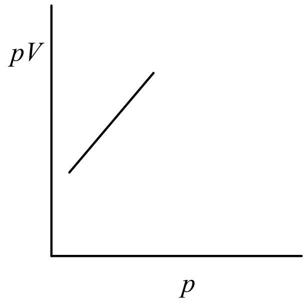
a) 10^6 dyne cm^{-2} b) 10^2 dyne cm^{-2} c) 10^4 dyne cm^{-2} d) 10^8 dyne cm^{-2}

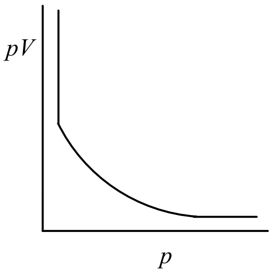
202. Calculate the total pressure in a 10.0 L cylinder which contains 0.4 g helium, 1.6 g oxygen and 1.4 g nitrogen at 27°C.

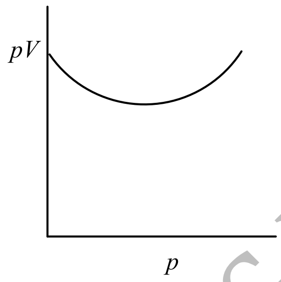
a) 0.492 atm b) 49.2 atm c) 4.92 atm d) 0.0492 atm

203. Which of the following is a Boyle plot at very low pressure?

a) 

b) 

c) 

d) 

204. A flask filled with CCl_4 was weighed at a temperature and pressure. The flask was then filled with oxygen at the same temperature and pressure. The mass of CCl_4 vapour would be about:

a) The same as that of the oxygen
b) One-fifth as heavy as oxygen
c) Five times as heavy as oxygen
d) Twice as heavy as oxygen

205. In a face centred cubic cell, an atom at the face contributes to the unit cell

a) 1 part b) $\frac{1}{2}$ part c) $\frac{1}{4}$ part d) $\frac{1}{8}$ part

206. Four rubber tubes are respectively filled with H_2, O_2, N_2 and He. The tube which will be reinflated first is:

a) H_2 filled tube b) O_2 filled tube c) N_2 filled tube d) He filled tube

207. Schottky defect generally appears in

a) KCl b) NaCl c) CsCl d) All of these

208. Calculate the ionic radius of a Cs^+ ion, assuming that the cell edge length for CsCl is 0.4123 nm and that the ionic radius of a CI^- ion is 0.181 nm

a) 0.352 nm b) 0.116 nm c) 0.231 nm d) 0.176 nm

209. The deuiation from the ideal gas behaviour of a gas can be expressed as

a) $Z = \frac{p}{VRT}$ b) $Z = \frac{pV}{nRT}$ c) $Z = \frac{nRT}{pV}$ d) $Z = \frac{VR}{pT}$

210. Positive deviation from ideal behaviour takes place because of

a) Molecular interaction between atom and $\frac{pV}{nRT} > 1$
b) Molecular interaction between atom and $\frac{pV}{nRT} < 1$
c) Finite size of atoms and $\frac{pV}{nRT} > 1$
d) Finite size of atoms and $\frac{pV}{nRT} < 1$

211. In an experiment during the analysis of a carbon compound, 145 mL of H_2 was collected at 760 mm Hg pressure and 27°C. The weight of H_2 is nearly :

a) 10 mg b) 12 mg c) 6 g d) 8 g

212. The pressure and temperature of $4 dm^3$ of carbon dioxide gas are doubled, then the volume of carbon dioxide gas would be

a) $2\ dm^3$ b) $3\ dm^3$ c) $4\ dm^3$ d) $8\ dm^3$

213. Adiabatic demagnetisation is a technique used for:

a) Adiabatic expansion of a gas

b) Production of low temperature
c) Production of high temperature
d) None of the above

214. A real gas at high pressure occupies under identical conditions:
a) More volume than that of an ideal gas
b) Less volume than that of an ideal gas
c) Same volume as that of an ideal gas
d) More or less volume than that of an ideal gas depending upon the nature of the gas

215. Structure similar to zinc blende is found in
a) NaCl b) AgCl c) CuCl d) TlCl

216. One mole of a gas is defined as:
a) The number of molecules in one litre of gas
b) The number of molecules in 2.24 litre of a gas
c) The number of atoms contained in 12g of C^{14} isotope
d) The number of molecules in 22.4 litre of a gas at STP

217. The formula for determination of density of unit cell is
a) $\frac{a^3 \times N_A}{Z \times M}$ g cm^{-3} b) $\frac{M \times N_A}{A^3 \times Z}$ g cm^{-3} c) $\frac{Z \times M}{a^3 \times N_A}$ g cm^{-3} d) $\frac{a^3 \times M}{Z \times N_A}$ g cm^{-3}

218. The crystal system of a compound with unit cell dimensions, $a = 0.387, b = 0.387$ and $c = 0.504$ nm, and $\alpha = \beta = 90°$ and $\gamma = 120°$ is
a) Cubic b) Hexagonal c) Orthorhombic d) Rhombohedral

219. Air at sea level is dense, this is a practical implementation of
a) Boyle's law b) Charles' law c) Avogadro's law d) Dalton's law

220. During the evaporation of liquid
a) The temperature of the liquid will rise
b) The temperature of the liquid will fall
c) May rise or fall depending on the nature
d) The temperature remains unaffected

221. A spherical balloon of 21 cm diameter is to be filled with hydrogen at STP from a cylinder containing the gas at 20 atm and 27°C. If the cylinder can hold 2.82 L of water, the number of balloons that can be filled up is
a) 5 b) 2 c) 10 d) 12

222. O_2 is collected over water at 20°C. The pressure inside shown by the gas is 740 mm of Hg. What is the pressure due to O_2 alone if vapour pressure of H_2O is 18 mm at 20°C ?
a) 722 mm b) 740 mm c) 758 mm d) None of these

223. A pure crystalline substance, on being heated gradually, first forms a turbid looking liquid and then the turbidity completely disappears. This behavior is the characteristic of substances forming
a) isomeric crystals b) liquid crystals c) isomorphous crystals d) allotropic crystals

224. If pressure of a gas contained in a closed vessel is increased by 0.4% when heated by 1°C its initial temperature must be:
a) 250 K b) 250°C c) 2500 K d) 25°C

225. A solid has a structure in which 'W' atoms are located at the corners of a cubic lattice 'O' atoms at the centre of edges and Na atoms at the centre of the cube. The formula for the compound is
a) Na_2WO_3 b) Na_2WO_2 c) $NaWO_2$ d) $NaWO_3$

226. 10 g each of CH_4 and O_2 are kept in cylinders of same volume under same temperatures, give the pressure ratio of two gases
a) 2 : 1 b) 1 : 4 c) 2 : 3 d) 3 : 4

227. A sample of gas is at 0°C. The temperature at which its rms speed of the molecules will be doubled is:
a) 103°C b) 273°C c) 723°C d) 819°C

228. If the concentration of water vapour in the air is 1% and the total atmospheric pressure equals 1 atm then the partial pressure of water vapour is:
a) 0.1 atm b) 1 mm Hg c) 7.6 mm Hg d) 100 atm

229. 0.5 mole of each of H_2, SO_2 and CH_4 are kept in a container. A hole was made in the container. After 3 h, the order of partial pressures in the container will be
a) $pSO_2 > pH_2 > pCH_4$ b) $pSO_2 > pCH_4 > pH_2$ c) $pH_2 > pSO_2 > pCH_4$ d) $pH_2 > pCH_4 > pSO_2$
230. 22 g solid CO_2 or dry ice is enclosed in a bottle of one litre properly closed. If temperature of bottle is raised to 25°C to evaporate all the CO_2, the pressure in bottle is:
a) 13.23 atm b) 12.23 atm c) 11.23 atm d) 14.23 atm
231. Gases deviate from ideal gas behaviour at high pressure. Which of the following is correct for non ideality?
a) At high pressure, the collision between the gas molecules becomes enormous
b) At high pressure, the gas molecules move only in one direction
c) At high pressure, the volume of gas becomes insignificant
d) At high pressure, the intermolecular interaction become significant
232. CsBr crystal has bcc structure. It has an edge length of 4.3 Å. The shortest interionic distance between Cs^+ and Br^- ions is
a) 1.86 Å b) 2.86 Å c) 3.72 Å d) 4.72 Å
233. Two gases A and B having the same volume diffuse through a porous partition in 20 and 10 seconds respectively. The molecular mass of A is 49 u. Molecular mass of B will be:
a) 25.00 u b) 50.00 u c) 12.25 u d) 6.50 u
234. In the van der Waals' equation, the constant $'a'$ and $'b'$ with temperature shows which trend:
a) Both remains same
b) $'a'$ remains same, b varies
c) $'a'$ varies, b remains same
d) Both varies
235. Frenkel defect is found in crystals in which the radius ration is
a) 1.5 b) 1.7
c) Very low d) Slightly less than unity
236. Graham's law deals with the relation between
a) Pressure and volume b) Density and rate of diffusion
c) Rate of diffusion and volume d) Rate of diffusion and viscosity
237. The density of a gas A is twice that of a gas B at the same temperature. The molecular weight of gas B is thrice that of A. The ratio of the pressures acting on A and B will be
a) $\frac{1}{6}$ b) $\frac{7}{8}$ c) $\frac{2}{5}$ d) $\frac{1}{4}$
238. The CO_2 gas does not follow gaseous laws at all ranges of pressure and temperature because
a) It is triatomic gas b) Its internal energy is quite high
c) There is attraction between its molecules d) It solidify at low temperature
239. Based on kinetic theory of gases following laws can be proved
a) Boyle's law b) Charles' law c) Avogadro's law d) All of these
240. The quantity $pV/(k_B T)$ represents the
a) Number of molecules in the gas b) Mass of the gas
c) Number of moles of the gas d) Translation energy of the gas
241. Hydrogen diffuses six times faster than gas A. The molar mass of gas A is
a) 72 b) 6 c) 24 d) 36
242. A certain mass of gas occupies a volume of 300 cc at 27°C and 620 mm pressure. The volume of this gas at 47°C and 640 mm pressure will be
a) 400 cc b) 510 cc c) 310 cc d) 350 cc
243. A closed vessel contains equal number of oxygen and hydrogen molecules at a total pressure of 740 mm. If oxygen is removed from the system, the pressure:
a) Becomes half of 740 mm
b) Remains unchanged
c) Becomes 1/9th of 740 mm
d) Becomes double of 740 mm

244. 2 g of hydrogen diffuses from a container in 10 minute. How many gram of oxygen would diffused through the same container in the same time under similar conditions?
a) 5 g   b) 4 g   c) 6 g   d) 8 g
245. The critical temperature of a gas is that temperature:
a) Above which it can no longer remain in the gaseous state
b) Above which it cannot be liquefied by pressure
c) At which it solidifies
d) At which volume of gas becomes zero
246. A preweighted vessel was filled with CO_2 at STP and weighed. It was then evaluated, filled with SO_2 at the same temperature and pressure and again weighted. The weight of the CO_2 will be
a) The same as that of the SO_2 b) Twice of that of the SO_2
c) Half that of the SO_2 d) Two third of that of SO_2
247. The term that corrects for the attractive forces present in a real gas in the van der Waals' equation is
a) nb b) $n^2\ a/V^2$ c) $-(n^2a/V^2)$ d) $-nb$
248. 1.0 L of N_2 and 7/8 L of O_2 at the same temperature and pressure were mixed together. What is the relation between the masses of the two gases in the mixture?
a) $M_{N_2} = 3M_{O_2}$ b) $M_{N_2} = 8M_{O_2}$ c) $M_{N_2} = M_{O_2}$ d) $M_{N_2} = 16M_{O_2}$
249. A gas will approach ideal behaviour at
a) Low temperature and high pressure   b) Low temperature and low pressure
c) High temperature and low pressure   d) High temperature and high pressure
250. Which gas may be collected over water?
a) NH_3 b) N_2 c) HCl   d) SO_2
251. The relationship between coefficient of viscosity of a liquid and temperature can be expressed as
a) $\eta = Ae^{ERT}$ b) $\eta = Ae^{E/RT}$ c) $\eta = ET/R$ d) $\eta = Ae^{RT/E}$
252. All the three states H_2O, *i.e.*, the triple point for H_2O the equilibrium,
Ice ⇌ Water ⇌ Vapour exist at:
a) 3.85 mm and 0.0981°C
b) 4.58 mm and 0.0098°C
c) 760 mm and 0°C
d) None of the above
253. Which is a postulate of kinetic theory of gases?
a) Gases combine in simple ratio
b) There is an attraction between gaseous molecules
c) There is no influence of gravity on gas molecules
d) Atom is indivisible
254. If a vessel containing hydrogen chloride at a pressure p is connected with another vessel of the same volume containing ammonia at a pressure p and the connecting tube opened so that they can mix and form a white solid then the gas pressure
a) Is equal to the pressure p b) Will be $p/p = 1$
c) Will be doubled, *ie*, $2p$ d) Drops to zero
255. The Joule-Thomson coefficient for a gas is zero at:
a) Inversion temperature
b) Critical temperature
c) Absolute temperature
d) Below 0°C
256. Consider an ideal gas contained in a vessel. If the intermolecular interactions suddenly begins to acts, which of the following will happen?
a) The pressure decrease   b) The pressure increase
c) The pressure remains unchanged   d) The gas collapses
257. 5 g each of the following gases at 87°C and 750 mm pressure are taken. Which of them will have the least

volume?

a) HF b) HCl c) HBr d) HI

258. A thin balloon filled with air at 47°C has a volume of 3.0 litre. If on placing it in a cooled room, its volume becomes 2.7 litre, the temperature of room is:

a) 42°C b) 30°C c) 15°C d) 0°C

259. The temperature at which nitrogen under 1.00 atm pressure has the same root mean square as that of carbon dioxide at STP, is

a) 0°C b) 27°C c) −99°C d) −200°C

260. At what temperature will hydrogen molecules have the same kinetic energy as nitrogen molecules have at 35°C ?

a) $\frac{28 \times 35}{2}$°C b) $\frac{2 \times 35}{28}$°C c) $\frac{2 \times 28}{35}$°C d) 35°C

261. Gay-Lussac's law of combining volume is applicable for those gases which on mixing:

a) Do not react b) React with each other c) Diffuse d) All of these

262. Consider an ideal gas contained in a vessel. If the intermolecular interactions suddenly begins to act, which of the following will happen?

a) The gas collapses
b) The pressure decreases
c) The pressure increases
d) The pressure remain unchanged

263. The number of moles of H_2 in 0.224 L of hydrogen gas at STP (273 K, 1 atm) is

a) 0.1 b) 1 c) 0.001 d) 0.01

264. If the distance between Na^+ and CI^- ions in sodium chloride crystal is x pm, the length of the edge of the unit cell is

a) $\frac{x}{2}$ pm b) $\frac{x}{4}$ pm c) $2x$ pm d) $4x$ pm

265. When a gas undergoes adiabatic expansion, it gets cooled due to

a) Loss of kinetic energy
b) Fall in temperature
c) Decrease in velocity
d) Energy change in doing work

266. For one mole of an ideal gas, increasing the temperature from 10°C to 20°C

a) Increases the average kinetic energy by two times
b) Increases the rms velocity by $\sqrt{2}$ times
c) Increases the rms velocity by two times
d) Increases both the average kinetic energy and rms velocity, but not significantly

267. The energy of an ideal gas depends only on its

a) Pressure b) Volume c) Number of moles d) Temperature

268. X- ray analysis shows that the unit cell length in NaCl is 562.8 pm. Calculate the density you would expect on this basis, $N_A = 6.023 \text{ x} 10^{23} \text{mol}^{-1}$

a) 0.3216 g cm^{-3} b) 2.179 g cm^{-3} c) 1.859 g cm^{-3} d) 2.346 g cm^{-3}

269. At what temperature will most probable speed of the molecules of the second number of alkyne series be the same as that of SO_2 at 527°C?

a) 347°C b) 227°C c) 800°C d) 254°C

270. Two gases A and B having the same temperature T, same pressure P and same volume V are mixed. If the mixture is at the same temperature T and occupies a volume V, the pressure of the mixture is:

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

271. On a hot day of rainy season we feel discomfort as:

a) Temperature is high
b) The blood pressure increases
c) The rate of evaporation decreases due to large relative humidity
d) The question is irrelevant

272. Which of the given sets of temperature and pressure will cause a gas to exhibit the greatest deviation from ideal gas behavior?

a) 100°C and 4 atm b) 100°C and 2 atm c) −100°C and 4 atm d) 0°C and 2 atm

273. In van der Waals' equation of state of the gas, the constant $'b'$ is a measure of:
a) Intermolecular collisions per unit volume
b) Intermolecular attraction
c) Volume occupied by molecules
d) Intermolecular repulsions

274. Which statement about evaporation is incorrect?
a) Evaporation takes place at all temperature
b) Evaporation occurs only at the surface
c) Evaporation produces cooling
d) Average KE of residual liquid molecules increase as evaporation occurs

275. One mole of oxygen at 273 K and one mole of sulphur di-oxide at 546 K are taken in two separate containers, then
a) Kinetic energy of $O_2 > kinetic\ energy\ of\ SO_2$
b) Kinetic energy of $O_2 < kinetic\ energy\ of\ SO_2$
c) Kinetic energy of both are equal
d) None of the above

276. Piezoelectric crystals are used in
a) TV
b) Radio
c) Freeze
d) Record player

277. The root mean square speed of an ideal gas in a closed container of fixed volume is increased from 5×10^4 cms^{-1} to 10×10^4 cms^{-1}. Which statement might correctly explain how the change accomplished?
a) By heating the gas, the temperature is doubled
b) By heating the gas, the pressure is made four times
c) By heating the gas, the volume is tripled
d) By heating the gas, the pressure is made three times

278. At low pressure, the van der Waals' equation is reduced to
a) $Z = \frac{pV_m}{RT} = 1 - \frac{ap}{RT}$
b) $Z = \frac{pV_m}{RT} = 1 + \frac{b}{RT}p$
c) $pV_m = RT$
d) $Z = \frac{pV_m}{RT} = 1 - \frac{a}{RT}$

279. If saturated vapours are compressed slowly (temperature remaining constant) to half the initial volume, the vapour pressure will
a) Become four times
b) Become doubled
c) Remain unchanged
d) Become half

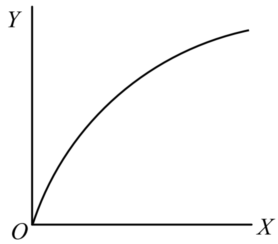
280. In two vessels of 1 L each at the same temperature 1 g of H_2 and 1 g of CH_4 are taken, for these
a) V_{rms} values will be same
b) Kinetic energy per mol will be same
c) Total kinetic energy will be same
d) Pressure will be same

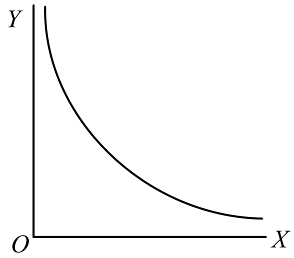
281. Which of the following statements about amorphous solids is incorrect?
a) They melt over a range of temperature
b) There is no orderly arrangement of particles
c) They are rigid and incompressible
d) They are anisotropic

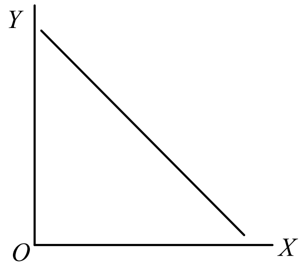
282. Kinetic theory of gases assumes that tiny particles called molecules:
a) Contain average KE proportional to absolute temperature
b) Exert no force during collisions
c) Exert attractive force on each other
d) Contain constant KE at all temperatures

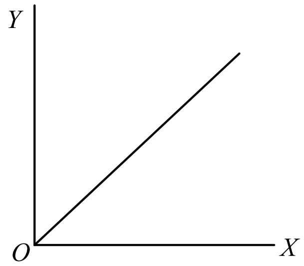
283. The absolute temperature of a gas is increased 3 times. The root mean square speed of the molecules will be:
a) 3 times
b) 9 times
c) 1/3 times
d) $\sqrt{3}$ times

284. Which one of the following represents the graph between $\log p$ (on $Y-$axis) and $\frac{1}{T}$ (on $X-$axis)?
($p =$ vapour pressure of a liquid, $T =$ absolute temperature)

a) 

b) 

c) 

d) 

285. Joule-Thomson coefficient $(\partial T/\partial P)_{\mathrm{H}}$ for an ideal gas is:
a) Zero b) +ve c) −ve d) None of these
286. In AgBr crystal, the ion size lies in the order $Ag^+ << Br^-$. The AgBr crystal should have the following characteristics
a) Defect less (perfect) crystal
b) Schottky defect
c) Frenkel defect
d) Both Schottky and Frenkel defect
287. A bottle of dry NH_3 and bottle of dry HCl connected through a long tube are opened simultaneously at both ends, the white (NH_4Cl) ring first formed will be:
a) At the centre of the tube
b) Near the HCl bottle
c) Near the ammonia bottle
d) Throughout the length of the tube
288. At 20°C and 1.00 atm partial pressure of hydrogen, 18 mL of hydrogen, measured at STP, dissolves in 1 L of water. If water at 20°C is exposed to a gaseous mixture having total pressure of 1400 torr (excluding the vapour pressure of water) and containing 68.5% H_2 by volume, find the volume of H_2, measured at STP, which will dissolve in 1 L of water
a) 18 mL b) 12 mL c) 23 mL d) 121 mL
289. A compound is formed by elements A and B. This crystallizes in the cubic structure when atoms A are at the corners of the cube and atoms B are at the centre of the body. The simplest formula of the compound is
a) AB b) AB_2 c) A_2B d) AB_4
290. If the pressure at the triple point of a substance is greater than 1 atm, we expect:
a) The boiling point of the liquid to be lower than triple point temperature
b) That the substance cannot exist as a liquid
c) The solid sublimes without melting
d) The melting point of the solid to be at a lower temperature than the triple point temperature
291. An aqueous solution of methanol has vapour pressure
a) More than that of water
b) Less than that of water
c) Equal to that of water
d) Equal to that of methanol
292. Dalton's law of partial pressure is not applicable to
a) H_2 and N_2 mixture b) H_2 and Cl_2 mixture c) H_2 and CO_2 mixture d) None of these
293. The numerical value of $c_p - c_v$ is equal to:
a) R b) R/M c) M/R d) None of these
294. The rms speed of N_2 molecules in a gas is u. If the temperature is doubled and the nitrogen molecules dissociate into nitrogen atoms, the rms speed becomes
a) $u/2$ b) $2u$ c) $4u$ d) $14u$
295. When two atoms of hydrogen combine to form a molecule of hydrogen gas, the energy of the molecule is:

a) Equal to that of sum of energy of separate atoms
b) Higher than that of sum of energy of separate atoms
c) Lower than that of sum of energy of separate atoms
d) None of the above

296. A bubble of volume V_1 is in the bottom of a pond at 15°C and 1.5 atm pressure when it comes at the surface it observes a pressure of 1 atm at 25°C and have volume V_2 , give $\frac{V_2}{V_1}$

a) 15.5 b) 0.155 c) 155.0 d) 1.55

297. One mole of an ideal monoatomic gas is mixed with 1 mole of an ideal diatomic gas. The molar specific heat of the mixture at constant volume is:

a) 3 cal b) 4 cal c) 8 cal d) 9 cal

298. The arrangement ABC, ABC, ABC ... is referred as

a) Cubic close packing
b) Tetrahedral close packing
c) Octahedral close packing
d) Hexagonal close packing

299. Which is lighter than dry air?

a) Moist air b) SO_2 c) Cl_2 d) O_2

300. Slope between pV and p at constant temperature is

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

301. When a capillary tube of diameter 0.8 mm is dipped in a liquid having density 800 kg m^{-3}, then the height of liquid in the capillary tube rises to 4 cm. The surface tension of liquid is ($g = 9.8 \text{ m/s}^2$)

a) 4.3×10^{-2} Nm^{-1} b) 5.6×10^{-2} Nm^{-1} c) 6.3×10^{-2} Nm^{-1} d) 7.3×10^{-2} Nm^{-1}

302. Which contains the same number of molecules as 16 g of oxygen?

a) 16 g O_3 b) 16 g SO_2 c) 32 g SO_2 d) All of these

303. The number of octahedral sites per sphere in a fcc structure is

a) 1 b) 2 c) 4 d) 8

304. One gram mole of a gas at NTP occupies 22.4 L as volume. This fact was derived from

a) Dalton's theory
b) Avogadro's hypothesis
c) Berzelius hypothesis
d) Law of gaseous volumes

305. Ionic solids, with Schottky defects, contain in their structure

a) equal number of cation and anion vacancies
b) anion vacancies and interstitial anions
c) cation vacancies only
d) cation vacancies and cations

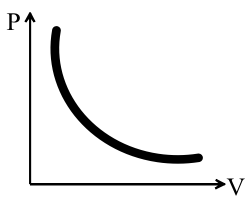
306. In the equation of state of an ideal gas $pV = nRT$, the value of the universal gas constant would depend only on

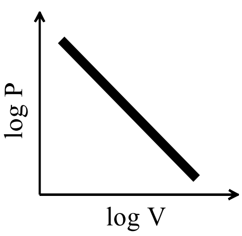
a) The nature of the gas
b) The pressure of the gas
c) The units of the measurement
d) None of the above

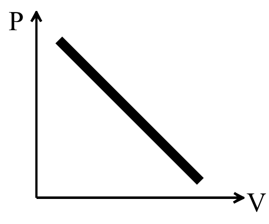
307. The number of molecules present in 1 mL of gas or vapour at STP is:

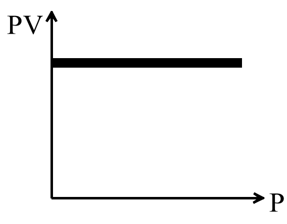
a) Called Loschmidt's number
b) Equal to 2.617×10^{19} per mL
c) Both (a) and (b)
d) None of the above

308. Which curve does not represent Boyle's law?

a) 

b) 

c) 

d) 

309. The rate of effusion doesn't depend on

a) The area of cross section of hole
b) Number of molecules per unit volume

c) The average molecular speed
d) Size of the molecule

310. A bottle of dry ammonia and one of dry hydrogen chloride are connected through a long tube. The stoppers at both ends of the tube are opened simultaneously. The white ammonium chloride ring first formed will be
a) At the centre of the tube
b) Near the hydrogen chloride bottle
c) Near the ammonia bottle
d) Throughout the length of the tube

311. Point defects are present in
a) ionic solids
b) amorphous solids
c) molecular solids
d) Liquids

312. Frenkel defect is caused due to
a) The shift of a positive ion from its normal lattice site to an interstitial site
b) An ion missing from the normal lattice site creating a vacancy
c) An extra positive ion occupying an interstitial position in the lattice
d) An extra negative ion occupying an interstitial position in the lattice

313. Which of the following is not correct for ionic crystals?
a) All are electrolyte
b) Exhibit the property of isomorphism
c) They process high melting point and boiling point
d) Exhibit directional properties of the bond

314. If temperature of 1 mole of gas is increased by 50°C, calculate the change in kinetic energy of the system.
a) 623.25 J
b) 6.235 J
c) 623.5 J
d) 6235.0 J

315. Oxygen gas generated by the decomposition of potassium chlorate is collected. The volume of oxygen collected at 24°C and atmospheric pressure of 760 mm Hg is 128 mL. Calculated the mass of oxygen gas obtained. The pressure of the water vapour at 24°C is 22.4 mm Hg
a) 0.123 g
b) 0.163 g
c) 0.352 g
d) 1.526 g

316. Which set of conditions represents easiest way to liquefy a gas?
a) Low temperature and high pressure
b) High temperature and low pressure
c) Low temperature and low pressure
d) High temperature and high pressure

317. At STP, the order of root mean square velocities of molecules of H_2, N_2, O_2 and HBr is
a) $H_2 > N_2 > O_2 > HBr$
b) $HBr > O_2 > N_2 > H_2$
c) $HBr > H_2 > O_2 > N_2$
d) $N_2 > O_2 > H_2 > HBr$

318. The molecular weight of a gas which diffuse through a porous plug of 1/6th of the speed of hydrogen under identical conditions is:
a) 27
b) 72
c) 36
d) 48

319. The average molecular speed is greatest in case of a gas sample of:
a) 2.0 mole of He at 140 K
b) 0.05 mole of Ne at 500 K
c) 0.40 mole of O_2 at 400 K
d) 1.0 mole of N_2 at 560 K

320. A curve drawn at constant temperature is called an isotherm. This shows the relationship between
a) p and $\frac{1}{V}$
b) pV and V
c) V and $\frac{1}{p}$
d) p and V

321. Which gas is adsorbed by charcoal?
a) CO
b) N_2
c) H_2
d) All of these

322. If the temperature of 500 mL of air increases from 27°C to 42°C under constant pressure, then the increase in volume shall be
a) 15 mL
b) 20 mL
c) 25 mL
d) 30 mL

323. In the closest packed structure of a metallic lattice, the number of nearest neighbours of a metallic atom is
a) 4
b) 6
c) 8
d) 12

324. Which gas when passed through dilute blood will impart a cherry red colour to the solution?
a) CO_2
b) $COCl_2$
c) NH_3
d) CO

325. Which one of the following has Frenkel defect?
a) NaCl b) AgBr c) Graphite d) Diamond

326. The number of close neighbour in a body centred cubic lattice of identical sphere is
a) 2 b) 4 c) 6 d) 8

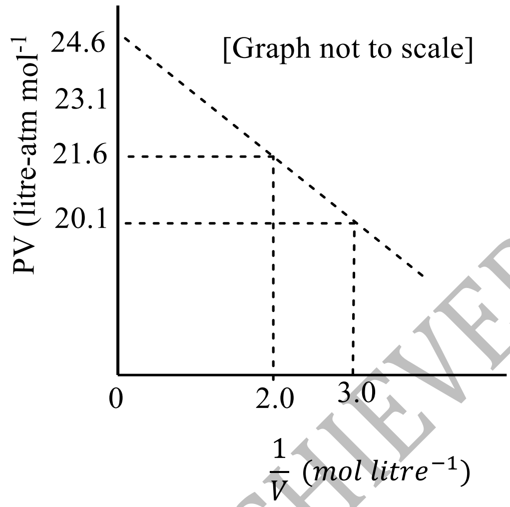
327. For an ideal gas, the value of $\left(\frac{\partial E}{\partial V}\right)_T$ is :
a) Positive b) Zero c) Negative d) Interchangeable

328. In a mixture of a light gas and a heavy gas in a closed container, the light gas will:
a) Have a lower average speed per molecule than the heavy gas
b) Have a higher average speed per molecule than the heavy gas
c) Rise to the top of the container
d) All are wrong

329. Which gas can be most readily liquefied?
a) NH_3 b) Cl_2 c) SO_2 d) CO_2

330. It is easier to liquefy oxygen than hydrogen because:
a) Oxygen has a higher critical temperature and lower inversion temperature than hydrogen
b) Oxygen has a lower critical temperature and higher inversion temperature than hydrogen
c) Oxygen has a higher critical temperature and a higher inversion temperature than hydrogen
d) The critical temperature and inversion temperature of oxygen is very low

331. For one mole of a van der Waals' gas when $b = 0$ and $T = 300$ K, the $PV\ vs.\ 1V$ plot is shown below. The value of the van der Waals' constant $a(\text{atm. litre}^2\text{mol}^{-2})$ is:



a) 1.0 b) 4.5 c) 1.5 d) 3.0

332. The characteristic features of solids are
a) Definite shape b) Definite size
c) Definite shape and size d) Definite shape, size and rigidity

333. The liquefaction behaviour of temporary gases like CO_2 approaches that of permanent gases like N_2, O_2 etc, as we go to
a) Below critical temperature b) Above critical temperature
c) Above absolute zero d) Below absolute zero

334. The density of O_2 is 16 at NTP. At what temperature its density will be 14? Consider that the pressure remains constant, at
a) 50℃ b) 39℃ c) 57℃ d) 43℃

335. The density of CCl_4 vapour at 0℃ and 76 cm Hg in g/litre is:
a) 11.2 b) 77 c) 6.88 d) None of these

336. Which gas has the, same rate of diffusion as that of CO_2 at same P and T?
a) N_2O b) NO_2 c) N_2 d) CO

337. Which gas has the highest partial pressure in atmosphere?

a) CO_2 b) H_2O c) O_2 d) N_2

338. Which of the following statements is not true about NaCl structure?
a) CI^- ions are in fcc arrangement
b) Na^+ ions has coordination number 4
c) CI^- ions has coordination number 6
d) Each cell contains 4 NaCl molecules

339. For real gases van der Waals' equation is written as
$$\left(p+\frac{an^2}{V^2}\right)(V-nb)=nRT$$
Where $'a'$ and $'b'$ are van der Waals' constants
Two set of gases are:
(I) O_2, CO_2, H_2 and He
(II) CH_4, O_2 and H_2
The gases given in set-I in increasing order of $'b'$ and gases given in set-II in decreasing order of $'a'$, are arranged below. Select the correct order from the following:
a) (I) $He < H_2 < CO_2 < O_2$ (II) $CH_4 > H_2 > O_2$
b) (I) $O_2 < He < H_2 < CO_2$ (II) $H_2 > O_2 > CH_4$
c) (I) $H_2 < He < O_2 < CO_2$ (II) $CH_4 > O_2 > H_2$
d) (I) $H_2 < O_2 < He < CO_2$ (II) $O_2 > CH_4 > H_2$

340. An ideal gas is allowed to expand both reversibly and irreversibly in an isolated system. If T_i is the initial temperature and T_f is the final temperature, which of the following statements is correct?
a) $(T_f)_{\text{irrev}} > (T_f)_{\text{rev}}$
b) $T_f > T_i$ for reversible process but $T_f = T_i$ for irreversible process
c) $(T_f)_{\text{rev}} = (T_f)_{\text{irrev}}$
d) $T_f = T_i$ for both reversible and irreversible processes

341. A gas cannot be liquefied if:
a) Forces of attraction are low under ordinary conditions
b) Forces of attraction are high under ordinary conditions
c) Forces of attraction are zero under ordinary conditions
d) Forces of attraction either high or low under ordinary conditions

342. The average speed of gas molecules is equal to:
a) $\left[\frac{2RT}{M}\right]^{1/2}$ b) $\left[\frac{3RT}{M}\right]^{1/2}$ c) $\left[\frac{8RT}{\pi M}\right]^{1/2}$ d) $\left[\frac{4RT}{\pi M}\right]^{1/2}$

343. If the pressure on a NaCl structure is increased, then its coordination number will
a) Increase b) Decrease c) Either (a) or (b) d) Remain the same

344. To raise the volume of a gas by four times, the following method may be adopted. Which of the method is wrong?
a) T is doubled and P is also doubled
b) Keeping P constant, T is raised by four times
c) Temperature is doubled and pressure is halved
d) Keeping temperature constant, pressure is reduced to 1/4 of its initial value

345. 50 mL of hydrogen diffuses through small hole from a vessel in 20 min. Time taken for 40 mL of oxygen to diffuse out under similar conditions will be
a) 12 min b) 32 min c) 8 min d) 64 min

346. Tetragonal crystal system has the following unit cell dimensions
a) $a = b = c$ and $\alpha = \beta = \gamma = 90°$
b) $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90°$
c) $a = b \neq c$ and $\alpha = \beta = \gamma = 90°$
d) $a = b \neq c$ and $\alpha = \beta = 90°$ and $\gamma = 120°$

347. A balloon filled with methane CH_4 is pricked with a sharp point and quickly plunged into a tank of hydrogen at the same pressure. After sometime, the balloon will have
a) Enlarged
b) Collapsed
c) Remained unchanged in size
d) Ethylene (C_2H_4) inside it

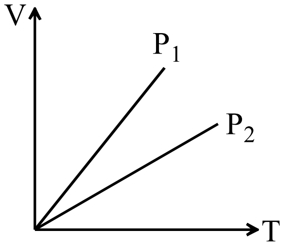
348. If a gas is expanded at constant temperature:

a) Number of molecules of the gas decreases
b) The kinetic energy of the molecules decreases
c) The kinetic energy of the molecules remains the same
d) The kinetic energy of the molecules increases

349. The compressibility factor for H_2 and He is usually:
a) > 1 b) $= 1$ c) < 1 d) Either of these

350. The number of spheres contained (i) in one body centred cubic unit cell and (ii) in one face centred cubic unit cell, is
a) In (i) 2 and in (ii) 4 b) In (i) 4 and in (ii) 2
c) In (i) 2 and in (ii) 3 d) In (i) 3 and in (ii) 2

351. V *versus* T curves at constant pressure P_1 and P_2 for an ideal gas are shown in figure. Which is correct?



a) $P_1 > P_2$ b) $P_1 < P_2$ c) $P_1 = P_2$ d) All of these

352. The root mean square speed of hydrogen molecules at room temperature is 2400 ms^{-1}. At room temperature the root mean square speed of oxygen molecules would be:
a) 400 ms^{-1} b) 300 ms^{-1} c) 600 ms^{-1} d) 1600 ms^{-1}

353. 4.4 g of CO_2 and 2.24 litre of H_2 at STP are mixed in a container. The total number of molecules present in the container will be:
a) 6.022×10^{23} b) 1.2044×10^{23} c) 2 d) 6.023×10^{24}

354. If 10^{-4} dm^3 of water is introduced into a 1 dm^3 flask at 300 K, how many moles of water are in the vapour phase when equilibrium is established (Given vapour pressure of H_2O at 300K is 3170 Pa; $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$)
a) 5.56×10^{-6} mol b) 1.53×10^{-2} mol c) 4.46×10^{-2} mol d) 1.27×10^{-3} mol

355. The most probable velocity (in cm/s) of hydrogen molecule at 27°C, will be
a) 19.3×10^4 b) 17.8×10^4 c) 24.93×10^9 d) 17.8×10^8

356. Four particles have speed 2,3,4 and 5 cm/s respectively. Their rms speed is:
a) 3.5 cm/s b) (272) cm/s c) $\sqrt{54}$ cm/s d) $(\sqrt{54}/2)$ cm/s

357. An open vessel containing air is heated from 300 K to 400 K. The fraction of air originally present which goes out of it is:
a) $\frac{3}{4}$ b) $\frac{1}{4}$ c) $\frac{2}{3}$ d) $\frac{1}{8}$

358. Which is valid at absolute zero?
a) KE of the gas becomes zero, but molecular motion does not become zero
b) KE of the molecules becomes zero and the molecular motion also becomes zero
c) KE of the gas decreases but does not become zero
d) None of the above

359. Types of forces that can be present in ethanol giving it a liquid state
a) Dipole-dipole interaction b) London forces
c) Hydrogen bonding d) All of these

360. At what temperature would the volume of a given mass of a gas at constant pressure be twice to its volume at 0°C ?
a) 100°C b) 273°C c) 373°C d) 446°C

361. Specific heat is defined as:
a) Heat capacity/g
b) Heat capacity/mol

c) Heat capacity at constant pressure
d) Heat capacity at constant volume

362. The kinetic energy of two moles of N_2 at 27°C is ($R = 8.314\ JK^{-1}mol^{-1}$):
a) 5491.6 J b) 6491.6 J c) 7482.6 J d) 8882.4 J

363. An example of a substance possessing giant covalent structure is
a) Solid CO_2 b) Silica c) Iodine crystal d) White phosphorus

364. The ratio of cationic radius to anionic radius in an ionic crystal is greater than 0.732. Its coordination number is
a) 1 b) 4 c) 6 d) 8

365. The most probable speed of 8 g of H_2 200 ms^{-1}. Average kinetic energy of H_2 gas is
a) 240 J b) 180 J c) 320 J d) 360 J

366. The intermetallic compound LiAg crystallizes in cubic lattice in which both lithium and silver have coordination number of eight. The crystal class is
a) Simple cubic b) Body centred cube c) Face-centred cube d) None of these

367. Graham's law of diffusion gives better results at:
a) High pressure b) High temperature c) Low pressure d) At all conditions

368. Ratio of average to most probable velocity is
a) 1.128 b) 1.224 c) 1.0 d) 1.112

369. A sample of pure gas has a density of 1.60 g $litre^{-1}$ at 26.5°C and 680.2 mm Hg. Which of the following is present in the sample?
a) CH_4 b) C_2H_6 c) CO_2 d) Xe

370. Dalton's law of partial pressure is not applicable to
a) $O_2 + O_3$ b) $CO + CO_2$ c) $NH_3 + HCl$ d) $I + O_2$

371. The rate of diffusion of hydrogen gas is
a) 1.4 times to He gas b) Same as He gas c) 5 times to He gas d) 2 times to He gas

372. Which is not true in case of an ideal gas?
a) It cannot be converted into a liquid
b) There is no interaction between the molecules
c) All molecules of the gas move with same speed
d) At a given temperature pV is proportional to the amount of the gas

373. Weight of 112 mL of oxygen at NTP on liquefaction would be:
a) 0.32 g b) 0.64 g c) 0.96 g d) 0.16 g

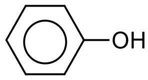
374. Gas equation $pV = nRT$ is obeyed by ideal gas in
a) Adiabatic process b) Isothermal process c) Both (a) and (b) d) None of the above

375. A gas can be easily liquefied
a) When its inversion temperature equals the Boyle temperature
b) Under adiabatic compression
c) Under pressure when it is cooled to below the critical temperature
d) All of the above

376. At 400 K, the root mean square (rms) speed of a gas X (molecular weight = 40) is equal to the most probable speed of gas Y at 60 K. The molecular weight of the gas Y is
a) 2 b) 4 c) 6 d) 8

377. What is the pressure of 2 moles of NH_3 at 27°C, when its volume is 5 L in van der Waals' equation? ($a = 4.17, b = 0.03711$)
a) 10.33 atm b) 9.33 atm c) 9.74 atm d) 9.2 atm

378. Vapours of a liquid exist only:
a) Below b.p.
b) Below critical temperature
c) Below inversion temperature
d) Above critical temperature

379. If a mixture of gases has a total pressure of 100 cm Hg and the partial pressure of nitrogen in the mixture is 25 mm Hg, then the per cent of nitrogen in the mixture is:
a) 4% b) 40% c) 400% d) 2.5%
380. A metallic element has a cubic lattice. Each edge of the unit cell is 2Å. Thedensity of the metal is 2 g cm^{-3}. The unit cells in 200 g of the metal are
a) 1×10^{25} b) 1×10^{24} c) 1×10^{22} d) 1×10^{20}
381. By what ratio the average velocity of the molecule in gas change when the temperature is raised from 50 to 200°C?
a) $\frac{1.21}{1}$ b) $\frac{1.46}{1}$ c) $\frac{1.14}{1}$ d) $\frac{4}{1}$
382. A gaseous mixture contains 1 g of H_2, 4 g of He, 7 g of N_2 and 8 g of O_2. The gas having the highest partial pressure is:
a) H_2 b) O_2 c) He d) N_2
383. In a solid 'AB' having the NaCl structure, 'A' atoms occupy the corners of the cubic unit cell. If all the face-centred atoms along one of the axes are removed then the resultant stoichiometry of the solid is
a) AB_2 b) A_2B c) A_3B_4 d) A_4B_3
384. Which has maximum vapour pressure at a given temperature?
a) $CH_3CH_2CH_2OH$ b) 

c) $CH_3 - O - CH_3$ d) CH_3COOH
385. The molecular mass of each N_2 and CO is 28. If 0.5 L of N_2 at 27°C and 700 mm pressure contains n molecules, the number of molecules in 1.0 L of CO under identical conditions will be
a) $\frac{n}{2}$ b) n c) $2n$ d) None of these
386. If a gas is allowed to expand at constant temperature then
a) Number of molecules of the gas decreases
b) The kinetic energy of the gas molecules decreases
c) The kinetic energy of the gas molecules increases
d) The kinetic energy of the gas molecules remains the same
387. The ratio of average speed of an oxygen molecule to the rms speed of a nitrogen molecule at the same temperature is
a) $\left(\frac{3\pi}{7}\right)^{1/2}$ b) $\left(\frac{7}{3\pi}\right)^{1/2}$ c) $\left(\frac{3}{7\pi}\right)^{1/2}$ d) $\left(\frac{7\pi}{3}\right)^{1/2}$
388. The relative rates of diffusion of $U^{235}F_6$ and $U^{238}F_6$ are:
a) 1.0043 b) 1.2 c) 1.4 d) 1.6
389. In van der Waals' equation of state of the gas law, the constant $'b'$ is a measure of
a) Intermolecular repulsions b) Intermolecular attraction
c) Volume occupied by the molecules d) Intermolecular collisions per unit volume
390. There is 10 litre of a gas at STP. Which of the following changes keep the volume constant?
a) 273 K and 2 atm b) 273°C and 2 atm c) 546°C and 0.5 atm d) 0°C and 0 atm
391. In the gas equation $PV = nRT$ the value of universal gas constant depends upon:
a) The nature of the gas
b) The pressure of the gas
c) The temperature of the gas
d) The units of measurement
392. Sodium metal crystallizes as a body centred cubic lattice with the cell edge 4.29 Å. What is the radius sodium atom?
a) 1.857×10^{-8}cm b) 2.371×10^{-7}cm c) 3.817×10^{-8}cm d) 9.312×10^{-7}cm
393. The density of a gas is 1.964 g dm^{-3} at 273 K and 76 cm Hg. The gas is
a) CH_4 b) C_2H_6 c) CO_2 d) Xe
394. How many space lattices are obtainable from the different crystal systems?
a) 7 b) 14 c) 32 d) 230

395. By what factor does the average velocity of a gaseous molecule increase when the temperature (in Kelvin) is doubled?

a) 1.4 b) 2.0 c) 2.8 d) 4.0

396. Consider 1 cm^3 sample of air at absolute temperature T_0 at sea-level and another 1 cm^3 sample of air at a height where the pressure is one third atmosphere. The absolute temperature T of the sample at the height is :

a) Equal to $T_0/3$

b) Equal to T_0

c) Equal to $3T_0$

d) Cannot be determined in terms of T_0 from the above data

397. Which among the following will show anisotropy?

a) Glass b) Plastic c) Barium chloride d) Wood

398. If the radius ratio is in the range of $0.414 - 0.732$, then the coordination number will be

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

399. A gaseous mixture contains oxygen and nitrogen in the ratio of 1 : 4 by weight. Therefore, the ratio of their number of molecules is:

a) 1 : 4 b) 1 : 8 c) 7 : 8 d) 3 : 16

400. A vogadro's hypothesis states that

a) The ideal gas consists of a large number of small particles called molecules.

b) Under the same conditions of temperature and pressure equal volumes of gases contain the same number of molecules.

c) Volume of definite quantity of gas at constant pressure is directly proportional to absolute temperature.

d) A given mass of gas at constant pressure is directly proportional to absolute temperature.

401. An fcc lattice has a lattice parameter $a = 400$ pm. Calculate the molar volume of the lattice including all the empty space

a) 7.6 mL b) 6.5 mL c) 10.8 mL d) 9.6 mL

402. Pressure remaining the same, the volume of a given mass of an ideal gas increases for every degree centigrade rise in temperature by a definite fraction of its volume at:

a) Zero degree centigrade

b) Its critical temperature

c) Absolute zero

d) Its Boyle's temperature

403. A gaseous mixture of 2 moles of A, 3 moles of B, 5 moles of C and 10 moles of D is contained in a vessel. Assuming that gases are ideal and the partial pressure of C is 1.5 atm, total pressure is

a) 3 atm b) 6 atm c) 9 atm d) 15 atm

404. At constant volume, for a fixed number of mole of a gas, the pressure of the gas increases with rise of temperature due to

a) Increase in average molecular speed b) Increase in number of mole

c) Increase in molecular attraction d) Decrease in mean free path

405. A gaseous mixture contains 56 g of N_2, 44 g ofCO_2 and 16 g of CH_4. The total pressure of mixture is 720 mm of Hg. The partial pressure of methane is

a) 75 atm b) 160 atm c) 180 atm d) 215 atm

406. A certain gas diffuses from two different vessels A and B. The vessel A has a circular orifice while vessel B has square orifice of length equal to the radius of the orifice of vessel A. The ratio of the rates of diffusion of the gas from vessel A to vessel B, assuming same temperature and pressure is:

a) π b) 7 : 22 c) 1 : 1 d) 2 : 1

407. Two gases A and B, having the mole ratio of 3 : 5 in a container, exert a pressure of 8 atm. If A is removed, what would be the pressure due to B only, temperature remaining constant?

a) 1 atm b) 2 atm c) 4 atm d) 5 atm

408. By what ratio the average velocity of the molecule in a gas change when the temperature is raised from 50

to 200°C?

a) $\frac{1.21}{1}$ b) $\frac{1.46}{1}$ c) $\frac{1.14}{1}$ d) $\frac{4}{1}$

409. If surface area is increased

a) evaporation increases
b) b.p. increases
c) m.p. increases
d) Surface tension increases

410. At the same temperature calculate the ratio of average velocity of SO_2 to CH_4.

a) 2 : 3 b) 3 : 4 c) 1 : 2 d) 1 : 6

411. The molar volume of CO_2 is maximum at

a) NTP b) 0°C and 2.0 atm c) 127°C and 1 atm d) 273°C and 2 atm

412. If two molecules of A and B having mass 100 kg and 64 kg and rate of diffusion of A is 12×10^{-3}, then what will be the rate of diffusion of B?

a) 15×10^{-3} b) 64×10^{-3} c) 5×10^{-3} d) 46×10^{-3}

413. When r, p and M represent rate of diffusion, pressure and molecular mass, respectively, then the ratio of the rates of diffusion (r_A/r_B) of two gases A and B, is given as

a) $(p_A/p_B)^{1/2}\ (M_A/M_B)$ b) $(p_A/p_B)\ (M_B/M_A)^{1/2}$ c) $(p_A/p_B)^{1/2}\ (M_B/M_A)$ d) $(p_A/p_B)\ (M_A/M_B)^{1/2}$

414. A gas behaves like an ideal gas at

a) High pressure and low temperature
b) Low pressure and high temperature
c) High pressure and high temperature
d) Low pressure and low temperature

415. Which gas is hydrolysed in the lungs to form HCl and ultimately lead to suffocation?

a) NH_3 b) Cl_2 c) SO_2 d) $COCl_2$

416. In CsCl structure, the coordination number of Cs^+ is

a) Equal to that of CI^-, that is 6
b) Equal to that of CI^-, that is 8
c) Not equal to that of CI^-, that is 6
d) Not equal to that of CI^-, that is 8

417. The intermolecular force of attraction between non-polar molecules is called

a) H-bonding
b) Dispersion forces
c) Interionic attraction
d) Adhesive forces

418. Non-reacting gases have a tendency to mix with each other. This property is known as:

a) Diffusion b) Fusion c) Mixing d) None of these

419. In orthorhombic, the value of a, b and c are respectively 4.2Å, 8.6 Å and 8.3Å. Given the molecular mass of the solute is 155 g mol^{-1} and that of density is 3.3 g/cc, the number of formula units per unit cell is

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

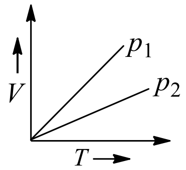
420. At room temperature the rms speed of the molecules of a certain diatomic gas is found to be 1930 m/s. The gas is:

a) H_2 b) F_2 c) O_2 d) Cl_2

421. The correct statement regarding F-centre is

a) Electron are held in the voids of crystals
b) F-centre produces colour to the crystals
c) Conductivity of the crystal increases due to F-centre
d) All of the above

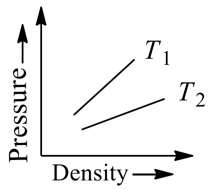
422. V *versus* T curves at constant pressure p_1 and p_2 for an ideal gas are shown in figure. Which is correct?



a) $p_1 > p_2$ b) $p_1 < p_2$ c) $p_1 = p_2$ d) All of these

423. Which gas has the highest partial pressure in atmosphere?
a) CO_2 b) H_2O c) O_2 d) N_2

424. Figure shows graphs of pressure *versus* density for an ideal gas at two temperatures T_1 and T_2. Which is correct?



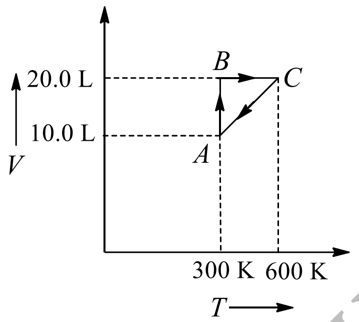
a) $T_1 > T_2$ b) $T_1 = T_2$ c) $T_1 < T_2$ d) None of these

425. For an ideal gas, number of moles per litre in terms of its pressure P, gas constant R and temperature T is:
a) PT/R b) PRT c) P/RT d) RT/P

426. The compressibility factor for a real gas at high pressure is:
a) 1 b) $1 + (Pb/RT)$ c) $1 - (Pb/RT)$ d) $1 + (RT/Pb)$

427. If NaCl is doped with 10^{-3}mol % $SrCl_2$, then the concentration of cation vacancies will be
a) 1×10^{-3}mol % b) 2×10^{-3}mol % c) 3×10^{-3} mol % d) 4×10^{-3} mol %

428. This graph expresses the various steps of the system containing 1 mole of gas. Which type of process, system has when it moves from C to A?



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

429. The temperature, at which a gas shows maximum ideal behaviour, is known as
a) Boyle's temperature b) Inversion temperature
c) Critical temperature d) Absolute temperature

430. The rate of diffusion of methane at a given temperature is twice that of gas X. The molecular mass of gas X is
a) 64.0 b) 32.0 c) 4.0 d) 8.0

431. The liquefaction behaviour of temporary gases like CO_2 approaches that of permanent gases like N_2, O_2, etc., as we go:
a) Below critical temperature
b) Above critical temperature
c) Above absolute zero
d) Below absolute zero

432. The rates of diffusion of SO_2, CO_2, PCl_3 and SO_3 are in the following order
a) $PCl_3 > SO_3 > SO_2 > CO_2$ b) $CO_2 > SO_2 > PCl_3 > SO_3$
c) $SO_2 > SO_3 > PCl_3 > CO_2$ d) $CO_2 > SO_2 > SO_3 > PCl_3$

433. Hexagonal close packed arrangement of ions is described as
a) $AB\ AB\ A$ … b) $ABC\ ABC$ … c) $ABBBAB$ … d) $ABC\ ABA$ …

434. If both oxygen and helium gases are at the same temperature, the rate of diffusion of O_2 is very close to

a) 4 times that of He b) 2 times that of He c) 0.35 times that of He d) 8 times that of He

435. If $C_1, C_2, C_3, \ldots$ represent the speeds of $n_1, n_2, n_3, \ldots$ molecules, then the root mean square speed is:

a) $\left[\frac{n_1C_1^2 + n_2C_2^2 + n_3C_3^2 + \cdots}{n_1 + n_2 + n_3 + \cdots}\right]^{1/2}$

b) $\left[\frac{n_1^2C_1^2 + n_2^2C_2^2 + n_3^2C_3^2 + \cdots}{n_1 + n_2 + n_3 + \cdots}\right]^{1/2}$

c) $\frac{(n_1C_1^2)^{1/2}}{n_1} + \frac{(n_2C_2^2)^{1/2}}{n_2} + \frac{(n_3C_3^2)^{1/2}}{n_3} + \cdots$

d) $\left[\frac{(n_1C_1 + n_2C_2 + n_3C_3 + \cdots)^2}{(n_1 + n_2 + n_3 + \cdots)}\right]^{1/2}$

436. The ratio of molar heats of vaporization and boiling point of a liquid is constant. This is known as

a) Ostwald's rule b) Phase rule c) Vant Hoff rule d) Trouton's rule

437. At high temperature and low pressure, the van der Waals' equation is reduced to

a) $\left(p + \frac{a}{V_m^2}\right)(V_m) = RT$ b) $pV_m = RT$

c) $p(V_m - b) = RT$ d) $\left(p + \frac{a}{V_m^2}\right)(V_m - b) = RT$

438. To what temperature must a neon gas sample be heated to double its pressure, if the initial volume of gas at 75°C is decreased by 15.0%?

a) 319°C b) 592°C c) 128°C d) 60°C

439. Consider following pairs of gases A and B

S. no.	A	B
(i)	CO_2	N_2O
(ii)	CO	N_2
(iii)	O_2	O_3
(iv)	H_2O	D_2O
(v)	$^{235}UF_6$	$^{238}UF_6$

Relative rates of effusion of gases A and B is in the order

a) $a = b < c < d < e$ b) $a = b < d < c < e$

c) (i)= (ii) < (v) < (iv) < (iii) d) $a < b < c < d < e$

440. What is the ratio of diffusion rate of oxygen and hydrogen?

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

441. A monoatomic ideal gas undergoes a process in which the ratio of P to V at any instant is constant and equal to unity. The molar heat capacity of the gas is:

a) $\frac{4R}{2}$ b) $\frac{3R}{2}$ c) $\frac{5R}{2}$ d) Zero

442. The units of van der Waals' constants a, b respectively, are

a) L atm^2 mol^{-1} and mol L^{-1} b) L atm mol^2 and mol L^{-1}

c) L^2 atm mol^{-2} and mol^{-1} L d) L^{-2} atm^{-1} mol^{-1} and L mol^{-2}

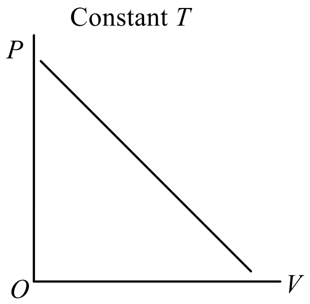
443. In the Bragg's equation for diffraction of X-rays, n represents for

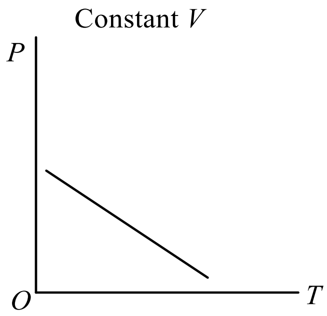
a) Avogadro's number b) quantum number c) Moles d) an integer

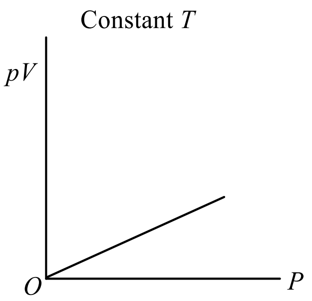
444. The rms velocity of an ideal gas at constant pressure varies with density (d) as

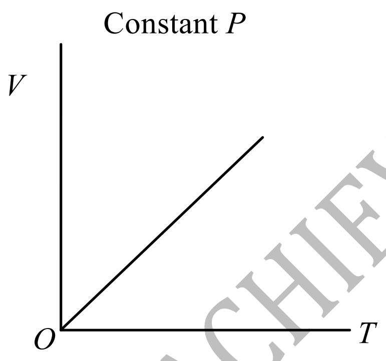
a) $\frac{1}{\sqrt{d}}$ b) d c) $\sqrt{d}$ d) d^2

445. Which of the following diagrams correctly describes the behaviour of a fixed mass of an ideal gas? (T is measured in K).

a) 

b) 

c) 

d) 

446. An AB_2 type structure is found in
a) N_2O b) NaCl c) Al_2O_3 d) CaF_2

447. In a solid lattice, the cation has left a lattice site and is located at an interstitial position, the lattice defect is
a) Frenkel defect b) Schottky defect c) Interstitial defect d) Valency defect

448. Volume occupied by molecules of one mole gas at NTP, each having radius of 10^{-8} cm is:
a) 22.0 litre b) 22.4 litre c) 10.09 mL d) 10.09 litre

449. According to the kinetic theory of gases, in an ideal gas, between two successive collisions a gas molecule travels
a) In a circular path b) In a wavy path
c) In a straight line path d) With an accelerated velocity

450. At what temperature, both Celsius and Fahrenheit scale read the same value?
a) 100° b) 130° c) 60° d) $-40°$

451. The gases showing heating and cooling effect during Joule-Thomson's experiment have Joule-Thomson coefficient:
a) +ve and −ve respectively

b) −ve and +ve respectively

c) +ve

d) −ve

452. If a gas is heated at constant pressure, its density

a) Will decrease b) Will increase

c) May increase or decrease d) Will remain unchanged

453. At NTP, the density of a gas, whose molecular weight is 45, is

a) 44.8 g/L b) 11.4 g/L c) 2 g/L d) 3 g/L

454. The gases are at absolute temperature 300 K and 350 K respectively. The ratio of average kinetic energy of their molecules is:

a) 7 : 6 b) 6 : 7 c) 36 : 49 d) 49 : 36

455. The ratio of the rate of diffusion of helium and methane under identical condition of pressure and temperature will be

a) 4 b) 0.2 c) 2 d) 0.5

456. An example of a non-stoichiometric compound is

a) PbO b) NiO_2 c) Al_2O_3 d) Fe_3O_4

457. For 1 mole of gas, the average kinetic energy is given as E. The u_{rms} of gas is:

a) $\left[\frac{2E}{M}\right]^{1/2}$ b) $\left[\frac{3E}{M}\right]^{1/2}$ c) $\left[\frac{2E}{3\,M}\right]^{1/2}$ d) $\left[\frac{3E}{2\,M}\right]^{1/2}$

458. Which of the following is not the assumption of kinetic theory of gases?

a) The actual volume of the gaseous molecules is negligible as compared to the total volume of the gas

b) Molecules are perfectly elastic

c) The critical temperature is the measure of the kinetic energy of the molecule

d) The effect of gravity on motion of molecules is negligible

459. For a given mass of a gas, if pressure is reduced to half and temperature is increased two times, then the volume would become:

a) $V/4$ b) $2V^2$ c) $6V$ d) $4V$

460. The pressure of gas having 2 mole in 44.8 litre vessel at 540 K is:

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

461. Charles' law is represented mathematically as

a) $V_t = KV_0t$ b) $V_t = \frac{KV_0}{t}$ c) $V_t = V_0\left(1 + \frac{273}{t}\right)$ d) $V_t = V_0\left(1 + \frac{t}{273}\right)$

462. How many mole of He gas occupy 22.4 litre at 30°C and one atmospheric pressure?

a) 0.90 b) 1.11 c) 0.11 d) 1.0

463. An open vessel at 27°C is heated until 3/8th of the air in it has been expelled. Assuming that the volume remains constant, calculate the temperature at which the vessel was heated

a) 307°C b) 107°C c) 480°C d) 207°C

464. The excluded volume of a molecule in motion is… times the actual volume of a molecule in rest

a) 2 b) 4 c) 3 d) 0.5

465. In octahedral holes (voids)

a) a bi-triangular void surrounded by six spheres

b) a bi-triangular void surrounded by four spheres

c) a bi-triangular void surrounded by eight spheres

d) a simple triangular void surrounded by four spheres

466. Monoclinic crystal has dimension

a) $a \neq b \neq c, \alpha = \gamma = 90°, \beta \neq 90°$ b) $a = b = c, \alpha = \beta = \gamma = 90°$

c) $a = b = c, \alpha = \beta = 90°, \gamma = 120°$ d) $a \neq b = c, \alpha = \beta = \gamma = 120°$

467. When the temperature is raised, the viscosity of the liquid decreases. This is because of:

a) Decreased volume of the solution

b) Increase in temperature increases the average kinetic energy of molecules which overcome the attractive force between them

c) Decreased covalent and hydrogen bond forces
d) Increased attraction between the molecules

468. 10 mL of oxygen and 10 mL of hydrogen is kept at the same temperature and pressure, which is correct about number of molecules?
a) $No_2 > N_{H_2}$ b) $No_2 < N_{H_2}$ c) $No_2 = 16N_{H_2}$ d) $No_2 = N_{H_2}$

469. The speed possessed by majority of gaseous molecules is:
a) Average speed b) Most probable speed c) RMS speed d) None of these

470. If the number of atoms per unit in a crystal is 2, the structure of crystal is
a) Simple cubic b) Body centred cubic (bcc)
c) Octahedral d) Face centred cubic (fcc)

471. Average speed is equal to
a) 0.9813 RMS speed b) 0.9 RMS speed
c) 0.9213 RMS speed d) 0.9602 RMS speed

472. The number of unit cells in 58.5 g of NaCl is nearly
a) 0.5×10^{24} b) 1.5×10^{23} c) 3×10^{22} d) 6×10^{20}

473. During the evaporation of liquid
a) The temperature of the liquid will rise b) The temperature of the liquid will fall
c) May rise or fall depending on the nature d) The temperature remains unaffected

474. A mixture of two gases, having partial pressures p_1 and p_2, has total pressure p, then according to Dalton's law
a) $p = p_1 + p_2$ b) $p = \sqrt{(p_1 + p_2)}$ c) $p = p_1 \times p_2$ d) $p = (p_1 + p_2)/2$

475. The cooling caused by the adiabatic expansion of a compressed gas below its inversion temperature (T_i) without doing external work is called:
a) Joule-Thomson effect
b) Adiabatic demagnetism
c) Tyndall effect
d) Compton effect

476. The rates of diffusion of O_2 and H_2 at same P and T are in the ratio:
a) 1 : 4 b) 1 : 8 c) 1 : 16 d) 4 : 1

477. 300 mL of a gas at 27°C is cooled to 3°C at constant pressure, the final volume is
a) 270 mL b) 340 mL c) 150 mL d) 240 mL

478. Surface tension of water is 73 dyne cm^{-1} at 20°C. If surface area is increased by 0.10 m^2, work done is
a) 7.3 erg b) 7.3×10^4 erg c) 73 J d) 0.73 J

479. The temperature at which real gases obey the ideal gas laws over a wide range of pressure is called
a) Critical temperature b) Boyle temperature
c) Inversion temperature d) Reduced temperature

480. A gas behaves most like an ideal gas under conditions of:
a) High pressure and low temperature
b) High temperature and high pressure
c) Low pressure an high temperature
d) Low pressure and low temperature

481. The partial pressure of a dry gas is:
a) Less than that of wet gas
b) Greater than that of wet gas
c) Equal to that of wet gas
d) None of the above

482. The number of collisions depends on:
a) Mean free path b) Pressure c) Temperature d) All of these

483. The molecular velocity of any gas is
a) Inversely proportional to the square root of temperature

b) Inversely proportional to absolute temperature
c) Directly proportional to square of temperature
d) Directly proportional to square root of temperature

484. In order to increase the volume of a gas by 10%, the pressure of the gas should be
a) Increased by 10% b) Increased by 1% c) Decreased by 10% d) Decreased by 1%

485. Compounds with identical crystal structure and analogous chemical formula are called
a) Isomers b) Isotones c) Allotropes d) Isomorphous

486. 26 mL of CO_2 are passed over hot coke. The maximum volume of CO formed is :
a) 15 mL b) 10 mL c) 32 mL d) 52 mL

487. Under what conditions will a pure sample of an ideal gas not only exhibit a pressure of 1 atm but also a concentration of 1 mol litre^{-1}?
($R = 0.082$ litre atm mol^{-1} deg^{-1})
a) At STP
b) When $V = 22.4$ litre
c) When $T = 12K$
d) Impossible under any condition

488. 380 mL of a gas at 27°C, 800 mm of Hg weighs 0.455 g. The molecular weight of gas is
a) 46 b) 38 c) 28 d) 24

489. If a gas contains only three molecules that move with velocities of 100, 200, 500 ms^{-1}. What is the rms velocity of that gas in ms^{-1}?
a) $100\frac{\sqrt{8}}{3}$ b) $100\sqrt{30}$ c) $100\sqrt{10}$ d) $\frac{800}{3}$

490. A vessel has nitrogen gas and water vapours at a total pressure of 1 atm. The partial pressure of water vapours is 0.3 atm. The contents of this vessel are transferred to another vessel having one third of the capacity of original volume, completely at the same temperature, the total pressure of the system in the new vessel is:
a) 3.0 atm b) 1 atm c) 3.33 atm d) 2.4 atm

491. Average speed of the molecules of a gas in a container moving in one direction is:
a) $\sqrt{\frac{8RT}{\pi M}}$ b) $\sqrt{\frac{3RT}{M}}$ c) $\sqrt{\frac{2RT}{M}}$ d) Zero

492. Cooking is fast in a pressure cooker, because
a) Food particles are effectively smashed
b) Water boils at higher temperature inside the pressure cooker
c) Food is cooked at constant volume
d) Loss of heat due to radiation is minimum

493. If one mole of a monoatomic gas ($\gamma = 5/3$) is mixed with one mole of a diatomic gas ($\gamma = 7/5$), the value of γ for the mixture is:
a) 1.4 b) 1.5 c) 1.53 d) 3.07

494. The kinetic energy of N molecules of O_2 is x joule at -123°C. Another sample of O_2 at 27°C has a kinetic energy of $2x$ joule. The latter sample contains:
a) N molecules of O_2 b) $2N$ molecules of O_2 c) $N/2$ molecules of O_2 d) None of these

495. A gas is heated in such a way so that its pressure and volume both becomes double. Again by lowering temperature, one fourth of initial number of moles of air has been taken in, to maintain the double volume and pressure. By what fraction, the temperature must have been raised finally?
a) $\frac{1}{5}$ times b) $\frac{4}{5}$ times c) $\frac{16}{5}$ times d) $\frac{8}{5}$ times

496. If the absolute temperature of a gas is doubled and the pressure is reduced to one half, the volume of the gas will
a) Remain unchanged b) Be doubled

c) Increase four fold
d) Be halved

497. Diffusion of helium gas is four times faster than
a) CO_2
b) SO_2
c) NO_2
d) O_2

498. The ratio between root mean square speed of H_2 at 50 K and that of O_2 at 800 K is:
a) 4
b) 2
c) 1
d) 1/4

499. The product of pressure and volume (PV) has a unit of:
a) Impulse
b) Energy or work
c) Entropy
d) Force

500. Boyle's law may be expressed as:
a) $(\partial P/\partial V)_T = K/V$
b) $(\partial P/\partial V)_T = -K/V^2$
c) $(\partial P/\partial V)_T = -K/V$
d) None of these

501. The structure of Na_2O crystal is
a) NaCl type
b) CsCl type
c) ZnS type
d) Antifluorite type

502. If detergent is added
a) Surface tension decreases
b) Surface tension increases
c) Surface tension can increase or decrease
d) No effect

503. Under identical conditions of temperature the density of a gas A is three times that of gas B while molecular mass of gas B is twice that of A. The ratio of pressures of A and B will be:
a) 6
b) 1/6
c) 2/3
d) 3/2

504. One mole of CO_2 contains:
a) 6.02×10^{23}atoms of C
b) 6.02×10^{23} atoms of O
c) 3.01×10^{23} molecules of CO_2
d) None of the above

505. The pressure exerted by 6.0 g of methane gas in a 0.03 m^3 vessel at 129°C is: (Atomic masses of C = 12.01, H = 1.01 and $R = 8.314$ J $K^{-1}mol^{-1}$)
a) 215216 Pa
b) 13409 Pa
c) 41648 Pa
d) 31684 Pa

506. Two vessels having equal volume contain molecular hydrogen at one atmospheric and helium at two atmospheric pressure respectively. If both samples area at the same temperature the mean velocity of hydrogen molecular is:
a) Equal to that of helium
b) Twice that of helium
c) Half that of helium
d) $\sqrt{2}$ times that of helium

507. Solid carbon dioxide is an example of
a) Metallic crystal
b) Covalent crystal
c) Molecular crystal
d) Ionic crystal

508. A gas is heated from 0°C to 100°C at 1.0 atm pressure. If the initial volume of the gas is 10 litre, its final volume would be:
a) 7.32 litre
b) 10.0 litre
c) 13.66 litre
d) 20.0 litre

509. 32 g of oxygen and 3 g of hydrogen are mixed and kept in a vessel of 760 mm pressure and 0°C. The total volume occupied by the mixture will be nearly:
a) 22.4 litre
b) 33.6 litre
c) 56 litre
d) 44.8 litre

510. The rate of diffusion of a gas is proportional to
a) $\frac{p}{\sqrt{d}}$
b) $\sqrt{\frac{p}{d}}$
c) $\frac{p}{d}$
d) $\frac{\sqrt{p}}{d}$

511. The structure of MgO is similar to NaCl. What would be the coordination number of magnesium?
a) 2
b) 4
c) 6
d) 8

512. Which solid will have the weakest intermolecular forces?
a) P
b) Naphthalene
c) NaF
d) Ice

513. A 0.5 dm^3 flask contains gas A and another flask of 1dm^3 contains gas B at the same temperature. If density of gas A is 3.0 g dm^{-3} and of gas B is 1.5 g dm^{-3} and mol. wt. of $A = \frac{1}{2}$ mol. wt. of B, then the ratio of pressure exerted by gases is:

a) $\frac{P_A}{P_B} = 2$ b) $\frac{P_A}{P_B} = 1$ c) $\frac{P_A}{P_B} = 4$ d) $\frac{P_A}{P_B} = 3$

514. A helium atoms is two times heavier than a hydrogen molecule. At 298 K, the average kinetic energy of a helium atom is
a) Two times that of a hydrogen molecule
b) Four times that of a hydrogen molecule
c) Half that of a hydrogen molecule
d) Same as that of a hydrogen molecule

515. Pressure exerted by 1 mole of methane in a 0.25 L container at 300 K using van der Waals' equation is (Given, $a = 2.253$ atm L^2 mol^{-2}, $b = 0.0428$ L mol^{-1})
a) 82.82 atm b) 152.51 atm c) 190.52 atm d) 70.52 atm

516. The temperature of an ideal gas is increased from 140 K to 560 K. If at 140 K the root mean square velocity of the gas molecules is V, at 560 K it becomes:
a) $5\,V$ b) $2\,V$ c) $V/2$ d) $V/4$

517. When a certain crystal was studied by the Bragg technique using X-rays of wavelength 229 pm, an X-ray reflection was observed at an angle of 23° 20'. What is the corresponding interplanar spacing? [$\sin(23°20') = 0.396$]
a) 375.6 pm b) 256.5 pm c) 289.2 pm d) 315.4 pm

518. The compressibility factor of a gas is defined as $Z = PV/nRT$. The compressibility factor of an ideal gas is:
a) Zero b) Infinite c) 1 d) -1

519. The numerical value of $\frac{RT}{PV}$ for a gas at critical condition is … times of $\frac{RT}{PV}$ at normal condition.
a) 4 b) 3/8 c) 8/3 d) ¼

520. Which gas is most soluble in water?
a) H_2S b) NH_3 c) SO_2 d) CO_2

521. Introduction of absolute scale of thermometry is the result of:
a) Gaseous law b) Graham's law c) Charles' law d) Dalton's law

522. As the temperature is raised from 20°C to 40°C, the average kinetic energy of neon atoms changes by a factor of which of the following?
a) 1/2 b) $\sqrt{313/293}$ c) 313/293 d) 2

523. Calculate the total pressure in a 10.0 L cylinder which contains 0.4 g helium, 1.6 g oxygen and 1.4 g nitrogen at 27°C
a) 0.492 atm b) 49.2 atm c) 4.92 atm d) 0.0492 atm

524. Which one, among the following, is the van der Waals' equation, describing the behaviour of one mole of a real gas over wide ranges of temperature and pressure?
a) $\left(p + \frac{a}{V^2}\right)(V - b) = RT$
b) $\left(p - \frac{a}{V^2}\right)(V - b) = RT$
c) $\left(p + \frac{a}{V^2}\right)(V - b) = \frac{R}{T}$
d) $\left(p + \frac{a}{V^2}\right)(V + b) = RT$

525. Four one litre flasks are separately filled with the gases, O_2, F_2, CH_4 and CO_2 under the same conditions. The ratio of number of molecules in these gases:
a) 2 : 2 : 4 : 3 b) 1 : 1 : 1 : 1 c) 1 : 2 : 3 : 4 d) 2 : 2 : 3 : 4

526. At absolute zero:
a) Gaseous phase does not exist
b) Molecular motion ceases
c) Temperature is -273°C
d) All of the above

527. The equation of state corresponding to 8g of O_2 is
a) $pV = 8RT$ b) $pV = RT/4$ c) $pV = RT$ d) $pV = RT/2$

528. The molecular velocities of two gases at the same temperature are u_1 and u_2 and their masses are m_1 and m_2 respectively. Which of the following expressions are correct?
a) $\frac{m_1}{u_1^2} = \frac{m_2}{u_2^2}$ b) $m_1u_1 = m_2u_2$ c) $\frac{m_1}{u_1} = \frac{m_2}{u_2}$ d) $m_1u_1^2 = m_2u_2^2$

529. Evaporation and boiling differs

a) Evaporation is spontaneous at all temperature while boiling is at constant temperature
b) Boiling is spontaneous at all temperatures while evaporation takes place at constant temperature
c) Both are spontaneous at all temperature
d) Evaporation is exothermic while boiling is endothermic

530. Certain volume of a gas exerts on its walls some pressure at a particular temperature. It has been found that by reducing the volume of the gas to half of its original value the pressure becomes twice that of the initial value at constant temperature. This happens because:
a) Weight of the gas increases with pressure
b) Speed of the gas molecules decreases
c) More number of gas molecules strike the surface per second
d) Gas molecules attract each other

531. The three dimensional graph of lattice points which sets the pattern for the whole lattice is called
a) Space lattice b) Simple lattice c) Crystal lattice d) Unit cell

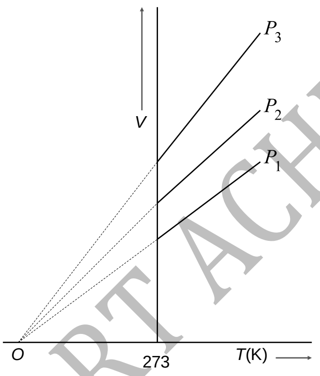
532. According to kinetic theory of gases for a diatomic molecule
a) The pressure exerted by the gas is proportional to the mean square speed of the molecules
b) The pressure exerted by the gas is proportional to the root mean square speed of the molecules
c) The root mea square speed is inversely proportional to the temperature
d) The mean translational KE of the molecule is directly proportional to the absolute temperature

533. 10 g of hydrogen fluoride gas occupy 5.6 litre of volume at NTP. The empirical formula of the gas is HF. The molecular formula of the gas will be:
(at. Wt. of fluorine = 19)
a) H_4F_4 b) HF c) H_2F_2 d) H_3F_3

534. Dalton's law of partial pressure is applicable to which one of the following systems?
a) $NH_3 + HCl$ b) $NO + O_2$ c) $H_2 + Cl_2$ d) $CO + H_2$

535. 50 mL of each gas A and of gas B takes 150 and 200 seconds respectively for effusing through a pin hole under the similar conditions. If molecular mass of gas B is 36, the molecular mass of gas A will be:
a) 32 b) 64 c) 96 d) 128

536. The volume-temperature graphs of a given mass of an ideal gas at constant pressures are shown below. What is the correct order of pressures?



a) $p_1 > p_3 > p_2$ b) $p_1 > p_2 > p_3$ c) $p_2 > p_3 > p_1$ d) $p_2 > p_1 > p_3$

537. A balloon filled with N_2O is pricked with a sharp point and quickly plunged into a tank of CO_2 under the same pressure and temperature. The balloon will:
a) Be enlarged
b) Shrink
c) Remain unchanged in size
d) Collapse completely

538. Kinetic energy of one mole of an ideal gas at 300 K in kJ is
a) 3.74 b) 348 c) 34.8 d) 3.48

539. In the laboratory, sodium chloride is made by burning the sodium in the atmosphere of chlorine which is yellow in colour. The cause of yellow colour is

a) Presence of electrons in the crystal lattice
b) Presence of Na^+ ions in the crystal lattice
c) Presence of Cl^- ions in the crystal lattice
d) Presence of face centred cubic crystal lattice

540. A mixture of 0.50 mole of H_2 and 0.50 mole of SO_2 is introduced into a 10.00 L container at 25°C. The container has a pinhole leak. After a period of time, the partial pressure of H_2 in the remaining mixture
a) Exceeds that of SO_2
b) Is equal to that of SO_2
c) Is less than that of SO_2
d) Is the same as in the original mixture

541. The density of oxygen gas at 25°C is 1.458 mg/litre at one atmosphere. At what pressure will oxygen have the density twice the value?
a) 0.5 atm and 25°C
b) 2 atm and 25°C
c) 4 atm and 25°C
d) None of these

542. A device used for measurement of gaseous pressure based on Boyle's law is known as:
a) Macleod gauge
b) Manometer
c) Fortin's barometer
d) Screw gauge

543. The average speed of an ideal gas molecule at 27°C is 0.3 m sec^{-1}. The average speed at 927°C will be …m sec^{-1}
a) 0.6
b) 0.3
c) 0.9
d) 3.0

544. Potassium crystallizes in a bcc lattice, hence the coordination number of potassium metal is
a) 0
b) 4
c) 6
d) 8

545. Which of the following is correct for critical temperature?
a) It is the lowest temperature at which liquid and vapour can coexist
b) Beyond the critical temperature, there is no distinction between the two phases and a gas cannot be liquefied by compression
c) At critical temperature, the surface tension of the system is not zero
d) At critical temperature, the gas and the liquid phases have different critical densities

546. 20 g of hydrogen is present in 5 litre vessel. The molar concentration of hydrogen is:
a) 2
b) 4
c) 3
d) 1

547. The ratio of most probable velocity to average velocity is
a) $\frac{\pi}{2}$
b) $\frac{2}{\pi}$
c) $\frac{\sqrt{\pi}}{2}$
d) $\frac{2}{\sqrt{\pi}}$

548. The interionic distance for cesium chloride crystal will be
a) a
b) $\frac{a}{2}$
c) $\frac{2a}{\sqrt{3}}$
d) $\frac{\sqrt{3}}{2}a$

549. A certain mass of a gas occupies a volume of 2 L at STP. To what temperature the gas must be heated to double its volume, keeping the pressure constant?
a) 100 K
b) 273 K
c) 273°C
d) 546°C

550. In A^+B^- ionic compound, radii of A^+ and B^- ions are 180 pm and 187 pm respectively. The crystal structure of this compound will be
a) NaCl type
b) CsCl type
c) ZnS type
d) Similar to diamond

551. The density of a gas filled electric lamp is 0.75 kg/m^3. After the lamp has been switched on, the pressure in it increases from 4×10^4 Pa to 9×10^4 Pa. What is increases in U_{rms}?
a) 100
b) 300
c) 200
d) 400

552. The van der Waals' equation for a real gas is given by the formula $\left(p + \frac{n^2a}{V^2}\right)(V - nb) = nRT$, where p, V, T and n are the pressure, volume, temperature and the number of moles of the gas. Which one is the correct interpretation for the parameter a?
a) The parameter a accounts for the finite size of the molecule, not included temperature in the ideal gas law.
b) The parameter a accounts for the shape of gas phase molecules.
c) The parameter a accounts for intermolecular interaction's present in the molecule.
d) The parameter a has no physical significance and van der Waals' introduced it as a numerical correction factor only.

553. Compressibility factor of an ideal gas is

a) Equal to 2 b) Equal to 1 c) Greater than 1 d) Always less than 1

554. Which of the given sets of temperature and pressure will cause a gas to exhibit the greatest deviation from ideal gas behaviour?

a) 100°C and 4 atm b) 100°C and 2 atm c) −100°C and 4 atm d) 0°C and 2 atm

555. The van der Waals' equation for a real gas is given by the formula $\left(p+\frac{n^2a}{V^2}\right)(V-nb)=nRT$ where p, V, T and n are the pressure, volume, temperature and the number of moles of the gas. Which one is the correct interpretation for the parameter a?

a) The parameter a accounts for the finite size of the molecule, not included temperature in the ideal gas law

b) The parameter a account for the shape of gas phase molecules

c) The parameter a accounts for intermolecular interactions present in the molecule

d) The parameter is a correction factor to the volume of the container

556. Schottky defect in crystals is observed when

a) Density of crystal is increased

b) An ion leaves its normal site and occupies an interstitial site

c) Equal number of cations and anions are missing from the lattice

d) Unequal number of cations and anions are missing from the lattice

557. Following properties will decrease with increase in temperature except

a) Surface tension b) Viscosity c) Density d) Vapour pressure

558. Which statement is incorrect?

a) A curve plotted between p and V at constant temperature is called isotherm

b) A curve plotted between p and T at constant volume is called isochore

c) A curve plotted between V and T at constant pressure is called isobar

d) At absolute zero, the gas equation holds good

559. The closest distance between the centres of two molecules of a gas taking part in collision is called

a) Effective molecular diameter b) Collision diameter

c) Both (a) and (b) d) None of the above

560. A flask containing air is heated from 300 K to 500 K. The percentage of air escaped to the atmosphere is nearly

a) 40% b) 30% c) 80% d) 60%

561. Equal masses of ethane and hydrogen are mixed in an empty container at 25°C. The fraction of the total pressure exerted by hydrogen is

a) 1 : 2 b) 1 : 1 c) 1 : 16 d) 15 : 16

562. If the pressure of N_2/H_2 mixture in a closed vessel is 100 atmosphere and 20% of the mixture then reacts, the pressure at the same temperature would be:

a) The same b) 110 atmospheres c) 90 atmospheres d) 80 atmospheres

563. Which is not correct for gases?

a) Gases do not have definite shape and volume

b) Volume of gas is equal to volume of container confining the gas

c) Confined gas exerts uniform pressure on the walls of its container in all directions

d) None of the above

564. If the intermolecular forces vanish away, the volume occupied by the molecules contained in 4.5 kg water at STP will be:

a) 5.6 m^3 b) 4.5 m^3 c) 11.2 litre d) 11.2 m^3

565. At low pressure, van der Waals' equation is reduced to $\left[p+\frac{a}{V^2}\right]V=RT$. The compressibility factor can be given as

a) $1+\frac{a}{RTV}$ b) $1-\frac{RTV}{a}$ c) $1+\frac{RTV}{a}$ d) $1-\frac{a}{RTV}$

566. Air contains 79% N_2 and 21% O_2 by volume. If the barometric pressure is 750 mm Hg the partial pressure of oxygen is:

a) 157.5 mm of Hg b) 175.5 mm of Hg c) 315.0 mm of Hg d) None of these

567. A gas can be liquefied by pressure alone when its temperature is
a) Higher than its critical temperature
b) Lower than its critical temperature
c) Either (a) or (b)
d) None of the above

568. Gas equation $PV = nRT$ is obeyed by:
a) Only isothermal process
b) Only adiabatic process
c) Both (a) and (b)
d) None of these

569. Charles' law is applicable under:
a) Isobaric process b) Isochoric process c) Isothermal process d) Adiabatic process

570. A metal has bcc structure and the edge length of its unit cell is 3.04 Å. The volume of the unit cell in cm^3 will be
a) 1.6×10^{21} cm^3 b) $2.81 \times 10^{-23} cm^3$ c) 6.02×10^{-23} cm^3 d) 6.6×10^{-24} cm^3

571. Bragg's law is given by the equation
a) $n\lambda = 2\theta \sin\theta$ b) $n\lambda = 2d \sin\theta$ c) $2n\lambda = d \sin\theta$ d) $n\frac{\theta}{2} = \frac{d}{2}\sin\theta$

572. Surface tension vanishes at
a) Boiling point b) Critical point c) Condensation point d) Triple point

573. Based on kinetic theory of gases following laws can be proved
a) Boyle's law b) Charles' law c) Avogadro's law d) All of these

574. Which gas cannot be kept in a glass bottle because it chemically reacts with glass?
a) F_2 b) Cl_2 c) Br_2 d) SO_2

575. Most probable speed, average speed and RMS speed are related as:
a) 1 : 1.128 : 1.224 b) 1 : 1.128 : 1.424 c) 1 : 2.128 : 1.224 d) 1 : 1.428 : 1.442

576. While He is allowed to expand through a small jet under adiabatic condition heating effect is observed. This is due to the fact that:
a) Helium is an inert gas
b) Helium is a noble gas
c) Helium is an ideal gas
d) The inversion temperature of helium is very low

577. At 27° the ratio of root mean square speeds of ozone to oxygen is
a) $\sqrt{(3/5)}$ b) $\sqrt{(4/3)}$ c) $\sqrt{(2/3)}$ d) 0.25

578. 6.4 g of SO_2 at 0°C and 0.99 atm pressure occupies a volume of 2.241 L. Predict which of the following is correct?
a) The gas is ideal
b) The gas is real with intermolecular attraction
c) The gas is real without intermolecular repulsion
d) The gas is real with intermolecular repulsion greater than intermolecular attraction

579. A gas of unknown identity effuses at the rate of 83.3 mLs^{-1} in an effusion apparatus in which carbon dioxide effuses at the rate of 102 mLs^{-1}. Calculate molar mass of the unknown gas.
a) 6.597 g mol^{-1} b) 65.97 g mol^{-1} c) 3.650 g mol^{-1} d) 36.50 g mol^{-1}

580. The flame colours of metal ions are due to
a) Schottky defect
b) Frenkel defect
c) Metal excess defect
d) Metal deficiency defect

581. With increase of pressure, the mean free path:
a) Decreases b) Increases c) Becomes zero d) Remains same

582. The pyknometric density of sodium chloride crystal is 2.165×10^3 kg m^{-3}, while its X-rays density is 2.178×10^3 kg m^{-3}. The fraction of unoccupied sites in sodium chloride crystal is
a) 5.96 b) 5.96×10^{-1} c) 5.96×10^{-2} d) 5.96×10^{-3}

583. The rate of diffusion of NH_3 is 3.32 times faster than that of an unknown gas when both gases are at 350 K. The molecular weight of the unknown gas is:

a) 188 b) 56 c) 94 d) 31.0

584. Which is not a surface phenomenon?

a) Surface tension b) Viscosity c) Evaporation d) All of these

585. A certain gas takes three times as long to effuse out as helium. Its molecular mass will be:

a) 27 u b) 36 u c) 64 u d) 9 u

586. Which of the following statements is not true?

a) The ratio of the mean speed to the RMS speed is independent of the temperature

b) The square of the mean speed of the molecules is equal to the mean squared speed at a certain temperature

c) Mean kinetic energy of the gas molecules at any given temperature is independent of the mean speed

d) The difference between RMS speed and mean speed at any temperature for different gases diminishes as larger and yet larger molar masses are considered

587. A cylinder was filled with gaseous mixture containing CO and N_2 (equal masses). The ratio of their partial pressures in cylinder is:

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

588. Potassium fluoride has NaCl type structure. What is the distance between K^+ and F^- ions if cell edge is a cm?

a) $\frac{a}{2}$ cm b) $\frac{a}{4}$ cm c) $2a$ cm d) $4a$ cm

589. Amorphous substances show

(i)Short and long range order

(ii)Short range order

(iii)Long range order

(iv)Have no sharp melting point

a) (i)and (iii) are correct b) (i)and (ii) are correct

c) (ii)and (iii) are correct d) (ii)and (iv) are correct

590. Doping of silicon (Si) with boron (B) leads to

a) n-type semiconductor b) p-type semiconductor

c) Metal d) Insulator

591. The value of gas constant R in SI unit is:

a) 83 erg $K^{-1}mol^{-1}$ b) 0.082 litre atm c) 8.3 J $mol^{-1}K^{-1}$ d) 0.987 cal $mol^{-1}K^{-1}$

592. Which represents the largest amount of energy?

a) Calorie b) Joule c) Erg d) Electron-volt

593. A gaseous mixture containing He, CH_4 and SO_4 was allowed to effuse through a fine hole then find what molar ratio of gases coming out initially? (Given mixture contains He, CH_4 and SO_2 in 1 : 2 : 3 mole ratio)

a) $\sqrt{2}:\sqrt{2}:3$ b) $2:2:3$ c) $4:4:3$ d) $1:1:3$

594. Gas at a pressure P_0 is contained in a vessel. If the masses of all the molecules are halved and their speed doubled, the resulting pressure P will be equal to:

a) $4P_0$ b) $2P_0$ c) P_0 d) $P_0/2$

595. The number of atoms/molecules contained in one face centred cubic unit cell of a monoatomic substance is

a) 1 b) 2 c) 4 d) 6

596. Surface tension of water is 73 dyne cm^{-1} at 20°C. If surface area is increased by 0.10 m^2, work done is

a) 7.3 erg b) 7.3×10^4 erg c) 73 J d) 0.73 J

597. The volume of balloon filled with 4.0 g of He at 22°C and 720 mm of Hg is:

a) 25.565 litre b) 20 litre c) 15 litre d) 30 litre

598. The ratio a/b (the terms used in van der Waals' equation) has the unit:

a) atm litre mol^{-1} b) atm dm^3 mol^{-1} c) dyne cm mol^{-1} d) All of these

599. Which has more weight at NTP?

a) One litre of oxygen b) One litre of hydrogen c) One litre of nitrogen d) One litre of chlorine

600. 0.44 g of a colourless oxide of nitrogen occupies 224 mL at STP. The compound is:
a) N_2O b) NO c) N_2O_2 d) NO_2

601. When an ideal diatomic gas is heated at constant pressure the fraction of the heat energy supplied which increases the internal energy of the gas is:
a) 2/5 b) 3/5 c) 3/7 d) 5/7

602. Helium atom is two times heavier than a hydrogen molecule. At 15°C, the average KE of helium atom is:
a) Twice that of hydrogen
b) Same as that of hydrogen
c) Four times that of hydrogen
d) Half that of hydrogen

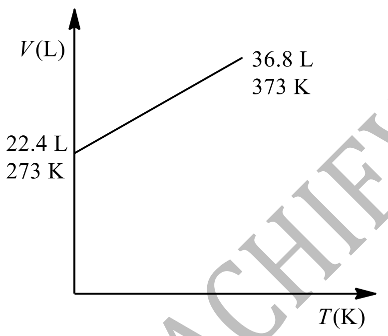
603. Of these quantities, the one that we except to be largest
a) Molar heat capacity of liquid b) Heat of fusion
c) Heat of vaporisation d) Heat of sublimation

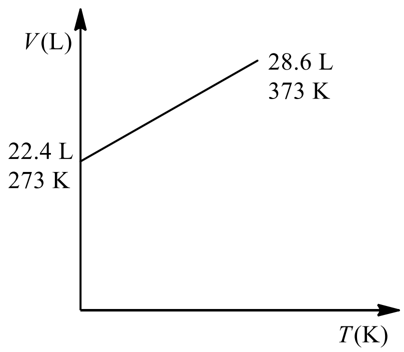
604. For a monoatomic gas kinetic energy $= E$. The relation with rms velocity is
a) $u = \left(\frac{2E}{m}\right)^{1/2}$ b) $u = \left(\frac{3E}{2m}\right)^{1/2}$ c) $u = \left(\frac{E}{2m}\right)^{1/2}$ d) $u = \left(\frac{E}{3m}\right)^{1/2}$

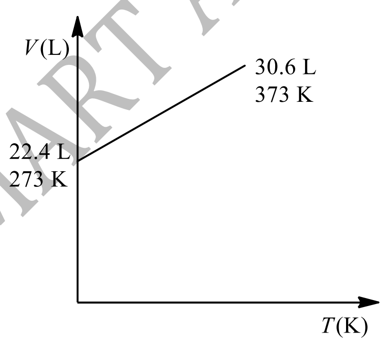
605. Under the similar conditions of P and T the rate of diffusion of hydrogen is about:
a) One half that of He b) 1.4 times that of He c) Twice that of He d) Four times that of He

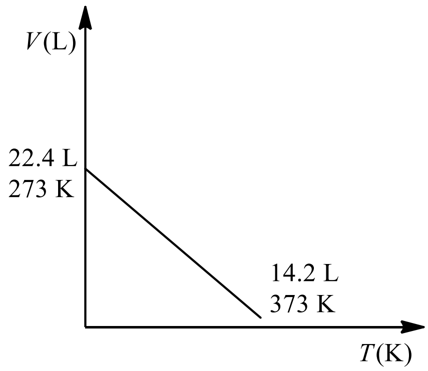
606. Which one of the following is the most correct statement?
a) Brass is an interstitial alloy, while steel is a substitutional alloy
b) Brass is a substitutional alloy, while steel is an interstitial alloy
c) Brass and steel are both substitutional alloy
d) Brass and steel are both interstitial alloy

607. Which one of the following volume (V) −temperature (T) plots represents the behaiour of one mole of an ideal gas at one atmospheric pressure?

a) 

b) 

c) 

d) 

608. A fcc unit cell of aluminium contains the equivalent of how many atoms?
a) 1 b) 2 c) 3 d) 4

609. Equal volumes of H_2 and Cl_2 are mixed. How will the volume of the mixture change after the reaction?
a) Unchanged b) Reduced to half c) Increases two fold d) None of these

610. If both gases are at the same temperature, the rate of diffusion of O_2 is very close to:

a) 8 times that of He b) 0.35 times that of He c) 2 times that of He d) 4 times that of He

611. The average kinetic energy of an ideal gas per molecule in SI units at 25°C will be

a) 6.17×10^{-21} kJ b) 6.17×10^{-21} J c) 6.17×10^{-20} J d) 7.16×10^{-20} J

612. What is the temperature at which the kinetic energy of 0.3 mole of helium is equal to the kinetic energy of 0.4 mole of argon at 400 K?

a) 400 K b) 873 K c) 533 K d) 300 K

613. A gaseous mixture was prepared by taking equal mole of CO and N_2. If the total pressure of the mixture was found 1 atmosphere, the partial pressure of the nitrogen (N_2) in the mixture is:

a) 1 atm b) 0.5 atm c) 0.8 atm d) 0.9 atm

614. Which does not change during compression of a gas at constant temperature?

a) Density of a gas
b) The distance between molecules
c) Average speed of molecules
d) The number of collisions

615. Under which category iodine crystals are placed among the following?

a) Ionic crystal b) Covalent crystal c) Molecular crystal d) Metallic crystal

616. At lower temperatures, all gases except H_2 and He show

a) Negative deviation b) Positive deviation
c) Positive and negative deviation d) None of the above

617. Two gas cylinders having same capacity have been filled with 44 g of H_2 and 44 g of CO_2 respectively. If the pressure in CO_2 cylinder is 1 atm at a particular temperature, the pressure in the hydrogen cylinder at the same temperature is

a) 2 atm b) 1 atm c) 22 atm d) 44 atm

STATES OF MATTER

CHEMISTRY

: ANSWER KEY :

1)	b	2)	b	3)	c	4)	d	169)	d	170)	a	171)	b	172)	c
5)	c	6)	d	7)	b	8)	b	173)	b	174)	a	175)	c	176)	c
9)	b	10)	c	11)	d	12)	d	177)	d	178)	d	179)	c	180)	d
13)	a	14)	a	15)	d	16)	a	181)	a	182)	b	183)	d	184)	d
17)	a	18)	c	19)	d	20)	c	185)	c	186)	d	187)	b	188)	a
21)	b	22)	a	23)	c	24)	b	189)	a	190)	d	191)	d	192)	a
25)	d	26)	b	27)	b	28)	d	193)	a	194)	c	195)	a	196)	d
29)	b	30)	a	31)	d	32)	c	197)	b	198)	c	199)	b	200)	d
33)	d	34)	a	35)	d	36)	c	201)	a	202)	a	203)	d	204)	c
37)	a	38)	b	39)	c	40)	c	205)	b	206)	a	207)	d	208)	d
41)	c	42)	c	43)	b	44)	a	209)	b	210)	a	211)	b	212)	c
45)	c	46)	b	47)	a	48)	d	213)	b	214)	b	215)	c	216)	d
49)	b	50)	c	51)	d	52)	d	217)	c	218)	b	219)	a	220)	b
53)	d	54)	b	55)	c	56)	d	221)	c	222)	a	223)	b	224)	a
57)	c	58)	a	59)	c	60)	b	225)	d	226)	a	227)	d	228)	c
61)	a	62)	a	63)	c	64)	b	229)	b	230)	a	231)	d	232)	c
65)	b	66)	d	67)	a	68)	b	233)	c	234)	d	235)	c	236)	b
69)	d	70)	c	71)	c	72)	d	237)	a	238)	c	239)	d	240)	a
73)	b	74)	a	75)	c	76)	a	241)	a	242)	c	243)	a	244)	d
77)	a	78)	c	79)	b	80)	c	245)	b	246)	c	247)	b	248)	c
81)	b	82)	c	83)	d	84)	a	249)	c	250)	b	251)	b	252)	b
85)	a	86)	c	87)	c	88)	d	253)	c	254)	d	255)	a	256)	a
89)	d	90)	d	91)	b	92)	a	257)	d	258)	c	259)	c	260)	d
93)	c	94)	c	95)	b	96)	b	261)	b	262)	b	263)	d	264)	c
97)	c	98)	c	99)	a	100)	c	265)	b	266)	d	267)	d	268)	b
101)	c	102)	b	103)	d	104)	a	269)	b	270)	a	271)	c	272)	c
105)	b	106)	a	107)	a	108)	c	273)	c	274)	d	275)	b	276)	d
109)	b	110)	b	111)	d	112)	d	277)	b	278)	d	279)	c	280)	b
113)	c	114)	c	115)	c	116)	a	281)	d	282)	a	283)	d	284)	c
117)	d	118)	a	119)	a	120)	a	285)	a	286)	c	287)	b	288)	c
121)	a	122)	a	123)	a	124)	d	289)	a	290)	c	291)	a	292)	b
125)	c	126)	b	127)	a	128)	b	293)	b	294)	b	295)	c	296)	d
129)	a	130)	b	131)	c	132)	c	297)	b	298)	a	299)	a	300)	a
133)	d	134)	c	135)	d	136)	c	301)	c	302)	c	303)	a	304)	b
137)	c	138)	a	139)	c	140)	c	305)	a	306)	c	307)	c	308)	c
141)	a	142)	c	143)	c	144)	d	309)	d	310)	b	311)	a	312)	a
145)	b	146)	a	147)	a	148)	a	313)	d	314)	a	315)	b	316)	a
149)	a	150)	b	151)	a	152)	d	317)	a	318)	b	319)	a	320)	d
153)	d	154)	b	155)	a	156)	b	321)	d	322)	c	323)	d	324)	d
157)	d	158)	a	159)	b	160)	c	325)	b	326)	d	327)	b	328)	b
161)	b	162)	a	163)	a	164)	a	329)	c	330)	c	331)	c	332)	d
165)	c	166)	d	167)	c	168)	b	333)	b	334)	b	335)	c	336)	a

337)	d	338)	b	339)	c	340)	a
341)	c	342)	c	343)	a	344)	a
345)	d	346)	c	347)	a	348)	c
349)	a	350)	a	351)	b	352)	c
353)	b	354)	d	355)	b	356)	d
357)	b	358)	b	359)	d	360)	b
361)	a	362)	c	363)	b	364)	d
365)	a	366)	b	367)	c	368)	a
369)	c	370)	c	371)	a	372)	c
373)	d	374)	c	375)	c	376)	b
377)	b	378)	b	379)	d	380)	d
381)	c	382)	c	383)	c	384)	c
385)	c	386)	d	387)	b	388)	a
389)	c	390)	b	391)	d	392)	a
393)	c	394)	b	395)	a	396)	d
397)	c	398)	c	399)	c	400)	b
401)	d	402)	a	403)	b	404)	a
405)	c	406)	a	407)	d	408)	c
409)	a	410)	c	411)	c	412)	a
413)	b	414)	b	415)	d	416)	b
417)	b	418)	a	419)	c	420)	a
421)	d	422)	b	423)	d	424)	a
425)	c	426)	b	427)	a	428)	b
429)	a	430)	a	431)	b	432)	d
433)	a	434)	c	435)	a	436)	d
437)	b	438)	d	439)	c	440)	a
441)	a	442)	c	443)	d	444)	a
445)	d	446)	d	447)	a	448)	c
449)	c	450)	d	451)	b	452)	a
453)	c	454)	b	455)	c	456)	d
457)	a	458)	c	459)	d	460)	b
461)	d	462)	a	463)	d	464)	b
465)	a	466)	a	467)	b	468)	d
469)	b	470)	b	471)	c	472)	b
473)	b	474)	a	475)	a	476)	a
477)	a	478)	b	479)	b	480)	c

481)	a	482)	d	483)	d	484)	c
485)	d	486)	d	487)	c	488)	c
489)	c	490)	d	491)	d	492)	b
493)	b	494)	a	495)	c	496)	c
497)	b	498)	c	499)	b	500)	b
501)	d	502)	a	503)	a	504)	a
505)	c	506)	d	507)	c	508)	c
509)	c	510)	a	511)	c	512)	d
513)	c	514)	d	515)	a	516)	b
517)	c	518)	c	519)	c	520)	b
521)	c	522)	c	523)	a	524)	a
525)	b	526)	d	527)	b	528)	d
529)	a	530)	c	531)	d	532)	d
533)	c	534)	d	535)	c	536)	a
537)	c	538)	a	539)	a	540)	c
541)	b	542)	b	543)	a	544)	d
545)	b	546)	a	547)	c	548)	d
549)	c	550)	b	551)	c	552)	c
553)	b	554)	c	555)	c	556)	c
557)	d	558)	d	559)	c	560)	d
561)	d	562)	c	563)	d	564)	a
565)	d	566)	a	567)	b	568)	c
569)	a	570)	b	571)	b	572)	b
573)	d	574)	a	575)	a	576)	d
577)	c	578)	a	579)	b	580)	c
581)	a	582)	d	583)	a	584)	b
585)	b	586)	b	587)	a	588)	a
589)	d	590)	b	591)	c	592)	a
593)	c	594)	b	595)	c	596)	b
597)	a	598)	d	599)	d	600)	a
601)	d	602)	b	603)	d	604)	a
605)	b	606)	b	607)	c	608)	d
609)	a	610)	b	611)	b	612)	c
613)	b	614)	c	615)	c	616)	a
617)	c						

STATES OF MATTER

CHEMISTRY

: HINTS AND SOLUTIONS :

2 **(b)**
Molecular weight $= 2 \times$ vapour density (valid for gases).

3 **(c)**
Let the number of nickel ions =98
$\therefore$ The number of oxide ions =100
Total negative charge on O^{2-} ions= $2 \times 100 = 200$
Let number of Ni^{2+} ions $= 98 - x$
$\therefore x = 4$
% of Ni as $Ni^{3+} = \frac{4}{98} \times 100 = 4.08\%$

4 **(d)**
The Ca^{2+} ions are arranged in (ccp) arrangement, *ie*, Ca^2 ions are present at all corners and the centre of each face of the cube. The fluoride ions occupy all the tetrahedral sites. This is 8 : 4 arrangement, *ie*, Ca^{2+} ion is surrounded by $8F^-$ ions and each F^- ion by four Ca^{2+} ions

5 **(c)**
It is definition of root mean square speed.

7 **(b)**
Poise is unit of viscosity.

8 **(b)**

$$\frac{r_{\text{H}}}{r_{\text{He}}} = \sqrt{\frac{M_{He}}{M_H}}$$

$$= \sqrt{\frac{2}{1}}$$

$$\frac{r_{\text{H}}}{r_{\text{He}}} = 1.414$$

9 **(b)**

$$\left(p + \frac{n^2a}{V^2}\right)(V - nb) = nRT$$

$$p = \frac{nRT}{(V - nb)} - \frac{an^2}{V^2}$$

$$= \frac{2 \times 0.082 \times 300}{5 - 2 \times 0.03711} - \frac{4.17 \times 4}{25}$$

$= 9.33$ atm

$$\frac{U_{\text{av}}}{U_{\text{rms}}} = \sqrt{\frac{8RT}{\pi M} \times \frac{M}{3RT}}$$

$$= \sqrt{\frac{8}{3 \times \pi}}$$

$$= \sqrt{\frac{8}{3 \times 3.14}}$$

$U_{\text{av}} = U_{\text{rms}} \times 0.9213$

10 **(c)**
In liquid state, van der Waals' forces becomes appreciable.

12 **(d)**
$C_p - C_v = R$ for each gas.

13 **(a)**
Solid NaCl is a bad conductor of electricity because ions are not free to move

14 **(a)**
At high pressure, the volume is decreased appreciably, so the attractive forces become large and the molecules are crowded together. Thus, pressure correction is necessary and the gas deviates more from ideal behaviour.

15 **(d)**
Mole of O_2 = Mole of H_2; $\therefore \frac{w_{O_2}}{32} = \frac{w_{H_2}}{2}$;
$\therefore W_{O_2} \neq W_{H_2}$

16 **(a)**
$P_m = P_1 + P_2 = 1 + 2.5 = 3.5$

17 **(a)**
White ring of NH_4Cl will appear nearer to the HCl end. The reason is that HCl (mol. wt. = 36.5) is heavier than NH_3 (mol. wt. Hence, according to Graham's law of diffusion, the rate of diffusion of NH_3 will be higher than that of HCl.)

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

18 **(c)**
$V \propto$ mole at same P and T.

20 **(c)**
Gram molecular weight (=1 mol) of any gas contains the volume = 22.4 L

21 **(b)**

$v_{H_2} = v_{O_2}$

So, $\sqrt{M_{O_2}T_{H_2}} = \sqrt{M_{H_2}T_{O_2}}$

$32 \times T_{H_2} = 2 \times 1600$

$T_{H_2} = \frac{2 \times 1600}{32}$

$= 100$ K

22 **(a)**

Boyle's temperature $T_B = \frac{a}{Rb}$

24 **(b)**

Number of tetrahedral voids in the unit cell $= 2 \times$ no. of atoms

$= 2Z$

25 **(d)**

A method in which Dewar flask is used to involves separation of noble gases from liquid air.

26 **(b)**

In Na_2O, each oxide ions (O^{2-}) is co-ordinated to $8Na^+$ ions and each Na^+ ion to 4 oxide ions. Hence, it has 4 : 8 coordination

27 **(b)**

$d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$

$d_{(111)} = \frac{a}{\sqrt{(1)^2 + (1)^2 + (1)^2}}$

$= \frac{a}{\sqrt{3}}$

$d_{(111)} = \frac{318}{\sqrt{3}} = 184$ pm

29 **(b)**

$T_B = \frac{a}{R \cdot b}; T_c = \frac{a}{27R \cdot b} \therefore \frac{T_B}{T_c} = \frac{27}{8}$

30 **(a)**

If $Z > 1$, the gas is less compressible than expected from ideal behaviour and shows positive deviation usually at high pressure, *ie*, $pV > RT$

31 **(d)**

van der Waals' constant a is due to force of attraction and b due to finite size of molecules.

Thus greater the value of a and smaller the value of b, larger the liquefaction.

Thus, $a(Cl_2) > a(C_2H_6)$ and $b\ (Cl_2) > b\ (C_2H_6)$

32 **(c)**

Smaller size of H_2 molecule and mean free path $\propto \frac{1}{(\text{radius})^2}$

33 **(d)**

Let the units of ferrous oxide in a unit cell $= n$. Molecular Weight of ferrous oxide (FeO)

$= 56 + 16 = 72 \text{g mol}^{-1}$

Weight of n units $= \frac{72 \times n}{6.023 \times 10^{23}}$

Volume of one unit = (length of corner)^3

$= (5\text{Å})^3 = 125 \times 10^{-24} \text{cm}^3$

Density $= \frac{\text{wt.of cell}}{\text{volume}}$

$\therefore 4.09 = \frac{72 \times n}{6.023 \times 10^{23} \times 125 \times 10^{-24}}$

Hence, $n = \frac{3079.2 \times 10^{-1}}{72} = 42.7 \times 10^{-1}$

$= 4.27 \approx 4$

34 **(a)**

Both surface tension (S.T) and viscosity (η) decreases with temperature

35 **(d)**

In body centred cubic, each atom/ion has a coordination number of 8

36 **(c)**

Ideal gas equation

$pV = nRT$

If $V = 1$ L

$n = \frac{p}{RT}$

37 **(a)**

$\because R = C_p - C_v$

$\therefore \quad \frac{R}{C_v} = \frac{C_p - C_v}{C_v} = 0.67$

or $\quad \frac{C_p}{C_v} - 1 = 0.670$ or $\frac{C_p}{C_v} = 1.67$

38 **(b)**

Collision frequency $= \frac{u_{\text{rms}}}{\text{mean free path}}$

39 **(c)**

Since, the external pressure is 1.0 atm, the gas pressure is also 1.0 atm as piston is movable. Out of this 1.0 atm partial pressure due to unknown compound is 0.68 atm.

Therefore, partial pressure of He=1.00-0.68=0.32 atm.

$\Rightarrow$ Volume $= \frac{n(\text{He})RT}{p(\text{He})}$

$= \frac{0.1 \times 0.082 \times 273}{0.32} = 7\text{L}$

$\Rightarrow$ Volume of container = Volume of He.

40 **(c)**

$P \propto n(V, T \text{ constant})$

41 **(c)**

The volume of one mole of a gas is called molar volume. It is 22.4 L at STP or NTP for CO_2 gas it is maximum at 127°C and 1 atm

43 **(b)**

We know that density

$$d = \frac{pM}{RT}$$

$d \propto \frac{1}{T}$ and $d \propto p$

Thus, density of neon is maximum at 0°C and 2 atm

44 **(a)**

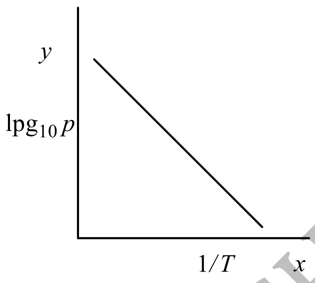
The rate of effusion of He and CH_4

$$\frac{r_{He}}{r_{CH_4}} = \sqrt{\frac{M_{CH_4}}{M_{He}}} = \sqrt{\frac{16}{4}} = 2:1$$

If 4 : 1 mixture of He and CH_4 contained in a vessel, then the composition of mixture of He and CH_4 effusing out initially is 8 : 1.

45 **(c)**

$\frac{1}{T}$ on x axis and $\log_{10} p$ on y axis gives a straight line with a negative slope.



46 **(b)**

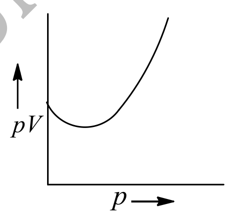
N molecules of a gas at NTP occupies 22.4 litre.

47 **(a)**

$V = KT$; on differentiating at constant $P, (\delta V/\delta T)_p = K$

48 **(d)**

At very low pressure, Boyle's plot is represented as



49 **(b)**

The value of van der Waals' constant 'a' increases in the same order as the critical temperature.

Here, the value of a is highest of Q hence, gas Q has the highest critical temperature.

50 **(c)**

$KE = \frac{3}{2}nRT$, if KE are same $\therefore$

$n_1T_1 = n_2T_2$

51 **(d)**

For a fixed amount of gas at constant temperature, the gas volume is inversely proportional to the gas pressure. Thus

pV =constant

52 **(d)**

$\frac{V_1}{T_1} = \frac{V_2}{T_2}; \frac{V}{273} = \frac{2V}{T_2};$

$\therefore T_2 = 546$ K

53 **(d)**

Glass is an amorphous solid

54 **(b)**

Every constituent has two tetrahedral voids. In ccp lattice atoms

$= 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$

$\therefore$ tetrahedral voids $= 4 \times 2 = 8$

Thus, ratio $= 4 : 8 = 1 : 2$

55 **(c)**

According to Graham's law the rate of diffusion is inversely proportional to square root of molecular weight and density.

$$r \propto \frac{1}{\sqrt{d}} \quad \text{and} \quad r \propto \frac{1}{\sqrt{M}}$$

56 **(d)**

Both P and V increase due to increase in moles of air.

57 **(c)**

Joule Thomson coefficient (μ) is zero at inversion temperature

Mathematically, $\mu = \left(\frac{\partial T}{\partial p}\right)_H$

When, $\mu = 0$, the gas neither gets cooled down nor gets heated upon expansion

58 **(a)**

$$v_{rms} = \sqrt{\frac{3p}{d}}$$

$$= \sqrt{\frac{3 \times 1.2 \times 10^5}{4}} = 300 \text{ ms}^{-1}$$

59 **(c)**

$$u = \sqrt{\frac{3RT}{M}}$$

$$u_{H_2} = \sqrt{\frac{3RT_{H_2}}{M}}\ ; u_{N_2} = \sqrt{\frac{3RT_{N_2}}{M}}$$

$$\sqrt{\frac{3RT_{H_2}}{M}} = \sqrt{7} \times \sqrt{\frac{3RT_{N_2}}{M}}$$

(because rms speed of H_2 is $\sqrt{7}$ times the rms speed of N_2)

$$\frac{3RT_{H_2}}{M} = 7 \times \frac{3RT_{N_2}}{M}$$

$$\frac{T_{H_2}}{2} = \frac{7 \times T_{N_2}}{28}$$

$$\frac{T_{H_2}}{14} = \frac{T_{N_2}}{28}$$

or $T_{H_2} < T_{N_2}$

61 **(a)**

rms speed of a gaseous molecule is x m/s at a pressure p atm.

We know that in kinetic theory of gas

rms speed $= \sqrt{\frac{3RT}{M}}$

We know, $pV = RT$

then rms speed $= \sqrt{\frac{3pV}{M}}$

As temperature is constant so, pV is constant. Hence, rms speed is also constant. If the pressure is doubled at constant temperature, there is no change in rms speed.

62 **(a)**

Using $PV = nRT$

Initially $2 \times 2.24 = n \times 0.0821 \times 300$; $\therefore n = 0.182$

Finally $\frac{100}{76} \times 2.24 = n_1 \times 0.0821 \times 300$;

$n_1 = 0.120$

Mole given out $= 0.182 - 0.120 = 0.062$

63 **(c)**

Follow Avogadro's hypothesis.

64 **(b)**

$$\frac{r_{He}}{r_{CH_4}} = \sqrt{\frac{M_{CH_4}}{M_{He}}} = \sqrt{\frac{16}{4}} = 2$$

65 **(b)**

$$r \propto u_{rms}, \frac{r_{N_2}}{r_{SO_2}} = \frac{u_{N_2}}{u_{SO_2}}$$

$$= \sqrt{\left(\frac{3RT}{M}\right)_{N_2}} \Big/ \sqrt{\left(\frac{3RT}{M}\right)_{SO_2}} = \sqrt{\frac{M_{SO_2} \times T_{N_2}}{M_{N_2} \times T_{SO_2}}}$$

66 **(d)**

At constant temperature, for ideal gas,

$p_1V_1 = p_2V_2$

For the given sample,

$15 \times 76 = 60 \times 20.5$

$\therefore p_1V_1 \neq p_2V_2$

$\therefore$ The gas behaves non-ideally. However the gas neither undergo dimerisation nor adsorbed into the vessel walls.

67 **(a)**

$$v_{rms} = \sqrt{\frac{3RT}{M}}$$

$\therefore v_{rms} \propto \sqrt{T}$

$$\Rightarrow \frac{v_{rms}}{v'_{rms}} = \sqrt{\frac{T}{T''}}$$

$$\frac{1}{2} = \sqrt{\frac{T}{T'}} \quad [\because V''_{rms} = 2v_{rms}]$$

$$\frac{1}{4} = \frac{T}{T''}$$

$T'' = 4T$

Hence, the rms velocity doubles when the temperature is increased four times

68 **(b)**

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ and, then $(V_1 - V_2)$

69 **(d)**

A crystal system is hexagonal if its unit cell having $a = b \neq c$ axial ratio and $\alpha = \beta = 90°, \gamma = 120°$, axial angles

70 **(c)**

There are two atoms in a bcc unit cell

So, number of atoms in 12.08×10^{23} unit cells

$= 2 \times 12.08 \times 10^{23}$

$= 24.16 \times 10^{23}$ atoms

71 **(c)**

Ideal gas do not show change in temperature during expansion.

72 **(d)**
The viral equation for gaseous state is $PV = \left(A + \frac{B}{V} + \cdots\right)$ at Boyle's temperature, gas shows ideal gas behaviour, $i.e., PV = RT$ which is possible only when $A = RT$ and $B = 0$.

73 **(b)**
$$KE = \frac{3}{2}RT = \frac{3}{2} \times 2 \times 300 = 900 \text{ cal}$$

74 **(a)**
$KE = \frac{3}{2}RT = \frac{3}{2} \times 2 \times 273 \text{ cal} = 819 \text{ cal}.$

75 **(c)**
$PV \gtreqless RT$; H_2, He shows $PV > RT$; Rest all shows $PV \gtreqless RT$.

76 **(a)**
Maximum deviations are noticed at low T and high P.

77 **(a)**
Effect of temperature on viscosity is given by **hole theory**

79 **(b)**
$$\Delta S = \frac{L}{T} = LT^{-1}$$

80 **(c)**
This is Avogadro's hypothesis.

81 **(b)**
From Charles' law $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$$\frac{300 \text{ mL}}{300 \text{ K}} = \frac{V_2}{270 \text{ K}}$$

$(V_2 = 270 \text{ mL})$

83 **(d)**
Temperature is doubled in °C and not on Kelvin scale.

84 **(a)**
Ideal gas equation is

$$Vp = nRT$$

When V and T are same,

$$p \propto n$$

Thus, when number of moles, $i.e., n$ is least, it will exert least pressure.

(a) $n = \frac{\text{wt.}}{\text{mol. wt.}} = \frac{0.0355}{33.5} = 1 \times 10^{-3}$ mol

(b) $n = \frac{0.071}{33.5} = 2 \times 10^{-3}$ mol

(c) $n = \frac{\text{number of molecules}}{N_A}$

$$= \frac{6.023 \times 10^{21}}{6.023 \times 10^{23}} = 0.01 \text{ mol}$$

(d) $n = 0.02$ mol

Thus, 0.0335 g chlorine will exert the least pressure.

85 **(a)**
A crystalline substance has a sharp melting point *ie*, solid changes abruptly into liquid state

86 **(c)**
$H_2O \rightleftharpoons H_2O(g)$. This is endothermic process, taking place with increase in pressure. If pressure is increased, equilibrium is displaced in backward side (Le-Chatelier) hence, steam is liquefied. To boil the liquid again, boiling point increases

87 **(c)**
Mol. wt. of gas $= \frac{8 \times 22.4}{5.6} = 32$;
Also, vapour density $= \frac{\text{Mol. wt.}}{2} = \frac{32}{2} = 16$

88 **(d)**
As the temperature rises, the kinetic energy of the molecules increases. Due to which the molecules can leave the liquid surface easily. In other words the vapour pressure increases. However, surface tension and viscosity decrease with rise in temperature. Molality is the ratio of moles of solute to weight of solvent, hence it does not depend upon the temperature.

89 **(d)**
SATP means 1 bar and 25°C.

90 **(d)**
Follow law of corresponding state, proposed by van der Waals'.

91 **(b)**
The compressibility factor
$Z = \frac{p \times 22.4}{RT} = 1$ (for ideal gas)
$Z = \frac{p \times Vm}{RT} < 1$
$\therefore \frac{22.4}{V_m} > 1$ or $V_m < 22.4$

92 **(a)**
Use $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

93 **(c)**

Gaseous phase possesses maximum compressibility.

94 **(c)**

Mole of $H_2 = 22$;

Mole of $CO_2 = \frac{44}{44} = 1; P \propto n$

95 **(b)**

Vapour pressure becomes identical as the atmospheric pressure at boiling point. If the liquid is heated beyond that only evaporation continues, vapour pressure does not rise further.

96 **(b)**

Cu atoms are at eight corners of the cube. Therefore, the number of Cu atoms in the unit cell $= \frac{8}{8} = 1$

Ag atoms are at the face-centre of six faces. Therefore, its share in the unit cell $= \frac{6}{2} = 3$

Au atoms are at the body centre

$\therefore$ the number of Au atoms = 1

$\therefore$ The formula of the alloy is $CuAg_3Au$

97 **(c)**

$u = \sqrt{\frac{3RT}{M}}$; if $T = 2T$ and $M = M/2$, then u_1

$$= \sqrt{\frac{3R \times 2T}{M/2}}$$

$\therefore \frac{u_1}{u} = \sqrt{4} = 2$

98 **(c)**

$KE = (3/2)RT$ in gaseous and liquid phase both.

99 **(a)**

Use $V \propto T$ then $\frac{V_1}{V_2} = \frac{T_1}{T_2}$

if $V_2 = \left(V_1 + \frac{10V_1}{100}\right)$ find T_2 and calculate percent change.

100 **(c)**

$P'_{\text{Argon}} = \frac{2}{2+3} \times P_M = \frac{2P_M}{5}$

101 **(c)**

A constant temperature refers for isothermal process.

102 **(b)**

More is the Schottky defect in crystal, more is the decrease in density

103 **(d)**

$\because PV = nRT$ or $P = \frac{nR}{V} \cdot T$

Thus, P-T curves are linear but with different slopes.

104 **(a)**

Both gases and liquids posses fluidity and hence, viscosity. Molecules in the solid state do not have translational motion

105 **(b)**

The average kinetic energy of a gaseous assembly depends on temperature of the gas

KE $\propto T$

106 **(a)**

From gas equation, $pV = nRT$

Given that, $V = 44.8$ L

$n = 2$

$R = 0.0821$ L atm mol^{-1} K^{-1}

$T = 546$ K

$\therefore p = \frac{2 \times 0.0821 \times 546}{44.8}$

$= 2$ atm

107 **(a)**

Kinetic energy $= \frac{3w}{2M} RT$

where, w = mass of a gas = 1 g

M = molecular mass of gas = 32

$R = 8.314$ J K^{-1} mol^{-1}

$T = 47° + 273° = 320$ K

Kinetic energy $= \frac{3}{2} \times \frac{1}{32} \times 8.314 \times 320$

$= \frac{7981.44}{64} = 1.24 \times 10^2$ J

108 **(c)**

A gas is not escaped or injected, so, number of moles remain the same. When volume of gas is compressed to half, no change will occur in the vessel.

109 **(b)**

$P \propto T$ (n, V are constant).

112 **(d)**

$a = P \times V^2$ = atm litre^2 mol^{-2} = dyne $cm^4 mol^{-2}$ = Newton $m^4 mol^{-2}$ = atm $dm^6 mol^{-2}$

113 **(c)**

Balloons obey Charles' law, *i.e.*, $V \propto T$.

114 **(c)**

$\because$ 100 mL blood has 0.02 g O_2 and 0.08 g CO_2
10,000 mL blood has 2 g O_2 and 8 g CO_2
using $PV = nRT$, for $O_2 : 1 \times V$

$$= \frac{2}{32} \times 0.0821 \times 310$$

$\therefore V_{O_2} = 1.59$ litre

For $CO_2 : 1 \times V = \frac{8}{44} \times 0.0821 \times 310$

$V_{CO_2} = 4.62$ litre

115 **(c)**
Length of the edge of NaCl unit cell,
$= 2 \times$ distance between Na^+ and CI^-

116 **(a)**
The conditions for which NTP signifies.

117 **(d)**
$CuSO_4(aq)$ reacts with all these gases.

118 **(a)**
van der Waals' gas approaches ideal behaviour at low pressure and high temperature.

119 **(a)**
The compressibility factor (Z) of an ideal gas is one because

$$pV = nRT, \left(Z = \frac{pV}{nRT}\right)$$

120 **(a)**
Initially the product PV in compartments A and $B = 1 \times V + 1 \times V = 2V$ if volume of compartment is V. Now PV = constant at constant temperature and if wall is removed, then V becomes $2V$, thus, pressure should be 1 atm to have PV constant.

121 **(a)**
Quartz is a covalent crystal having a framework of silicates of silica, *ie*, a three diamensional network when all the four oxygen atoms of each of SiO_4 tetrahedron are shared

122 **(a)**
$V_1/V_2 = T_1/T_2$

123 **(a)**
$V \propto \frac{1}{P}$ or density $\propto P \left(\because d \propto \frac{1}{V}\right)$

124 **(d)**
These are the three factors on which van der Waals' forces depends.

125 **(c)**
In bcc structure 68% of the available volume is occupied by spheres. Thus, vacant space is 32%

126 **(b)**
Use $\frac{V_1}{V_2} = \frac{T_1}{T_2}$

127 **(a)**
Forces of attractions among molecules depends upon molar mass and polarity. NH_3 is polar molecule.

128 **(b)**
In case of $(NH_3 + HCl + HBr)$ mixture, the Dalton's law is not applicable

130 **(b)**
We know that

$$u_{rms} = \sqrt{\frac{3RT}{M}}$$

$\therefore$ u_{rms} of hydrogen is more than the u_{rms} of nitrogen, thus its temperature is also greater than nitrogen

131 **(c)**
$P_M = P_{N_2} + P_{C_2H_4}$
and P_{N_2}/P_M = mole fraction of N_2

$$\frac{P_{N_2}}{1} = \frac{w/28}{\frac{w}{28} + \frac{w}{28}} = \frac{1}{2} \quad (P_M = 1 \text{ atm})$$

132 **(c)**
Use $P \propto \frac{1}{V}$

$$\frac{P_1}{P_2} = \frac{V_2}{V_1}$$

also, $V_2 = \left[V_1 - \frac{5V_1}{100}\right]$

Find P_2 and calculate percent change.

133 **(d)**
$V \propto T(P, n$ are constant).

134 **(c)**
Tetrahedral sites are double comparable to octahedral sites then ratio of X and Z respectively 2:1, since formula of the compound X_2Z

135 **(d)**
For body centred cubic arrangement coordination number is 8 and radius ratio $\left(\frac{r_+}{r_-}\right)$ is $0.732 - 1.000$

138 **(a)**
Andrew derived critical temperature as a characteristic temperature below which only liquefaction was possible by his studies on CO_2 isotherms.

139 **(c)**
Correct gas equation is

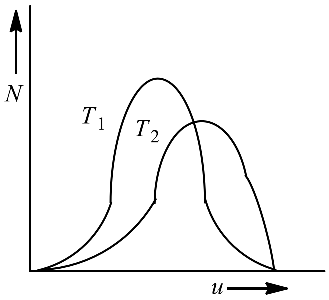
$$\frac{p_1V_1}{p_2V_2} = \frac{T_1}{T_2}$$

140 **(c)**

$$r = \frac{a}{2\sqrt{2}} = \frac{620}{2\sqrt{2}} = 219.25 \text{ pm}$$

141 **(a)**
Addition of impurity does not establish equilibrium

142 **(c)**
Distribution of molecules (N) with velocity (u) at two temperatures T_1 and $T_2 (T_2 > T_1)$ is shown below



At both temperatures, distribution of molecules with increase in velocity first increases, reaches a maximum value and then decreases.

143 **(c)**
Rate of diffusion depends upon the molecular masses of gases. Therefore, the gases which have equal molecular mass, have equal rates of diffusion.

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

Molecular mass of $N_2O = 28 + 16 = 44$

Molecular mass of $CO_2 = 12 + 32 = 44$

$$\because \frac{r_{N_2O}}{r_{CO_2}} = 1$$

$$\therefore \quad r_{N_2O} = r_{CO_2}$$

144 **(d)**
$P_{\text{dry } O_2} + P_{\text{water vapour}} = P_{\text{wet } O_2}$

146 **(a)**

$$v_{\text{rms}} = \sqrt{\frac{3RT}{M}}$$

$$\therefore \quad v_{\text{rms}} \propto \sqrt{T}$$

$\therefore$ At two different temperatures,

$$\frac{v_{\text{rms}}}{v'_{\text{rms}}} = \sqrt{\frac{T}{T'}}$$

Given, $v'_{\text{rms}} = 2v_{\text{rms}}$

$$\frac{1}{2} = \sqrt{\frac{T}{T'}} \text{ or } \frac{1}{4} = \frac{T}{T'}$$

$$\therefore \quad T' = 4T$$

$\therefore v_{\text{rms}}$ gets doubled, when the temperature is increased four times.

147 **(a)**
$P'_{O_2} = P_M \times$ mole fraction of O_2;
$P'_{O_2} = 740 \times \frac{21}{100} = 155.4$ mm

148 **(a)**
$P_1V_1 = \frac{w_1}{30} RT_1; (w_1 = 15)$
$P_2V_2 = \frac{w_2}{M} RT_2; (w_2 = 75)$
if $P_1 = P_2, V_1 = V_2, T_1 = T_2$ then $M = 150$ also;
VD = M/2

149 **(a)**
More is the number of mole, more will be number of molecules.

150 **(b)**
$28\,x = 70 \times 2$;
$\therefore \; x = 5$

151 **(a)**
MnO_2 is antiferromagnetic in nature

152 **(d)**
Use $PV = nRT$; find n for A and B separately; Now again use $PV = nRT$ for mixture using $V = 2$ litre

153 **(d)**

$$u_{\text{rms}} \propto \sqrt{\left[\frac{1}{M}\right]}$$

154 **(b)**
Molecules are never in stationary state.

156 **(b)**
Zinc blende (ZnS) has fcc structure and is an ionic crystal having 4 : 4 coordination number

157 **(d)**
Given, $r_{He} = \frac{500}{30}$ mL/min.

$$r_{SO_2} = \frac{1000}{t} \text{ mL/min}$$

$M_{He} = 4$

$M_{SO_2} = 64$

From Graham's law

$$\frac{r_{He}}{r_{SO_2}} = \sqrt{\frac{M_{SO_2}}{M_{He}}}$$

$$\frac{500}{30} \times \frac{t}{1000} = \sqrt{\frac{64}{4}}$$

$$\frac{t}{60} = 4$$

$t = 240 \text{ min} = 4 \text{ h}$

159 **(b)**

Total kinetic energy $= \frac{3}{2}nRT$

Where, $n =$ number of moles of gas

$n = 1$

Then, KE $= \frac{3}{2}\ RT$

160 **(c)**

Gay-Lussac's were derived from the experiments facts.

161 **(b)**

$$u_{AV}(O_2) = \sqrt{\frac{8RT}{\pi \times 32}}; u_{\text{rms}}(N_2) = \sqrt{\frac{3RT}{28}}$$

$$\therefore \frac{u_{AV}(O_2)}{u_{rms}(N_2)} = \sqrt{\frac{8 \times 28}{\pi \times 32 \times 3}} = \sqrt{\frac{7}{3\pi}}$$

162 **(a)**

Single capillary method is used to determine surface tension of liquids.

163 **(a)**

For an element, term 'atom' is used.

165 **(c)**

Use $PM = dRT$

166 **(d)**

According to Graham's law of diffusion

$$r \propto \frac{1}{\sqrt{M}}$$

Hence, the order of rate of diffusion is

Gases : $A > B > C$

Mol. Weight : 2 4 28

167 **(c)**

Initially for argon : $P \times V = \frac{4}{m} \times R \times T$

On heating for argon : $P \times V = \frac{3.2}{m} \times R \times (T + 50)$

$\therefore 4T = 3.2T + 160$ or $T = 200$ K

168 **(b)**

$$T_i = \frac{2a}{Rb}$$

169 **(d)**

These are van der Waals' equations for 1 mole (a) and n mole gas (b), (c).

171 **(b)**

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{20}{10} = \frac{V_2}{30} \Rightarrow V_2 = 60 \text{ L}$$

$V_2 - V_1 = 60 - 20 = 40$ L

172 **(c)**

At constant P, V and $T, w \propto m$.

173 **(b)**

Solid $\longrightarrow$ Vapour is called sublimation.

174 **(a)**

The structure arrangement of coordination number 6 is octahedral and its radius ratio is $0.414 - 0.732$. The example of octahedral is KCl and NaCl

175 **(c)**

$250 \times p_1 = 1000 \times p_2$

$$\therefore \frac{p_2}{p_1} = \frac{250}{1000} = \frac{1}{4}$$

or $p_2 = \frac{p_1}{4}$

176 **(c)**

Moles of $A, n_A = \frac{p_A V_A}{RT} = \frac{8 \times 12}{RT} = \frac{96}{RT}$

Moles of $B, n_B = \frac{p_B V_B}{RT} = \frac{8 \times 5}{RT} = \frac{40}{RT}$

Total pressure × total volume $= (n_A + n_B) \times RT$

$$p \times (12 + 8) = \frac{1}{RT}(96 + 40)RT$$

$p = 6.8$

$\therefore$ Partial pressure of $A = p \times$ mole fraction of A

$$= 6.8 \times \left(\frac{96}{RT} / \frac{96 + 40}{RT}\right)$$

$= 4.8$ atm

$\therefore$ Partial pressure of $B = p \times$ mole fraction of B

$$= 6.8\left(\frac{40}{RT} / \frac{96 + 40}{RT}\right)$$

$= 2$ atm.

177 **(d)**
From kinetic molecular theory of gases, different gases at the same temperature have same average kinetic energy.

178 **(d)**
When polar crystal is subjected to a mechanical stress, electricity is produced-a case of piezoelectricity. Reversely, if electric field is applied, mechanical stress is developed. Piezoelectric crystal acts as a mechanical transduce

179 **(c)**
$$\text{Mol. wt. of sample} = \frac{28 \times 4 + 32 \times 1}{5} = 28.8$$
$\therefore$ V. D. $= 14.4$

180 **(d)**
For fcc arrangement,
$4r = \sqrt{2}a$
$$a = \frac{4r}{\sqrt{2}}$$

181 **(a)**
In absence of attractive forces, energy is not needed to separate molecules from each other on expansion.

182 **(b)**
Use $P_1V_2 = P_2V_2$.

183 **(d)**
$$\frac{RT_c}{P_cV_c} = \frac{8}{3} \because T_c = \frac{8a}{27Rb}, V_c = 3b \text{ and } P_c = \frac{a}{27b^2}$$

184 **(d)**
$$u_{\text{rms}} = \sqrt{\left[\frac{3RT}{M}\right]}$$

185 **(c)**
In rock salt structure, the coordination number of $Na^+ : Cl^-$ is 6 : 6

186 **(d)**
$$P = \frac{P_1 + P_2}{2}$$

187 **(b)**
A derivation for mean free path of gas.

188 **(a)**
The dipoles in certain solids are spontaneously aligned in a particular direction, even in the absence of electric field. Such substances are called ferroelectric substances. Barium titanate ($BaTiO_3$) and potassium hydrogen phosphate (KH_2PO_4) are ferroelectric solids

189 **(a)**
Higher the critical temperature, greater will be the ease of liquification

190 **(d)**
$b = 4Nv$; $\therefore$ unit of b = litre mol^{-1} = $cm^3 mol^{-1}$ = $m^3 mol^{-1}$

191 **(d)**
$$M = \frac{\rho \times a^3 \times N_A \times 10^{-30}}{Z}$$
$$= \frac{10 \times (100)^3 \times 6.02 \times 10^{23} \times 10^{-30}}{4} = 15.05$$
$\therefore$ Number of atoms in 100 g $= \frac{6.02 \times 10^{23}}{15.05} \times 100$
$= 4 \times 10^{25}$

192 **(a)**
$$\text{Mole of } O_2 = \frac{16}{32}; \text{ mole of } N_2 = \frac{14}{28}$$

193 **(a)**
$$\frac{p_1}{T_1} + \frac{p_1}{T_1} = \frac{p}{T_1} + \frac{p}{T_2}$$
$$\frac{2p_1}{T_1} = p\left(\frac{T_1 + T_2}{T_1T_2}\right)$$
$$\text{or } p = \frac{2p_1T_2}{T_1 + T_2}$$

194 **(c)**
H_2 and He possess minimum mol. wt. among all gases.

195 **(a)**
N_2 and H_2 combine in 1 : 3 ratio forming 2 mole of NH_3.

196 **(d)**
The value of ionic radius ratio is 0.52 which is between $0.414 - 0.732$, then the geometrical arrangement of ions in crystal is octahedral

197 **(b)**
The constituent particles of a solid can only vibrate about their fixed position

198 **(c)**
At high pressure, volume of molecules should not be neglected in comparison to volume of gas. Also experimental studies reveals $PV > RT$ at high P.

200 **(d)**
Metallic crystals are good conductor of heat and current due to the presence of free electrons in them

201 **(a)**
1 atm $= 76$ cm $= 76 \times 13.6 \times 980$ dyne cm^2

202 **(a)**
$$\text{Number of moles of He} = \frac{0.4}{4} = 0.1$$
$$\text{Number of moles of oxygen} = \frac{1.6}{32} = 0.05$$

Number of moles of nitrogen $= \frac{1.4}{28} = 0.05$

Total moles in the 10.0 L cylinder at 27°C

$= 0.1 + 0.05 + 0.05$

$= 0.2$ mol

$$p_T = \frac{nRT}{V} = \frac{0.2 \times 0.082 \times 300}{10} = 0.492 \text{ atm}$$

204 **(c)**
At constant P, V and $T, w \propto m$.

205 **(b)**
In face centred cubic structure, contribution of $\frac{1}{8}$ by each atompresent on the corner and $\frac{1}{2}$ by each atom present on the face

206 **(a)**
Rate of diffusion for H_2 is maximum.

207 **(d)**
Schottky defects occurs in highly ionic compounds which have high coordination number,
*e*g. NaCl, KCl, CsCl etc

208 **(d)**
CsCl has a bcc lattice. So, $d_{\text{body}} = a\sqrt{3}$
or $d_{\text{body}} = \sqrt{3} \times 0.4123 \text{ nm} = 0.7141 \text{ nm}$
The sum of the ionic radii of Cs^+ and Cl^- ions is half this distance *ie*
$r_{Cs^+} + r_{Cs^-} = \frac{d_{\text{body}}}{2} = \frac{0.7141}{2}$ nm
$= 0.3571$ nm
Ionic radius of $Cs^+ = 0.3571 - 0.181 = 0.1761$

209 **(b)**
According to ideal gas equation

$$pV = nRT$$

$n =$ number of moles of gas

then, $\frac{pV}{nRT} = 1$

Therefore, the compressibility factor

$$Z = \frac{pV}{nRT} = 1$$

For an ideal gas. For real gas Z may be either greater than one or less than one.

210 **(a)**
$\frac{pV}{nRT} > 1$, the gas is less compressible than expected from ideal behaviour and shows positive deviation.

211 **(b)**
$PV = \frac{w}{m}RT$

212 **(c)**
Given, $\frac{p_2}{p_1} = 2, \frac{T_2}{T_1} = 2, V_1 = 4 \text{ dm}^3, V_2 = ?$

From gas equation

$$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$$

$$or\ \frac{V_1}{V_2} = \frac{p_2}{p_1} \times T_1/T_2$$

$$\therefore\ \frac{4}{V_2} = 2 \times \frac{1}{2} = 1$$

$$\therefore\ V_2 = 4 \text{ dm}^3$$

213 **(b)**
A principle used for cooling gas.

214 **(b)**
For real gases van der Waals' pointed out volume correction in gas equation where V was replaced by $(V - b)$.

215 **(c)**
Zinc blende (ZnS) has fcc structure and is an ionic crystal having 4:4 coordination number

216 **(d)**
Follow Avogadro's hypothesis.

218 **(b)**
Given, $a = b \neq c, \alpha = \beta = 90°, \gamma = 120°$
This is true for hexagonal system

219 **(a)**
$\frac{p_1}{d_1} = \frac{p_2}{d_2}$ (at a constant temperature)
This is the Boyle's law
So, the case – "Air at sea level is dense" is studied under Boyle's law

220 **(b)**
During evaporation, molecule having high energy leave the surface of liquid. As a result average kinetic energy of liquid decreases
$\because$ KE $\propto T$
$\therefore$ Temperature of liquid falls

221 **(c)**
Volume of balloon $= \frac{4}{3}\pi r^3$

$$= \frac{4}{3} \times \frac{22}{7} \times \left(\frac{21}{2}\right)^3 = 4851 \text{ mL}$$

Volume of the cylinder containing gas =2.82 L = 2820 mL

Volume at STP = $V_1 = 2820 \times \frac{273}{300} \times 20 = 51324$ mL

Volume of the gas that will remain in the cylinder after filling balloons is equal to the volume of cylinder, *ie*, 2820 mL

Available hydrogen for filling

$= 51324 - 2820$

$= 48504$ mL

Number of balloons $= \frac{48504}{4851} \approx 10$

222 **(a)**

$P_{\text{dry gas}} = P_{\text{wet gas}} - P_{H_2O}$

223 **(b)**

It is a characteristic of liquid crystal

224 **(a)**

$T_2 = T_1 + 1;\ P_2 = P_1 + \frac{0.4\,P_1}{100}$

Now use, $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

assuming $V_1 = V_2$

225 **(d)**

In a unit cell, W atoms at the corner $= \frac{1}{8} \times 8 = 1$

O-atoms at the centre of edges $= \frac{1}{4} \times 12 = 3$

Na-atoms at the centre of the cube =1

W : O : Na =1 : 3 : 1

Hence, formula = $NaWO_3$

226 **(a)**

$pV = nRT$

$V =$ same

$R =$ constant

$T =$ same

$p \propto n$

or $p \propto \frac{w}{M}$ but w is same.

So, $p \propto \frac{1}{M}$

$\frac{p_{CH_4}}{p_{O_2}} = \frac{M_{O_2}}{M_{CH_4}} = \frac{32}{16} = \frac{2}{1}$

227 **(d)**

$u_1/u_2 = \sqrt{\left[\frac{T_1}{T_2}\right]}$

228 **(c)**

$P'_{H_2O} = P_M \times \frac{1}{100} = 760 \times \frac{1}{100}$

$= 7.6$ mm of Hg

229 **(b)**

Rate of diffusion $\propto \frac{1}{\sqrt{\text{molecular mass}}}$

$\therefore$ Order of diffusion : $H_2 > CH_4 > SO_2$

and amount left is in the order $SO_2 > CH_4 > H_2$

Hence, order of partial pressure is

$$pSO_2 > pCH_4 > pH_2$$

230 **(a)**

$w = 22$ g; $V = 1$ litre, $T = 298$ K

using $PV = \frac{w}{m}RT$ (for CO_2)

$P \times 1 = \frac{22}{44} \times 0.0821 \times 298$

$\therefore\ P_{CO_2} = 12.23$ atm

$\therefore\ P_{\text{in bottle}} = P_{CO_2} + \text{atm. pressure}$

$= 12.23 + 1 = 13.23$ atm

231 **(d)**

A fact for deviations from ideal gas behaviour.

232 **(c)**

Closest approach in bcc lattice

$= \frac{1}{2}$ of body diagonal $= \frac{1}{2} \times \sqrt{3}a$

$= \frac{\sqrt{3}}{2} \times 4.3 = 3.72$ Å

233 **(c)**

$\frac{V_A}{t_A} \times \frac{t_B}{V_B} = \sqrt{\frac{M_B}{M_A}}$

$\frac{10}{20} = \sqrt{\frac{M_B}{49}}$

$M_B = \frac{49}{4} = 12.254$

234 **(d)**

This is one of the limitation of van der Waals' equation.

235 **(c)**

Frenkel defect is observed in the crystals in which the radius ratio is low

236 **(b)**

Graham's law of diffusion of gases

$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}} = \sqrt{\frac{d_2}{d_1}}$

237 **(a)**

$\frac{d}{p} = \frac{M}{R}$

Let density of gas $B = d$

So, density of gas $A = 2d$
And molecular weight of $A = M$
So molecular weight of $B = 3M$

$p_A = \frac{M_A}{d_A}$ and $p_B = \frac{M_B}{d_B}$

$\frac{p_A}{p_B} = \frac{M_A}{d_A} \times \frac{d_B}{M_B}$

$= \frac{M}{2d} \times \frac{d}{3M} = \frac{1}{6}$

238 **(c)**
Real gases do not follow gas laws at all temperature and pressure conditions due to two wrong assumptions in kinetic molecular theory of gases :

(i) The volume occupied by gas molecules is negligible. It is not true because gas

molecules do occupy small volume.

(ii) The forces of attraction between gas molecules are zero. It is not true because

attractive forces are present between molecules of real gases.

239 **(d)**
Boyle's law, Charles' law and Avogadro's law can be proved on the basis of kinetic theory of gases.

241 **(a)**
Given, $\frac{r_{H_2}}{r_A} = 6, M_{H_2} = 2, M_A = ?$

From Graham's law of diffusion,

$$\frac{r_{H_2}}{r_A} = \sqrt{\frac{M_A}{M_{H_2}}}$$

or $6 = \sqrt{\frac{M_A}{2}}$ or $36 = \frac{M_A}{2}$

$\therefore M_A = 72$

242 **(c)**
Given initial volume $(V_1) = 300$ cc; initial temperature $(T_1) = 27°C = 300$ K, initial pressure $(p_1) = 620$ mm, final temperature $(T_2) = 47°C = 320$ K and final pressure $(p_2) = 640$ mm. We know from the general gas equation

$$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$$

$$= \frac{620 \times 300}{300} = \frac{600 \times V_2}{320}$$

$= 310$ cc

(where, V_2 is the final volume of the gas)

243 **(a)**
Use $P_m = P_{O_2} + P_{H_2}$ or $740 = 2P(P_{H_2} = P_{O_2} = P)$

244 **(d)**
Use $\frac{w_1}{w_2} = \sqrt{\left[\frac{M_1}{M_2}\right]}$

245 **(b)**
Follow definition of critical temperature.

246 **(c)**
$\frac{\text{M wt. of } CO_2}{\text{M wt. of } SO_2} = \frac{M_1}{M_2} = \frac{44}{64} = \frac{11}{16}$

approx $= \frac{2}{3}$

247 **(b)**
In the van der Waals' equation :

$$\left(p + \frac{n^2a}{V^2}\right)(V - nb) = nRT$$

The pressure correction factor (n^2a/V^2) accounts for intermolecular attraction in real gas.

248 **(c)**
At constant temperature and pressure, the masses of two gases in a mixture are same, so
$M_{N_2} = M_{O_2}$

249 **(c)**
A real gas will approach ideal behaviour at high temperature and low pressure.

250 **(b)**
Rest all are dissolved in water to greater extent.

251 **(b)**
$\eta = Ae^{E/RT}$

252 **(b)**
The conditions for triple point of H_2O.

253 **(c)**
Follow assumptions of kinetic theory.

255 **(a)**
At inversion temperature gases show neither cooling nor heating on subjecting to Joule-Thomson effect.

257 **(d)**
$PV = \frac{w}{m}RT$;

If other factors are same, $V \propto \frac{1}{m}$

258 **(c)**

$V \propto T$

259 **(c)**

Let rms speed of nitrogen at T K be u and is equal to that of CO_2 at STP

$$u_{\text{rms}} = \sqrt{\frac{3RT}{28}} = \sqrt{\frac{3R \times 273}{44}}$$

$$T = \frac{273 \times 28}{44}$$

$= 173.73$ K $= -99.27$°C

260 **(d)**

$KE \propto T$

261 **(b)**

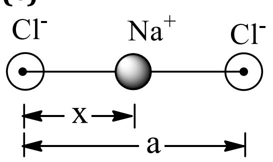
Under similar conditions of P and T, moles or volume of gases react according to stoichiometry of reaction. This is Gay-Lussac's law of combining volume, e.g., 1 volume H_2 combines with 1 volume Cl_2 to give 2 volume HCl as:

$$H_2 + Cl_2 \rightarrow 2HCl$$

262 **(b)**

Real gases show less pressure than ideal gases because molecular interactions lowers the speed of molecules with which they collide

264 **(c)**



Or, $a = \frac{2d}{\sqrt{3}} = \frac{2 \times 4.52}{\sqrt{3}} = 5.219$Å $= 522$ pm

$\therefore a = 2x$

266 **(d)**

Given $T_1 = 273 + 10 = 283$ K

$$T_2 = 273 + 20 = 293 \text{ K}$$

Average KE $= \frac{3}{2}kT$

$$\frac{KE_1}{KE_2} = \frac{283}{293} = 0.96$$

Root mean square (rms) velocity,

$$v_{\text{rms}} = \sqrt{\frac{3RT}{M}}$$

$$\frac{v_{(\text{rms})_1}}{v_{(\text{rms})_2}} = \sqrt{\frac{T_1}{T_2}}$$

$$= \sqrt{\frac{283}{293}} = 0.98$$

Thus both average kinetic energy and root mean square velocity increase but not significantly when temperature is increased from 10°C to 20°C.

268 **(b)**

Destiny, $d = \frac{Z\,M}{a^3 N_A}$

$$= \frac{4(58.5)\text{g mol}^{-1}}{(5.628 \times 10^{-8}\text{cm})^3 (6.023 \times 10^{23}\text{mol}^{-1})}$$

$= 2.179$ g cm^{-3}

269 **(b)**

Second member of alkyne series is C_3H_4. $(m - 40)$

C_3H_4 **SO_2**

$$\sqrt{\frac{2RT_1}{M_1}} = \sqrt{\frac{2RT_2}{M_2}}$$

$$T_1 = T_2\left(\frac{M_1}{M_2}\right) = 800\left(\frac{40}{64}\right)\text{K}$$

$= 500$ K $= 227$°C

270 **(a)**

Both gases are filled in a container of volume V;

Thus, $P_m = P_1 + P_2 = 2P$

271 **(c)**

A fact why we feel discomfort on hot rainy day.

272 **(c)**

Greatest deviation from ideal behaviour is exhibited by real gases at low temperature and high pressure.

From the given choices it is clear that choice (c) has lowest temperature and highest pressure.

273 **(c)**

$b = 4 \times N \times$ volume of one molecule in rest.

274 **(d)**

Evaporation takes place at constant temperature and thus, kinetic energy does not change.

275 **(b)**

$$KE = \frac{3}{2}RT$$

$KE \propto T$

$$\frac{KE_{O_2}}{KE_{SO_2}} = \frac{T_{O_2}}{T_{SO_2}} = \frac{273}{546} = \frac{1}{2}$$

$KE_{SO_2} = 2\,KE_{O_2}$

$KE_{SO_2} > KE_{O_2}$

277 **(b)**

$PV = \frac{1}{3}mu^2$; at constt. V: $\frac{P_1}{P_2} = \frac{u_1^2}{u_2^2}$

278 **(d)**

Van der Waals' equation (at low pressure),

$\left[p + \frac{a}{V^2}\right](V - b) = RT$

or $pV = RT + pb - \frac{a}{V} + \frac{ab}{V^2}$

or $\frac{pV_m}{RT} = 1 - \frac{a}{RT} = Z$

280 **(b)**

KE= $\frac{3}{2}$ kT

Where, k is constant.

KE $\propto T$

Here the temperature is same. Hence, for 1 g of H_2 and 1 g of CH_4 which are taken in two vessels, of 1 L each at same temperature, the kinetic energy per mole will be the same.

281 **(d)**

Amorphous solids are isotropic, as these substances show same properties in all directions

282 **(a)**

$KE/\text{molecule} = \frac{3}{2}\frac{R}{N} \cdot T$

283 **(d)**

$u_1/u_2 = \sqrt{\left[\frac{T_1}{T_2}\right]}$

284 **(c)**

According to Clausis-Clapeyron, if a graph is plotted between $\log p$ and $\frac{1}{T}$, a straight line is obtained with negative slope.

285 **(a)**

Ideal gas does not show Joule-Thomson effect.

287 **(b)**

NH_3 diffuses more readily than HCl because of low mol. wt.;

$r \propto \frac{1}{\sqrt{M}}$

288 **(c)**

$p(H_2) = \frac{1400 \times 68.5}{100}$ torr

$= 959$ torr $= 959/760$ atm

$= 1.26$ atm

According to Henry's law,

amount of gas absorbed is directly proportional to pressure

Hence, $\frac{V}{18 \text{ mL}} = \frac{1.26 \text{ atm}}{1 \text{ atm}}$

$V = 23$ mL

289 **(a)**

A atoms are at eight corners of the cube. Therefore, the number of A atoms in the unit cell $= \frac{8}{8} = 1$, atoms B per unit cell=1. Hence, the formula is AB

290 **(c)**

Boiling point of a liquid is the temperature at which its vapour pressure becomes equal to 1 atm.

291 **(a)**

Methanol being more volatile than water, an aqueous solution of methanol will have vapour pressure more than that of water

292 **(b)**

Dalton's law of partial pressure is not applicable to gases which react chemically and produce different number of moles of products than the reactants. Some gases which do not obey this law are

$SO_2 + Cl_2, CO + Cl_2, NO + O_2, NH_3 + HCl$ and $H_2 + Cl_2$

293 **(b)**

$C_p - C_v = R; c_p = M \times c_p$ and $C_v = M \times C_v$

294 **(b)**

$\frac{u_1}{u_2} = \sqrt{\frac{n_1T_1}{n_2T_2}} = \sqrt{\frac{n \times T}{2n \times 2T}} = \sqrt{\frac{1}{4}} = \frac{1}{2}$

$\therefore u_2 = 2u_1$

295 **(c)**

Bond formation is exothermic.

296 **(d)**

$pV = nRT$ (Ideal gas equation)

or $V = \frac{nRT}{p}$

$\frac{V_1}{V_2} = \frac{T_1}{T_2} \times \frac{p_2}{p_1}$

$\frac{V_1}{V_2} = \frac{273 + 15}{273 + 25} \times \frac{1}{1.5}$

$\frac{V_1}{V_2} = \frac{288}{298} \times \frac{1}{1.5}$

or $\frac{V_1}{V_2} = \frac{1}{1.55}$

or $\frac{V_2}{V_1} = 1.55$

297 **(b)**

$C_V = \frac{3}{2}$R(for monoatomic) and $\frac{5}{2}R$(for diatomic).

Thus, for mixture, $C_V = \frac{\left[\frac{3}{2}R + \frac{5}{2}R\right]}{2} = 2R = 4$ cal.

299 **(a)**

Mol. wt. of moist air is lesser than dry air.

300 **(a)**

According to Boyle's law

$pV =$ constant

The plot of pV against p is straight line parallel to x- axis

∴ Slope is zero.

301 **(c)**

Given that,

Density of liquid $(D) = 800$ kgm^{-3}

Height of liquid $(h) = 4$ cm $= 0.04$ m

Acceleration due to gravity (g) $= 9.8$ ms^{-2}

Diameter of tube $(d) = 0.8$ mm

Radius of tube $(r) = 0.4$ mm $= 4 \times 10^{-4}$ m

Surface tension (T) =?

By using

$$T = \frac{rh\,Dg}{2}$$

$$= \frac{(4 \times 10^{-4}) \times (0.04) \times 800 \times 9.8}{2}$$

$$= 4 \times 10^{-4} \times 0.04 \times 400 \times 9.8$$

$$= 4 \times 4 \times 4 \times 98 \times 10^{-5}$$

Hence, $T = 6.272 \times 10^{-2} \approx 6.3 \times 10^{-2}$ Nm^{-1}

302 **(c)**

$M_{O_2} = 16/32$

$M_{SO_2} = \frac{32}{64}$;

Equal mole contain equal no. of molecules.

303 **(a)**

Number of octahedral sites = Number of sphere in the packing

∴ Number of octahedral sites per sphere = 1

304 **(b)**

One gram mole of a gas at NTP occupies 22.4 L as volume. This fact was derived from Avogadro's hypothesis

306 **(c)**

In ideal gas equation the value of universal gas constant depends on the units of the measurement.

Numerical values of R,

(a) 0.0821 L atm K^{-1} mol^{-1}

(b) 8.314 J K^{-1} mol^{-1}

(c) 8.314 $\times 10^7$ erg K^{-1} mol^{-1}

307 **(c)**

These are facts about Loschmidt's number.

308 **(c)**

According to Boyle's law $V = \frac{K}{P}$

309 **(d)**

Effusion does not depend on size of the molecule

310 **(b)**

According to Graham's law of diffusion

$$r \propto \sqrt{\frac{1}{M}}$$

The rate of diffusion of ammonia $(M = 17)$ is more than the HCl $(M = 36.5)$, thus white ring forms near the hydrogen chloride bottle

312 **(a)**

Frenkel's defect is due to shift of an ion from the normal lattice site (creating a vacancy) and occupy interstitial spaces

314 **(a)**

KE $= \frac{3}{2}\,RT$ for 1 mole of gas

$$\Delta\text{KE} = \frac{3}{2} \times 8.315 \times (50 - 0)$$

$$= \frac{3}{2} \times 8.315 \times 50$$

$$= 623.25 \text{ J}$$

315 **(b)**

From the total pressure and the vapour pressure of water, we can calculate the partial pressure of O_2

$p_{O_2} = p_T - p_{H_2O} = 760 - 22.4 = 737.6$ mm Hg

From the ideal gas equation we write

$$m = \frac{pVM}{RT}$$

$$= \frac{0.974 \times 0.128 \times 32.0}{0.0821 \times 297} = 0.163 \text{ g}$$

316 **(a)**

Lowering of temperature decreases kinetic energy and increase of pressure increases forces of attractions.

317 **(a)**

We know that,

$$V_{\text{rms}} = \sqrt{\frac{3RT}{M}}$$

So, as the molecular mass increases, rms speed decreases. Thus, the correct order of root mean square speed is

$H_2 > N_2 > O_2 > HBr$

318 **(b)**

$$\frac{r_1}{r_2} = \frac{1}{6} = \sqrt{\left[\frac{M_2}{M_1}\right]} = \sqrt{\frac{2}{M}} \therefore M = 72$$

319 **(a)**

$$u_{AV} \propto \sqrt{\left[\frac{8RT}{\pi M}\right]} \text{ or } u \propto \sqrt{\left[\frac{T}{M}\right]}$$

321 **(d)**

Charcoal adsorbs gases.

322 **(c)**

Given, $V_1 = 500$ mL, $T_1 = 27 + 273 = 300$ K

$V_2 = ?, T_2 = 42 + 273 = 315$ K

From Charles' law

$$V_1 T_2 = V_2 T_1$$

$$\therefore V_2 = \frac{500 \times 315}{300} = 525 \text{ mL}$$

Hence, increase in volume $= 525 - 500$

$= 25$ mL

324 **(d)**

CO reacts with red colouring haemoglobin molecules in blood to form a complex of cherry red colour.

325 **(b)**

AgBr exhibits Frenkel defect due to large difference in the size of Ag^+ and Br^- ions

327 **(b)**

The internal energy, *i.e.*, kinetic energy of gas depends only on temperature.

328 **(b)**

$$u_{\text{rms}} = \sqrt{\frac{3RT}{M}}$$

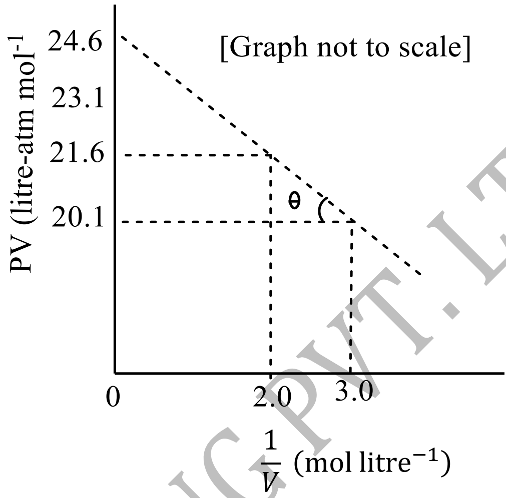
329 **(c)**

SO_2 has higher value of van der Waals' forces of attraction and thus, more easily liquefied.

330 **(c)**

Liquefaction of a gas is easier if it possesses high T_c and higher T_i

331 **(c)**



Van der Waals' equation for 1 mol of real gas is

$$\left[P + \frac{a}{V^2}\right][V - b] = RT$$

Given that $b = 0$

$$\therefore \left(P + \frac{a}{V^2}\right)(V) = RT$$

$$\therefore PV = RT - \frac{a}{V} \quad ....(i)$$

Following $y = mx + c$ for the curve $PV \; vs \frac{1}{V}$

Slope $= -a$

$$\text{Slope} = \frac{21.6 - 20.1}{2 - 3} = -1.5$$

$\therefore a = 1.5$

333 **(b)**

Gases for which intermolecular forces of attraction are small such as N_2, O_2 etc have low value of T_c, thus liquefied above critical temperature

334 **(b)**

$$d_1 T_1 = d_2 T_2$$

When p remains constant

$$d_1 = 16; d_2 = 14; T_1 = 273 \text{ K}, T_2 = ?$$

$$d_1 T_1 = d_2 T_2$$

$$16 \times 273 = 14 \times T_2$$

$$T_2 = 312 \text{ K}$$

$$T_2 = 312 - 273 = 39°\text{C}$$

335 **(c)**

$$d = \frac{P_m}{RT}$$

336 **(a)**

Both CO_2 and N_2O have same mol. wt.

337 **(d)**

Mole fraction of nitrogen in air is greater than the given gases so it has highest partial pressure in the atmosphere.

338 **(b)**

In rock salt structure, the coordination number of $Na^+ : Cl^-$ is 6 : 6

339 **(c)**

CO_2 is more easily liquefied than O_2 gas. Hence (a) of CO_2 is more than that of O_2. Also CH_4 is easily liquefied than H_2 and He. Hence $'a'$ of CH_4 is more than H_2 and He.

	He	H_2	O_2	CO_2	CH_4
a	0.434	0.244	1.36	3.59	2.25
atom l^2 mole^{-2}					
b	0.0237	0.0266	0.0318	0.0427	0.0428 l mol

$\therefore$ Order of a $CH_4 > O_2 > H_2$

$\therefore$ Order of b $He < H_2 < O_2 < CO_2$

340 **(a)**

$(T_f)_{\text{irrev}} > (T_f)_{\text{rev}}$

341 **(c)**

Ideal gas cannot be liquefied as its molecules have no force of attractions.

342 **(c)**

$u_{AV} = [8RT/\pi M]^{1/2}$

344 **(a)**

$V \propto \frac{T}{P}$

345 **(d)**

$$\frac{r_{H_2}}{r_{O_2}} = \sqrt{\frac{M_{O_2}}{M_{H_2}}}$$

$$\frac{50/20}{40/t} = \sqrt{\frac{32}{2}} \qquad \left(\because r = \frac{V}{t}\right)$$

$$\frac{t}{16} = 4 \Rightarrow t = 64 \text{ min}$$

347 **(a)**

Rate of diffusion of hydrogen is more than methane thus the balloon will have enlarged

348 **(c)**

Kinetic energy depends on temperature only.

349 **(a)**

For H_2 and He, $PV > nRT$; Also $Z = \frac{PV}{nRT}$

350 **(a)**

The number of spheres in one body centred cubic and in one face centred cubic unit cell is 2 and 4 respectively

351 **(b)**

$PV =$ constant at constant temperature.

352 **(c)**

$$\frac{u_{H_2}}{u_{O_2}} = \sqrt{\left[\frac{M_{O_2}}{M_{H_2}}\right]} \text{ if } T \text{ is constant.}$$

353 **(b)**

Total mole $= \frac{4.4}{44} + \frac{2.24}{22.4} = \frac{1}{5}$; molecules $= \frac{N}{5}$

354 **(d)**

$$n = \frac{pV}{RT} = \frac{3170 \times 10^{-3}}{8.314 \times 300} = 1.27 \times 10^{-3} \text{ mol}$$

355 **(b)**

Most probable velocity $= \sqrt{\frac{8RT}{\pi M}}$

$T = (27 + 273) = 300$ K

Molecular mass of $H_2 = 2 \text{ g mol}^{-1}$

Most probable velocity (H_2)

$$= \sqrt{\frac{8 \times 8.314 \times 10^7 \times 300}{3.14 \times 2}}$$

$= 17.8 \times 10^4$ cm/s

356 **(d)**

$$u_{\text{rms}} = \sqrt{\frac{2^2 + 3^2 + 4^2 + 5^2}{4}} = \frac{\sqrt{54}}{2} \text{cm/s}$$

357 **(b)**

On heating the gas in open vessel

At 300 K : $P_1V_1 = n_1 \cdot R \cdot 300$

At 400 K : $P_1V_1 = n_2 \cdot R \cdot 400$

$\therefore \frac{n_1}{n_2} = \frac{4}{3}$ or $n_2 = \frac{3}{4} n_1$

Thus, $\frac{n_1}{4}$ gas is given out

358 **(b)**

A fact at zero Kelvin.

360 **(b)**

$V_1/V_2 = T_1/T_2$

361 **(a)**

$c_p = C_p/M$

362 **(c)**

$$KE = \frac{3}{2}nRT = \frac{3}{2} \times 2 \times 8.314 \times 300$$
$$= 7482.6 \text{ J}$$

363 **(b)**

Silica (SiO_2) has gaint covalent structure

364 **(d)**

When radius ratio between 0.732 – 1.000, then coordination number is 8 and the structural arrangement is body centred cubic

365 **(a)**

$$200 = \sqrt{\frac{2RT}{2 \times 10^{-3}}}$$

or $RT = 40$

Average kinetic energy $= \frac{3}{2}nRT$

$$= \frac{3}{2} \times \frac{8}{2} \times 40$$

$= 240$ J

367 **(c)**

Graham's law is valid at low pressure.

368 **(a)**

Average speed of gas molecules

$$= \sqrt{\frac{8RT}{\pi M}}$$

Most probable speed of gas molecules

$$= \sqrt{\frac{2RT}{M}}$$

$$\therefore v_{av} : v_{mp} = \sqrt{\frac{8RT}{\pi M}} : \sqrt{\frac{2RT}{M}}$$

$$= \sqrt{\frac{8}{\pi}} : \sqrt{2}$$

$= 1.128 : 1$

369 **(c)**

Find m by : $m = \frac{wRT}{PV}$ and notice the choice.

370 **(c)**

Dalton's law of partial pressure : This law states that the total pressure exerted by a mixture of non-reacting gases is equal to the sum of partial pressure exerted by the individual gases.

$p = p_1 + p_2 + p_3 \dots$

Dalton's law of partial pressure follows by the mixture of non-reacting gas but NH_3 react with HCl gives NH_4Cl.

$NH_3 + HCl \rightarrow NH_4Cl$

Hence, Dalton's law of partial pressure is not applicable to NH_3 + HCl.

371 **(a)**

We know that molecular mass of hydrogen $(M_1) = 2$ and that of helium $(M_2) = 4$. We also know that Graham's law of diffusion

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}} = \sqrt{\frac{4}{2}} = \sqrt{2} = 1.4$$

$$r_1 = 1.4\, r_2$$

373 **(d)**

wt. of 112 litre $O_2 = \frac{32 \times 112}{22400} = 0.16$

374 **(c)**

Ideal gas equation $pV = nRT$ is obeyed by ideal gas in both adiabatic process and isothermal process.

375 **(c)**

A gas can be easily liquefied under pressure when it is cooled to below the critical temperature

376 **(b)**

$$V_{rms} = V_{mps}$$

$$\sqrt{\frac{3RT}{M\,(X)}} = \sqrt{\frac{2RT'}{M\,(Y)}}$$

$$\Rightarrow \sqrt{\frac{3R \times 400}{40}} = \sqrt{\frac{2R \times 60}{M\,(Y)}}$$

$$\Rightarrow \quad M(Y) = 4$$

377 **(b)**

For $'n'$ moles, the van der Waals' equation is

$$\left(p + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

where, $n = 2$ moles

$R = 0.0821$ L atm K^{-1} mol^{-1}

$T = 27 + 273 = 300$ K

$V = 5$ L

$a = 4.17$

$b = 0.03711$

so $\quad p = \frac{nRT}{V - nb} - \frac{an^2}{V^2}$

$$= \frac{2 \times 0.0821 \times 300}{(5 - 2 \times 0.3711)} - \frac{4.17 \times (12)^2}{(5)^2}$$

$$= \frac{49.26}{4.926} - \frac{16.68}{25}$$

$$= 10 - 0.66$$

$$= 9.33 \text{ atm}$$

378 **(b)**

Vapour form is the gaseous state of a substance below its critical temperature.

379 **(d)**

$P'_{N_2} = P_M \times \text{M.f. or} \frac{25}{10} = 100 \times \text{M.f.}$

or per cent M.f. $= \frac{25}{10} \times \frac{100}{100} = 2.5\%$

380 **(d)**

Edge length of the unit cell = 2 Å = 2×10^{-8}cm

Volume of the unit cell = $(2 \times 10^{-8})^3$ cm^3

= 8×10^{-24} cm^3

Mass of unit cell = volume × density

= $8 \times 10^{-24} \times 2.5$ g

No. of unit cells in 200 g of the metal

$= \frac{\text{mass of metal}}{\text{mass of unit cell}} = \frac{200}{8 \times 10^{-24} \times 2.5}$

= 1×10^{25}

381 **(c)**

$$\frac{(v_{av})_1}{(v_{(av)})_2} = \sqrt{\frac{T_1}{T_2}}$$

Given, $T_1 = 150 + 273 = 423$ K

$T_2 = 50 + 273 = 323$ K

$$\therefore \frac{(v_{av})_1}{(v_{av})_2} = \sqrt{\frac{T_1}{T_2}} = \sqrt{\frac{423}{323}} = \frac{1.14}{1}$$

382 **(c)**

P' = mole fraction × P_M

The gas having higher mole fraction has high partial pressure.

383 **(c)**

There are 6 A atoms on the face centres removing face centred atoms along one of the axes means removal of 2 A atoms

Now, number of A atoms per unit cell

$= 8 \times \frac{1}{8} + 4 \times \frac{1}{2} = 3$

(corners) (face- centred)

Number of B-atoms per unit cell

$= 12 \times \frac{1}{4} + 1 = 4$

(edge centred) (body Centred)

Hence, the resultant stoichiometry is A_3B_4

384 **(c)**

CH_3OCH_3 lacks H-bonding hence, it is most volatile, so it has maximum vapour pressure

385 **(c)**

Molecular mass of $N_2 = 28$, CO = 28

Number of molecules of N_2

($V = 0.5$ L, $T = 27$°C, $p = 700$ mm) = n

Number of molecules of N_2

($V = 1$ L, $T = 27$°C, $p = 700$ mm) = $2n$

387 **(b)**

$u_{av} = \sqrt{\frac{8RT}{\pi M}}$ So, $u_{av(O_2)} = \sqrt{\frac{8RT}{\pi \times 16}}$

$u_{rms} = \sqrt{\frac{3RT}{M}}$ so $u_{rms(N_2)} = \sqrt{\frac{3RT}{14}}$

$$\frac{u_{av(O_2)}}{u_{rms(N_2)}} = \sqrt{\frac{8 \times 14}{\pi \times 16 \times 3}} = \left(\sqrt{\frac{7}{3\pi}}\right)^{1/2}$$

388 **(a)**

$$\frac{r_1}{r_2} = \sqrt{\left[\frac{M_2}{M_1}\right]}$$

389 **(c)**

van der Waals' equation for one mole of a gas is

$$\left[p + \frac{a}{V^2}\right][V - b] = RT$$

Where, b is volume correction. It arises due to effective size of molecules.

390 **(b)**

P and T both are doubled;

Use $V = \frac{nRT}{P}$

391 **(d)**

R is universal constant and has different values in different units.

392 **(a)**

Radius of Na(if bcc lattice)= $\frac{\sqrt{3}a}{4} = \frac{\sqrt{3} \times 4.29}{4}$ Å

393 **(c)**

$pV = nRT$

or $pV = \frac{w}{M}RT$

or $M = \frac{w}{V}\frac{RT}{p}$

or $M = d\frac{RT}{p}$

$d = 1.964\ g/dm^3 = 1.964 \times 10^{-3}\ g/cc$

$p = 76$ cm Hg $= 1$ atm

$R = 0.0812$ L atm K^{-1} mol^{-1}

$= 82.1$ cc atm K^{-1} mol^{-1}

$T = 273$ K

$$M = \frac{1.964 \times 10^{-3} \times 82.1 \times 273}{1} = 44$$

The molecular weight of CO_2 is 44.

So, the gas is CO_2.

395 **(a)**

$u_{av} \propto \sqrt{T}$

$\therefore \frac{u_1}{u_2} = \sqrt{\frac{1}{2}}$

$\therefore u_2 = \sqrt{2}\, u_1 = 1.4\, u_1$

396 **(d)**

Mass of the gas is not known.

397 **(c)**

Crystalline solids such as NaCl, $BaCl_2$ etc, will show anisotropy

398 **(c)**

The radius ratio for coordination number 4, 6 and 8 lies in between the ranges $0.225 - 0.414, 0.414 - 0.732$ and $0.732 - 1.000$ respectively

399 **(c)**

Mole ratio = Molecule ratio

$$= \frac{w/32}{w/28} = 7 : 8$$

401 **(d)**

Volume $= a^3 = (400 \times 10^{-12} m)^3 = 64 \times 10^{-24} cm^3$

$V_{total} = VN_A = 64 \times 10^{-24} \times 6.02 \times 10^{23} = 38.4$

Molar volume $= \frac{1}{4} \times V_{total} = \frac{38.4}{4} = 9.6$mL

402 **(a)**

$V_i = V_0 \left[1 + \frac{t}{273}\right]$; where V_0 is volume at zero degree centigrade. Use $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ to get this

403 **(b)**

Partial pressure $= \frac{\text{no.of moles of gas} \times p_{Total}}{\text{total no.of moles}}$

$1.5 = \frac{5 \times p_{total}}{2 + 3 + 5 + 10}$

$\frac{1.5 \times 20}{5} = p_{total}$

$p_{total} = 6$ atm

404 **(a)**

As constant volume, pressure of the gases increases on increasing temperature due to increase in average molecular speed

405 **(c)**

Number of moles of $N_2 = \frac{56}{28} = 2$

Number of moles of $CO_2 = \frac{44}{44} = 1$

Number of moles of $CH_4 = \frac{16}{16} = 1$

$\therefore$ Total number of moles $= 2 + 1 + 1 = 4$

$\therefore$ Mole fraction of $CH_4 = \frac{1}{4}$

$\therefore$ Partial pressure of CH_4

= mole fraction of CH_4 × total presure

$$= \frac{1}{4} \times 720 = 180 \text{ atm}$$

406 **(a)**

The mole diffused per unit area in first case $\propto \pi r^2$

The mole diffused per unit area in second case $\propto r^2$

Thus, $\frac{r_1}{r_2} = \frac{a_1}{t_1} \times \frac{t_2}{a_2} = \frac{\pi r^2}{r^2} = \pi \ (\because t_1 = t_2)$

407 **(d)**

$P_M = 8$ atm; $P_A = \frac{3}{8} P_M$ and $P_B = \frac{5}{8} P_M$

408 **(c)**

$\frac{(v_{av})_1}{(v_{av})_2} = \sqrt{\frac{T_1}{T_2}}$

Given, $T_1 = 150 + 273 = 423$ K

$T_2 = 50 + 273 = 323$ K

$\therefore \frac{(v_{av})_1}{(v_{av})_2} = \sqrt{\frac{T_1}{T_2}} = \sqrt{\frac{423}{323}} = \frac{1.14}{1}$

410 **(c)**

$U_{av} \propto \frac{1}{\sqrt{M}}$ at constant temperature

$$\frac{U_{av}(SO_2)}{U_{av}(CH_4)} = \sqrt{\frac{M_{CH_4}}{M_{SO_2}}} = \sqrt{\frac{16}{64}} = \frac{1}{2}$$

$U_{SO_2} : U_{CH_4} = 1 : 2$

411 **(c)**

$pV = nRT$

$V = \frac{nRT}{p}$

Hence, molar volume of CO_2 is maximum at 127°C and 1 atm.

412 **(a)**

According to Graham's law of diffusion

Rate of diffusion $(r) \propto \frac{1}{\sqrt{d}}$

Molecular weight $(M) = 2 \times$ vapour density

$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$

$M_A = \left(\frac{100}{2}\right)$ kg/molecule

$M_B = \left(\frac{64}{2}\right)$ kg/molecule

$r_A = 12 \times 10^{-3}$ and $r_B = ?$

$\frac{r_A}{r_B} = \sqrt{\frac{d_B}{d_A}} = \sqrt{\frac{M_B}{M_A}}$

$\frac{12 \times 10^{-3}}{r_B} = \sqrt{\frac{64/2}{100/2}} = \sqrt{\frac{64}{100}} = \frac{8}{10}$

$r_B = \frac{12 \times 10^{-3} \times 10}{8}$

$= 15 \times 10^{-3}$

413 **(b)**

Rate of diffusion, $r \propto p$

$r \propto \frac{1}{\sqrt{M}} \quad \therefore r \propto \frac{p}{\sqrt{M}}$

For gas A, $\quad r_A \propto \frac{p_A}{\sqrt{M_A}}$ ... (i)

For gas B, $\quad r_B \propto \frac{p_B}{\sqrt{M_B}}$ ... (ii)

Eqs. (i)/(ii), we get

$\frac{r_A}{r_B} = \frac{p_A}{p_B}\sqrt{\frac{M_B}{M_A}}$

or $\quad = \frac{p_A}{p_B}\left(\frac{M_B}{M_A}\right)^{1/2}$

414 **(b)**

At high temperature and low pressure, a gas behaves like as an ideal gas

415 **(d)**

$COCl_2 + H_2O \longrightarrow CO_2 + 2HCl$

418 **(a)**

Follow diffusion of gases.

419 **(c)**

$Z = \frac{a^3 \times N_A \times \rho}{M}$

$= \frac{4.2 \times 8.6 \times 8.3 \times 10^{-24} \times 6.023 \times 10^{23} \times 3.3}{155} = 3.84 = 4$

420 **(a)**

Find mol. wt. of gas by $u_{\text{rms}} = \sqrt{\frac{3RT}{M}}$ and notice the gas.

421 **(d)**

All the given statements are correct about F-centres

422 **(b)**

At constant pressure $V \propto T$, but according to Gay Lussac's law the pressure of a given mass of a gas is directly proportional to the absolute temperature. Thus,

$p_1 < p_2$

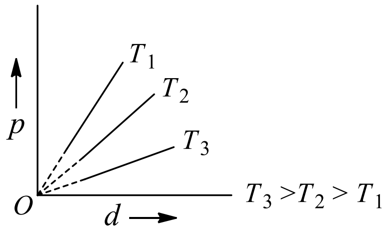
423 **(d)**

We know that

$$p = n\frac{RT}{V}\frac{w}{M} = \frac{RT}{V}$$

As the M increases, partial pressure decreases.
Thus, N_2 has highest partial pressure

424 **(a)**
At constant temperature, density of a gas is directly proportional to its pressure and inversely proportional to its volume



425 **(c)**

$$PV = nRT; \therefore \frac{n}{V} = \frac{P}{RT}$$

426 **(b)**
At high pressure, volume is very low

$$\left[P + \frac{a}{V^2}\right][V - b] = RT$$

Thus van der Waals equation reduces to the (term $\frac{a}{V^2}$ can be reglected in comparison of high pressure)

$$P[V - b] = RT$$

$$PV = RT + Pb$$

or $Z = \frac{PV}{RT} = 1 + \frac{Pb}{RT}$

427 **(a)**
At each Sr^{2+} ion introduces one cation vacancy, therefore, concentration of cation vacancies = mol % of$SrCl_2$ added

428 **(b)**
At A → temperature $= T$, volume $= V$, pressure $= p_1$
At C → temperature $= 2T$ volume $= 2V$, pressure $= p_2$

$$\frac{p_1 V}{T} = \frac{p_2 \times 2V}{2T}$$

$p_1 = p_2$, *ie*, system is isobaric

429 **(a)**
Boyles' temperature is the temperature at which a real gas exhibit ideal behaviour for considerable range of pressure. It is related with van der Waals' constant as

$$T_B = \frac{a}{bR}$$

430 **(a)**
Let the rate of diffusion of gas $x = a$ and molecular mass $= M$
So, $r_x = a, M_x = M$

$r_{CH_4} = 2a, M_{CH_4} = 16$

$$\frac{r_x}{r_{CH_4}} = \sqrt{\frac{M_{CH_4}}{M_x}}$$

or $\frac{a}{2a} = \sqrt{\frac{16}{M_x}}$ or $M_x = 64$

431 **(b)**
Even CO_2 cannot be liquefied above its critical temperature.

432 **(d)**
Rate of diffusion is inversely proportional to the molecular weight

$$r \propto \sqrt{\frac{1}{M}}$$

So, the order of rate of diffusion is
$CO_2 > SO_2 > SO_3 > PCl_3$

434 **(c)**
According to Graham's law of diffusion

$$\frac{r_{O_2}}{r_{He}} = \sqrt{\frac{M_{He}}{M_{O_2}}}$$

or $\quad = \sqrt{\frac{4}{32}} = \frac{1}{2.83}$

$\therefore r_{O_2} = 0.35\, r_{He}$

435 **(a)**
It is the desired formula for u_{rms}.

436 **(d)**
According to Trouton's rule,

$$\frac{\Delta H_{vap}}{T_b} = 21 \text{ cal K}^{-1} \text{ mol}^{-1}$$

438 **(d)**
If $V_1 = 1, V_2 = 1 - \frac{15}{100} = \frac{17}{20}$

$p_2 = 2p_1$

$T_1 = 348, T_2 = ?$

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$$

$$\frac{p_1}{348} = 2p_1 \times \frac{17}{20 \times T_2}$$

$T_2 = 60℃$

440 **(a)**

According to Graham's law

$$\frac{r_{O_2}}{r_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{O_2}}}$$

$$= \sqrt{\frac{2}{32}}$$

$$= \frac{1}{4}$$

$\therefore r_{O_2} : r_{H_2} = 1 : 4$

441 **(a)**
Let P_1V_1 be the pressure and volume of monoatomic gas at temperature T.
$P_1V_1 = RT$
$P_2(V_1 + dV) = R(T + 1)$
$\therefore P_2^2 = RT + R \ \left(\because \frac{P_2}{V_1 + dV} = 1\right)$
or $2\left(\frac{\partial P}{\partial T}\right)_v = R$
$\therefore \left(\frac{\partial P}{\partial T}\right)_v = \frac{R}{2}$
$\because C = C_v + \left(\frac{\partial P}{\partial T}\right)_v$ for a process
$= \frac{3}{2}R + \frac{R}{2} = \frac{4R}{2}$

442 **(c)**
van der Waals' equation is

$$\left(p + \frac{n^2a}{V^2}\right)(V - nb) = nRT$$

$\therefore$ Units of $a = \frac{pV^2}{n^2}$

$$= \frac{\text{atm} \times \text{L}^2}{\text{mol}^2}$$

$$= \text{L}^2 \text{ atm mol}^{-2}$$

$\therefore$ Units of $b = \frac{V}{n}$

$$= \frac{\text{L}}{\text{mol}} = \text{mol}^{-1}\text{L}$$

444 **(a)**
Kinetic gas equation, for one mole gas is

$$pV = \frac{1}{3} Mu^2$$

Where, p = pressure of gas

V = volume of gas

M = molecular mass of gas

u = root mean square velocity

$\Rightarrow \frac{Mu^2}{3} = pV$

or $u = \sqrt{\frac{3pV}{M}}$

or $u = \sqrt{\frac{3p}{d}}$

If pressure is constant, then

$$u \propto \sqrt{\frac{1}{d}}$$

445 **(d)**
According to Charles' law, graph between V and T at constant pressure is called isobar or isoplestics and is always straight line.

447 **(a)**
When cation shifts from lattice to interstitial site, the defect is called Frenkel defect

448 **(c)**
Volume of molecules in one mole

$$= 4 \times N \times V = 4 \times N \times \frac{4}{3}\pi r^3$$
$$= 4 \times 6.023 \times 10^{23} \times \frac{4}{3} \times \frac{22}{7} \times (10^{-8})^3$$
$$= 10.09 \text{ mL}$$

449 **(c)**
In between two successive collisions, no force is acting on the gas molecules. Resultantly it travels with uniform velocity during this interval, and hence, it moves along a straight line.

450 **(d)**
$\frac{F - 32}{9} = \frac{C}{5}$;
Let temperature be t, same on two scale
$\therefore t - 32 = \frac{9t}{5}$ or $t = -40°$

451 **(b)**
$\mu = +$ve for cooling effect and $\mu = -$ve for heating effect.

453 **(c)**
From gas equation,

$$pM = d.RT$$

$\therefore d = \frac{1 \times 45}{0.0821 \times 273}$

$= 2$ g/L

454 **(b)**
$KE_1/KE_2 = T_1/T_2$

455 **(c)**
By Graham's diffusion law,

$$\frac{r_{He}}{r_{CH_4}} = \sqrt{\frac{M_{CH_4}}{M_{He}}}$$

$M_{CH_4} = 12 + 4 = 16$

$M_{He} = 4$

$$\frac{r_{He}}{r_{CH_4}} = \sqrt{\frac{16}{4}} = \sqrt{\frac{4}{1}} = 2$$

Thus, the ratio of rate of diffusion of He and CH_4 is 2.

456 **(d)**
Fe_3O_4 is a non-stoichiometric compound because in it, the ratio of the cations to the anions becomes different from that indicated by the chemical formula

457 **(a)**
Average kinetic energy, $E = \frac{3}{2}RT$

$u_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{2E}{M}}$

458 **(c)**
It is not the critical temperature but temperature

459 **(d)**
Use $\frac{P_1V_1}{P_2V_2} = \frac{T_1}{T_2}$

460 **(b)**
$P = \frac{nRT}{V} = \frac{2 \times 0.0821 \times 540}{44.8} = 2$ atm

461 **(d)**
Mathematical expression for Charles' law is

$$V_t = V_0\left(1 + \frac{t}{273}\right)$$

462 **(a)**
$n = PV/RT = \frac{1 \times 22.4}{303 \times 0.0821} = 0.90$

463 **(d)**
According to Gay Lussac's law

$\frac{p_1}{T_1} = \frac{p_2}{T_2}$

If $\frac{3^{th}}{8}$ of the air is expelled out then remaining air $= \frac{5}{8}$

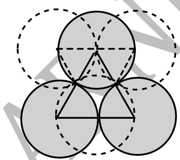
$T_2 = \frac{(273 + 27) \times 8}{5}$

$= \frac{2400}{5} = 480$ K

$= 480 - 273 = 207°C$

464 **(b)**
The volume of a molecule in motion is four times the actual volume of a molecule in rest
$b = 4Vm$

465 **(a)**
The interstitial void formed by the combination of two triangular voids of the first and second layer is called octahedral void because this is enclosed between six spheres, centres of which occupy corners of a regular octahedron



467 **(b)**
It is the reason for given fact.

468 **(d)**
From ideal gas equation,

$pV = nRT$

Since, p, V and T are same for both O_2 and H_2, therefore their number of moles(n) are also equal. Hence, number of molecules will be equal for O_2 and H_2.

469 **(b)**
Most probable velocity. $u_{MP} = \sqrt{\left[\frac{2RT}{M}\right]}$ is the velocity acquired by majority of molecules.

472 **(b)**
58.5 g NaCl =1 mol = 6.023×10^{23} NaCl units
One unit cell contains 4 NaCl units
Hence, number of unit cell present
$= \frac{6.023 \times 10^{23}}{4} = 1.5 \times 10^{23}$

473 **(b)**
During evaporation, molecule having high energy leave the surface of liquid. As a result average kinetic energy of liquid decreases.

$\because KE \propto T$

∴ Temperature of liquid falls.

475 **(a)**
Whenever, gases are allowed to expand through a small jet under adiabatic conditions, they suffer a change in temperature. This is Joule-Thomson effect.
if $T > T_i$; heating effect
if $T < T_i$; cooling effect

476 **(a)**
$$\frac{r_1}{r_2} = \sqrt{\left[\frac{M_2}{M_1}\right]} = \sqrt{\frac{2}{32}} = \frac{1}{4}$$

478 **(b)**
Work done = surface tension × increase in area
$= 73 \times 0.10 = 73 \times 0.10 \times 10^4$
$= 7.3 \times 10^4$ erg

479 **(b)**
Temperature at which real gas obeys the gas laws over a wide range of pressure is called Boyle's temperature
$T_b = \frac{a}{Rb}$

480 **(c)**
Deviation are maximum under high P and low T.

481 **(a)**
$P_{\text{dry gas}} = P_{\text{wet gas}} - P_{\text{water}}$

482 **(d)**
Collision frequency = $\frac{u_{\text{rms}}}{\lambda}$; u_{rms} depends on T, λ depends on P and T.

483 **(d)**
Molecular velocity can be

average velocity = $\sqrt{\frac{8RT}{\pi M}}$

root mean square velocity = $\sqrt{\frac{3RT}{M}}$

most probable velocity = $\sqrt{\frac{2RT}{M}}$

In all cases molecular velocity ∝ $\sqrt{T}$

484 **(c)**
According to Boyle's law,

$$p \propto \frac{1}{V}$$

Hence, in order to increase the volume of a gas by 10%, the pressure of the gas should be decreased by 10%.

486 **(d)**
$CO_2 + C \longrightarrow 2CO$

487 **(c)**
Use $PV = nRT; P = 1, \frac{n}{V} = 1 \ \therefore T = \frac{1}{R} = 12$ K

488 **(c)**
$$pV = \frac{w}{M}RT$$
$$M = \frac{wRT}{pV}$$
$$= \frac{0.455 \times 0.0821 \times 300 \times 760 \times 1000}{800 \times 380}$$
$= 28.0$ g

489 **(c)**
$C_1 = 100 \text{ ms}^{-1}, C_2 = 200 \text{ ms}^{-1}, C_3 = 500 \text{ ms}^{-1}$

rms velocity (C) =?

rms velocity $(C) = \sqrt{\frac{C_1^2 + C_2^2 + C_3^2}{n}}$

$$= \sqrt{\frac{(100)^2 + (200)^2 + (500)^2}{3}}$$

$= \sqrt{1{,}00{,}000} = 100\sqrt{10} \text{ ms}^{-1}$

490 **(d)**
$P_{N_2} + P_{H_2O(V)} = 1$ atm, $P'_{H_2O} = 0.3$ atm
$P_{N_2} = 0.7$ atm
Now new pressure of N_2 in another vessel of volume $V/3$ at same T is given by:
$$P_{N_2} \times \frac{V_1}{3} = 0.7 \times V_1$$
∴ $P_{N_2} = 2.1$ atm
Since aqueous tension remains constant and thus, total pressure in new vessel
$= P_{N_2} + P'_{H_2O} = 2.1 + 0.3 = 2.4$ atm

491 **(d)**
The average velocity of gas molecules in one direction is zero otherwise all molecules will be collected in one direction.

492 **(b)**
Water boils at higher temperature inside the pressure cooker because pressure is high in the pressure cooker and therefore, cooling becomes fast.

493 **(b)**
For monoatomic gas $C_v = \frac{3}{2}RT$; $C_p = \frac{5}{2}RT$
For diatomic gas $C_v = \frac{5}{2}RT$; $C_p = \frac{7}{2}RT$
Thus, for mixture of 1 mole each,

$$C_v = \frac{\frac{3}{2}RT + \frac{5}{2}RT}{2} \text{ and } C_p = \frac{\frac{5}{2}RT + \frac{7}{2}RT}{2}$$

Therefore, $C_p/C_v = \frac{3RT}{2RT} = 1.5$

494 **(a)**

Use $KE = \frac{3}{2}nRT$, where n is no. of moles.

495 **(c)**

$p_1 = p; V_1 = V; p_2 = 2p; V_2 = 2V$

$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$

$\frac{pV}{T_1} = \frac{2p \times 2V}{T_2}$

$T_2 = 4T_1$

When, air has been taken in and p, V remain constant,

$n_1 \cdot 4T_1 = n_2 \cdot T_2$

$n_1 = n$

and $n_2 = n + \frac{1}{4}n = \frac{5}{4}n$

$\therefore\ n \cdot 4T_1 = \frac{5}{4}n \cdot T_2$

$T_2 = \frac{16}{5}T_1$

496 **(c)**

For a gas,

$$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2} \left(\text{where}, T_2 = 2T_1, p_2 = \frac{1}{2}p_1, V_2 = ?\right)$$

$\frac{p_1V_1}{T_1} = \frac{1}{2}\frac{p_1 \times V_2}{2T_1}$

$V_1 = \frac{V_2}{4}$

$V_2 = 4V_1$

497 **(b)**

Rate of diffusion of gas $\propto \frac{1}{\text{molecular mass}}$

Let the molecular mass of other gas $= x$

$\because \frac{r_{He}}{r_x} = 4 = \sqrt{\frac{M_x}{M_{He}}}$

$4 = \sqrt{\frac{M_x}{4}}$

$4^2 = \frac{M_x}{4}$

$M_x = 64$

The gas having molecular mass 64 is SO_2.

498 **(c)**

$u_{rms(H_2)} = \sqrt{\frac{3 \times 50 \times R}{2}}$

and $u_{rms(O_2)} = \sqrt{\frac{3 \times 800 \times R}{32}}$

$\therefore \frac{u_{rms(H_2)}}{u_{rms(O_2)}} = 1$

499 **(b)**

$PV = \frac{\text{force}}{\text{area}} \times \text{area} \times \text{length}$

$= \text{force} \times \text{length} = \text{work or energy}$

500 **(b)**

$PV =$ constant; on differentiating.

$PdV + VdP = 0$

or $\frac{dP}{dV} = -\frac{P}{V} = -\frac{K}{V^2}$ $(\because PV = K)$

501 **(d)**

Na_2O has antifluorite (A_2B) type structure

502 **(a)**

Cleaning action of detergents is due to lowering of surface tension between water and greasy substances

503 **(a)**

Use $PM = dRT$

504 **(a)**

1 mole $CO_2 = N$ molecule $CO_2 = N$ atoms of $C =$ 2 N atoms of O.

505 **(c)**

$PV = \frac{w}{m}RT$

$P \times 0.03 = \frac{6}{16.05} \times 8.314 \times 402$

$\therefore P = 41647.7$ Pa

506 **(d)**

$u_{AV} \propto \sqrt{\left[\frac{T}{M}\right]}$

508 **(c)**

At constant pressure

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$\therefore \frac{10}{273} = \frac{V}{373}$

$\therefore V = 13.66$ litre

509 **(c)**

Total mole of gases

$$= \frac{32}{32}(\text{for } O_2) + \frac{3}{2}(\text{for } H_2) = \frac{5}{2}$$

$\therefore$ volume $= \frac{5}{2} \times 22.4$ litre $= 56$ litre

510 **(a)**

Rate of diffusion $\propto \frac{1}{\sqrt{d}}$

Rate of diffusion $\propto p$

$\therefore$ Rate of diffusion $\propto \frac{p}{\sqrt{d}}$

513 **(c)**

Using $PV = \frac{w}{m}RT$ or $P = \frac{d}{m}RT$

For gas A: $P_A = \frac{3}{m_A} \times R \times T$

For gas B: $P_B = \frac{1.5}{m_B} \times R \times T$

$\because$ $(m_B = 2 \times m_A)$

$\therefore$ $\frac{P_A}{P_B} = 2 \times \frac{m_B}{m_A} = 2 \times 2 = 4$

514 **(d)**

Kinetic energy $\left(= \frac{3}{2}RT\right)$ does not depends upon the atomic mass of the gases

515 **(a)**

From van der Waals' equation,

$$\left(p + \frac{n^2a}{V^2}\right)(V - nb) = RT$$

$$\left(p + \frac{2.253}{0.25 \times 0.25}\right)(0.25 - 0.0428) = 0.0821 \times 300$$

$$(p + 36.048)(0.2072) = 24.63$$

$$p + 36.048 = 118.87$$

$$p = 118.87 - 36.048 = 82.82 \text{ atm}$$

516 **(b)**

$u_{\text{rms}} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3R \times 140}{M}}$ at 140 K

$u'_{\text{rms}} = \sqrt{\frac{3R \times 560}{M}}$ at 560 K

$\therefore u'_{\text{rms}} = 2 \times u_{\text{rms}}$

517 **(c)**

Given that,

$\lambda = 229$ pm and $\theta = 23°20'$

Substituting these values in the Bragg's equation, we have

$$d_{hkl} = \frac{\lambda}{2\sin\theta} = \frac{229 \text{ pm}}{2\sin(23°20')}$$

$$= \frac{229 \text{ pm}}{2 \times 0.396}$$

$$= 289.2 \text{ pm}$$

518 **(c)**

For ideal gases $PV = nRT, \therefore Z = 1$; because $Z = \frac{PV}{nRT}$

519 **(c)**

$RT_c/P_c \cdot V_c = 8/3 = 8/3 \times 1 = 8/3 \times \frac{RT}{PV}$

520 **(b)**

Due to H-bonding.

521 **(c)**

Charles' used the term absolute temperature.

522 **(c)**

Average KE $= \frac{3}{2}\, RT/N_0$

(KE) $\propto T$

$\therefore \text{(KE)}_{313}/\text{(KE)}_{293} = \frac{313}{293}$

523 **(a)**

Number of moles of helium $= \frac{0.4}{4} = 0.1$

Number of moles of oxygen $= \frac{1.6}{32} = 0.05$

Number of moles of nitrogen $= \frac{1.4}{28} = 0.05$

Total moles in the 10.0 L cylinder at 27°C

$= (0.1 + 0.05 + 0.05)$

$= 0.2$ mol

$$p_T = \frac{nRT}{V} = \frac{0.2 \times 0.082 \times 300}{10} = 0.492 \text{ atm}$$

524 **(a)**

The van der Waals' equation for n moles of a gas is

$$\left[p + \frac{n^2a}{V^2}\right](V - nb) = nRT$$

For one mole ($n = 1$)

$$\left(p + \frac{a}{V^2}\right)(V - b) = RT$$

525 **(b)**

Avogadro's hypothesis.

526 **(d)**

These are characteristics observed at absolute zero.

527 **(b)**

Ideal gas equation

$pV = nRT$

$$pV = \frac{w}{M} RT = \frac{8}{32} RT$$

$$pV = \frac{RT}{4}$$

528 **(d)**

$$\frac{u_1}{u_2} = \sqrt{\frac{m_2}{m_1} \times \frac{T_1}{T_2}}$$

$\because T_1 = T_2$

So, $\frac{u_1^2}{u_2^2} = \frac{m_2}{m_1}$ or $u_1^2 m_1 = u_2^2 m_2$

530 **(c)**

Collision frequency increases when molecules come closer to each other.

533 **(c)**

Calculate m by $PV = \frac{w}{m} RT$ and suggest formula.

534 **(d)**

When a mixture of two or more non-reacting gases are enclosed in a container then the total pressure exerted by the gaseous mixture is equal to the sum of partial pressure of the components in the mixture.

e.g., $CO + H_2$ are non-reacting gases. Hence, Dalton's law of partial pressure is applicable to this system.

535 **(c)**

$$\frac{V_1}{t_1} \times \frac{t_2}{V_2} = \sqrt{\frac{M_2}{M_1}}$$

$$\therefore \frac{50}{150} \times \frac{200}{50} = \sqrt{\frac{36}{M_A}}$$

$$\therefore M_A = 36 \times \left(\frac{150}{200}\right)^2$$

$$= \frac{36 \times 9}{16} = 20.25$$

536 **(a)**

The correct order of pressure is $p_1 > p_3 > p_2$

537 **(c)**

Both CO_2 and N_2O have same rate of diffusion at constant P and T.

538 **(a)**

Kinetic energy (KE) $= \frac{3}{2} RT$

$$\therefore \quad KE = \frac{3}{2} \times 8.31 \times 300 \text{ J}$$

$$= 3.74 \text{ kJ}$$

539 **(a)**

Yellow colour on heating NaCl in presence of Na is due to presence of electrons in anion vacancies (F-centres)

540 **(c)**

$H_2 \rightleftharpoons SO_2$

Initial 0.5 mol 0.5 mol

After a period of time H_2 being lighter, effuse faster and hence, in larger amount. Thus, it will remain less than SO_2

541 **(b)**

Use $d = \frac{PM}{RT}$

542 **(b)**

Gaseous pressure are usually obtained by manometer;

Atmospheric pressure is usually read by barometer.

543 **(a)**

$$u_1/u_2 = \sqrt{\left[\frac{T_1}{T_2}\right]} \because u = \sqrt{\left[\frac{8RT}{\pi M}\right]}$$

544 **(d)**

For bcc lattice, the coordination number is 8

546 **(a)**

$$[H_2] = \frac{\text{mole}}{V \text{ in litre}} = \frac{20/2}{5} = 2$$

547 **(c)**

We know, average velocity $v = \sqrt{\frac{8RT}{\pi M}}$

and most probable velocity $\alpha = \sqrt{\frac{2RT}{M}}$

so, their ratio $= \alpha : v = \sqrt{\frac{2RT}{M}} : \sqrt{\frac{8RT}{\pi M}}$

so, $\frac{\sqrt{\pi}}{2}$

548 **(d)**

CsCl has body centred arrangement, thus,

Interionic distance, $d = \frac{\sqrt{3}a}{2}$

549 **(c)**

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ (Charles' law)

$$\frac{2}{273} = \frac{4}{T_2}$$

$$T_2 = \frac{273 \times 4}{2} = 546 \text{ K or } 273°\text{C}$$

550 **(b)**

$\frac{r_+}{r_-} = \frac{180}{187} = 0.962$, which lies in the range of $0.732 - 1.000$, hence, coordination number 8, *ie*, the structure is CsCl type

551 **(c)**

$$u_1 = \sqrt{\frac{3p}{d}}$$

$$\therefore\ \Delta u_{rms} = \sqrt{\frac{3}{d}} \times (\sqrt{p_2} - \sqrt{p_2})$$

$$= \sqrt{\frac{3}{0.75}} \times (300 - 200)$$

$$= \sqrt{4} \times 100 = 200$$

552 **(c)**

In van der Waals' equation

$$\left[p + \frac{n^2 a}{V^2}\right](V - nb) = nRT$$

Where, p = pressure, V = volume

T = temperature, n = moles of the gas

and parameter a accounts for intermolecular interactions present in the molecule.

553 **(b)**

Compressibility factor $(Z) = \frac{pV}{n\,.\,RT}$

For an ideal gas, we know that,

$$pV = nRT$$

$$\therefore\ Z = 1$$

554 **(c)**

Greatest deviation from ideal behaviour is exhibited by real has gases at low temperature and high pressure

555 **(c)**

In van der Waals' equation

$$\left[p + \frac{n^2 a}{V^2}\right](V - nb) = nRT$$

Where, p = pressure,

V = volume,

T = temperature

n = moles of the gas

and parameter 'a' accounts for intermolecular interactions present in the molecule

556 **(c)**

Schottky defect is due to missing of equal number of cations and anions

557 **(d)**

On increasing temperature, vaporisation increases. Hence, vapour pressure increases

558 **(d)**

At absolute zero temperature, KE of the gas is zero, volume of the gas is zero, heat constant is zero, pressure of a gas is zero, molecular motion cases thus no gas exists

559 **(c)**

Collision diameter or effective molecular diameter is the closest distance between the centre of two molecules of a gas taking part in collision

560 **(d)**

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{V_1}{300} = \frac{V_2}{500}, V_2 = 1.66\ \text{V}$$

Volume escape= $1.66\,V - V = 0.66$ V

$= 66\%$

561 **(d)**

Moles of $H_2 = \frac{w}{2}$, and ethane $= \frac{w}{30}$

Total mo. of moles $= \frac{w}{2} + \frac{w}{30} = \frac{16w}{30}$

Partial pressure of $H_2 = p \times \frac{w/2}{16w/30} = \frac{w}{2} \times \frac{30}{16w} = \frac{30}{32} = \frac{15}{16}$

562 **(c)**

20% mixture produce 10% NH_3

$N_2 + 3H_2 \rightarrow 2NH_3$

Thus, percentage remains 90%

564 **(a)**

Mole of water evaporated $= \frac{4.5 \times 10^3}{18}$;

Now, calculate volume of vapours assuming 1 mole occupies 22.4 litre $= 22.4 \times 10^{-3}\text{m}^3$

565 **(d)**

$$\left[p + \frac{a}{V^2}\right]V = RT$$

$$pV + \frac{a}{V} = RT$$

$$\frac{pV}{RT} + \frac{a}{VRT} = 1$$

$$\frac{pV}{RT} = \left(1 - \frac{a}{VRT}\right) = Z$$

566 **(a)**

$$P'_{O_2} = \text{mole fraction of } O_2 \times 750 = \frac{21}{100} \times 750$$

$$= 157.5 \text{ mm}$$

567 **(b)**

A gas can be liquified by pressure along when its temperature is either higher than its critical temperature or lower than its critical temperature

568 **(c)**
Gas equation is valid for isothermal and adiabatic conditions both.

569 **(a)**
A constant pressure refers for isobaric process.

570 **(b)**
Volume of unit cell $(V) = a^3$
$= (3.04 \times 10^{-8})^3$
$= 2.81 \times 10^{-23}\text{cm}^3$

572 **(b)**
At critical point, the meniscus between the liquid and vapour disappears, thus the surface tension of liquid becomes zero.

573 **(d)**
On the basis of kinetic theory of gases
$pV = \frac{1}{2} N_A m\bar{v}^2$
And $\frac{1}{2} m\bar{v}^2 = \frac{3}{2}\ KT$
$p = \frac{1}{3}\left(\frac{N}{V}\right) m\bar{v}^2$
or $p = \frac{2}{3}\left(\frac{N}{V}\right)\frac{1}{2} m\bar{v}^2$
$= \frac{2}{3}\left(\frac{N}{V}\right)\left(\frac{3}{2}\right) KT$
or $pV = nKT$

574 **(a)**
F_2 is highly reactive gas.

575 **(a)**

$$u_{\text{MP}}: u_{AV}: u_{\text{rms}} :: \sqrt{\left(\frac{2RT}{M}\right)} : \sqrt{\left(\frac{8RT}{\pi M}\right)} : \sqrt{\left(\frac{3RT}{M}\right)}$$

576 **(d)**
Heating effect is noticed on subjecting a gas for Joule-Thomson effect above its inversion temperature.

577 **(c)**

$$\frac{U_{O_3}}{U_{O_2}} = \sqrt{\frac{M_{O_2}}{M_{O_3}}} = \sqrt{\frac{32}{48}} = \sqrt{\frac{2}{3}}$$

578 **(a)**
6.4 g of SO_2 at 0°C and 0.99 atm pressure occupies a volume of 2.241 L. It indicates that the gas is ideal.

579 **(b)**

$$\frac{r_x}{r_{CO_2}} = \sqrt{\frac{M_{CO_2}}{M_x}}$$

$$\frac{83.3}{102} = \sqrt{\frac{M_{CO_2}}{M_x}} = \sqrt{\frac{44}{M_x}}$$

$$M_x = 44 \times \left(\frac{102}{83.3}\right)^2$$

$$= 65.97 \text{ g mol}^{-1}$$

580 **(c)**
In metal excess defect when holes created by missing of anions are occupied by electrons, there sites are called F-centres and are responsible for colour in the crystal

581 **(a)**
Increase of pressure decreases volume and molecules come closer to each other.

582 **(d)**
Difference $= 2.178 \times 10^3 - 2.165 \times 10^3 = 0.013 \times 10^3$
Fraction unoccupied $= \frac{0.013 \times 10^3}{2.178 \times 10^3} = 5.96 \times 10^{-3}$

585 **(b)**

$$\frac{r_1}{r_2} = \frac{V_1/t_1}{V_2/t_2} = \frac{t_2}{t_1} = \sqrt{\frac{M_2}{M_1}} \quad (\text{for equal volumes}, V_1 = V_2)$$

$$\Rightarrow \frac{M_2}{M_1} = \frac{t_2^2}{t_1^2}$$

$$\Rightarrow M_2 = 4(3)^2 = 36$$

586 **(b)**

$$u_{\text{rms}} = \sqrt{\frac{u_1^2 + u_2^2 + u_3^2 \ldots + u_n^2}{n}};$$

$$u_{AV} = \frac{u_1 + u_2 + u_3 \ldots + u_n}{n}$$

and $u_{\text{rms}} \neq (u_{AV})^2$

587 **(a)**
$P'_{N_2} = P_T \times$ mole fraction of N_2
$P'_{CO} = P_T \times$ mole fraction of CO

$$\therefore \frac{P'_{N_2}}{P'_{CO}} = \frac{\text{Mole fraction of N}_2}{\text{Mole fraction of CO}} = \frac{\text{Mole of N}_2}{\text{Mole of CO}}$$

$$= \frac{w/28}{w/28} = 1 : 1$$

588 **(a)**
Distance between K^+ and F^- $= \frac{1}{2} \times$ length of the edge

589 **(d)**
Amorphous solids have short range order but no sharp melting point

591 **(c)**

$R = \frac{PV}{nT}; R = 8.3 \text{JK}^{-1}\text{mol}^{-1} = 2 \text{ cal K}^{-1} \text{ mol}^{-1}$

$= 8.314 \text{ erg K}^{-1} \text{ mol}^{-1}$

$= 0.821 \text{ litre atm K}^{-1} \text{ mol}^{-1}$

592 **(a)**

$1 \text{ cal} = 4.18 \text{ J} = 4.18 \times 10^7 \text{erg}$

$= \frac{4.18 \times 10^7}{1.602 \times 10^{-19}} \text{eV}$

593 **(c)**

$\frac{n''_{He}}{n''_{CH_4}} = \frac{1}{2}\sqrt{\frac{16}{4}} = \frac{1}{1}$

$\frac{n''_{He}}{n''_{SO_2}} = \frac{1}{3}\sqrt{\frac{64}{4}} = \frac{4}{3}$

So, $n''_{He} : n''_{CH_4} : n''_{SO_2} = 4 : 4 : 3$

594 **(b)**

Use : $PV = \frac{1}{3} mnu^2$

595 **(c)**

The number of atoms present in sc, fcc and bcc unit cells are 1, 4, 2 respectively

596 **(b)**

Work done = surface tension × increase in area

$= 73 \text{ dyne cm}^{-1} \times 0.10 \text{ m}^2$

$= 73 \text{ dyne cm}^{-1} \times 0.10 \times 10^4 \text{ cm}^2$

$= 7.3 \times 10^4$ ergs

597 **(a)**

Use $PV = \frac{w}{m} RT$

598 **(d)**

The units of 'a' are : atm $\text{litre}^2\text{mol}^{-2}$

$= \text{atm dm}^6\text{mol}^{-2} = \text{dyne cm}^2\text{mol}^{-2}$

The units of 'b' are : $\text{litre mol}^{-1} = \text{dm}^3\text{mol}^{-1} = \text{cm}^3\text{mol}^{-1}$

599 **(d)**

$PV = \frac{w}{m} RT$ or $w \propto m$, if P, V, T are constants.

600 **(a)**

Find mol. wt. of oxide as,

$M = \frac{0.44 \times 22400}{224} = 44$ and notice the gas.

601 **(d)**

$C_P = C_v + w;$

$w = R$

and $C_v = \frac{3}{2}R + R = \frac{5}{2}R$ (for diatomic gas)

$C_p = \frac{5}{2}R + R = \frac{7}{2}R$

Thus, $(5/2)R$ factor of $C_P (7/2)R$ is used in increasing internal energy or heat supplied to increase internal energy of gas at constant P is -

$$\frac{(5/2)R}{(7/2)R} = \frac{5}{7}$$

602 **(b)**

$KE \propto T, \quad \because KE = \frac{3}{2}RT$

604 **(a)**

RMS velocity $u_{\text{rms}} = \sqrt{\frac{3pV}{M}}$ ... (i)

and $pV = nkT$ ($k \rightarrow$ Boltzmann's constant)

For a molecule $n = 1$

$$pV = kT$$

So, $u_{\text{rms}} = \sqrt{\frac{3kT}{m}}$ ... (ii)

Kinetic energy $(E) = \frac{3}{2} kT$ or $kT = \frac{2}{3} E$

$$u_{\text{rms}} = \sqrt{\frac{3 \times \frac{2}{3} E}{m}} = \sqrt{\frac{2E}{m}}$$

605 **(b)**

$\frac{r_{H_2}}{r_{He}} = \sqrt{\frac{4}{2}} = \sqrt{2} = 1.4$

606 **(b)**

Brass, Cu=80%, Zn = 20%, substitutional alloy

Brass is an interstitial alloy because it is an alloy of Fe with C, C atoms occupy the interstitial voids of Fe crystal

607 **(c)**

$V - T$ plot representing the behavior of 1 mole of an ideal gas at 1 atm pressure.

Volume of 1 mole of an ideal gas at 273 K and 1 atm pressure is 22.4 L.

Volume of 1 mole of an ideal gas at 373 K and 1 atm pressure will be

$$V = \frac{RT}{p} = \frac{0.0821 \times 373}{1} = 30.58 \text{ L}$$

608 **(d)**

$\frac{1}{8} \times$ 8 (at corners)= 1

$\frac{1}{2} \times$ 6(at face center)= 3

$Z = 1 + 3 = 4$ (total number of atoms)

609 **(a)**

When equal volumes of H_2 and Cl_2 are mixed, the volume of mixture does not changed after the reaction

610 **(b)**

$$r_1/r_2 = \sqrt{\left[\frac{M_1}{M_2}\right]}$$

611 **(b)**

Average kinetic energy per molecule

$= \frac{3}{2}KT$

$= \frac{3}{2} \times 1.38 \times 10^{-23} \times 300$ J

$= 6.17 \times 10^{-21}$ J

612 **(c)**

Number of moles of helium = 0.3

Number of moles of argon = 0.4

We know that KE = nRT

KE of helium = $0.3 \times R \times T$ ... (i)

KE of argon = $0.4 \times R \times 400$ ... (ii)

According to question

KE of helium = KE of argon

$0.3 \times R \times T = 0.4 \times R \times 400$

$T = 533$ K

613 **(b)**

$P'_{N_2} = P_T \times$ mole fraction of N_2

$= 1 \times \frac{1}{1+1} = \frac{1}{2}$

614 **(c)**

Speed depends only on temperature and mol. wt. of gas.

615 **(c)**

In iodine crystals, the constituent particles are iodine molecules and they are held together by weak van der Waals' forces. Thus, iodine crystal is an example of molecular solid

617 **(c)**

Partial pressure $\propto$ moles of a gas

Hence, $\frac{p_1}{p_2} = \frac{x_1}{x_2}$

$\frac{1}{p_2} = \frac{44/44}{44/2}$

$\therefore p_2 = \frac{44}{2} = 22$ atm

STATES OF MATTER

CHEMISTRY

Assertion - Reasoning Type

This section contain(s) 0 questions numbered 1 to 0. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

a) Statement 1 is True, Statement 2 is True; Statement 2 **is** correct explanation for Statement 1

b) Statement 1 is True, Statement 2 is True; Statement 2 **is not** correct explanation for Statement 1

c) Statement 1 is True, Statement 2 is False

d) Statement 1 is False, Statement 2 is True

1

Statement 1: The compressibility factor less than one is due to the van der Waals' constant $'a'$ of a real gas

Statement 2: The compressibility factor less than one is due to excluded volume of the gas

2

Statement 1: Compressibility factor z for non ideal gases is always greater than .

Statement 2: Non ideal gases always exert higher pressure than 1.

3

Statement 1: $\frac{n^2a}{V^2}$ in van der Waals' equation is a measure of the inter molecular forces

Statement 2: Easily condensable gases have comparatively higher values of the van der Waals' parameter 'a'

4

Statement 1: CO_2 above 31.1 °C and 600 bar pressure is used to remove caffeine from coffee beans.

Statement 2: CO_2 is gaseous in nature.

5

Statement 1: When the temperature is raised, the viscosity of the liquid decreases

Statement 2: Increase in temperature increases the average kinetic energy of molecule which overcome the attractive force between them

6

Statement 1: The hot air balloons in sports and for meteological observations is an application Charles law.

Statement 2: Hot air is less dense and hence gases expand on heating.

7

Statement 1: Doping of silicon with P or Al increases the conductivity

Statement 2: P gives rise to holes while Al gives rise to extra electrons

8

Statement 1: Crystalline solids are anisotropic

Statement 2: Crystalline solids are not as closely packed as amorphous solids

9

Statement 1: In the Schottky defect equal number of extra cations and electrons are present in the interstitial sites

Statement 2: In schottky defect equal number of cations and anions are missing

10

Statement 1: Greater the value of van der Waal's constant 'a' greater is the liquefication of gas.

Statement 2: 'a' indirectly measures the magnitude of attractive forces between the molecules.

11

Statement 1: H_2 and He show same ideal gas behaviour

Statement 2: All real gases deviate from ideal gas behaviour at low temperature and high pressure

12

Statement 1: At 300K, kinetic energy of 16 g of methane is equal to the kinetic energy of 32 g of oxygen.

Statement 2: At constant temperature, kinetic energy of one mole of all gases is equal.

13

Statement 1: The solid NaCl is a bad conductor of electricity

Statement 2: In solid NaCl there is no velocity of ions

14

Statement 1: The conductivity of semiconductor increases with increase in temperature

Statement 2: The ionic solids conduct electricity due to presence of ions

15

Statement 1: In van der Waals' equation of gases, the kinetic equation of gas is modified

Statement 2: This modification is carried out with respect to actual volume of molecules and attractive forces between the gaseous molecules

16

Statement 1: $\frac{1}{4}$Of the gas is expelled if air present in an open vessel is heated from 27°C to 127°C.

Statement 2: Rate of diffusion of a gas is inversely proportional to the square root of its molecular mass.

STATES OF MATTER

CHEMISTRY

: ANSWER KEY :

1)	c	2)	d	3)	b	4)	b	13)	a	14)	c	15)	a	16)	b
5)	a	6)	a	7)	c	8)	a								
9)	d	10)	a	11)	b	12)	a								

ACTIVE SITE TUTORIALS

Date : 23-07-2019
Time : 00:16:00
Marks : 64

TEST ID: 133
CHEMISTRY

5.STATES OF MATTER

: HINTS AND SOLUTIONS :

1 **(c)**
In van der Waals' equation of state

$$\left(p+\frac{a}{V^2}\right)(V-b)=RT$$

If we neglect b

$$Z=1-\frac{a}{VRT}$$

that is $Z<1$

It we neglect a

$$Z=1+\frac{pb}{RT}$$

that is $Z>1$

2 **(d)**
Z is greater than 1 or less than 1. Non ideal gases exert less pressure than expected due to backward pull by other molecules.

3 **(b)**
'a' measures intermolecular forces. The distance between molecules of an easily condensable gas will least

4 **(b)**
CO_2 above 31.1°C and 600 bar pressure acts is super critical fluid, which dissolves many organic substances (alkaloids-caffeine) and hence used for separation of mixture.

5 **(a)**
With increase in temperature, viscosity of liquid decreases as the average kinetic energy of the molecules increases

6 **(a)**
According to Charles' law; $V \propto T$

So, hot air is less dense.

7 **(c)**
Doping of Si with P gives extra electrons while doping with Al gives rise to holes

8 **(a)**
Crystalline solids possess the properties of rigidity. They are anisotropic and undergo a clean cleavage. The constituent particles are arranged in a definite and orderly pattern through the entire three dimensional space

9 **(d)**
In schottky defect equal number of cations and anions are missing

10 **(a)**
Considering the attractive force, pressure in ideal gas equation $(pV=nRT)$ is corrected by introducing a factor of $\frac{an^2}{V^2}$ where $'a'$ is van der Waals' constant.

11 **(b)**
Hydrogen and helium have weak van der Waals' forces of attraction. The intermolecular forces of attraction increases and volume occupied by gas molecules becomes appreciable and can't be neglected

12 **(a)**
Kinetic energy for one mole gas is given by equation,

$$E=\frac{3}{2}kT \text{ (where, } k = \text{Boltzmann's constat)}$$

$$\therefore \ E \propto T$$

Thus, at constant temperature kinetic energy of one mole of any gas is equal.

13 **(a)**
Solid NaCl is a bad conductor of electricity because ions are not free to move

14 **(c)**

Ionic solids conduct electricity not due to presence of ions but due to presence of defects

15 **(a)**
In the van der Waals' equation. 'a' refers to the attractive forces between the molecules and 'b' is the volume correction

16 **(b)**
$\frac{V_1}{V_2} = \frac{T_1}{T_2} \text{ or } \frac{V_1}{V_2} = \frac{300}{400} = \frac{3}{4}$

So, air expelled $= 1 - \frac{3}{4} = \frac{1}{4}$

According to Graham's law of diffusion $r \propto \frac{1}{\sqrt{M}}$