QB365

Important Questions - State of Matter

11th Standard CBSE

Chemistry Reg.No. : | | | | | | |

Time : 01:00:00 Hrs

Total Marks : 50

Section-A

1) What is the value of gas constant in SI units? **1**

2) How is the pressure of a gas related to its density at a particular temperature? **1**

3) Name two intermolecular force that exists between HF molecules in a liquid state. **1**

4) Explain the physical significance of van derWaals' parameters **1**

5) How much time would it take to distribute one Avogadro number of wheat grains if 10^{10} grains are distributed each second? **1**

   $1N_A=6.022 \times 10^{23}$

   where N_A =Avogadro's number.

   Convert time into years

6) What will be the molar volume of nitrogen and argon at 273.15k and 1 atm? **1**

7) Name the energy which arises due to a motion of atoms or molecules in a body.How is this energy affected when the temperature is increased? **1**

8) At a particular temperature, why vapour pressure of acetone id less than that of ether? **1**

9) A 2 L vessel contains oxygen at a pressure of 380 mm Hg at 27^oC.1.40 g of N_2 gas is introduced in the vessel.Will the pressure of gaseous mixture increase or decrease and to what extent? **1**

10) Use the inforamr=tion and data given below to answer the questions (a) to (c), stronger intermolecular forces result in higher boiling point. **1**

    Strength of London forces increases with the number of electrons in the molecules. Boiling point of HF, HCI, HBr, and HI are 293 K, 189 K, 206 K and 238 K respectively.

Section-B

11) Use the inforamr=tion and data given below to answer the questions (a) to (c), stronger intermolecular forces result in higher boiling point. **2**

    Strength of London forces increases with the number of electrons in the molecules. Boiling point of HF, HCI, HBr, and HI are 293 K, 189 K, 206 K and 238 K respectively.

    (ii) Looking at the trend of boiling points of HCI, HBr and HI, explain out of dipole-dipole interaction and London interaction, which one is predominant here.

12) Use the inforamr=tion and data given below to answer the questions (a) to (c), stronger intermolecular forces result in higher boiling point. **2**

Strength of London forces increases with the number of electrons in the molecules. Boiling point of HF, HCI, HBr, and HI are 293 K, 189 K, 206 K and 238 K respectively.

(iii) Why is boiling point of hydrogen fluoride highest while that of hydrogen chloride lowest?

13) Name the energy which arises due to motion of atoms or molecules in a body.How is this energy affected when the temperature is increased? **2**

14) 1 mole of sulphur dioxide occupies a volume of 350 ml at 27° C and 5×10^6 pressure. **2**

Calculate the compressibility factor of the gas.It is less or more compressible than an ideal gas?

15) 150 mL of a gas at NTP were taken to 20^0C and 0.96 bar pressure.What is the change in volume of the gas? **2**

16) For real gases the relation between *p*,Vand T is given by van der Waals'equation **2**

$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

Where 'a' and 'b' are van der Waals' constants,'nb' is approximately equal to the total volume of the molecules of a gas. 'a' is the measure of magnitude of intermolecular attraction

Arrange the following gases in the increasing order of 'b' Given reason

O_2,CO_2,H_2,He

17) For real gases the relation between *p*,Vand T is given by van der Waals'equation **2**

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Where ' a ' and 'b' are van der Waals' constants,'nb' is approximately equal to the total volume of the molecules of a gas. ' a ' is the measure of magnitude of intermolecular attraction

Arrange the following gases in the decreasing order of magnitude of 'a' .Give reason

$CH_4 O_2$, H_2

18) Calculate the temperature of 4.0 moles of a gas occupying 5 dm^3 at 3.32 bar **2**

(R=0.083 bar dm^3 k^{-1} mol^{-1})

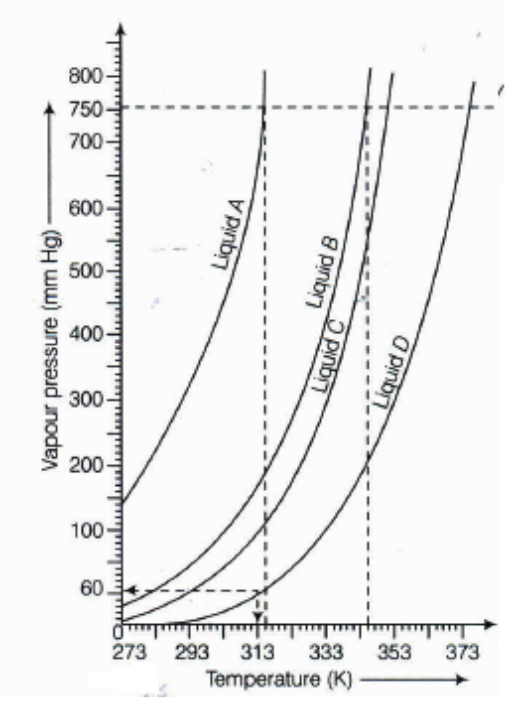
19) 34.05 ml of phosphorus vapor weight 0.0625g at 546^0C and 0.1 bar pressure.What is the molar mass of phosphorus? **2**

20) Calculate the volume occupied by 8.8g of CO_2 at 31.1^0C and 1 bar pressure. **2**

(R=0.083 bar L $K^{-1}$$mol^{-1}$)

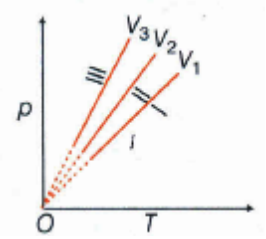
Section-C

21) The variation of vapour pressure of different liquids with temperature is shown in figure below. **5**

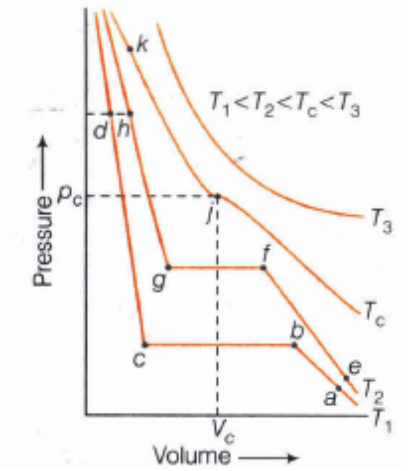


Pressure cooker is used for cooking food at hill station. Explain in terms of vapour pressure why is it so?

22) What do you understand by term isochore? Given below is the plot of pressure (p) versus temperature (T) for a certain volume of ideal gases I, II and III respectively. Give the correct order of volumes V_1, V_2 and V_3. **5**

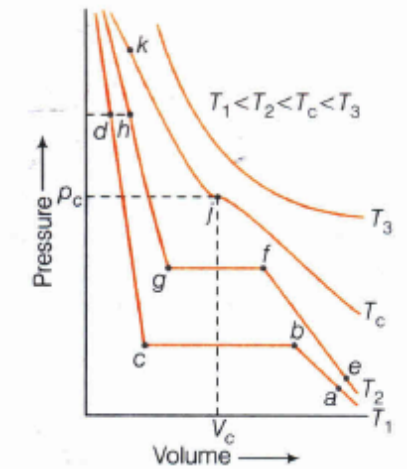


23) Isotherms of carbon dioxide at various temperatures are represented in the figure. Answer the following questions based on the figure. **5**



In which state will CO_2 exist between the points a and b at temperature T_1?

24) Isotherms of carbon dioxide at various temperatures are represented in the figure. Answer the following questions based on the figure. **5**



What portion of the isotherm at T_1 represent liquid and gaseous CO_2 at equilibrium?

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Section-A

1) **1**

2) **1**

3) **1**

HF molecules are polar covalent molecules.In a liquid state, there are dipole-dipole interactions and H-bonding.

4) **1**

a is measure of magnitude of intermolecular forces of attraction while b is a measure of the effective volume of the gas molecules.Value of a and b depends upon the characteristics of a gas.

5) Time required=$\frac{Total\ \ grains}{grains\ \ distributed} = \frac{6.022\times10^{23}}{10^{10}}$ $=6.022\times10^{13}$ $= \frac{6.022\times10^{13}}{365\times24\times60\times60}$ $= 1.909\times10^{6} yr$ **1**

6) Every gas has 22.4 L molar volume at 273.15K 1 atm pressure(STP) **1**

7) **1**

The energy which arises due to a motion of atoms or molecules in a body is known as thermal energy.It is a measure of the average kinetic energy of the particles.It increases with increase in temperature.

8) **1**

9) P_2=1.1157 atm and the pressure will increase **1**

10) **1**

From the information and data given in the question, we concluded that
In HCI, HBr and HI dipole-dipole and London forces are present because molecules possess permanent dipole. In HF molecules, dipole-dipole, London forces and hydrogen bonding are present.

Section-B

11) **2**

From the information and data given in the question, we concluded that

Electronegativity of chlorine, bromine, and iodine decreases in the following order.

Cl>Br>

Therefore, dipole should moment decrease from HCI to HI. As a result, dipole-dipole interaction should also decrease from HCI to HI. But boiling point increases on moving from HCI and HI. This means that London forces are predominant.

This is so because London forces increases as the number of electrons in a molecules increases and in this case, number of electrons is increasing from HCI towards HI.

12) **2**

From the information and data given in the question, we concluded that

Hydrogen fluoride has highest dipole moment is due to highest electronegativity of fluorine as well as due to the presence of hydrogen bonding in HF. Therefore, HF has highest boiling point.

13) **2**

The energy which arises due to motion of atoms or molecules in a body is known as thermal energy.It is a measure of average kinetic energy of the particles.It increases with increases with increase in temperature.

14) Compressibility factor , $Z = \frac{pV}{nRT}$ **2**

$n = 1mol, p = 5 \times 10^6 \quad pa, V = 350 \quad mL = 0.350 \times 10^{-3} m^3$

$R = 8.314 \quad Nm \quad K^{-1} mol^{-1}, T = 27 + 273 = 300 \quad K$

$\therefore \qquad Z = \frac{5 \times 10^6 \times 0.350 \times 10^{-3}}{1.0 \times 8.314 \times 300} = 0.702$

Thus,SO_2 is more compressible than an ideal gas (Which has Z=1)

15) V = 169.91 mL **2**

16) **2**

Molar volume occupied by the gas molecules size of the molecules and van der Waals' constant 'b' represents molar volume of the gas molecules.Hence, value of 'b' increases in the following order

$H_2 < He < O_2 < CO_2$

17) **2**

Van der Waals constant 'a' is the measure of magnitude of intermolecular attraction.The magnitude of intermolecular attraction increases with increase in size of electron cloud in a molecule.Hence,for given gases magnitude of 'a' decreases in the following order

$CH_4$2>H_2

Greater the size of electron cloud, greater is the polarizability of the molecule and greater are the dispersion forces London forces.

18) Apply ideal gas equation, pV=nRT **2**

$T = \frac{pV}{Rn} = \frac{3.32 \quad bar \times 5 dm^3}{0.083 \quad bar \quad dm^3 k^{-1} mol^{-1} \times 4 \quad mol}$

$T = 50 \quad k$

19) $pV = nRT = \frac{mRT}{M}$ **2**

(m=mass of phosphorus (g) and

M=molar mass of phosphorus)

$M = \frac{mRT}{pV}$

$M = \frac{0.0625g \times 0.0821 \quad L \quad atm \quad k^{-1}mol^{-1} \times 819k}{0.1 \times 0{,}987 \quad atm \times 0.03405L}$

$M = 1250.4gmol^{-1}$

20) pV=nRT **2**

$pV = \frac{m}{M}RT$

Volume occupied by 8.8g of CO_2

$V = \frac{mRT}{pM} = \frac{8.8g \times 0.083 \quad bar \quad L \quad k^{-1}mol^{-1} \times 304.1k}{1 \quad bar \times 44gmol^{-1}}$

V =5.048L

Section-C

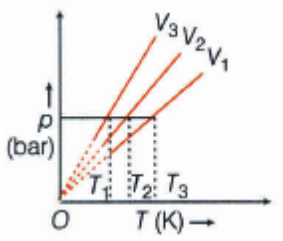
21) **5**

A liquid boils when vapour pressure becomes equal to atmospheric pressure. At hill station, atmospheric pressure is low. Therefore, liquid boils at a lower temperature and cooking is not perfect. In a pressure cooker, the pressure inside the cooker increases and the liquid boils at a higher temperature.

22) **5**

Isochore is plot of p vs T for a definite amount of a gas at constant volume. It is a graphical representation of Gay-Lussac or Amonton's law. For different isochores at different volumes, draw a line parallel to the temperature axis representing a constant pressure and cutting the three isochores at T_1, T_2, T_3 respectively. From the graph we find that $T_1 > T_2 > T_3$. As $V \propto T$ at constant p.

Thus, $V_1 > V_2 > V_3$



23) CO_2 will exist as gaseous state between 'a' and 'b'. **5**

24) Between 'b' and 'c' is the portion of isotherm at which liquid CO_2 is in equilibrium with gaseous CO_2. **5**