CHEMISTRY

WORKSHEET-12

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-12

(Physical Chemistry)

Gases

Q.1 **When sample of a gas is compressed at constant temperature from 15 atm to 60 atm, its volume changes from 76.0cm^3 to 20.5cm^3? Give reason.**

A) The gas behaves ideally

B) The gas behaves non-ideally

C) The volume of gas decreases

D) Gas is absorbed on the vessel walls

Q.2 **Under what conditions of temperature and pressure will a real gas behave like an ideal gas?**

Options	Temperature	Pressure
A)	Low	Low
B)	Low	High
C)	High	High
D)	High	Low

Q.3 **When oxygen gas volume decreases from 4.0dm^3 to 2.0dm^3, the pressure increases from 400 kP$_a$ to?**

A) 600 kP$_a$ C) 200 kP$_a$

B) 800 kP$_a$ D) 500 kP$_a$

Q.4 **Which one of the following gases shows more non-ideal behaviour?**

A) O_2 C) N_2

B) CO_2 D) H_2

Q.5 **Which of the following equations is used for real gases?**

A) PV = nRT

B) $PV = \frac{1}{3} m N \bar{C}^2$

C) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

D) $\left(P_{obs} + \frac{n^2a}{V^2}\right)(V_{vessel} - nb) = nRT$

USE THIS SPACE FOR SCRATCH WORK

Q.6 **The gas laws can be summarized in the ideal gas equation PV = nRT. Which of the following statements is / are incorrect?**

A) One mole of any ideal gas occupies the same volume under the same condition of temperature and pressure

B) The density of an ideal gas at constant pressure is inversely proportional to temperature

C) Volume of a given mass of a gas increases two times if temperature is raised from 25°C to 50°C at constant pressure

D) Both A and B

Q.7 **Which one of the following mathematical expression does not correctly represent the behavior of an ideal gas?**

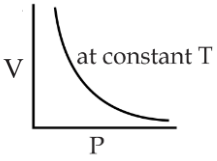
A) $PV_m \propto T$

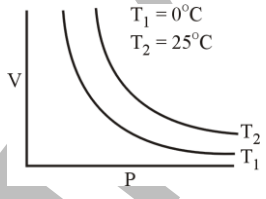
B) $P \propto CT$

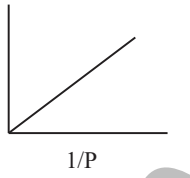
C) $PM \propto dT$

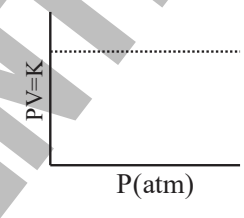
D) $P \propto \frac{1}{d}$

Q.8 **In which of the following isotherms volume increases?**

A) 

C) 

B) 

D) 

Q.9 **Which one of the following postulates of kinetic molecular theory (KMT) of gases explains Charles's law?**

A) Gases exert pressure

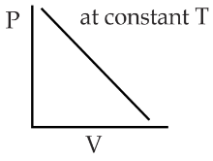
B) With the increase of temperature kinetic energy of the gas molecule increases

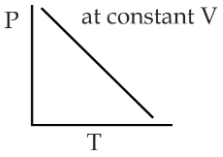
C) Gas molecules show elastic collision

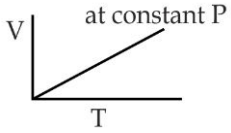
D) No attractive forces among gas molecules

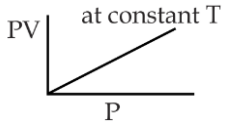
USE THIS SPACE FOR SCRATCH WORK

Q.10 **Which of the following diagram correctly describes the behavior of fixed mass of an ideal gas (T is measured in k)?**

A) 

C) 

B) 

D) 

Q.11 **Calculate the density of carbon dioxide (CO_2) gas at 0^oC and 1atm pressure.**

A) $= \frac{1 \times 44}{0.0821 \times 273} g dm^{-3}$

C) $= \frac{1 \times 44}{8.3143 \times 273} g dm^{-3}$

B) $= \frac{1 \times 44}{0.0821 \times 298} g dm^{-3}$

D) $= \frac{1 \times 44}{1.987 \times 273} g dm^{-3}$

Q.12 **According to Boyle's law, the volume of a given mass of a gas is inversely proportional to pressure at constant temperature. Mathematically PV = k. The value of k depends on all of the following factors EXCEPT:**

A) Amount of the gas
C) Nature of the gas
B) Rate of diffusion of the gas
D) Temperature

Q.13 **Which one of the following gas laws can only be explained on the basis of Kelvin scale?**

A) Boyle's law
C) Dalton's law
B) Charles's law
D) Avogadro's law

Q.14 **Which of the following is/are application of general gas equation. It is used to determine?**

A) Molecular mass of a gas only
B) Density of a gas only
C) Both A and B
D) Neither A nor B

USE THIS SPACE FOR SCRATCH WORK

Q.15 **Which one of the following relationship is correct regarding van der waal's gas equation?**

A) $a_{NH_3} > a_{N_2}$ but $b_{NH_3} < b_{N_2}$

B) $a_{NH_3} < a_{N_2}$ but $b_{NH_3} < b_{N_2}$

C) $a_{NH_3} < a_{N_2}$ but $b_{NH_3} > b_{N_2}$

D) $a_{NH_3} > a_{N_2}$ but $b_{N_2} \geq b_{NH_3}$

Q.16 **Equal volumes of all the ideal gases at the same temperature and pressure contain equal number of molecules. This is in accordance to:**

A) Boyle's law C) Charles's law

B) Avogadro's law D) Dalton's law

Q.17 **Which of the following statement is incorrect?**

A) The simplest form of matter is gaseous state

B) Most of the matter around us is the solid state

C) Liquid is less common state of matter

D) The most abundance state in the universe and on the earth is plasma

Q.18 **With the increase of temperature from T_1 to T_2 isotherm moves away from the axis. This is because of:**

A) Increase in pressure C) Increase in mass

B) Increase in volume D) Increase in density

Q.19 **If absolute temperature of gas is doubled and pressure is reduced to half, the volume of gas will:**

A) Remains unchanged

B) Increase to $1/4^{th}$

C) Increases four times

D) Be doubled

Q.20 **The value of universal gas constant R depends on:**

A) Temperature of gas

B) Volume of gas

C) Number of moles of gas

D) Units of volume and pressure

Q.21 **5g H_2 gas is confined in 1dm^3 container if H_2 were a true ideal gas how would its behaviour differ from its actual behaviour:**

A) Its molecules would attract each other

B) Its molecules would repel each other

C) Its molecules would be in continuous motion

D) It would exert more pressure

USE THIS SPACE FOR SCRATCH WORK

Q.22 **Gas is enclosed in a container of 20cm^3 with the moving piston. According to kinetic theory of gases, what will be the effect on freely moving molecules of the gas if temperature is increased from 20^{o}C to 100^{o}C?**

A) Pressure will become one half
B) Volume will increase
C) Temperature has no effect on freely moving molecules
D) Colliding capability of molecules will decrease

Q.23 **Consider the following statements for gases:**
I. Gases do not have a definite volume
II. Gases can diffuse and effuse
III. Gases have the properties of contraction and expansion
IV. Gases do not have a definite shape
Which of the statements is/are correct?

A) I only
B) II only
C) II and III
D) I, II, III and IV

Q.24 **Following is general gas equation for an ideal gas PV = nRT where R is known as general gas constant or universal gas constant. Which of the following statement is incorrect for R?**

I. The value of R in non-SI system is 0.821atm dm^3 mol^{-1}K^{-1}
II. The value of R is independent from nature of the gas
III. R is work done per kelvin per mol
IV. The unit of R in SI system is 8.3143Jmol^{-1}K^{-1}

A) I only
B) II only
C) III and IV
D) I, II, III and IV

Q.25 **When 100 cm^3 of a gas at constant pressure is heated from 27^{o}C to 100^{o}C, the volume must be multiplied by?**

A) $\frac{373}{273}$
B) $\frac{350}{300}$
C) $\frac{300}{273}$
D) $\frac{373}{300}$

Q.26 **Hydrogen gas possesses _____ kinetic energy at the same temperature as compared to oxygen:**

A) More
B) Same
C) Less
D) Sometimes less or sometimes more

USE THIS SPACE FOR SCRATCH WORK

Q.27 **Consider the following properties of gases:**
I. Molecules are widely separated by large empty species in them.
II. Molecules of gases have maximum kinetic energy.
III. Their rate of diffusion is maximum.
IV. They do not have definite shaped and fixed volume.
Which of the above statement is/are correct?
A) I only
B) II only
C) III and IV only
D) I, II, III and IV

Q.28 **Which of the following postulates of KMT explains Charles's law:**
A) Each gas consists of a large number of molecules
B) The molecules of a gas have no forces of attraction
C) The average K.E of the gas molecules is directly proportional to absolute temperature
D) The molecules of a gas are widely separated

Q.29 **Under what conditions ideal gases behave like real gas:**
A) At low temperature and high pressure
B) At low temperature and low pressure
C) At high temperature and high pressure
D) At high temperature and low pressure

Q.30 **Calculate the density of CH_4 (gas) at 27°C and 1 atmospheric pressure (supposed value of R) ($R = 0.05 dm^3 atm K^{-1} mol^{-1}$):**
A) $1.06 gdm^{-3}$ C) $1.09 gdm^{-3}$
B) $1.08 gdm^{-3}$ D) $1.09 gdm^{-3}$

Q.31 **Which of the following is the main causes of deviation of real gases from ideal behavior:**
A) No force of attraction among the gas molecules
B) The actual volume of gas molecules is negligible as compared to volume of the vessel
C) A gas cannot be liquefied
D) Both A and B

Q.32 **Which of the following gas would behave most like an ideal gas at room temperature?**
A) CO_2 C) He
B) H_2 D) N_2

USE THIS SPACE FOR SCRATCH WORK

USE THIS SPACE FOR SCRATCH WORK

Q.33 **For an ideal gas, the value of factor $\frac{PV}{nRT}$ is _____ called proportionality factor and is denoted by Z.**

A) $Z = \frac{PV}{nRT} = 1$

C) $Z = \frac{PV}{nRT} = 1.5$

B) $Z = \frac{PV}{nRT} = 2.0$

D) $Z = \frac{PV}{nRT} = 2.5$

Q.34 **At the same temperature and pressure which of the following gases has the greatest density:**

A) CO_2

C) SO_2

B) Cl_2

D) O_2

Q.35 **800 cm^3 of a gas at 400 torr pressure and 27°C was heated until the volume of gas was 2000 cm^3 at the same pressure. What is the final temperature of the gas?**

A) 750K

C) 800K

B) 700K

D) 850K

ANSWER KEY (Worksheet-12)							
1	B	11	A	21	A	31	D
2	D	12	B	22	B	32	C
3	B	13	B	23	D	33	A
4	B	14	C	24	D	34	B
5	D	15	A	25	D	35	A
6	C	16	B	26	B		
7	D	17	D	27	D		
8	C	18	B	28	C		
9	B	19	B	29	D		
10	B	20	D	30	A		

ANSWERS EXPLAINED

Q.1 (B) With reference to **Boyle's law** with the **increase of pressure** form **15 atm to 60 atm (4 times),** then the volume of a gas should be **decreased ¼ times**. But in this case the decrease in volume is not according to **Boyle's law**. Therefore, the gas behaves **non-ideally**.

Q.2 (D) At high temperature and low pressure real gases behave like ideal gas.

i. **At low pressure** gas molecules move away from each other and in such condition effective volume of a gas molecules can be neglected **(Gases are ideal at low pressure and non-ideal at high pressure)**

ii. **At high temperature** K.E increases and thus attractive forces develop between gas molecules become almost zero. **(Gases show ideal behavior at high temperature and non-ideal behavior at low temperature)**

Q.3 (B) According to **Boyle's law,** mathematically

$$P_1V_1 = P_2V_2 \text{ (at constant n \& T)}$$

$$\therefore P_2 = \frac{P_1V_1}{V_2}$$

$$P_2 = 4 \times \frac{400}{2} = 800 \text{ kPa}$$

Q.4 (B) Greater is the **molar mass,** greater is the size. Therefore, greater is the **polarizability, stronger are intermolecular forces.** Thus greater is the deviation from the **ideal gas** behaviour. That is why CO_2 gas shows more **non-ideal** behaviour as its molar mass is greater as compared to other gases.

Q.5 (D) $\left(P_{obs} + \frac{n^2a}{V^2}\right)(V_{vessel} - nb)$ This equation is van der Waal's gas equation. A real gas obeys this equation because real gas shows deviation from ideal gas behaviour at low temperature and high pressure.

Q.6 (C) **Charles's law** can only be explained on the basis of **Kelvin scale**, not on the basis of centigrade scale. Therefore, under the given condition the volume of a given mass of a gas would not increase two times by **increasing temperature** from **25°C to 50°C**.

Q.7 (D) **It is incorrect statement.** In fact, with the **increase of pressure** under the given condition **density of a gas also increases** i.e. $P \propto d$.

Q.8 (C) **Two isotherms** are obtained, one at **0°C** and other at **25°C** as shown in the figure. By keeping the temperature constant and again vary the pressure and volume and plot the isotherm. **It goes away from both the axes**. The reason is that at **higher temperature**, the volume of given mass of a gas increases. Similarly if we increase the temperature further, make it constant and plot another isotherm, it further goes away from the axis and thus volume of a gas increases as the isotherms move away from the axes.

Q.9 (B) According to **KMT** the average kinetic energy of a gas molecules varies directly as the absolute temperature of the gas. **i.e. (T ∝ K.E)**. This **postulates** clearly explains **Charles's law**. According to this law, the volume of the given mass of a gas is directly proportional to the absolute temperature, when the **pressure** is kept **constant**.

Q.10 (B) **PV = nRT,** since **P, n** and **R** are **constant,** we have V = aT, a = $\frac{nR}{P} > 0$. Therefore, a plot of **V** vs **T** gives a **straight line** with a **positive gradient** ($\frac{nR}{P}$) passing through the **origin.**

Q.11 (A) **Density of CO_2 gas**

$$= \frac{1 \times 44}{0.0821 \times 273} g\,dm^{-3}$$

$= 0.7138 g\ dm^3$

Q.12 (B) Rate of diffusion does not affect the value of k (proportionality constant).

Q.13 (B) **Charles's law can only be explained on the basis of Kelvin scale. It cannot be explained on the basis of centigrade scale.**

Q.14 (C) **General gas equation in the form of (PM = dRT) can be used to determine**

- **Molecular mass of the gas** ($M = \frac{dRT}{P}$)
- **Density of a gas by the formula** ($d = \frac{PM}{RT}$).

Q.15 (A) Since there is **hydrogen bonding in ammonia** and **London dispersion forces** in **nitrogen gas.**

- As hydrogen bond is **stronger than** London dispersion forces, therefore, the value of "a" constant of **ammonia** is greater than that of "**a" constant of nitrogen (a constant is a measure of strength of intermolecular forces). Intermolecular forces develop at high pressure and low temperature in the real gases.**
- On the other hand the value of "b" **constant** of nitrogen is **greater than that** of "**b" constant of ammonia (b constant is excluded volume at high pressure).**
- As we known that in **nitrogen molecules** there are weaker London dispersion forces as compared to hydrogen bonding in **ammonia,** so that is why **value of constant "b" for ammonia is less than that of constant "b" of nitrogen gas as shown in the table.**

Gas	"a" (atm dm^6 mol^{-2})	"b" (dm^3 mol^{-1})
NH_3	4.170	0.371
N_2	1.390	0.391

Q.16 (B) Actually it is **definition** of **Avogadro's law. Mathematically it is shown as** $V \propto n\ (at\ constant\ T\ and\ P)$.

Q.17 (D) **It is incorrect statement. In fact, boiling point of water is 69°C at 323 torr pressure at the top of Mount Everest.**

Q.18 (B) **With the increase of temperature from T_1 to T_2 isotherm moves away from the axis. This is because of increase in volume**

Q.19 (B) **If absolute temperature of a gas is doubled and pressure is reduced to half, the volume of the gas will increase four times.**

$V_1 = 1 dm^3$
$T_1 = T$
$P_1 = P$

According to condition

$T_2 = 2T$

$P_2 = \frac{P}{2}$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$V_2 = \frac{P_1 \times V_1 \times T_2}{P_2 \times T_1}$

$V_2 = \frac{P \times 1 \times 2 \times T \times 2}{P \times T}$

$V_2 = 4 times$

Q.20 (D) The value of universal gas constant R depends on units of volume and pressure.

Q.21 (A) 5g H_2 gas is confined in $1dm^3$ container if H_2 were a true ideal gas how would its behaviour differ from its actual behaviour its molecules would attract each other.

Q.22 (B) When temperature is increased from 20^oC to 100^oC volume will increase.

Q.23 (D) All the statements are correct.

- Gases do not have a definite volume
- Gases can diffuse and effuse
- Gases have the proparties of contraction and expansion
- Gases do not have a definite shape

Q.24 (A) It is incorrect statement. The correct statement is as follow:

I. The value of R in non-SI system is $0.0821 atm\ dm^3\ mol^{-1}K^{-1}$

Q.25 (D) When 100 cm^3 of a gas at constant pressure is heated from 27^oC to 100^oC, the volume must be multiplied by $\frac{373}{300}$.

Q.26 (B) Hydrogen gas possesses same kinetic energy at the same temperature as compared to oxygen.

Q.27 (D) All the statements are correct:

- Molecules are widely separated by large empty species in them.
- Molecules of gases have maximum kinetic energy.
- Their rate of diffusion is maximum.
- They do not have definite shape and fixed volume.

Q.28 (C) Postulate of KMT explains Charles's law, the average K.E of the gas molecules is directly proportional to absolute temperature.

Q.29 (D) Under the following conditions ideal gases behave like real gas at low temperature and high pressure.

Q.30 (A)

Given data:

Temperature of the gas = 300K

Pressure of gas = 1atm

Molar mass of the gas = $16 gmol^{-1}$

Gas constant = $0.05 atm dm^3 K^{-1} mol^{-1}$

Formula for density:

$$d = \frac{PM}{RT} = \frac{1 \times 16}{0.05 \times 300}$$

$$= \frac{1 \times 16 \times 100}{5 \times 300}$$

$$= \frac{16}{15} = 1.06 g dm^{-3}$$

Q.31 (D) The following is the main causes of deviation of real gases from ideal behavior:

- No force of attraction among the gas molecules
- The actual volume of gas molecules is negligible as compared to volume of the vessel

Q.32 (C) The gas which would behave like an ideal gas at room temperature is He.

Q.33 (A) The value of factor $\frac{PV}{nRT}$ is $Z = \frac{PV}{nRT} = 1$ called proportionality factor and is denoted by Z.

Q.34 (B)

$$d = \frac{M}{V},$$

$$d \propto M$$

In the following gases Cl_2 has the greater mass that's why it also has greater density.

Q.35 (A)

$V_1 = 800cm^3$ $T_1 = 27^oC + 273 = 300K$

$V_2 = 2000cm^3$ $T_2 = ?$

According to the Charles' law eq.

By re-arranging $T_2 = \frac{V_2 T_1}{V_1}$

$$T_2 = \frac{2000 cm^3 \times 300K}{800 cm^3}$$

$T_2 = 750K$

STEP

A PROGRAM BY PUNJAB GROUP