Important Questions for Class 11 Physics Chapter 12: Chapter 12 of Class 11 Physics, "Kinetic Theory," deals with the microscopic understanding of gases. It explores the behavior of gas molecules, assuming that they are in constant random motion. Key topics include the concept of pressure, temperature, and volume as related to molecular motion, and the ideal gas laws.

The chapter introduces the ideal gas equation PV=nRT and explains concepts like mean free path, root mean square velocity, and the kinetic energy of gas molecules. Important questions focus on deriving relations for pressure, temperature, and understanding the kinetic interpretation of the gas laws.

Important Questions for Class 11 Physics Chapter 12 Overview

Class 11 Physics Chapter 12 on Kinetic Theory explores the behavior of gases at the molecular level, providing essential insights into concepts like pressure, temperature, volume, and the ideal gas law. Important questions in this chapter help students grasp key principles such as the relationship between temperature and molecular motion, the kinetic theory assumptions, and the derivation of gas laws.

Mastery of these questions is crucial for building a solid foundation in thermodynamics and fluid mechanics. Understanding Kinetic Theory also aids in tackling real-world applications, such as engine efficiency and weather patterns, making it a vital topic for future physics studies.

Important Questions for Class 11 Physics Chapter 12 Kinetic Theory

Below is the Important Questions for Class 11 Physics Chapter 12 Kinetic Theory -

1. Given Samples of $1\ \mathrm{cm}^3$ of Hydrogen and $1\ \mathrm{cm}^3$ of oxygen, both at N. T. P. which sample has a larger number of molecules?

Ans: Equal volumes of all gases, at equivalent temperatures and pressures, contain the same number of molecules, according to Avogadro's hypothesis. As a result, the number of molecules in both samples is the same. As a result, the number of molecules in both samples is the same.

2. Find out the ratio between most probable velocity, average velocity and root Mean Square Velocity of gas molecules?

Ans : Since,

Most Probable velocity, $V_{mP} = \sqrt{\frac{2KT}{m}}$

Average velocity, $\bar{V} = \sqrt{\frac{8KT}{\pi m}}$

Root Mean Square velocity: Vr.m.s. $= \sqrt{\frac{3KT}{m}}$

Now, find out the Ratio between most probable velocity, average velocity and root mean square velocity of gas molecules

So, $\mathrm{V}_{=p} : \overline{\mathrm{V}}\mathrm{Vrm.s} = \sqrt{\frac{2\mathrm{KT}}{m}} : \sqrt{\frac{3KT}{\pi m}} : \sqrt{\frac{3\mathrm{KT}}{m}}$

$= \sqrt{2} : \sqrt{\frac{8}{\pi}} : \sqrt{3}$

$\mathrm{V}_{=\rho} : \overline{\mathrm{V}}$ Vr.m.s. $= 1.1.3 : 1.23$

3. What is Mean free path?

Ans: The average distance a molecule travels between collisions is known as the mean free path. It is symbolised by (lambda). Meters are the units of measurement (m).

4. What happens when an electric fan is switched on in a closed room?

Ans: When an electric fan is turned on, electrical energy is first transferred into mechanical energy, which is subsequently converted into heat. Heat energy increases the kinetic energy of air molecules, raising the temperature of the environment.

> **5. State the law of equi- Partition of energy?**
>
> **Ans:** The average kinetic energy of a molecule in each degree of freedom is equal to $\frac{1}{2}KT$. According to the law of equipartition of energy.

6. On what factors, does the average kinetic energy of gas molecules depend?

Ans: The absolute temperature is the only variable that affects average kinetic energy, and it is directly proportional to it.

7. Why the temperature less than absolute zero is not possible?

Ans: Since mean square velocity is proportional to temperature, it's a no-brainer. If the temperature is 0, the mean square velocity is also zero, and since molecules cannot be negative, temperatures lower than the absolute zone are not attainable.

8. What is the relation between pressure and kinetic energy of gas?

Ans: We are aware of this, Pressure$= P$ Kinetic energy $= \mathrm{E}$

Now, Kinetic theory of gases is $P = \frac{1}{3}Sc^2 \rightarrow 1$)

$\mathrm{S} =$ Density

$C = r.m.s$ Velocity of gas molecules

Translation's mean kinetic energy per unit

Volume of the gas $= E = \frac{1}{2}Sc^2 \rightarrow 2$)

Dividing 1) by 2)

Now, we find out relation between pressure and kinetic energy of gas:

$$\frac{P}{E} = \frac{1Sc^2 2}{3 \times Sc^2} = \frac{2}{3}$$

$$\Rightarrow P = \frac{2}{3}E$$

9. What is an ideal perfect gas?

Ans: Ideal gas is defined as a gas that obeys the following laws or qualities.

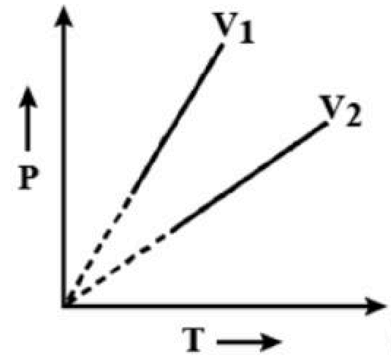
1) The size of a gas molecule is zero.

2) There is no attraction or repellent force between gas molecules.

2 Marks Questions

1. If a certain mass of gas is heated first in a small vessel of volume V_1 and then in a large vessel of volume V_2. Draw the P - T graph for two cases?

Ans: Equation of perfect gas; $P = \dfrac{RT}{V}$



Given, temperature is $P \alpha \dfrac{1}{V}$ As a result, when the gas is heated in a small vessel .

V_1 the pressure rises faster than when the gas is heated in a big vessel (Volume).

V_2 As a result, the slope of the graph in the case of a small vessel will be greater than in the case of a large vessel.

2. Derive the Boyle's law using kinetic theory of gases?

Ans: With the temperature constant, Boyle's law states that the volume of a given quantity of gas is inversely proportional to the pressure P, i.e. PV = constant.

The pressure exerted by a gas is now given by the kinetic theory of gases.

$\mathrm{P}=$ Pressure

$\mathrm{V}=$ Volume

$\overline{\mathrm{V}}=$ Average Velocity

m = Mass of 1 molecule

$\mathrm{N}=$ No. of molecules

$\mathrm{M}=\mathrm{mN}$ (Mass of gas)

$$P = \frac{1mN\bar{V}^2}{3V}$$

$$P_V = \frac{1}{3}M\bar{V}^2$$

3. At what temperature is the root mean square speed of an atom in an argon gas cylinder equal to the r.m.s speed of a helium gas atom at- $20^0\mathrm{C}$? Given Atomic Mass is $\mathrm{Ar} = 39.9$ and $\mathrm{He} = 4.0$?

Ans: Let we know that , Vr.m.s. and $\mathrm{V^1r}$.m.s. are the root mean square speeds of Argon and helium

We have , Atoms at temperature T and $\mathrm{T^1}$ respectively.

$\mathrm{R} =$ Universal Gas constant

$\mathrm{T} =$ Temperature

M = Atomic Mass of Gas

Now, Vr.m.s. $= \sqrt{\dfrac{3RT}{M}}$

$$\mathrm{V^1r \cdot m.s.} = \sqrt{\frac{3RT^1}{M^1}}$$

Given,$\mathrm{M} =$ Mass of Argon $= 39.9$

$\mathrm{M^1} =$ Mass of Helium $= 4.0$

$\mathrm{T^1} =$ Temperature of helium $= -20^0\mathrm{C}$

$\mathrm{T^1} = 273 + (-20) = 253\ \mathrm{K}$

$\mathrm{T} =$ Temperature of Argon =?

Now, Vr.m.s. = $\mathrm{V^1r \cdot m.}$

$$\sqrt{\frac{3RT}{M}} = \sqrt{\frac{3RT^1}{M^1}}$$

Squaring both side,

$$\frac{\cancel{3}\cancel{R}T}{M} = \frac{\cancel{3}\cancel{R}T^1}{M^1}$$

$$\frac{T}{M} = \frac{T^1}{M^2} \Rightarrow T = \frac{T^1 M}{M^1}$$

Now it's time to put the numbers together.T^1, M^1 \& M

$$T = \frac{253 \times 39.9}{4.0} = 2523.7\ \mathrm{K}$$

4. Show that constant - temperature bulk modulus K of an ideal gas is the pressure P of the gas?

Ans: When a substance P is exposed to increased pressure, a minor fractional volume drop occurs, which is related to bulk modulus k by:-

$$K = \frac{\Delta P}{\frac{-\Delta V}{V}} \rightarrow 1)$$

So we know that A negative sign implies that the volume is decreasing. Before, compression in the case of an ideal gas at a constant temperature.

$$PV = \frac{m}{M}RT \rightarrow 2)$$

M = Molecular Mass of gas

We have, After compression at constant temperature,

$$(P+\Delta P)(V+\Delta V) = \frac{m}{M}RT$$

Now, From equation 2)

$$PV = (P+\Delta P)(V+\Delta V)$$

$$PV' = P'V' + P\Delta V + V\Delta P + \Delta P\Delta V$$

or $-P\Delta V = V\Delta P + \Delta P\Delta V$

$$-\frac{P\Delta V}{V} = \Delta P + \frac{\Delta P\Delta V}{V} (\because \text{ Dividing by } \mathrm{V} \text{ on both sides })$$

$$-\frac{P\Delta V}{V} = \Delta P\left(1 + \frac{\Delta V}{V}\right)$$

$$-\frac{\Delta V}{V} = \frac{\Delta P}{P}\left(1 + \frac{\Delta V}{V}\right)$$

We're only concerned with minor fractional changes. Therefore, $\frac{\Delta V}{V}$ is much smaller than

5. The earth without its atmosphere would be inhospitably cold. Explain Why?

Ans: Infrared radiation from the earth's surface is reflected back to the lower layers of the atmosphere. As a result, the earth's heat radiation from the sun is trapped by the atmosphere during the day. The earth's surface would become too cold to live if it didn't have an atmosphere.

6. If a vessel contains 1 mole of 0_2 gas (molar mass 32) at temperature T. The pressure of the gas is P. What is the pressure if an identical vessel contains 1 mole of Hit at a temperature $2\mathrm{T}$?

Ans: According to the ideal gas equation: $\rightarrow$

$PV = nRT$

$P =$ pressure

V =volume

$\mathrm{n} = \mathrm{No}$. of molecule per unit volume

R=Universal Gas Constant

$\mathrm{T} =$ Temperature

So we get, $\frac{PV}{T} = nR$ or $\frac{PV}{T} =$ constant

Hence $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \rightarrow 1)$

Now, in response to the query,$\rightarrow$

$P_1 = P \mid T_1 = T$

$V_1 = V \mid T_2 = 2T$

Using above equations in equation 1)

$P_2 = \frac{P_1V_1}{T_1} K \frac{T_2}{V_2}$

$P_2 = \frac{PV}{T} X \frac{2T}{V} \quad \mathrm{V}_1 = \mathrm{V}_2 = \mathrm{V}(\because$ identical vessels)

$\mathrm{P}_2 = 2\mathrm{P}$

As a result, the pressure is doubled.

7. At very low pressure and high temperature, the real gas behaves like ideal gas. Why?

Ans: An ideal gas has a molecule volume of zero and no intermolecular forces.

1) At extremely low pressures, the amount of gas is so huge that the volume of a molecule is insignificant in comparison to the volume of gas.

2) Because the kinetic energy of molecules is very high at very high temperatures, the effect of intermolecular forces can be ignored.

As a result, at low pressure, real gases behave like an ideal gas.

8. Calculate the degree of freedom for monatomic, diatomic and triatomic gas?

Ans: The system's degrees of freedom are determined by:- $\mathrm{f}=3\ \mathrm{N}-\mathrm{K}$

Where, $\mathrm{f}=$ degrees of freedom

$\mathrm{N}=$ Number of Particles in the system.

$\mathrm{K}=$ Independent relation among the particles.

Now ,

1) For a monatomic gas, $\mathrm{N}=1$ and $\mathrm{K}=0$

$\mathrm{f}=3\times1-0=3$

2) For a diatomic gas; $\mathrm{N}=2$ and $\mathrm{K}=\mathrm{m}1$

$\mathrm{f}=3\times2-1=5$

3) For a triatomic gas; $\mathrm{N}=3$ and $\mathrm{K}=3$

$\mathrm{f}=3\times3-3$

$\mathrm{f}=6$

As a result, the degrees of freedom for monatomic, diatomic, and Triatomic particles are 3, 5, and 6 respectively.

9. Determine the volume of 1 mole of any gas at s. T. P., assuming it behaves like an ideal gas?

Ans: Using the ideal gas equation-

$\mathrm{P}=$ Pressure

$\mathrm{V}=$ Volume

$\mathrm{n}=\mathrm{No}$. of moles of gas

$\mathrm{R}=$ Universal Gas Constant

$\mathrm{T}=$ Temperature

We have,

$\mathrm{PV}=\mathrm{nRT}$

$\mathrm{V}=\dfrac{nRT}{P}$

Given is , $\mathrm{n}=1$ mole; $\mathrm{R}=8.31\ \mathrm{J/mol/K};\mathrm{T}=273\ \mathrm{K}$

$\mathrm{P}=1.01\times10^{5}\ \mathrm{N}\mid\mathrm{m}^{2}$

$\mathrm{V}=\dfrac{1\times(8.31)\times273}{1.01\times10^{3}}$

$\mathrm{V}=22.4\times10^{-3}\ \mathrm{m}^{3}$

Since 1 litre

$=1000\ \mathrm{cm}^{3}$

$=1\times10^{-3}\ \mathrm{m}^{3}$

Hence $\mathrm{V}=22.41$

i.e. at S.T.P., any gas has a volume of 22.41. (Standard Temperature & Pressure).

10. A tank of volume $0.3m^3$ contains 2 moles of Helium gas at $20^0\mathrm{C}$. Assuming the helium behave as an ideal gas;

Ans: 1) Find the total internal energy of the system.

Given, $\mathrm{n}=$ No. of moles $=2$

$\mathrm{T}=$ Temperature $=273+20=293\ \mathrm{K}$

$\mathrm{R}=$ Universal Gas constant $=8.31\ \mathrm{J/mole.}$

So we know that, Total energy of the system $=\mathrm{E}=\frac{3}{2}nRT$

Hence, $E=\frac{3}{2}\times n\times 8.31\times 293E=7.30\times 10^3J$

2) Determine the r. m. s. Speed of the atoms.

Molecular Mass of helium $=4\ \mathrm{g}$ \ mol

$=\frac{4\times 10^{-3}\mathrm{Kg}}{mol}$

Now , Root Mean speed $=\mathrm{Vr}\cdot\mathrm{m}\cdot\mathrm{s}=\sqrt{\frac{3RT}{M}}=\sqrt{\frac{3X8.31\times 293}{4X10^{-3}}}$

Vr.m.s. $=1.35\mathrm{X}10^3\ \mathrm{m/s}$

11. Air pressure in a car tyre increases during driving? Why?

Ans: Because of the action, the temperature of the air inside the Tyre rises during driving. According to Charles's law, as the temperature rises, the pressure inside the tyres rises as well.

12. What are the assumptions of kinetic theory of gas?

Ans: The following are the assumptions of the kinetic theory of gases:

1) A gas is made up of a vast number of molecules that should all be elastic spheres and identical.

2) A gas's molecules are in a constant state of rapid and unpredictable mobility.

3) Gas molecules are extremely small in comparison to the distance between them.

4) There is no attraction or repulsio between the molecules.

5) Molecule collisions with one another and with the vessel's walls are perfectly elastic.

Benefits of Using Important Questions for Class 11 Physics Chapter 12

Concept Reinforcement: Helps reinforce key concepts like molecular motion, pressure, temperature, and gas laws.

Improved Understanding: Deepens understanding of the kinetic theory and its real-world applications.

Exam Preparation: Provides targeted practice for exam preparation, ensuring familiarity with potential exam questions.

Critical Thinking: Encourages critical thinking and problem-solving skills in relation to gas behavior and thermodynamics.

Time Management: Aids in time management by allowing focused revision on the most important topics.

Foundation for Advanced Topics: Builds a solid foundation for higher-level physics topics like thermodynamics and fluid dynamics.