CHAPTER

14

Kinetic Theory of Gases

MHT CET Physics

PHYSICS CIRCLE

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MHT CET WEIGHTAGE

64 **Questions**

MHT CET · all years



Molecular Speeds	40	62%
Pressure & Kinetic Energy of a Gas	21	33%
Mean Free Path & Real Gases	3	5%
Law of Equipartition of Energy	0	0%

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01 CONCEPT Pressure & Kinetic Energy of a Gas

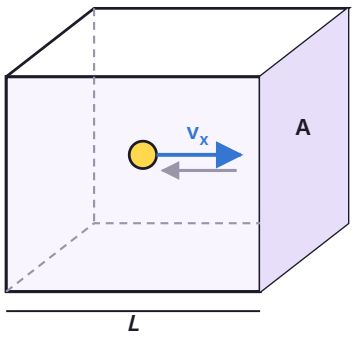
IN ONE LINE

Gas pressure is the result of molecules **bouncing off the walls**. The average kinetic energy of the molecules depends only on the **temperature**.

14.1.1 Assumptions of kinetic theory

- A gas is made of a very large number of identical molecules.
- Molecules are point masses: their volume is negligible compared with the volume of the gas.
- They move randomly in all directions with all possible speeds.
- Collisions with each other and with the walls are **perfectly elastic**.
- No force acts between molecules except during a collision; collision time is negligible.
- Gravity on the molecules is neglected.

14.1.2 Pressure of an ideal gas



A molecule hitting wall A of a cube of side L

- Change in momentum at the wall: $\Delta p = 2mv_x$.
- Time between hits on the same wall: $\frac{2L}{v_x}$.
- Force by one molecule = $\frac{mv_x^2}{L}$ ⇒ wall force ∝ $v^2 \propto T$.
- Random motion: $v_x^2 = v_y^2 = v_z^2 = \frac{v^2}{3}$.

$$P = \frac{1}{3}\frac{mN}{V}v^2_{rms} = \frac{1}{3}\rho v^2_{rms}$$

14.1.3 Pressure and kinetic energy

$$P = \frac{2}{3}E \cdot E = \frac{\text{translational KE}}{\text{volume}}$$

- Total translational KE of a gas = $\frac{3}{2}PV$.
- Pressure rises if: more molecules ($P \propto N$), smaller volume ($P \propto \frac{1}{V}$), higher temperature ($P \propto v^2_{rms} \propto T$).
- Masses halved and speeds doubled ⇒ P doubles ($P \propto mv^2$).

14.1.4 Kinetic energy and temperature

$$E_{molecule} = \frac{3}{2}k_BT \cdot E_{mole} = \frac{3}{2}RT$$

Amount of gas	Translational KE
1 molecule	$\frac{3}{2}k_BT$
N molecules	$\frac{3}{2}Nk_BT$
n moles	$\frac{3}{2}nRT$
1 gram	$\frac{3}{2}\frac{RT}{M}$

- Average translational KE per molecule depends **only on T**, not on the gas: H_2 and O_2 at the same T have equal average KE.
- KE ∝ T (in kelvin): to double KE, double T.
- At T = 0 K the translational motion stops.
- KE per gram depends on M: smaller M ⇒ larger KE per gram.
- Temperature is a measure of the average translational KE of the molecules.

$$N = \frac{3PV}{2E_{molecule}} \cdot \frac{3}{2}k_BT = eV \text{ (electron through V volt)}$$

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Solved Examples 01 Pressure & Kinetic Energy of a Gas

SOLVED 1 MHT CET 2026 · 15 Apr · Shift 1

The average force applied on the walls of a closed container depends on the temperature T of an ideal gas as

(a) T^2 (b) T^3
(c) T^1 (d) T^{-1}

STEP 1 Force per molecule $\propto \frac{mv^2}{L}$
STEP 2 $v^2_{rms} \propto T$
STEP 3 $F \propto \mathbf{T^1}$

Answer: **(c)**

SOLVED 2 MHT CET 2023 · 13 May · Shift 2

A gas at pressure p_0 is contained in a vessel. If the masses of all the molecules are halved and their velocities are doubled, the resulting pressure would be

(a) $4p_0$ (b) $2p_0$
(c) p_0 (d) $\frac{p_0}{2}$

STEP 1 $P = \frac{1}{3}\frac{mN}{V}v^2$
STEP 2 New $P \propto \frac{m}{2} \times (2v)^2 = 2mv^2$
STEP 3 $P = \mathbf{2p_0}$

Answer: **(b)**

SOLVED 3 MHT CET 2026 · 13 Apr · Shift 2

The energy of a gas per litre is 600 J. Its pressure is

(a) 4×10^5 N/m² (b) 10^5 N/m²
(c) 6×10^5 N/m² (d) 3×10^5 N/m²

STEP 1 $P = \frac{2}{3}E$, E = energy per unit volume
STEP 2 $E = \frac{600}{10^{-3}} = 6 \times 10^5$ J/m³
STEP 3 $P = \mathbf{4 \times 10^5\ N/m^2}$

Answer: **(a)**

SOLVED 4 MHT CET 2024 · 11 May · Shift 2

What is the pressure of hydrogen in a cylinder of volume 10 litre if its total energy of translation is 7.5×10^3 J?

(a) 5×10^5 N m^{-2} (b) 10^6 N m^{-2}
(c) 0.5×10^5 N m^{-2} (d) 5×10^6 N m^{-2}

STEP 1 $P = \frac{2}{3} \times \frac{E}{V}$
STEP 2 $P = \frac{2}{3} \times \frac{7.5 \times 10^3}{10^{-2}}$
STEP 3 $P = \mathbf{5 \times 10^5\ N\,m^{-2}}$

Answer: **(a)**

SOLVED 5 MHT CET 2026 · 13 May · Shift 1

At what temperature is the kinetic energy of a gas molecule half of its value at 27°C?

(a) 13.5°C (b) −123°C
(c) 75 K (d) 13.5 K

STEP 1 KE $\propto$ T (kelvin)
STEP 2 $T = \frac{300}{2} = 150$ K
STEP 3 $T = \mathbf{-123°C}$

Answer: **(b)**

SOLVED 6 MHT CET 2026 · 12 May · Shift 2

At 27°C the mean kinetic energy of the atoms of an ideal gas is E_1. If the temperature is increased by 300°C, the mean kinetic energy of the atoms will be

(a) $\frac{E_1}{\sqrt{2}}$ (b) $\sqrt{2}\,E_1$
(c) $2E_1$ (d) $\frac{E_1}{2}$

STEP 1 $T_1 = 300$ K, $T_2 = 600$ K
STEP 2 KE $\propto$ T
STEP 3 KE = $\mathbf{2E_1}$

Answer: **(c)**

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Solved Examples 01 Pressure & Kinetic Energy of a Gas (contd.)

SOLVED 7 MHT CET 2026 · 19 Apr · Shift 1

The kinetic energy of an ideal gas is E_0 at 27°C. When the temperature is increased to 177°C, the kinetic energy will be

(a) $\frac{E_0}{2}$ (b) $\frac{2E_0}{3}$
(c) $\frac{3E_0}{2}$ (d) $2E_0$

STEP 1 $T_1 = 300$ K, $T_2 = 450$ K
STEP 2 $E = E_0 \times \frac{450}{300}$
STEP 3 $E = \mathbf{\frac{3E_0}{2}}$

Answer: **(c)**

SOLVED 8 MHT CET 2026 · 16 Apr · Shift 1

The translational kinetic energy of the molecules of a gas at absolute temperature T can be doubled by

(a) increasing T to 4T
(b) increasing T to $\sqrt{2}$ T
(c) decreasing T to T ÷ 2
(d) increasing T to 2T

STEP 1 $KE = \frac{3}{2}kT$
STEP 2 $KE \propto T$
STEP 3 Double KE ⇒ **increase T to 2T**

Answer: **(d)**

SOLVED 9 MHT CET 2025 · 22 Apr · Shift 1

The mean kinetic energy of the molecules of an ideal gas at 399°C is E. The temperature at which the mean kinetic energy will be $\frac{E}{2}$ is

(a) 336°C (b) 276°C
(c) 123°C (d) 63°C

STEP 1 $T_1 = 672$ K
STEP 2 $T_2 = \frac{672}{2} = 336$ K
STEP 3 $T_2 = \mathbf{63°C}$

Answer: **(d)**

SOLVED 10 MHT CET 2025 · 19 Apr · Shift 2

Two gases A and B are at absolute temperatures 350 K and 420 K. The ratio of average kinetic energy of the molecules of gas B to that of gas A is

(a) 6 : 5 (b) $\sqrt{6} : \sqrt{5}$
(c) 36 : 25 (d) 5 : 6

STEP 1 Average KE $\propto$ T
STEP 2 $\frac{E_B}{E_A} = \frac{420}{350}$
STEP 3 = **6 : 5**

Answer: **(a)**

SOLVED 11 MHT CET 2024 · 2 May · Shift 2

The average translational kinetic energy of nitrogen (molar mass 28) molecules at a particular temperature is 0.042 eV. The translational kinetic energy of oxygen molecules (molar mass 32) in eV at double the temperature is

(a) 0.021 (b) 0.048
(c) 0.056 (d) 0.084

STEP 1 Average KE = $\frac{3}{2}kT$: independent of the mass
STEP 2 Doubling T doubles KE
STEP 3 KE = 2 × 0.042 = **0.084 eV**

Answer: **(d)**

SOLVED 12 MHT CET 2021 · 21 Sep · Shift 2

If E is the kinetic energy per mole of an ideal gas and T is the absolute temperature, the universal gas constant is

(a) $\frac{2T}{3E}$ (b) $\frac{2E}{3T}$
(c) $\frac{3T}{2E}$ (d) $\frac{3E}{2T}$

STEP 1 KE per mole E = $\frac{3}{2}RT$
STEP 2 $R = \frac{2E}{3T}$
STEP 3 $R = \mathbf{\frac{2E}{3T}}$

Answer: **(b)**

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02 CONCEPT Molecular Speeds

IN ONE LINE

Gas molecules have a spread of speeds. Three averages are used: the **most probable**, the **average** and the **root mean square** speed.

14.2.1 Root mean square speed

$$v_{rms} = \sqrt{\frac{v_1^2 + v_2^2 + \dots}{N}} = \sqrt{\frac{3P}{\rho}}$$

$$v_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3k_BT}{m}}$$

- $v_{rms} \propto \sqrt{T}$ (in kelvin) and $\propto 1 \div \sqrt{M}$.
- At the same T: lighter molecules move faster. H_2 is 4 times faster than O_2.
- v_{rms} does not depend on pressure alone at constant T ($P \propto \rho$).
- Same speed for two gases $\Rightarrow \frac{T_1}{M_1} = \frac{T_2}{M_2}$.
- For H_2 at NTP: $v_{rms} \approx 1840$ m/s.

14.2.2 Most probable, average, rms

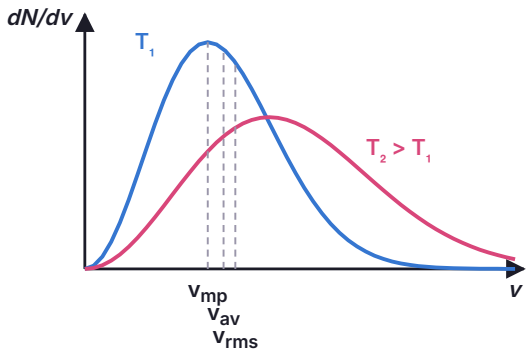
$$v_{mp} = \sqrt{\frac{2RT}{M}} \cdot v_{av} = \sqrt{\frac{8RT}{\pi M}} \cdot v_{rms} = \sqrt{\frac{3RT}{M}}$$

$$v_{rms} > v_{av} > v_{mp}$$

$$v_{rms} : v_{av} : v_{mp} \approx 1.73 : 1.60 : 1.41$$

- For a set of numbers: v_{av} = sum ÷ N; v_{rms} = √(mean of squares).
- v_{mp} = the speed held by the largest number of molecules.

14.2.3 How the speeds are spread



At higher T the peak moves right and the curve flattens

- Area under the curve = total number of molecules (stays the same).
- Peak is at v_{mp}. The curve is not symmetric.
- Higher T: peak shifts to higher speed and becomes lower and broader.

14.2.4 Compared with v_{rms}

$$v_{sound} = \sqrt{\frac{\gamma RT}{M}} \cdot \frac{v_{rms}}{v_{sound}} = \sqrt{\frac{3}{\gamma}}$$

- A planet keeps an atmosphere only if v_{rms} < escape speed. The Moon has none.

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Solved Examples 02 Molecular Speeds

SOLVED 1 MHT CET 2026 · 19 Apr · Shift 2

Assuming the expression for the pressure exerted by a gas, it can be shown that pressure is

(a) $\frac{2}{3}$ of kinetic energy per unit volume

(b) $\frac{3}{4}$ of kinetic energy per unit volume

(c) $\frac{1}{3}$ of kinetic energy per unit volume

(d) $\frac{3}{2}$ times kinetic energy per unit volume

STEP 1 $P = \frac{1}{3}\rho v^2_{rms}$

STEP 2 KE per unit volume $E = \frac{1}{2}\rho v^2_{rms}$

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

Answer: **(a)**

SOLVED 2 MHT CET 2026 · 19 May · Shift 1

If m is the mass of each molecule of a gas and T its absolute temperature, the root mean square velocity of the molecules is proportional to

(a) $m^{-\frac{1}{2}}T^{-\frac{1}{2}}$ (b) $m^{-\frac{1}{2}}T^{1/2}$

(c) $m^{1/2}T^{-\frac{1}{2}}$ (d) m^1T^1

STEP 1 $v_{rms} = \sqrt{\frac{3kT}{m}}$

STEP 2 $v_{rms} \propto T^{1/2}$ and $\propto m^{-\frac{1}{2}}$

STEP 3 $\mathbf{m^{-\frac{1}{2}}T^{1/2}}$

Answer: **(b)**

SOLVED 3 MHT CET 2026 · 18 Apr · Shift 2

The r.m.s. velocity of a gas is v at temperature T. Which relation is true?

(a) vT^2 = constant (b) $\frac{v}{T^2}$ = constant

(c) v^2T = constant (d) $\frac{v^2}{T}$ = constant

STEP 1 $v_{rms} \propto \sqrt{T}$

STEP 2 $v^2 \propto T$

STEP 3 $\mathbf{\frac{v^2}{T} = constant}$

Answer: **(d)**

SOLVED 4 MHT CET 2025 · 21 Apr · Shift 2

The r.m.s. speed of gas molecules at 800 K will be

(a) same as at 200 K

(b) twice the value at 200 K

(c) four times the value at 200 K

(d) half the value at 200 K

STEP 1 $v_{rms} \propto \sqrt{T}$

STEP 2 $\frac{v_{800}}{v_{200}} = \sqrt{\frac{800}{200}} = 2$

STEP 3 **Twice the value at 200 K**

Answer: **(b)**

SOLVED 5 MHT CET 2025 · 25 Apr · Shift 1

The temperature of an ideal gas is increased from 100 K to 400 K. If x is the r.m.s. velocity at 100 K, the r.m.s. velocity becomes

(a) $\frac{x}{4}$ (b) 2x

(c) 3x (d) 4x

STEP 1 $v_{rms} \propto \sqrt{T}$

STEP 2 T becomes 4 times

STEP 3 v_{rms} = **2x**

Answer: **(b)**

SOLVED 6 MHT CET 2023 · 11 May · Shift 2

If the temperature of gas molecules is raised from 127°C to 527°C, the ratio of r.m.s. speeds of the molecules is

(a) 1 : 2 (b) 2 : 1

(c) 1 : $\sqrt{2}$ (d) 2 : $\sqrt{2}$

STEP 1 T_1 = 400 K, T_2 = 800 K

STEP 2 $\frac{v_1}{v_2} = \sqrt{\frac{400}{800}}$

STEP 3 = **1 : $\sqrt{2}$**

Answer: **(c)**

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KINETIC THEORY OF GASES · TOPIC 01

Pressure & Kinetic Energy of a Gas

LEVEL 1 · EASY

Topic-wise Previous Year Questions

MHT CET · NEET · JEE Main

19	2	1
questions	concepts	easy

CONTENTS

01	Pressure & Kinetic Energy of a Gas	Q 1–19	19 Qs
	Level 1 · Easy		19 Qs
	◆ **Assumptions & pressure of a gas**		2 Qs
	◆ **Kinetic energy & temperature**		17 Qs
	Answer key		

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TOPIC 01

Pressure & Kinetic Energy of a Gas

19 PYQs · Easy 19 · Medium 0 · Difficult 0 | MHT CET 9 · NEET 2 · JEE 8

Concepts covered: Assumptions & pressure of a gas (2) · Kinetic energy & temperature (17)

LEVEL 1 · EASY 19 questions

◆ Assumptions & pressure of a gas 2 Qs

1. According to kinetic theory of gases, at absolute zero of temperature

AIPMT 1990

(a) water freezes
(b) liquid helium freezes
(c) molecular motion stops
(d) liquid hydrogen freezes

2. On the basis of kinetic theory of gases, the gas exerts pressure because its molecules:

JEE MAIN 2021 · 24 FEB · SHIFT 2

(a) continuously lose their energy till it reaches wall.
(b) are attracted by the walls of container.
(c) suffer change in momentum when impinge on the walls of container.
(d) continuously stick to the walls of container.

◆ Kinetic energy & temperature 17 Qs

3. At what temperature, the kinetic energy of a gas molecule is half of the value at 27°C?

MHT CET 2026 · 13 MAY · SHIFT 1

(a) 13.5°C (b) − 123° C (c) 75K (d) 13.5K

4. At $27^{\circ}C$ temperature, the mean kinetic energy of the atoms of an ideal gas is E_1. If the temperature is increased by $300^{\circ}C$ then the mean kinetic energy of the atoms will be

MHT CET 2026 · 12 MAY · SHIFT 2

(a) $\frac{E_1}{\sqrt{2}}$ (b) $\sqrt{2}E_1$ (c) $2E_1$ (d) $\frac{E_1}{2}$

5. The kinetic energy of an ideal gas is E_0 at 27° C. When the temperature is increased to 177° C, then kinetic energy will be

MHT CET 2026 · 19 APR · SHIFT 1

(a) $E_0/2$ (b) $2E_0/3$ (c) $3E_0/2$ (d) $2E_0$

6. The translational kinetic energy of the molecules of a gas at absolute temperature (T) can be doubled by

MHT CET 2026 · 16 APR · SHIFT 1

(a) increasing T to 4 T (b) increasing T to $\sqrt{2}$ T
(c) decreasing T to T/2 (d) increasing T to 2T

7. The initial average kinetic energy of the molecules was E, when a gas sample is at 27°C. When the gas is heated to 327°C, then the final average kinetic energy will be

MHT CET 2025 · 25 APR · SHIFT 2

(a) $\sqrt{2}$E (b) 2 E (c) 300 E (d) 327 E

8. The mean kinetic energy of the molecules of an ideal gas at 399°C is ' E '. The temperature at which the mean kinetic energy of its molecules will be ' E/2 ', is

MHT CET 2025 · 22 APR · SHIFT 1

(a) 336°C (b) 276°C (c) 123°C (d) 63°C

9. Two gases A and B are at absolute temperatures 350 K and 420 K respectively. The ratio of average kinetic energy of the molecules of gas B to that of gas A is

MHT CET 2025 · 19 APR · SHIFT 2

(a) 6 : 5 (b) $\sqrt{6} : \sqrt{5}$ (c) 36 : 25 (d) 5 : 6

10. The translational kinetic energy of the molecules of a gas at absolute temperature (T) can be doubled

MHT CET 2021 · 22 SEP · SHIFT 1

(a) by increasing T to 4 T
(b) by increasing T to 2 T
(c) by decreasing T to T/2
(d) by increasing T to $\sqrt{2}$ T

11. If 'E' is the kinetic energy per mole of an ideal gas and 'T' is the absolute temperature, then the universal gas constant is given as

MHT CET 2021 · 21 SEP · SHIFT 2

(a) $\frac{2\,T}{3E}$ (b) $\frac{2E}{3\,T}$ (c) $\frac{3\,T}{2E}$ (d) $\frac{3E}{2\,T}$

12. At 0 K which of the following properties of a gas will be zero?

AIPMT 1996

(a) vibrational energy (b) density
(c) kinetic energy (d) potential energy

13. The temperature of a gas is −78°C and the average translational kinetic energy of its molecules is K. The temperature at which the average translational kinetic energy of the molecules of the same gas becomes 2 K is:

JEE MAIN 2024 · 9 APR · SHIFT 2

(a) −78°C (b) 127°C (c) −39°C (d) 117°C

14. The average kinetic energy of a monatomic molecule is 0.414 eV at temperature: (Use $K_B = 1.38 \times 10^{-23}$ J/mol − K)

JEE MAIN 2024 · 27 JAN · SHIFT 1

(a) 3000 K (b) 3200 K (c) 1600 K (d) 1500 K

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15. A flask contains Hydrogen and Argon in the ratio $2:1$ by mass. The temperature of the mixture is $30^{\circ}\mathrm{C}$. The ratio of average kinetic energy per molecule of the two gases (K argon/K hydrogen) is: (Given: Atomic Weight of $\mathrm{Ar} = 39.9$)

JEE MAIN 2023 · 15 APR · SHIFT 1

(a) $\frac{39.9}{2}$ (b) 2 (c) 39.9 (d) 1

16. The temperature at which the kinetic energy of oxygen molecules becomes double than its value at $27^{\circ}\mathrm{C}$ is

JEE MAIN 2023 · 8 APR · SHIFT 2

(a) $627^{\circ}\mathrm{C}$ (b) $927^{\circ}\mathrm{C}$ (c) $327^{\circ}\mathrm{C}$ (d) $1227^{\circ}\mathrm{C}$

17. The average kinetic energy of a molecule of the gas is

JEE MAIN 2023 · 1 FEB · SHIFT 1

(a) proportional to volume
(b) dependent on the nature of the gas
(c) proportional to absolute temperature
(d) proportional to pressure

18. A flask contains hydrogen and oxygen in the ratio of $2:1$ by mass at temperature $27^{\circ}\mathrm{C}$. The ratio of average kinetic energy per molecule of hydrogen and oxygen respectively is:

JEE MAIN 2023 · 30 JAN · SHIFT 2

(a) 1: 1 (b) 4: 1 (c) 1: 4 (d) 2: 1

19. A flask contains argon and oxygen in the ratio of 3: 2 in mass and the mixture is kept at 27°C. The ratio of their average kinetic energy per molecule respectively will be:

JEE MAIN 2022 · 26 JUN · SHIFT 2

(a) 3: 2 (b) 9: 4 (c) 2: 3 (d) 1: 1

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ANSWER KEY

Shaded by level: **Easy**

01 Pressure & Kinetic Energy of a Gas

1. (c)	2. (c)	3. (b)	4. (c)	5. (c)	6. (d)	7. (b)	8. (d)	9. (a)	10. (b)
11. (b)	12. (c)	13. (d)	14. (b)	15. (d)	16. (c)	17. (c)	18. (a)	19. (d)	

Note: *"Bonus" = no option is correct as the question is printed (dropped in the official key). Numerical questions show the numerical answer.*

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KINETIC THEORY OF GASES · TOPIC 02

Molecular Speeds & Maxwell Distribution

LEVEL 1 · EASY

Topic-wise Previous Year Questions

MHT CET · NEET · JEE Main

41	1	1
questions	concepts	easy

CONTENTS

02	Molecular Speeds & Maxwell Distribution	Q 1–41	41 Qs
	Level 1 · Easy		41 Qs
	◆ **Molecular speeds: rms, average & most probable**		41 Qs
	Answer key		

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TOPIC 02

Molecular Speeds & Maxwell Distribution

41 PYQs · Easy 41 · Medium 0 · Difficult 0 | MHT CET 20 · NEET 2 · JEE 19

Concepts covered: Molecular speeds: rms, average & most probable (41)

LEVEL 1 · EASY 41 questions

1. If 'm' represents the mass of each molecule of a gas and 'T' its absolute temperature respectively, then the root mean square velocity of the gaseous molecule is proportional to

MHT CET 2026 · 19 MAY · SHIFT 1

(a) $m^{-1/2}T^{-1/2}$ (b) $m^{-1/2}T^{1/2}$
(c) $m^{1/2}T^{-1/2}$ (d) $m^{1}T^{1}$

2. Assuming the expression for the pressure exerted by the gas, it can be shown that pressure is

MHT CET 2026 · 19 APR · SHIFT 2

(a) $2^{rd}\left(\frac{2}{3}\right)$ of kinetic energy per unit volume of a gas.
(b) $3^{th}\left(\frac{3}{4}\right)$ of kinetic energy per unit volume of a gas.
(c) $1^{rd}\left(\frac{1}{3}\right)$ of kinetic energy per unit volume of a gas.
(d) $3^{nd}\left(\frac{3}{2}\right)$ times kinetic energy per unit volume of a gas.

3. When the r.m.s. velocity of a gas is denoted by 'v' at temperature 'T'. Out of the following relations, the true one is

MHT CET 2026 · 18 APR · SHIFT 2

(a) $v \cdot T^2 =$ constant (b) $\frac{}{} = ^{v}$ constant
(c) $v^2T =$ constant (d) $v^2\ T^2\ \frac{}{T} =$ constant

4. The temperature of an ideal gas is increased from 100 K to 400 K. If 'x' is the root mean square velocity of its molecules at 100 K, r.m.s. velocity becomes

MHT CET 2025 · 25 APR · SHIFT 1

(a) $\frac{x}{4}$ (b) $2x$ (c) $3x$ (d) $4x$

5. According to the kinetic theory of gases, when two molecules of a gas collide with each other then

MHT CET 2025 · 25 APR · SHIFT 1

(a) both kinetic energy and momentum are conserved.
(b) neither kinetic energy nor momentum is conserved.
(c) momentum is conserved but kinetic energy is not conserved.
(d) kinetic energy is conserved but momentum is not conserved.

6. Six molecules of a gas in container have speeds $2\ \mathrm{m/s}, 5\ \mathrm{m/s}, 3\ \mathrm{m/s}, 6\ \mathrm{m/s}, 3\ \mathrm{m/s}$, and $5\ \mathrm{m/s}$. The r.m.s. speed is

MHT CET 2025 · 23 APR · SHIFT 2

(a) $4\ \mathrm{m/s}$ (b) $1.7\ \mathrm{m/s}$
(c) $4.24\ \mathrm{m/s}$ (d) $5\ \mathrm{m/s}$

7. For a gas at a particular temperature on an average, the quantity which remains same for all molecules is

MHT CET 2025 · 22 APR · SHIFT 1

(a) velocity (b) momentum
(c) kinetic energy (d) angular momentum

8. The r.m.s. speed of gas molecules at 800 K will be

MHT CET 2025 · 21 APR · SHIFT 2

(a) same as at 200 K
(b) twice the value at 200 K
(c) four times the value at 200 K
(d) half the value at 200 K

9. The temperature of an ideal gas is increased from 100 K to 400 K. If 'x' is the R.M.S. velocity of its molecules at 100 K, it becomes

MHT CET 2025 · 21 APR · SHIFT 2

(a) $\frac{x}{4}$ (b) $2x$ (c) $3x$ (d) $4x$

10. Assuming the expression for the pressure exerted by the gas, it can be shown that pressure is

MHT CET 2024 · 16 MAY · SHIFT 1

(a) $\left(\frac{3}{4}\right)^{\text{th}}$ of kinetic energy per unit volume of a gas.
(b) $\left(\frac{2}{3}\right)^{\text{rd}}$ of kinetic energy per unit volume of a gas.
(c) $\left(\frac{1}{3}\right)^{\text{rd}}$ of kinetic energy per unit volume of a gas.
(d) $\left(\frac{3}{2}\right)^{\text{rd}}$ of kinetic energy per unit volume of a gas.

11. The absolute temperature of a gas is determined by

MHT CET 2024 · 15 MAY · SHIFT 2

(a) the average momentum of the molecule.
(b) the velocity of sound in the gas.
(c) the number of molecules in the gas.
(d) the mean square velocity of the molecules.

12. The molecular mass of a gas having r.m.s. speed four times as that of another gas having molecular mass 32 is

MHT CET 2023 · 14 MAY · SHIFT 2

(a) 2 (b) 4 (c) 16 (d) 32

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13. The temperature of a gas is measure of
MHT CET 2023 · 14 MAY · SHIFT 2
(a) the average kinetic energy of gas molecules.
(b) the average potential energy of gas molecules.
(c) the average distance between the molecules of a gas
(d) the size of the molecules of a gas

14. If temperature of gas molecules is raised from $127^{\circ}C$ to $527^{\circ}C$, the ratio of r.m.s. speed of the molecules is respectively
MHT CET 2023 · 11 MAY · SHIFT 2
(a) $1:2$ (b) $2:1$ (c) $1:\sqrt{2}$ (d) $2:\sqrt{2}$

15. The pressure exerted by an ideal gas at a particular temperature is directly proportional to
MHT CET 2023 · 9 MAY · SHIFT 2
(a) the mean speed of the gas molecules.
(b) mean of the square of the speed of the gas molecules.
(c) the square of the mean speed of the gas molecules.
(d) the root mean square speed of the gas molecules.

16. The temperature of an ideal gas is increased from $27^{\circ}C$ to $927^{\circ}C$. The r.m.s. speed of its molecules becomes
MHT CET 2023 · 9 MAY · SHIFT 2
(a) twice (b) four times.
(c) half. (d) one-fourth.

17. When the rms velocity of a gas is denoted by 'v', which one of the following relations is true? ($T =$ Absolute temperature of the gas.)
MHT CET 2022 · 11 AUG · SHIFT 2
(a) $\frac{v}{T} = ^{v^2}$ constant (b) $v^2T =$ constant
(c) $vT^2 =$ constant (d) $\frac{v}{T^2} = ^{v}$ constant

18. The rms speed of a gas molecule is 'V' at pressure 'P'. If the pressure is increased by two times, then the rms speed of the gas molecule at the same temperature will be
MHT CET 2021 · 23 SEP · SHIFT 2
(a) V (b) $\sqrt{2}\,V$ (c) $\frac{V}{3}$ (d) $\frac{V}{2}$

19. If 'm' represents the mass of each molecules of a gas and 'T' its absolute temperature then the root mean square speed of the gas molecule is proportional to
MHT CET 2021 · 23 SEP · SHIFT 1
(a) $m^{-\frac{1}{2}}T^{\frac{1}{2}}$ (b) mT (c) $m^{\frac{1}{2}}T^{-\frac{1}{2}}$ (d) $m^{\frac{1}{2}}T^{\frac{1}{2}}$

20. An ideal gas having molar mass 'M_0', has r.m.s. velocity 'V' at temperature 'T'. Then
MHT CET 2021 · 22 SEP · SHIFT 2
(a) $VT^2 =$ constant
(b) $\frac{v}{T} = ^{v^2}$ constant
(c) $V^2T =$ constant
(d) V is independent of T

21. The temperature of a gas is $-50^{\circ}C$. To what temperature the gas should be heated so that the rms speed is increased by 3 times?
NEET 2023
(a) $3295^{\circ}C$ (b) $3097\ K$ (c) $223\ K$ (d) $669^{\circ}C$

22. Increase in tempertaure of a gas filled in a container would lead to:
NEET 2019
(a) increase in its kinetic energy
(b) decrease in intermolecular distance
(c) decrease in its pressure
(d) increase in its mass

23. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R
Assertion A: If the average kinetic energy of H_2 and O_2 molecules, kept in two different sized containers are same, then their temperatures will be same.
Reason R: The r.m.s speed of H_2 and O_2 molecules are same at same temperature. Choose the correct answer from the options given below
JEE MAIN 2026 · 4 APR · SHIFT 2
(a) Both **A** and **R** are true and **R** is the correct explanation of **A**
(b) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**
(c) A is true but **R** is false
(d) A is false but **R** is true

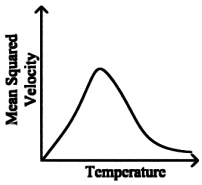
24. The ratio of vapour densities of two gases at the same temperature is $\frac{4}{25}$, then the ratio of r.m.s. velocities will be:
JEE MAIN 2025 · 28 JAN · SHIFT 2
(a) $\frac{5}{2}$ (b) $\frac{25}{4}$ (c) $\frac{4}{25}$ (d) $\frac{2}{5}$

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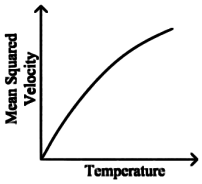
25. For a particular ideal gas which of the following graphs represents the variation of mean squared velocity of the gas molecules with temperature?

JEE MAIN 2025 · 28 JAN · SHIFT 1

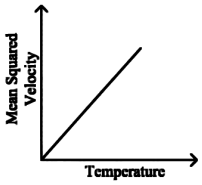
(a)



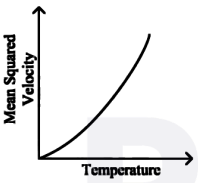
(b)



(c)



(d)



26. A sample contains mixture of helium and oxygen gas. The ratio of root mean square speed of helium and oxygen in the sample, is:

JEE MAIN 2024 · 6 APR · SHIFT 1

(a) $\frac{1}{2\sqrt{2}}$ (b) $\frac{1}{4}$ (c) $\frac{2\sqrt{2}}{1}$ (d) $\frac{1}{32}$

27. If the root mean square velocity of hydrogen molecule at a given temperature and pressure is $2\ \mathrm{km/s}$, the root mean square velocity of oxygen at the same condition in $\mathrm{km/s}$ is:

JEE MAIN 2024 · 1 FEB · SHIFT 2

(a) 1.0 (b) 1.5 (c) 2.0 (d) 0.5

28. The parameter that remains the same for molecules of all gases at a given temperature is:

JEE MAIN 2024 · 31 JAN · SHIFT 1

(a) kinetic energy (b) mass
(c) momentum (d) speed

29. At which temperature is the r.m.s. velocity of a hydrogen molecule equal to that of an oxygen molecule at $47^\circ\mathrm{C}$?

JEE MAIN 2024 · 30 JAN · SHIFT 1

(a) 20 K (b) 80 K (c) 4 K (d) -73 K

30. The temperature of an ideal gas is increased from 200 K to 800 K. If r.m.s. speed of gas at 200 K is v_0. Then, r.m.s. speed of the gas at 800 K will be:

JEE MAIN 2023 · 6 APR · SHIFT 2

(a) v_0 (b) $2v_0$ (c) $4v_0$ (d) $\frac{v_0}{4}$

31. The root mean square velocity of molecules of gas is

JEE MAIN 2023 · 25 JAN · SHIFT 1

(a) Proportional to temperature (T)
(b) Inversely proportional to square root of temperature $\left(\sqrt{\frac{1}{T}}\right)$
(c) Proportional to square of temperature (T^2)
(d) Proportional to square root of temperature ($\sqrt{T}$)

32. If the r.m.s speed of oxygen at room temperature is $\sqrt{56}\ \mathrm{m/s}$. The r.m.s speed of nitrogen at the same temperature is _____.

JEE MAIN 2022 · 30 JUL · SHIFT 2

(a) $8\sqrt{2}\ \mathrm{m/s}$ (b) $8\ \mathrm{m/s}$
(c) $16\ \mathrm{m/s}$ (d) $7\ \mathrm{m/s}$

33. Following statements are given:

(A) The average kinetic energy of a gas molecule decreases when the temperature is reduced. (B) The average kinetic energy of a gas molecule increases with increase in pressure at constant temperature.

(C) The average kinetic energy of a gas molecule decreases with increase in volume. (D) Pressure of a gas increases with increase in temperature at constant pressure. (E) The volume of gas decreases with increase in temperature.

Choose the correct answer from the options given below:

JEE MAIN 2022 · 25 JUL · SHIFT 1

(a) (A) and (D) only (b) (A), (B) and (D) only
(c) (B) and (D) only (d) (A), (B) and (E) only

34. if the rms speed of oxygen molecules at 0°C is 160 m/s, find the rms speed of hydrogen molecules at 0°C.

JEE MAIN 2021 · 27 AUG · SHIFT 2

(a) 640 m/s (b) 40 m/s (c) 80 m/s (d) 332 m/s

35. The rms speeds of the molecules of Hydrogen, Oxygen and Carbon dioxide at the same temperature are VH, VO and VC respectively then:

JEE MAIN 2021 · 26 AUG · SHIFT 1

(a) VH > VO > VC (b) VC > VO > VH
(c) VH = VO > VC (d) VH = VO = VC

36. Consider a mixture of gas molecule of types A, B and C having masses mA < mB < mC. The ratio of their root mean square speeds at normal temperature and pressure is:

JEE MAIN 2021 · 20 JUL · SHIFT 1

(a) $v_A = v_B \neq v_C$ (b) $\frac{1}{v_A} > \frac{1}{v_B} > \frac{1}{v_C}$
(c) $\frac{1}{v_A} < \frac{1}{v_B} < \frac{1}{v_C}$ (d) $v_A = v_B = v_C = 0$

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37. A mixture of 2 moles of helium gas (atomic mass = 4 u), and 1 mole of argon gas (atomic mass = 40 u) is kept at 300 K in a container. The ratio of their rms speeds $\left[\frac{V_{rms}\,(helium)}{V_{rms}\,(\arg on)}\right]$, is close to:

JEE MAIN 2019 · 9 JAN · SHIFT 1

(a) 3.16 (b) 0.32 (c) 0.45 (d) 2.24

38. The value closest to the thermal velocity of a Helium atom at room temperature (300 K) in ms-1 is: [kB =1.4 × 10-23 J/K; mHe = 7 × 10 -27 kg]

JEE MAIN 2018 · 15 APR · SHIFT 2

(a) 1.3 × 104 (b) 1.3 × 103
(c) 1.3 × 105 (d) 1.3 × 102

39. At room temperature a diatomic gas is found to have an r.m.s. speed of 1930 ms¯1. The gas is:

JEE MAIN 2014 · 12 APR · SHIFT 1

(a) H2 (b) Cl2 (c) O2 (d) F2

40. Cooking gas containers are kept in a lorry moving with uniform speed. The temperature of the gas molecules inside will

AIEEE 2002

(a) increase
(b) decrease
(c) remain same
(d) decrease for some, while increase for others

41. At what temperature is the $r.m.s$ velocity of a hydrogen molecule equal to that of an oxygen molecule at $47^{\circ}C$?

AIEEE 2002

(a) $80K$ (b) $-73\ K$ (c) $3\ K$ (d) $20\ K$

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ANSWER KEY

Shaded by level: **Easy**

02 Molecular Speeds & Maxwell Distribution

1. (b)	2. (a)	3. (d)	4. (b)	5. (a)	6. (c)	7. (c)	8. (b)	9. (b)	10. (b)
11. (d)	12. (a)	13. (a)	14. (c)	15. (b)	16. (a)	17. (a)	18. (a)	19. (a)	20. (b)
21. (a)	22. (a)	23. (c)	24. (a)	25. (c)	26. (c)	27. (d)	28. (a)	29. (a)	30. (b)
31. (d)	32. (b)	33. Scan QR	34. (a)	35. (a)	36. (c)	37. (a)	38. (b)	39. (a)	40. (c)
41. (d)									

Note: *"Bonus" = no option is correct as the question is printed (dropped in the official key). Numerical questions show the numerical answer.*

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KINETIC THEORY OF GASES · TOPIC 03

Law of Equipartition of Energy

LEVEL 1 · EASY

Topic-wise Previous Year Questions

MHT CET · NEET · JEE Main

3	1	1
questions	concepts	easy

CONTENTS

03	Law of Equipartition of Energy	Q 1–3	3 Qs
	Level 1 · Easy		3 Qs
	◆ **Law of equipartition of energy**		3 Qs
	Answer key		

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TOPIC 03

Law of Equipartition of Energy

3 PYQs · Easy 3 · Medium 0 · Difficult 0 | MHT CET 0 · NEET 1 · JEE 2

Concepts covered: Law of equipartition of energy (3)

LEVEL 1 · EASY 3 questions

1. A polyatomic gas with n degrees of freedom has a mean energy per molecule given by

AIPMT 1989

(a) $\frac{nkT}{N}$ (b) $\frac{nkT}{2N}$ (c) $\frac{nkT}{2}$ (d) $\frac{3kT}{2}$

2. What will be the average value of energy for a monoatomic gas in thermal equilibrium at temperature T?

JEE MAIN 2021 · 22 JUL · SHIFT 2

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

3. What will be the average value of energy along one degree of freedom for an ideal gas in thermal equilibrium at a temperature T? (kB is Boltzmann constant)

JEE MAIN 2021 · 18 MAR · SHIFT 1

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

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ANSWER KEY

Shaded by level: **Easy**

03 Law of Equipartition of Energy

1. (c)	2. (a)	3. (a)							

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KINETIC THEORY OF GASES · TOPIC 04

Mean Free Path & Real Gases

LEVEL 1 · EASY

Topic-wise Previous Year Questions

MHT CET · NEET · JEE Main

9	2	1
questions	concepts	easy

CONTENTS

04	Mean Free Path & Real Gases	Q 1–9	9 Qs
	Level 1 · Easy		9 Qs
	◆ **Mean free path & collisions**		8 Qs
	◆ **Real gases & van der Waals**		1 Qs
	Answer key		

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TOPIC 04

Mean Free Path & Real Gases

9 PYQs · Easy 9 · Medium 0 · Difficult 0 | MHT CET 2 · NEET 4 · JEE 3

Concepts covered: Mean free path & collisions (8) · Real gases & van der Waals (1)

LEVEL 1 · EASY 9 questions

◆ Mean free path & collisions 8 Qs

1. According to kinetic theory of gases, which one of the following statements is wrong?

MHT CET 2023 · 9 MAY · SHIFT 1

(a) All the molecules of a gas are identical.
(b) Collisions between the molecules of a gas and that of the molecules with the walls of the container are perfectly elastic.
(c) The molecules do not exert appreciable force on one another except during collision.
(d) The pressure exerted by a gas is due to the collision between the molecules of the gas.

2. The mean free path ℓ for a gas molecule depends upon diameter, d of the molecule as

NEET 2020 · PHASE 2

(a) $\ell \propto \frac{1}{d}$ (b) $\ell \propto \frac{1}{d^2}$ (c) $\ell \propto d$ (d) $\ell \propto d^2$

3. The mean free path for a gas, with molecular diameter d and number density n can be expressed as:

NEET 2020 · PHASE 1

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

4. The mean free path of molecules of a gas, (radius r) is inversely proportional to

AIPMT 2014

(a) r3 (b) r2 (c) r (d) $\sqrt{r}$

5. At constant volume temperature is increased then

AIPMT 1989

(a) collision on walls will be less
(b) number of collisions per unit time will increase
(c) collisions will be in straight lines
(d) collisions will not change

6. The mean free path and the average speed of oxygen molecules at 300 K and 1 atm are 3×10^{-7} m and 600 m/s, respectively. Find the frequency of its collisions.

JEE MAIN 2025 · 4 APR · SHIFT 1

(a) 5×10^8/s (b) 9×10^5/s
(c) 2×10^{10}/s (d) 2×10^9/s

7. Given below are two statements:

Statement (I): The mean free path of gas molecules is inversely proportional to square of molecular diameter.

Statement (II): Average kinetic energy of gas molecules is directly proportional to absolute temperature of gas.

In the light of the above statements, choose the correct answer from the options given below:

JEE MAIN 2024 · 8 APR · SHIFT 2

(a) Statement I is false but Statement II is true
(b) Both Statement I and Statement II are true
(c) Statement I is true but Statement II is false
(d) Both Statement I and Statement II are false

8. If n is the number density and d is the diameter of the molecule, then the average distance covered by a molecule between two successive collisions (i.e. mean free path) is represented by:

JEE MAIN 2024 · 5 APR · SHIFT 2

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

◆ Real gases & van der Waals 1 Q

9. A real gas behaves as an ideal gas at

MHT CET 2024 · 4 MAY · SHIFT 2

(a) low pressure and low temperature.
(b) low pressure and high temperature.
(c) high pressure and low temperature.
(d) high pressure and high temperature.

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ANSWER KEY

Shaded by level: **Easy**

04 Mean Free Path & Real Gases

1. (d)	2. (b)	3. (a)	4. (b)	5. (b)	6. (d)	7. (b)	8. (a)	9. (b)	

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