TEST

JEE Mains PYQs Kinetic Theory (Physics Master Academy)

QUESTIONS

SECTIONS

1. Section A - 25 Questions

Section 1 : Section A - 25 Questions

SECTION INSTRUCTIONS

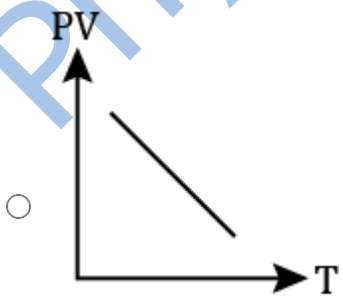
This section contains 25 MCQs. +4 for every correct answer, -1 for every incorrect answer.

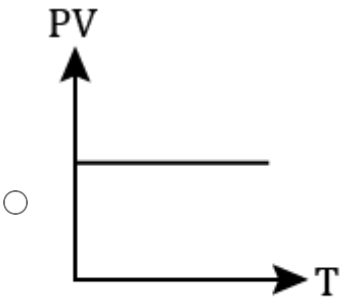
1 For an ideal gas the instantaneous change in pressure 'p' with volume 'v' is given by the equation $\frac{dp}{dv} = -ap$. If p = p0at v = 0 is the given boundary condition, then the maximum temperature one mole of gas can attain is (here h is gas constant)

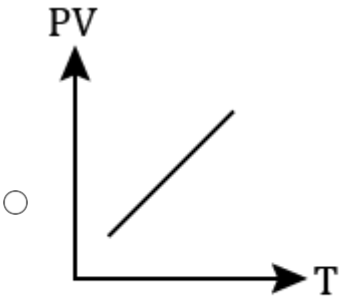
- $\frac{p_0}{aeR}$
- $\frac{ap_0}{eR}$
- inknity
- 0°C

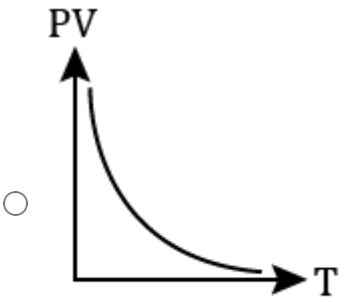
Correct: +4 · Incorrect: -1

2 Which of the following graphs represent the behavior of an ideal gas? Symbols have their usual meaning.









Correct: +4 · Incorrect: -1

3 Initially a gas of diatomic molecules is contained in a cylinder of volume V_1 at pressure P_1 and temperature 250K. Assuming that 25% of the molecules get dissociated causing a change in number of moles. The pressure of the resulting gas at temperature 2000K, when contained in a volume $2V_1$ is given by P_2. The ratio P_2/P_1 is ___

- 2
- 3
- 4
- 5

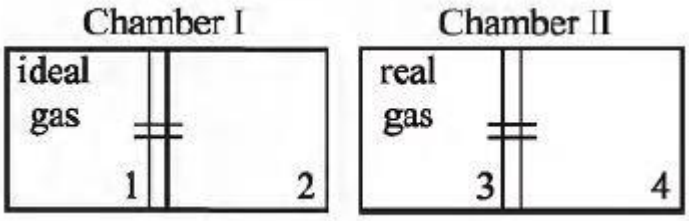
Correct: +4 · Incorrect: -1

4 The number density of molecules of a gas depends on their distance r from the origin as $n(r) = n_0 e^{-\alpha r^4}$. Then the total number of molecule is proportional to

- $n_0 \alpha^{-3/4}$
- $\sqrt{n_0}\,\alpha^{1/24}$
- $n_0 \alpha^{1/4}$
- $n_0 \alpha^{-3}$

Correct: +4 · Incorrect: -1

5 There are two identical chambers completely thermally insulated from surroundings. Both chambers have a position wall dividing the chambers in two compartments. Compartment 1 is klled with an ideal gas and compartment 3 is klled with a real gas. Compartments 2 and 4 are vacuum. A small hole (orikce) is made in the partition walls and the gases are allowed to expand in vacuum.



Statement 1: No change in the temperature of the gas takes place when ideal gas expands in vacuum. However, the temperature of real gas goes down (cooling) when it expands in vacuum.
Statement 2: The internal energy of an ideal gas is only kinetic. The internal energy of a real gas is kinetic as well as potential.

- Statement 1 is false and Statement is true
- Statement 1 and statement 2 both are true. Statement 2 is the correct explanation of statement 1
- Statement 1 is true and Statement is false
- Statement 1 and statement 2 both are true. Statement 2 is not the correct explanation of statement 1

Correct: +4 · Incorrect: -1

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

- increase
- decrease
- remain same
- decrease for some, while increase for some

Correct: +4 · Incorrect: -1

7 The rms speeds of the molecules of Hydrogen, Oxygen and Carbon dioxide at the same temperature are V_H, V_O and V_C respectively , then

- $V_H > V_O > V_C$
- $V_C > V_O > V_H$
- $V_H = V_O > V_C$
- $V_H = V_O = V_C$

Correct: +4 · Incorrect: -1

8 Number of molecules in a volume of $4cm^3$ of a perfect monoatomic gas at some temperature T and at a pressure of 2cm of mercury is close to?(Given mean kinetic energy of a molecule (at T) is 4×10^{-4} erg, g = 980 cm/s^2, density of mercury = $13.6g/cm^3$)

- 4.0×10^{18}
- 4.0×10^{16}
- 5.8×10^{16}
- 5.8×10^{18}

Correct: +4 · Incorrect: -1

9 For a given gas at 1atm pressure rams speed of the molecules is 200 m/s at 127°C. At 2 atm pressure and a 227°C the rms speed of the molecules will be

- 100 m/s
- $80\sqrt{5}$ m/s
- $100\sqrt{5}$ m/s
- 80m/s

Correct: +4 · Incorrect: -1

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

- $\frac{2}{3}k_BT$
- k_BT

- $\frac{3}{2}k_BT$
- $\frac{1}{2}k_BT$

Correct: +4 · Incorrect: -1

11 Two ideal polyatomic gases at temperature T_1 and T_2 are mixed so that there is no loss of energy. If F_1 and F_2, m_1 and m_2, n_1 and n_2 be the degrees of freedom, masses, number of molecules of the krst and second gas respectively, the temperature of mixture of these two gases is

- $\frac{n_1F_1T_1+n_2F_2T_2}{F_1+F_2}$
- $\frac{n_1T_1+n_2T_2}{n_1+n_2}$
- $\frac{n_1F_1T_1+n_2F_2T_2}{n_1+n_2}$
- $\frac{n_1F_1T_1+n_2F_2T_2}{n_1F_1+n_2F_2}$

Correct: +4 · Incorrect: -1

12 Calculate the value of mean free path (λ) for oxygen molecules at temperature 27°C and pressure 1.01×10^5Pa. Assume the molecular diameter 0.3nm and the gas is ideal. ($k = 1.38\times10^{-23}$ JK^{-1})

- 86nm
- 32nm
- 58nm
- 102nm

Correct: +4 · Incorrect: -1

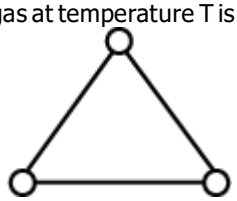
13 Molecules of an ideal gas are known to have three translational degrees of freedom and two rotational degrees of freedom. The gas is maintained at a temperature of T. The total internal energy, U of a mole of the gas, and the value of $\gamma\left(¿\frac{C_p}{C_v}\right)$ are given, respectively by

- $U=\frac{5}{2}RT\wedge\gamma=\frac{6}{5}$

- ○ $U=5RT \wedge \gamma=\frac{7}{5}$
- ○ $U=\frac{5}{2}RT \wedge \gamma=\frac{7}{5}$
- ○ $U=5RT \wedge \gamma=\frac{6}{5}$

Correct: +4 · Incorrect: -1

14 Consider a gas triatomic molecules. The molecules are assumed to be triangular and made of massless rigid rods whose vertices are occupied by atoms. The internal energy of a mole of the gas at temperature T is



- ○ 5/2 RT
- ○ 3/2 RT
- ○ 9/2 RT
- ○ 3RT

Correct: +4 · Incorrect: -1

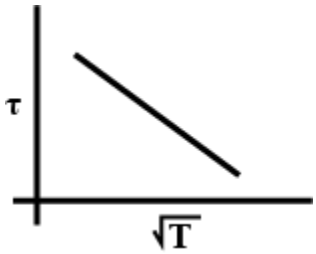
15 A gas mixture consists 3 moles fop oxygen and 5 moles of argon at temperature T. Assuming the gases to be ideal and the oxygen bond to be rigid, the total internal energy (in units of RT) of the mixture is

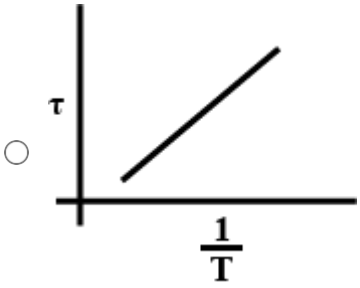
- ○ 15
- ○ 13
- ○ 20
- ○ 11

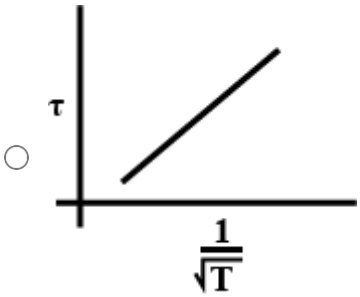
Correct: +4 · Incorrect: -1

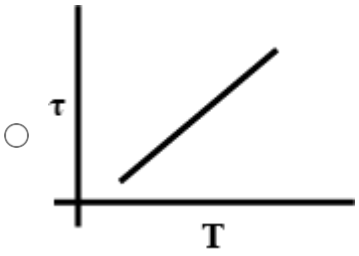
16 The plot that depicts the behavior of the mean free time τ (time between two successive collisions) for the molecules of an ideal gas, as a function of temperature (T), qualitatively, is (Graphs are schematic and not drawn to scale)

- ○









Correct: +4 · Incorrect: -1

17 Two moles of helium gas is mixed with three moles of hydrogen molecules (taken to be rigid). What is the molar specikc heat of mixture at constant volume? (R = 8.3 J/mol K)

- 19.7 J/mol L
- 15.7 J/mol K
- 17.4 J/mol K
- 21.6 J/mol K

Correct: +4 · Incorrect: -1

18 A diatomic gas with rigid molecules does 10J of work when expanded at constant pressure. What should be the heat energy absorbed by the gas, in this process?

- 25J
- 35J
- 30J
- 40J

Correct: +4 · Incorrect: -1

19 When heat Q is supplied to a diatomic gas of rigid molecules, at constant volume its temperature increases by ΔT. The heat required to produce the same change in temperature, at a constant pressure is

- 2/3 Q
- 5/3 Q
- 7/5 Q
- 3/2 Q

Correct: +4 · Incorrect: -1

20 An HCl molecule has rotational, translational and vibrational motions. If the rms velocity of HCl molecules in its gaseous phase is $\acute{v}$, m is its mass and k_B is Boltzmann constant, then its temperature will be

- $\frac{m\acute{v}^2}{6k_B}$
- $\frac{m\acute{v}^2}{3k_B}$
- $\frac{m\acute{v}^2}{7k_B}$
- $\frac{m\acute{v}^2}{5k_B}$

Correct: +4 · Incorrect: -1

21 The specikc heats, C_P and V_V of a gas of diatomic molecules, A, are given (in units of J $mol^{-1}K^{-1}$) by 29 and 22, respectively. Another gas of diatomic molecules, B, has the corresponding values 30 and 21. If they are treated as ideal gases

- A is rigid but B has a vibrational mode
- A has a vibrational mode but B has none

- A has one vibrational mode and B has two
- Both A and B have a vibrational mode each

Correct: +4 · Incorrect: -1

22 An ideal gas is enclosed in a cylinder at pressure of 2atm and temperature 300K. The mean time between two successive collisions is 6×10^{-8} s. If the pressure is doubled and temperature is increased to 500K, the mean time between two successive collisions will be close to

- 2×10^{-7}s
- 4×10^{-8}s
- 0.5×10^{-8}s
- 3×10^{-6}s

Correct: +4 · Incorrect: -1

23 A gas mixture consists of 3 moles of oxygen and 5 moles of argon at temperature T. Considering only translational and rotational modes, the total internal energy of the system is

- 15RT
- 12RT
- 4RT
- 20RT

Correct: +4 · Incorrect: -1

24 Two kg of a monoatomic gas is at a pressure of 4×10^4 N/m^2. The density of the gas is 8 kg/m^2. What is the order of energy of the gas due to its thermal motion?

- 10^3J
- 10^5J
- 10^4J
- 10^6J

Correct: +4 · Incorrect: -1

25 An ideal gas have molecules with 5 degrees of freedom. The ratio of specikc heats at constant pressure (C_P) and at constant volume (C_v) is

- ○ 6
- ○ 7/2
- ○ 5/2
- ○ 7/5

Correct: +4 · Incorrect: -1

TEST

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ANSWERS

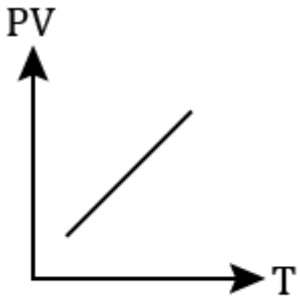
SECTIONS

1. Section A - 25 Questions

Section 1 : Section A - 25 Questions

1 $\frac{p_0}{a\,e\,R}$

2



3 5

4 $n_0 \alpha^{-3/4}$

5 Statement 1 is false and Statement is true

6 remain same

7 $V_H > V_O > V_C$

8 4.0×10^{18}

9 $100\sqrt{5}$ m/s

10 $\frac{3}{2}k_BT$

11 $\frac{n_1F_1T_1+n_2F_2T_2}{n_1F_1+n_2F_2}$

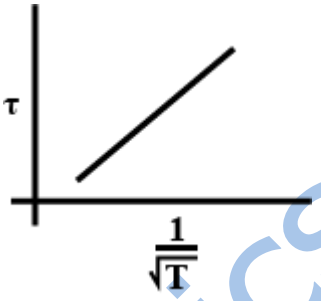
12 102nm

13 $U=\frac{5}{2}RT \wedge \gamma=\frac{7}{5}$

14 3RT

15 15

16



17 17.4 J/mol K

18 35J

19 7/5 Q

20 $\frac{m\acute{v}^2}{6k_B}$

21 A has a vibrational mode but B has none

22 4×10^{-8}s

23 15RT

24 10^{4}J

25 7/5