Lakshya
Forum for Competitions

PHYSICS

Topic Test

Topic: 3. Kinetic Theory of Gases and Radiation **Std: XII**
Time : 1 Hour **Total Marks: 25**

SECTION A

Q.1. Select and write the correct answer: **[04]**

i. The ratio of emissive power of perfectly blackbody at 727 °C and 227 °C is
(A) 4:1 (B) 16 : 1 (C) 2 : 1 (D) 8 : 1

ii. Increase in temperature of a gas filled in a container would lead to:
(A) decrease in its pressure (B) decrease in intermolecular distance
(C) increase in its mass (D) increase in its kinetic energy

iii. According to the law of equipartition of energy, the average kinetic energy of one molecule of monatomic gas will be
(A) $3k_BT/2$ (B) $5k_BT/2$ (C) $3RT/2$ (D) $5RT/2$

iv. Let n be the number of molecules per unit volume and d is the diameter of the molecules. The mean free path λ of molecules is given by
(A) $\sqrt{\frac{2}{\pi nd^2}}$ (B) $\frac{1}{\pi nd^2}$ (C) $\frac{1}{\sqrt{2}\pi nd^2}$ (D) $\frac{1}{\sqrt{2\pi nd}}$

Q.2. Answer the following: **[03]**

i. Write ideal gas equation for a mass of 8 g of oxygen gas.
ii. What will happen to the mean square speed of the molecules of a gas if the temperature of the gas decreases?
iii. Calculate the adiabatic ratio for a polyatomic gas having 2 vibrational degrees of freedom.

SECTION B (Attempt any Four) [08]

Q.3. A gas in a cylinder is at pressure 20 atm. If the masses of all the molecules are made one forth of their original value and their speeds are tripled, then find the resultant pressure.
Q.4. How does rms velocity of a gas molecule vary according to its absolute temperature? Derive the relation.
Q.5. Calculate molar specific heat of di-atomic gases at constant volume and constant pressure using law of equipartition of energy.
Q.6. What is a perfect blackbody? How can it be realized in practice?
Q.7. Explain spectral distribution of blackbody radiation.
Q.8. For a perfectly blackbody at temperature of 5794 K, in which region of electromagnetic spectrum does its maximum λ_{max} lie? ($b = 2.897 \times 10^{-3}$ mK)

SECTION C (Attempt any Two) [06]

Q.9. Obtain the mean free path of a gas molecule at 27 °C and 1.0 atm pressure. The molecular diameter is 300 pm (assume that the gas is ideal).
Q.10. State Stefan-Boltzmann law. Using Stefan's law, obtain the expression for the rate of loss of heat by a blackbody in cooler surroundings. How is this expression modified, if the body is not black?
Q.11. State and explain law of equipartition of energy. Define degrees of freedom.

SECTION D (Attempt any One) [04]

Q.12. i. On which factors does amount of heat radiated by a body depend?
ii. Calculate the energy radiated in one minute by a blackbody of surface area 100 cm^2 when it is maintained at 527 °C.
Q.13. With a neat labelled diagram, explain Ferry's perfectly blackbody.