CBSE

KINETIC THEORY WS 4

Class 11 - Physics

Section A

1. Law of equipartition of energy is used to **[1]**

   a) predict the specific heats of gases

   b) predict the specific heats of gases and solids

   c) predict the specific heats of waves

   d) predict the specific heats of solids

2. Diatomic molecule (rigid rotator) has **[1]**

   a) 3 translational degrees of freedom

   b) All of these

   c) Both 3 translational degrees of freedom & 2 rotational degrees of freedom

   d) 2 rotational degrees of freedom

3. The total energy for one mole of solid is **[1]**

   a) $\frac{3}{2}$ RT

   b) 3 RT

   c) 2 RT

   d) 4 RT

4. The mean kinetic energy of one mole of gas per degree of freedom (on the basis of kinetic theory of gases) is **[1]**

   a) $\frac{1}{2}RT$

   b) $\frac{3}{2}RT$

   c) $\frac{1}{2}kT$

   d) $\frac{3}{2}kT$

5. The two gases with the ratio 3 : 2 of their masses in a container are at a temperature T. The ratio of the kinetic energies of the molecule of two gases is **[1]**

   a) 3 : 2

   b) 9 : 4

   c) 1 : 1

   d) 4 : 9

6. The average energy associated with each translational degree of freedom is **[1]**

   a) $\frac{3}{2}k_BT$

   b) $2k_BT$

   c) $\frac{1}{2}k_BT$

   d) k_BT

7. According to Atomic Hypothesis: little particles of atom **[1]**

   a) repel each other when they are at small distance apart, but repel upon being squeezed into one another

   b) attract each other when they are at small distance apart, but repel upon being squeezed into one another

   c) repel each other when they are at small distance apart, but attract upon being squeezed into one another

   d) repel each other when they are at large distance apart, but attract upon being separated from one another

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

   a) $\frac{nkT}{2N}$

   b) $\frac{nkT}{2}$

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

9. One mole of hydrogen gas is heated at constant pressure from 300 K to 420 K. Calculate the energy transferred by heat to the gas **[1]**

a) 3.49 kJ b) 3.66 kJ

c) 3.86 kJ d) 3.26 kJ

10. **Fill in the blanks:** **[1]**

(a) The total number of independent ways in which the particles of the system can absorb energy is called _____ of the system. **[1]**

11. Does the average K.E. per molecule of the gas depend upon the mass of the molecule? **[1]**

12. How is the average K.E. of a gas molecule related to the temperature of the gas? **[1]**

13. State the law of equi-partition of energy. **[1]**

14. State the law of equipartition of energy of a dynamic system. **[1]**

15. Fill in the blank: The average energy associated with each degree of freedom per molecule at absolute temperature T is _____. **[1]**

Section B

16. State the law of equipartition of energy. Determine the values of γ for diatomic gas N_2 at moderate temperature. **[2]**

17. How many degrees of freedom are associated with 2 g of He at N.T.P.? Calculate the amount of heat energy required to raise the temperature of this amount from 27°C to 127°C. Given Boltzmann's constant = 1.38×10^{-16} erg molecule^{-1} K^{-1} and Avogadro's number = 6.02×10^{23}. **[2]**

18. A balloon has 5.0 g mole of helium at 7°C. Calculate **[2]**

a. the number of atoms of helium in the balloon,

b. the total internal energy of the system.

19. Show that pressure exerted by a gas is $\frac{2}{3}$rd of the kinetic energy of gas molecules per unit volume. **[2]**

20. What is basic law followed by equipartition of energy? **[2]**

21. Calculate the kinetic energy per molecule and also r.m.s. velocity of a gas at 127° C. **[2]**

Given $k_B = 1.38 \times 10^{-23}$ J molecule^{-1} K^{-1} and mass per molecule of the gas = 6.4×10^{-27} kg.

Section C

22. From a certain apparatus, the diffusion rate of hydrogen has an average value of 28.7 cm^3 s^{-1}. The diffusion of another gas under the same conditions is measured to have an average rate of 7.2 cm^{3}s^{-1}. Identify the gas.[**Hint:** Use Graham's law of diffusion: $R_1/R_2 = (M_2/M_1)^{1/2}$, where R_1, R_2 are diffusion rates of gases 1 and 2, and M_1 and M_2 their respective molecular masses. The law is a simple consequence of kinetic theory.] **[3]**

23. State and establish the law of equipartition of energy. **[3]**

24. Deduce Grahm's law of diffusion from kinetic theory of gases using expression for pressure. **[3]**

25. i. Define Absolute zero. **[3]**

ii. Deduce the dimensional formula for R, using ideal gas equation

PV = nRT.

iii. Find the degree of freedom of a monoatomic gas.

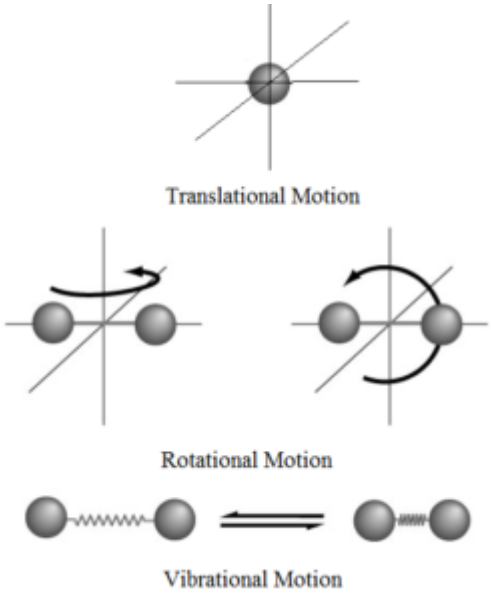
26. State the law of equipartition of energy and using this find the relation for the total internal energy of a mole of monoatomic gases. **[3]**

27. On the basis of equipartition law of energy obtain an expression for specific heat capacity of a solid. **[3]**

Section D

Question No. 28 to 32 are based on the given text. Read the text carefully and answer the questions: **[5]**

The number of independent ways by which a dynamic system can move, without violating any constraint imposed on it, is called the number of **degrees of freedom**. According to the law of equipartition of energy, for any dynamic system in thermal equilibrium, the total energy for the system is equally divided among the degree of freedom.



28. If gas has n degree of freedom, the ratio of specific heat is:

a) -2n
b) 2n
c) 1 + 2/n
d) 1 - 2/n

29. The kinetic energy, due to translational motion, of most of the molecules of an ideal gas at absolute temperature T, is:

a) kT^3
b) kT^2
c) kT
d) k/T

30. The mean free path is the:

a) length of the container that contains the gas
b) mean of the square of the average distance between two successive collisions
c) the average distance covered by a molecule between two successive collisions
d) height of the container that contains the gas

31. The law of equipartition of energy is applicable to the system whose constituents are:

a) in non random motion
b) in random motion
c) in orderly motion
d) in rest

32. Thermochemical calorie is equal to

a) 41.48 joule
b) 4.148 joule
c) 4148 joule
d) 414.8 joule

33. State the law of equipartition energy of a dynamic system and use it to find the values of internal energy and the ratio of the specific heats of (a) monoatomic, (b) diatomic and (c) triatomic gas molecules. **[5]**