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KINETIC THEORY OF GASES

Class 11 - Physics

Time Allowed: 1 hour and 30 minutes **Maximum Marks: 45**

1. Why do the gases at low temperature and high pressure show large deviations from ideal behaviour? **[1]**
2. Calculate the temperature at which rms velocity of SO_2 is the same as that of oxygen at 27°C. **[1]**
3. What is an ideal gas? Give its main characteristics. **[1]**
4. Two gases, each at temperature T, volume V and pressure P are mixed such that the temperature and volume of the mixture are T and V respectively. What would be the pressure of the mixture? Justify your answer on the basis of kinetic theory. **[1]**
5. The earth with out its atmosphere would be inhospitably cold. Explain. **[1]**
6. A gas mixture consists of molecules of types A, B and C with masses $m_A > m_B > m_C$ at constant temperature and pressure. Rank the three types of molecules in decreasing order of **[3]**
   a. average K.E
   b. rms speeds
7. A metre long narrow bore held horizontally (and closed at one end) contains a 76 cm long mercury thread, which traps a 15 cm column of air. What happens if the tube is held vertically with the open end at the bottom? **[3]**
8. State Avogadro's law and establish it from kinetic theory of gases. **[3]**
9. The container shown in the table has two chambers, separated by a partition, of volumes V_1 = 2.0L and V_2 = 3.0L. The chambers contain μ_1 = 4.0 and μ_2 = 5.0 moles of a gas at pressures p_1 = 1.00 atm and p_2 = 2.00 atm. Calculate the pressure after the partition is removed and the mixture attains equilibrium. **[3]**

V_1	V_2
$\mu_1 \cdot p_1$	$\mu_2 \cdot p_2$

10. Give a formula for mean free path of the molecules of a gas. Briefly explain, how its value is affected by **[3]**
    i. change in temperature and
    ii. change in pressure.
11. An oxygen cylinder of volume 30 litres has an initial gauge pressure of 15 atm and a temperature of 27 °C. After some oxygen is withdrawn from the cylinder, the gauge pressure drops to 11 atm and its temperature drops to 17 °C. Estimate the mass of oxygen taken out of the cylinder (R = 8.31 J mol^{-1} K^{-1}, molecular mass of O_2 = 32 u). **[5]**
12. Explain why **[5]**
    a. there is no atmosphere on moon.
    b. there is fall in temperature with increase in altitude.
13. Derive an expression for the pressure due to an ideal gas. **[5]**
14. **Assertion:** Air pressure in a car tyre increases during driving. **[1]**
    Reason: Absolute zero temperature is not zero energy temperature.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

15. **Assertion:** For an ideal gas at constant temperature, the product of the pressure and volume is a constant. **[1]**

Reason: The mean square velocity of the molecules is inversely proportional to mass.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

16. **Assertion (A):** Diatomic molecule has five degree of freedom. **[1]**

Reason (R): Total degree of freedom is addition of translatory motion and rotatory motion.

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.

17. **Assertion:** An undamped spring-mass system is the simplest free vibration system. **[1]**

Reason: It has three degrees of freedom.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

18. **Assertion:** A real gas behaves as an ideal gas at high temperature and low pressure. **[1]**

Reason: At low pressure and high temperature intermolecular forces vanish away and volume of gas molecules is negligible.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

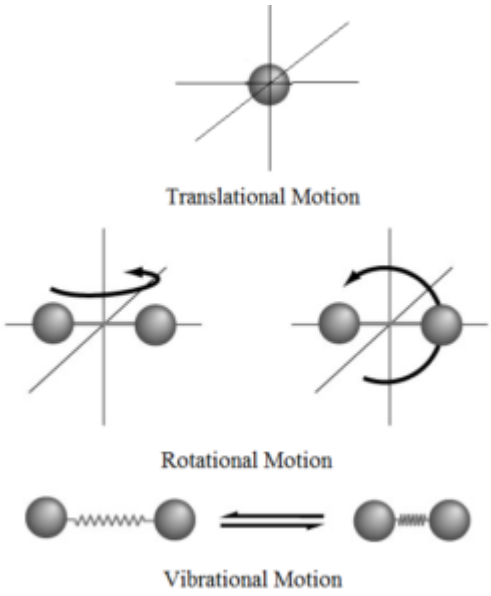
b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

Question No. 19 to 23 are based on the given text. Read the text carefully and answer the questions: **5.0**

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.



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

a) none of these
b) 2n
c) 1 + 2/n
d) 1 - 2/n

20. 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

21. 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) none of these

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

a) none of these
b) in random motion
c) in orderly motion
d) in rest

23. Thermochemical calorie is equal to

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

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