CBSE

KINETIC THEORY WS 2

Class 11 - Physics

Section A

1. According to the kinetic theory of gases, molecules of a gas behave like **[1]**

   a) inelastic spheres
   b) inelastic non-rigid spheres
   c) perfectly elastic rigid spheres
   d) perfectly elastic non-rigid spheres

2. Temperature remaining constant, the pressure of gas is decreased by 20%. The percentage change in volume **[1]**

   a) increases by 25%
   b) decreases by 25%
   c) decreases by 20%
   d) increases by 20%

3. Two gases A and B having same pressure P, volume V and temperature T are mixed. If mixture has volume and temperature as V and T respectively, then pressure of mixture is **[1]**

   a) 2P
   b) P
   c) 4P
   d) 3P

4. **Assertion (A):** Internal energy of an ideal gas does not depend upon volume of the gas. **[1]**
   Reason (R): Internal energy of ideal gas depends on temperature of gas.

   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.

5. **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.

6. **Assertion:** State variables (P, V and T) of any gas at low densities obey the equation PV = nRT. **[1]**
   Reason: Real gases are good approximation of an ideal gas at low density.

   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.

7. **Assertion (A):** State variables (P, V and T) of any gas at low densities obey the equation PV = nRT. **[1]**

Reason (R): Real gases are good approximation of an ideal gas at low density.

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.

8. **Assertion:** In the pressure-temperature (P-T) phase diagram of water, the slope of the melting curve is found to be negative. **[1]**

Reason: Ice contracts on melting to water.

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.

9. **Assertion:** Absolute zero temperature is not the temperature of zero energy. **[1]**

Reason: Only the translational kinetic energy of the molecules is represented by 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.

10. **Assertion:** All molecular motion ceases at - 273.15°C. **[1]**

Reason: Temperature 0 K cannot be attained.

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.

11. **Assertion:** If a gas container in motion is suddenly stopped, the temperature of the gas rises. **[1]**

Reason: In given process, the kinetic energy of ordered mechanical motion is converted into the kinetic energy of random motion of gas molecules.

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.

12. **Assertion:** The melting point of ice decreases with the increase of pressure. **[1]**

Reason: Ice contracts on melting.

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.

13. **Assertion:** Internal energy of real gas is always negative at absolute zero temperature. **[1]**

Reason: Potential energy of a bounded system is negative.

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

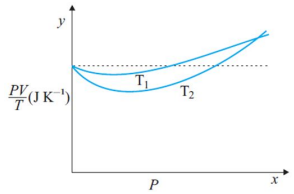
b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

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

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

14. The figure shows a plot of $\frac{PV}{T}$ versus P for 1.00×10^{-3} kg of oxygen gas at two different temperatures. **[1]**

Comparing T_1 and T_2.



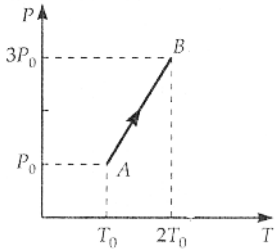
a) $T_1 < T_2$

b) $T_1 = T_2$

c) $T_1 > T_2$

d) $T_1 \geq T_2$

15. Pressure versus temperature graph of an ideal gas is as shown in figure. Density of the gas at point A is ρ_0. **[1]**



Density at point B will be

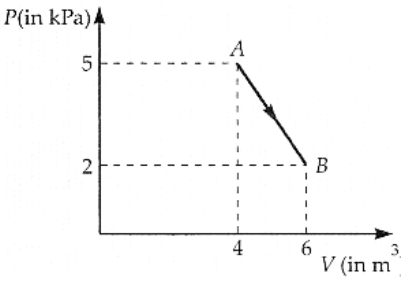
a) $2\rho_0$

b) $\frac{4}{3}\rho_0$

c) $\frac{3}{4}\rho_0$

d) $\frac{3}{2}\rho_0$

16. One mole of an ideal diatomic gas undergoes a transition from A to B along a path AB as shown in the figure. **[1]**



The change in internal energy of the gas during the transition is

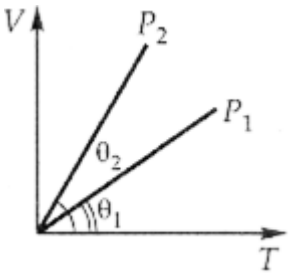
a) -12 kJ

b) 20 kJ

c) 20 J

d) -20 kJ

17. In the given (V - T) diagram, what is the relation between pressures P_1 and P_2? **[1]**



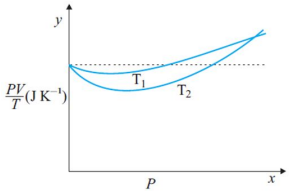
a) $P_2 = P_1$

b) Cannot be predicted

c) $P_2 > P_1$

d) $P_2 < P_1$

18. The figure shows a plot of $\frac{PV}{T}$ versus P for 1.00×10^{-3} kg of oxygen gas at two different temperatures. What is the value of $\frac{PV}{T}$ where the curves meet on the y-axis? **[1]**



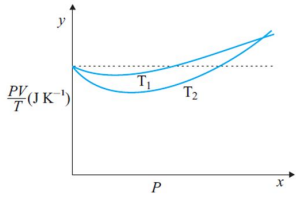
a) 0.28 JK^{-1}

b) 0.22 JK^{-1}

c) 0.24 JK^{-1}

d) 0.26 $J\ K^{-1}$

19. The figure shows a plot of $\frac{PV}{T}$ versus P for 1.00×10^{-3} kg of oxygen gas at two different temperatures. The dotted plot corresponds to **[1]**



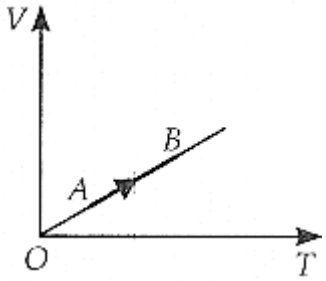
a) 'ideal' gas behavior

b) 'super cooled' gas behavior

c) 'real' gas behavior

d) 'super heated' gas behavior

20. The volume (V) of a monoatomic gas varies with its temperature (T), as shown in the graph. The ratio of work done by the gas, to the heat absorbed by it, when it undergoes a change from state A to state B, is **[1]**



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

b) $\frac{2}{7}$

c) $\frac{2}{5}$

d) $\frac{1}{3}$

21. Two gases of equal masses are in thermal equilibrium. If P_a, P_b and V_a, V_b are their respective pressures and volumes, then which relation is true? **[1]**

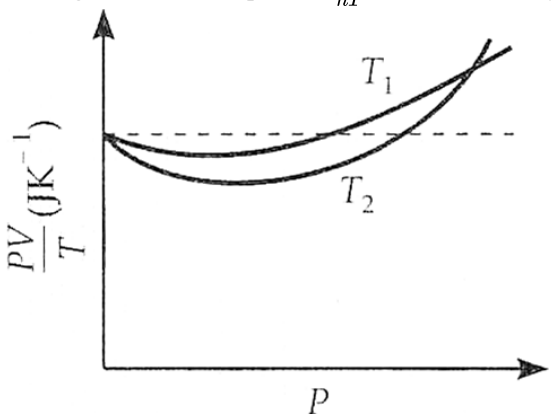
a) $P_aV_a = P_bV_b$

b) $2P_aV_a = P_bV_b$

c) $P_a \neq P_b$, $V_a = V_b$

d) $\frac{P_a}{V_a} = \frac{P_b}{V_b}$

22. The figure shows the plot of $\frac{PV}{nT}$ versus P for oxygen gas at two different temperatures. **[1]**



Read the following statements concerning the above curves:

i. The dotted line corresponds to ideal gas behaviour.

ii. $T_1 > T_2$

iii. The value of $\frac{PV}{nT}$ at the point, where the curves meet on the Y-axis is the same for all gases.

Which of the above statements is true?

a) (ii) only

b) all the these

c) (i) only

d) (i) and (ii) only

Section B

23. A gas mixture consists of 2.0 moles of oxygen and 4.0 moles of neon at temperature *T*. Neglecting all vibrational modes, calculate the total internal energy of the system. (Oxygen has two rotational modes.) **[2]**

24. A vessel contains a mixture of 1 mole of oxygen and 2 moles of nitrogen at 300 K. Find the ratio of average rotational kinetic energy per oxygen molecule to per nitrogen molecule. **[2]**

25. At very low pressure and high temperature, the real gas behaves like ideal gas. Why? **[2]**

26. When do the real gases obey more correctly the gas equation : PV = nRT? **[2]**

27. Two thermally insulated vessels 1 and 2 are filled with air at temperatures (T_1, T_2), volumes (V_1, V_2)and pressures (P_1, P_2) respectively. If the valve joining the two vessels is opened, what will be the temperature inside the vessel at equilibrium? **[2]**

28. Two non-reactive gases are kept in a container. The ratio of their partial pressures is given 5 : 3. Find the ratio of number of molecules. **[2]**

29. Calculate the number of molecules in 2×10^{-6} m^3 of a perfect gas at 27°C and at a pressure of 0.01 m of mercury. Mean kinetic-energy of a molecule at 27°C = 4×10^{-11} J and g = 98 ms^{-2}. **[2]**

30. Briefly explain why there is practically no atmosphere on the surface of the moon. **[2]**

31. At a given temperature, equal masses of monoatomic and diatomic gases are supplied equal quantities of heat. Which of the two gases will suffer a larger temperature rise? **[2]**

32. Why does evaporation cause cooling? **[2]**

33. Molecules of which gas will possess higher rms speed, hydrogen or helium? Give reason too. **[2]**

34. Derive Boyle's law on the basis of kinetic theory of gases. **[2]**

35. Although the velocity of air molecules is nearly 0.5 km s^{-1}, yet the smell of scent spreads at a much slower rate. Why? **[2]**

36. Two glass bulbs of equal volumes are connected by a narrow tube and are filled with a gas at 0°C and a pressure of 76 cm of mercury. One of the bulbs is then placed in melting ice and the other in a water-bath maintained at **[2]**

62°C. What is the new value of the pressure inside the bulbs? The volume of the connecting tube is negligible.

37. If a certain mass of gas is heated first in a small vessel of volume V_1 and then in a large vessel of volume V_2. Draw the P - T graph for two cases? **[2]**

38. Equal masses of monoatomic and diatomic gases are supplied heat at the same temperature, pressure and volume. If same amount of heat is supplied to both the gases, which of them will undergo greater temperature rise? **[2]**

39. A gas is filled in a cylinder fitted with a piston at a constant temperature. Explain on the basis of kinetic theory: **[2]**
    i. The pressure of the gas increases by raising the temperature.
    ii. On pulling the piston out, the pressure of the gas decreases.

40. A narrow uniform glass tube contains air enclosed by 15 cm long thread of mercury. When the tube is vertical with the open end upper most, the air column is 30 cm long. When the tube is inverted, the length of the air column becomes 45 cm. Calculate the atmospheric pressure. **[2]**

41. What will be the internal energy of 8 g of oxygen at STP? **[2]**

42. Draw P-V curves showing deviations from ideal behaviour for a given mass of a gas for two different temperatures. **[2]**

43. As an air bubble rises from the bottom of a lake to the surface, its volume is doubled. Find the depth of the lake. Take atmospheric pressure as to be 76 cm of Hg. **[2]**

44. In the upper part of the atmosphere the kinetic temperature of air is of the order of 1000 K, even then one feels severe cold there. Why? **[2]**

45. State Graham's law of diffusion and derive it. **[2]**

46. i. Write ideal gas equation in terms of density, **[2]**
    ii. If molar volume is the volume occupied by 1 mole of any (ideal) gas at STP, show that it is 22.4 L (take R $=8.313\ Jmol^{-1}K^{-1}$).

Section C

47. Draw experimental temperature-volume curves for a real gas (say CO_2) at constant pressure. What conclusion do you draw from it? **[3]**

48. There are N molecules of a gas in a container. If the number of molecules is increased to 2N, what will be **[3]**
    i. pressure of the gas,
    ii. total energy of the gas and
    iii. r.m.s. speed of the gas?

49. Explain qualitatively how the extent of Brownian motion is affected by the **[3]**
    a. size of the Brownian particle,
    b. density of the medium,
    c. temperature of the medium,
    d. viscosity of the medium?

50. State Charles law. Obtain it from kinetic theory of gases. **[3]**

51. State Avogadro's law and establish it from kinetic theory of gases. **[3]**

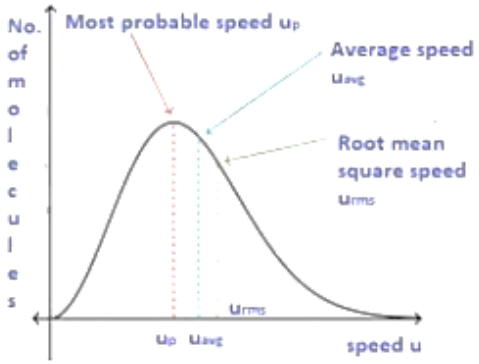
52. The container shown in the table has two chambers, separated by a partition, of volumes V_1 = 2.0L and V_2 = 3.0L. The chambers contain μ_1 = 4.0 and μ_2 = 5.0 moles of a gas at pressures p_1 = 1.00 atm and p_2 = 2.00 atm. Calculate the pressure after the partition is removed and the mixture attains equilibrium. **[3]**

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

Section D

Question No. 53 to 57 are based on the given text. Read the text carefully and answer the questions: **[5]**

Root mean square velocity (RMS value)is the square root of the mean of squares of the velocity of individual gas molecules and the Average velocity is the arithmetic mean of the velocities of different molecules of a gas at a given temperature.



53. Moon has no atmosphere because:

a) the escape velocity of the moon's surface is more than the r.m.s velocity of all molecules

b) it is far away from the surface of the earth

c) the r.m.s. velocity of all the gas molecules is more than the escape velocity of the moon's surface

d) its surface temperature is 10^oC

54. For an ideal gas, $\frac{C_P}{C_V}$ is

a) ≤ 1

b) none of these

c) > 1

d) < 1

55. The root means square velocity of hydrogen is $\sqrt{5}$ times that of nitrogen. If T is the temperature of the gas then:

a) $T(H_2) = T(N_2)$

b) $T(H_2) < T(N_2)$

c) $T(H_2) \neq T(N_2)$

d) $T(H_2) > T(N_2)$

56. Suppose the temperature of the gas is tripled and N_2 molecules dissociate into an atom. Then what will be the rms speed of atom:

a) $v_0\sqrt{2}$

b) $v_0\sqrt{6}$

c) $v_0\sqrt{3}$

d) v_0

57. The velocities of the molecules are v, 2v, 3v, 4v & 5v. The RMS speed will be:

a) 11 v

b) $v(12)^{11}$

c) v

d) $v(11)^{12}$

58. Write the difference between ideal gas and real gas. **[5]**

59. Given below are densities of some solids and liquids. Give rough estimates of the size of their atoms : **[5]**

Substance	**Atomic Mass (u)**	**Density (10^3 Kg m^{-3})**

Carbon (diamond)	12.01	2.22
Gold	197.00	19.32
Nitrogen (liquid)	14.01	1.00
Lithium	6.94	0.53
Fluorine	19.00	1.14

[**Hint :** Assume the atoms to be 'tightly packed' in a solid or liquid phase, and use the known value of Avogadro's number. You should, however, not take the actual numbers you obtain for various atomic sizes too literally. Because of the crudeness of the tight packing approximation, the results only indicate that atomic sizes are in the range of a few $\mathring{A}$].

Section E

60. **Fill in the blanks:** **[6]**

(a) Average kinetic energy of a molecule is _____ proportional to the absolute temperature of the gas. **[1]**

(b) The graph between pressure P and volume V for a given mass of a gas a fixed temperature T is a _____. **[1]**

(c) At _____ pressures and _____ temperatures, some real gases behave like an ideal gas. **[1]**

(d) In solid, the interatomic spacing is least (about $2\mathring{A}$) and interatomic force of attraction is _____. **[1]**

(e) One mole any gas occupies a volume of _____ litre at normal temperature and pressure. **[1]**

(f) A gas that obeys the gas laws at all values of temperature and pressure is called an _____. **[1]**

Section F

61. **State True or False:** **[10]**

(a) The collision between gas molecules are perfectly elastic. **[1]**

(b) Boyle's Law states that for a given mass of a gas at constant temperature, the volume of that mass of gas is inversely proportional to its pressure. **[1]**

(c) Three vessels of equal capacity have gases at the same temperature and pressure. The first vessel contains neon, the second chlorine and the third contains uranium hexafluoride (polyatomic). All the vessels contain equal number of molecules. **[1]**

(d) In ideal gas, there is no intermolecular potential energy (U) because intermolecular force (F) is zero. **[1]**

(e) A real gas behaves as an ideal gas most closely at low pressure and low temperature. **[1]**

(f) Rate of diffusion of a gas is independent of the rms speed of its molecules. **[1]**

(g) Although the velocity of air molecules is nearly 0.5 km s^{-1}, yet the smell of scent spreads at a much slower rate. **[1]**

(h) Charles' Law states that for a given mass of an ideal gas at constant pressure, volume (V) of a gas is inversely proportional to its absolute temperature T. **[1]**

(i) In the upper atmosphere the kinetic temperature of air is of the order of 1000 K, even then one feels severe cold there. **[1]**

(j) The temperature less than 0 K is not possible. **[1]**