PHYSICS

BOOKS - BINA LIBRARY PHYSICS (ASSAMESE ENGLISH)

KINETIC THEORY OF GASES

Example

1. Find rms speed of oxygen molecule at temperature 27^0C

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2. The rms speed of nitrogen molecule is 490 m/s at 273 K.What would be the speed of hydrogen molecule at the same temperature?

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3. At what temperature will the rms velocity of molecules of a gas be double of that at 0^0C?

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Exercise

1. What is an ideal gas?

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2. State Boyle's Law.

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3. What is meant by rms velocity of a gas molecule?

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4. At what temperature would the kinetic energy of a gas molecule be zero?

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5. State the law of equipartition of energy.

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6. What is meant by degree of freedom?

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7. State the relation between rms speed of the molecules of a gas and its temperature.

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8. Define the term mean path.

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9. Write down the formula for average translational kinetic energy of a gas molecule.

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10. What is the minimum possible temperature on the basis of Charle's Law.

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11. What is the interpretation of temperature on the basis of kinetic theory of gas?

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12. Explain why molar specific heat at constant pressure is greater than that at constant volume?

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13. Establish the relation, $V_{rms} = \frac{\sqrt{3KT}}{m}$

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14. State the law of equipartition of energy.

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15. Why does the temperature of a gas rise when it is suddenly compressed?

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16. Why does the air pressure in a car tyre increase during driving?

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17. Show how the result of kinetic theory of gas leads to a relation between temperature of a gas and the average translational Kinetic energy of a gas molecule.

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18. What is the average kinetic energy per molecule of a monoatomic gas?

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19. State the basic assumption on which the kinetic theory of gases is based.

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20. Why does a gas exert pressure on the wall of its container?What are the two factors on which this pressure depends?

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21. Show that the pressure exerted by unit volume of a perfect gas is equal to two thirds of the total kinetic energy of the gas molecules.

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22. Prove that the pressure exerted by an ideal gas given by $P = \frac{1}{3}\rho v^2$.

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23. What do you understand by the terms (i)average velocity and (ii)root mean square velocity?

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24. What is meant by rms velocity of a gas molecule?

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25. Write down an expression for the pressure of a gas in terms of its mass,volume and rms velocity.

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26. Show that the rms velocity is proportional to the square root of the absolute temperature.

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27. Starting with the expression for pressure as given by the kinetic theory,obtain Boyle's Law and why this law is not accurately obeyed by real gases.

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28. Deduce the gas laws on the basis of kinetic theory of gases.

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29. Derive the gas equation for a perfect gas on the basis kinetic theory.

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30. What is Boltzmann's Law of equipartition of energy?Obtain it.

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31. What do you mean by 'Degrees of Freedom'?How many degrees of freedom are associated with monoatomic,diatomic and triatomic molecules?

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32. Two different gases have exactly the same temperature.Does this mean their molecules have the same rms speed?

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33. Can you explain 'evaporation' on the basis of the kinetic theory?

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34. Cooling is caused by evaporation - Explain.

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35. If the number of molecules of a gas in a container is doubled what will be the affect on pressure and rms speed?

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36. What is the total momentum of the molecules of a mole of a helium gas in a container at rest kept at temperature of 400 K?

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37. Absolute zero degree temperature is not the temperature of zero eneregy' - Explain.

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38. Distinguish between the internal energy of a body and temperature.

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39. If the temperature of a gas is increased four times its original value,what will be the change in rms velocity of its molecules?

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40. The pressure of a gas is halved at constant temperature.What will be the change in its volume?

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41. On expanding at constant temperature the pressure of a gas decreases.Explain on kinetic theory.

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42. On reducing the volume of a gas at constant temperature the pressure of the gas increases.Explain on kinetic theory.

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43. Does the pressure of a gas,on heating,increases?

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44. Find the r.m.s velocity of nitrogen molecules at 15^0 C and 76 cm of Hg.

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45. At what temperature will be r.m.s velocity of hydrogen be double of its value at NTP?

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46. Calculate the mean KE of one mole of helium gas at 300 K.

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47. Calculate the total translational KE of 3 molecules of an ideal gas at 227^0 C.

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48. At what temperature the rms velocity of oxygen will become half that of Hydrogen NTP?

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49. If the root mean squre velocity of molecules of hydrogen at NTP is 1840 ms^{-1} .Calculate the root mean square velocity of oxygen molecules at NTP.

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50. Calculate the rms velocity of oxygen molecules at NTP,the molecular weight of oxygen at being 32.

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51. The temperature of an ideal gas is increased from 120 K to 480 K.If at 120 K the rms speed is v,at 480 K it becomes

A. 4v

B. 2v

C. $\frac{v}{2}$

D. $\frac{v}{4}$

Answer: B

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52. At what temperature is rms speed of air molecules double of that at NTP?

A. 719^0 C

B. 819^0 C

C. 909^0 C

D. none of these

Answer: B

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53. The rms speed of molecules of a gas in a vessel is 400 ms^{-1}.If half of the gas leaks out at constant temperature. The rms speed of the remaining gas molecules will be

A. 800 ms^{-1}

B. $400\sqrt{2}$m/s

C. 400 m/s

D. 200 m/s

Answer: C

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54. At what temperature r.m.s velocity of H_2 molecules is equal to that of oxygen molecule at 47^0C?

A. 80 K

B. (-)73k

C. 3K

D. 20K

Answer: D

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55. At 27^0 C,The KE of an ideal gas is E.if temperature is increased to 327^0 C,K.E is

A. $\frac{E}{2}$

B. $\frac{E}{\sqrt{2}}$

C. $\sqrt{2}E$

D. 2E

Answer: D

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56. He is filled in a closed vessel.When it is heated from 300K to 600K .The average K.E will be

A. Half

B. Unchanged

C. Twice

D. sqrt(2) time

Answer: C

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57. A vessel contains 1 mole of O_2 gas at temperature T and pressure P.An identical

vessel containing 1 mole of He at temperature 2T has pressure

A. $\frac{P}{8}$

B. P

C. 2P

D. 8P

Answer: C

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58. The average translational K.E of O_2 molecule at a particular temperature is 0.048 eV.The translational K.E of N_2 molecules in eV at the same temperature is

A. 0.0015

B. 0.003

C. 0.048

D. 0.768

Answer: C

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59. In the equation PV=RT,V stands for the volume of

A. Any amount of gas

B. One gram of the gas

C. One gram molecule of gas

D. One litre of gas

Answer: C

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60. The relation PV=RT can describe the behaviour of a real gas at

A. high pressure and low temperature

B. low pressure and low temperature

C. low pressure and high temperature

D. high pressure and high temperature

Answer: C

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61. Avogadro number is the number of molecules in

A. one litre of a gas at NTP

B. one mole of a gas

C. one gram of a gas

D. one kilogram of a gas

Answer: B

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62. Internal energy of a gram molecule of ideal gas depends on

A. pressure alone

B. volume alone

C. temperature

D. both temperature and pressure

Answer: C

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63. The mean kinetic energy of a perfect gas molecule at temperature TK is

A. $\frac{1}{2}$RT

B. RT

C. $\frac{3}{2}$KT

D. 2KT

Answer: C

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64. Relation between prepssure P and average kinetic energy E per unit volume of a gas is

A. $P = \left(\frac{2}{3}\right)E$

B. $P = \frac{E}{3}$

C. $P = \left(\frac{3}{2}\right)E$

D. $P = 3E$

Answer: A

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65. the temperature of a gas is raised from 27^0 C to 927^0 C.The r.m.s molecular speed is

A. remains unchanged

B. gets halved

C. gets doubled

D. $\sqrt{\frac{927}{27}}$ times the earlier value

Answer: C

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66. The rms velocity of a gas molecule of mass m at a given temperature is proportional to

A. m^0

B. m

C. $\sqrt{m}$

D. $m^{-\left(\frac{1}{2}\right)}$

Answer: D

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67. At room temperature the rms speed of molecule of a certain diatomic gas is found to be 1930 ms^{-1}.The gas is

A. H_2

B. F_2

C. O_2

D. Cl_2

Answer: A

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68. At 0 k, which of the following properties of a gas is zero?

A. kinetic energy

B. potential enrgy

C. vibrational energy

D. density

Answer: A

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69. The temperature of an ideal gas is increased from 120 K to 480 K.If at 120 K the rms speed is v,at 480 K it becomes

A. 4v

B. 2v

C. $\frac{v}{2}$

D. $\frac{v}{4}$

Answer: B

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70. Two identical cylinders contain helium at 2.5 atm and argon at 1 atm respectively.If both the gases are filled in one of the cylinders,the pressure would be

A. 3.5 atm

B. 1.75 atm

C. 1.5 atm

D. 1 atm

Answer: A

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71. At a given temperature,the ratio of rms velocity of hydrogen to rms velocity of oxygen is

A. 4

B. $\frac{1}{4}$

C. 16

D. 8

Answer: A

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72. The equation of state corresponding to 8g of O_2 is

A. PV=RT

B. PV=8RT

C. $RV = \frac{RT}{2}$

D. $PV = \frac{RT}{4}$

Answer: D

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