Jupiter Academy

Subjects : Physics **PRACTICE PAPER 09**

Total Marks : 180

Physics - Section A (MCQ)

1. Kinetic theory of gases provide a base for

A) Charle's law
B) Boyle's law
C) Charle's law and Boyle's law
D) None of these

2. $3\,moles$ of an ideal gas at a temperature of $27^\circ\,C$ are mixed with $2\,moles$ of an ideal gas at a temperature $227^\circ\,C$, determine the equilibrium temperature (^oC) of the mixture, assuming no loss of energy.

A) 327 **B)** 107 **C)** 318 **D)** 410

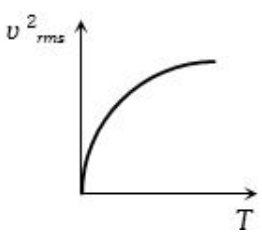
3. $50\ cal$ of heat is required to raise the temperature of 1 mole of an ideal gas from $20^\circ C$ to $25^\circ C$, while the pressure of the gas is kept constant. The amount of heat required to raise the temperature of the same gas through same temperature range at constant volume is ..... $cal\ (R = 2\,cal/mol - K)$

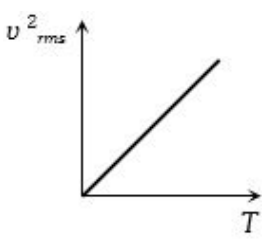
A) 70 **B)** 60 **C)** 40 **D)** 50

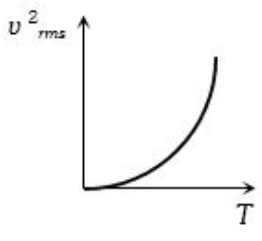
4. The temperature (T) of one mole of an ideal gas varies with its volume (V) as $T = -\alpha V^3 + \beta V^2$, where α and β are positive constants. The maximum pressure of gas during this process is .....

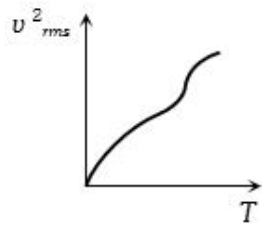
A) $\frac{\alpha\beta}{2R}$ **B)** $\frac{\beta^2 R}{4\alpha}$
C) $\frac{(\alpha+\beta)R}{2\beta^2}$ **D)** $\frac{\alpha^2 R}{2\beta}$

5. The curve between absolute temperature and $v^2{}_{rms}$ is

A) 

B) 

C) 

D) 

6. $125\,ml$ of gas A at 0.60 atmosphere and $150\,ml$ of gas B at 0.80 atmosphere pressure at same temperature is filled in a vessel of 1 litre volume. What will be the total pressure of mixture at the same temperature ..... $\mathrm{atmosphere}$

A) 0.140 **B)** 0.120
C) 0.195 **D)** 0.212

7. At NTP the mass of one litre of air is $1.293\ gm.$ The value of specific gas constant will be ..... $J/K - gm$

A) 0.29 **B)** 4.2 **C)** 8.3 **D)** 16.5

8. The temperature at which root mean square speed of a gas will be half of its value at $0\,^oC$ is ..... ^oC

A) -86.4 **B)** -204.75
C) -104.75 **D)** -68.25

9. A certain amount of an ideal monatomic gas needs $20\ J$ of heat energy to raise its temperature by $10^\circ C$ at constant pressure. The heat needed for the same temperature rise at constant volume will be ..... J

A) 30 **B)** 12 **C)** 200 **D)** 215.3

10. If the $r.m.s.$ velocity of a gas at a given temperature (Kelvin scale) is $300\,m/sec$. What will be the $r.m.s.$ velocity of a gas having twice the molecular weight and half the temperature on Kelvin scale ..... m/sec

A) 300 **B)** 600 **C)** 75 **D)** 150

11. If the mean free path of atoms is doubled then the pressure of gas will become

A) $P/4$ **B)** $P/2$ **C)** $P/8$ **D)** P

12. A monoatomic gas molecule has

A) Three degrees of freedom
B) Four degrees of freedom
C) Five degrees of freedom
D) Six degrees of freedom

13. The root mean square speed of the molecules of a gas is

A) Independent of its pressure but directly proportional to its Kelvin temperature
B) Directly proportional to the square roots of both its pressure and its Kelvin temperature

C) Independent of its pressure but directly proportional to the square root of its Kelvin temperature

D) Directly proportional to both its pressure and its Kelvin temperature

14. Under which of the following conditions is the law $PV = RT$ obeyed most closely by a real gas

A) High pressure and high temperature
B) Low pressure and low temperature
C) Low pressure and high temperature
D) High pressure and low temperature

15. The average kinetic energy of a gas molecule can be determined by knowing

A) The number of molecules in the gas
B) The pressure of the gas only
C) The temperature of the gas only
D) None of the above is enough by itself

16. If a Vander-Waal's gas expands freely, then final temperature is

A) Less than the initial temperature
B) Equal to the initial temperature
C) More than the initial temperature
D) Less or more than the initial temperature depending on the nature of the gas

17. Five moles of helium are mixed with two moles of hydrogen to form a mixture. Take molar mass of helium $M_1 = 4\ g$ and that of hydrogen $M_2 = 2\ g$ The equivalent value of γ is

A) 1.59 B) 1.53 C) 1.56 D) none

18. The average degree of freedom per molecule of a gas is 6. The gas performs $25\ J$ work, while expanding at constant pressure. The heat absorbed by the gas is .... J

A) 75 B) 100 C) 150 D) 125

19. At a temperature TK, the pressure of $4.0\ \ g$ argon in a bulb is p. The bulb is put in a bath having temperature higher by $50\ \ K$ than the first one. $0.8\ \ g$ of argon gas had to be removed to maintained original pressure. The temperature T is equal to ..... K

A) 510 B) 200 C) 100 D) 73

20. One mole of an ideal gas at STP is heated in an insulated closed container until the average speed of its molecules is doubled. Its pressure would therefore increase by factor.

A) 1.5 B) $\sqrt{2}$ C) 2 D) 4

21. Which of the following statements about kinetic theory of gases is wrong

A) The molecules of a gas are in continuous random motion
B) The molecules continuously undergo inelastic collisions
C) The molecules do not interact with each other except during collisions
D) The collisions amongst the molecules are of short duration

22. When an air bubble of radius 'r' rises from the bottom to the surface of a lake, its radius becomes $5r/4$ (the pressure of the atmosphere is equal to the $10\ m$ height of water column). If the temperature is constant and the surface tension is neglected, the depth of the lake is .... m

A) 3.53 B) 6.53 C) 9.53 D) 12.53

23. $14\ g$ of CO at $27^{\circ}C$ is mixed with $16g$ of O_2 at $47^{\circ}C$. The temperature of mixture is ..... $^{\circ}C$ (vibration mode neglected)

A) -5 B) 32 C) 37 D) 27

24. Two closed containers of equal volume filled with air at pressure P_0 and temperature T_0. Both are connected by a narrow tube. If one of the container is maintained at temperature T_0 and other at temperature T, then new pressure in the containers will be

A) $\frac{2P_0T}{T+T_0}$ B) $\frac{P_0T}{T+T_0}$
C) $\frac{P_0T}{2(T+T_0)}$ D) $\frac{T+T_0}{P_0}$

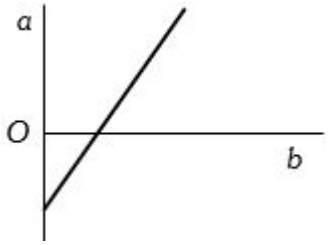
25. The average kinetic energy of a helium atom at $30^{o}C$ is

A) Less than $1\,eV$ B) A few keV
C) $50 - 60eV$ D) $13.6eV$

26. The capacity of a vessel is 3 litres. It contains $6\ gm$ oxygen, $8\,gm$ nitrogen and $5\,gm\ CO_2$ mixture at $27\,^{\circ}C$. If $R = 8.31\ J/mole\ \times\ kelvin$, then the pressure in the vessel in N/m^2 will be (approx.)

A) 5×10^5 B) 5×10^4
C) 10^6 D) 10^5

27. The expansion of unit mass of a perfect gas at constant pressure is shown in the diagram. Here



A) $a =$ volume, $b =°C$ temperature
B) $a =$ volume, $b = K$ temperature
C) $a =°C$ temperature, $b =$ volume
D) $a = K$ temperature, $b =$ volume

28. Select the incorrect statement about Maxwell's speed distribution

A) The distribution function depends only on the absolute temperature
B) $V_{ms} > V_{av} > V_{mp}$
C) The area under the distribution curve gives total number of molecules of the gas
D) The distribution curve is symmetric about the most probable speed

29. The ratio of specific heats (γ) of a ideal gas is given by

A) $\frac{1}{1-\frac{R}{C_P}}$ B) $1+\frac{R}{C_V}$
C) $\frac{C_P}{C_P-R}$ D) All of these

30. Let A and B the two gases and given : $\frac{T_A}{M_A} = 4.\frac{T_B}{M_B}$; where T is the temperature and M is molecular mass. If C_A and C_B are the $r.m.s.$ speed, then the ratio $\frac{C_A}{C_B}$ will be equal to

A) 2 B) 4 C) 1 D) 0.5

31. What is the ratio of specific heats of constant pressure and constant volume for NH_3

A) 1.33 B) 1.44 C) 1.28 D) 1.67

32. Which of the following formulae is wrong

A) $C_V = \frac{R}{\gamma-1}$
B) $C_P = \frac{\gamma R}{\gamma-1}$
C) $C_p/C_v = \gamma$
D) $C_P - C_V = 2R$

33. The following sets of values for C_V and C_P of a gas has been reported by different students. The units are $cal/gm-mole-K$. Which of these sets is most reliable

A) $C_v = 3,\ C_p = 5$
B) $C_V = 4,\ C_P = 6$
C) $C_v = 3,\ C_p = 2$
D) $C_V = 3,\ C_P = 4.2$

34. The volume of a gas at $21\,°C$ temperature and $768\ mm$ pressure is $1\ litre$. If the density of the gas is $1.2\ gm/litre$ at NTP, then its mass will be ..... gm

A) 4 B) 4.21 C) 1.13 D) 10

35. The respective speeds of five molecules are $2, 1.5, 1.6, 1.6$ and $1.2\ km/sec$. The most probable speed in km/sec will be

A) 2 B) 1.58 C) 1.31 D) 1.6

36. In the relation $n = \frac{PV}{RT}, n =$

A) Number of molecules B) Atomic number
C) Mass number D) Number of moles

37. Kinetic theory of gases was put forward by

A) Einstein B) Newton C) Maxwell D) Raman

38. We write the relation for Boyle's law in the form $PV = C$ when the temperature remains constant. In this relation, the magnitude of C depends upon

A) The nature of the gas used in the experiment
B) The magnitude of g in the laboratory
C) The atmospheric pressure
D) The quantity of the gas enclosed

39. A gas at the temperature $250\ K$ is contained in a closed vessel. If the gas is heated through $1\ K$, then the percentage increase in its pressure will be .... $\%$

A) 0.4 B) 0.2 C) 0.1 D) 0.8

40. Boyle's law holds for an ideal gas during

A) Isobaric changes B) Isothermal changes
C) Isochoric changes D) Isotonic changes

41. Assertion (A) : The total translational kinetic energy of all the molecules of a given mass of an ideal gas is 1.5 times the product of its pressure and volume.
Reason (R) : The molecules of gas collide with each other and the velocities of the molecules change due to the collision.

A) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
B) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
C) If Assertion is true but Reason is false.
D) If both Assertion and Reason are false.

42. At what temperature will the rms speed of oxygen molecules become just sufficient for escaping from the Earth's atmosphere ? (Given: Mass of oxygen molecule $(m) = 2.76 \times 10^{-26}\ kg$ Boltzmann's constant $k_B = 1.38 \times 10^{-23}\ JK^{-1}$)

A) $2.508 \times 10^4\ K$ B) $8.360 \times 10^4\ K$
C) $1.254 \times 10^4\ K$ D) $5.016 \times 10^4\ K$

43. The amount of heat energy required to raise the temperature of $1\ g$ of Helium at NTP, from T_1K to T_2K is

A) $\frac{3}{8}N_ak_B\left(T_2-T_1\right)$ **B)** $\frac{3}{2}N_ak_B\left(T_2-T_1\right)$
C) $\frac{3}{4}N_ak_B\left(T_2-T_1\right)$ **D)** $\frac{3}{4}N_ak_B\left(\frac{T_2}{T_1}\right)$

44. One mole of an ideal gas requires $207\ J$ heat to raise the temperature by $10\ K$ when heated at constant pressure. If the same gas is heated at constant volume to raise the temperature by the same $10\ K$, the heat required is ..... J
(Given the gas constant $R=8.3J/mol-K$)

A) 198.7 **B)** 29 **C)** 215.3 **D)** 124

45. The correct relation between the degree of freedom f and the ratio of specific heat γ is

A) $f=\frac{1}{\gamma+1}$ **B)** $f=\frac{2}{\gamma-1}$
C) $f=\frac{\gamma+1}{2}$ **D)** $f=\frac{2}{\gamma+1}$