EXPANSION OF GASES

1. It is decided to verify Boyle's law over a wide range of temperature and pressures. The most suitable gas to be selected for this purpose is

1) Carbon dioxide 2) Helium 3) Oxygen 4) Hydrogen

2. When the volume of a saturated vapour is decreased, its pressure

1) increases according to Boyle's law 2) decreases according to Boyle's law

3) changes but not according to Boyle's law 4) remains constant

3. Under which of the following conditions PV=RT is obeyed most closely by a real gas?

1) high pressure and high temperature 2) low pressure and low temperature
3) low pressure and high temperature 4) high pressure and low temperature

4. Equation of gas in terms of pressure (p), absolute temperature (T) and density (d) is

1) $\frac{P_1}{T_1 d_1} = \frac{P_2}{T_2 d_2}$ 2) $\frac{P_1 T_1}{d_1} = \frac{P_2 T_2}{d_2}$ 3) $\frac{P_1 d_2}{T_2} = \frac{P_2 d_1}{T_1}$ 4) $\frac{P_1 d_1}{T_1} = \frac{P_2 d_2}{T_2}$

5. A sample of an ideal gas occupies a volume 'V' at pressure 'P' and absolute temperature 'T'. The mass of each molecule is m. The expression for the density of gas is

1) mKT 2) P/KT 3) P/KTV 4) Pm/KT

6. The ratio of the volume expansivity of Helium to pressure expansivity of Hydrogen is

1) 1 2) 2 3) 273 4) $\frac{1}{273}$

7. The difference between volume and pressure coefficient of an ideal gas is

1) 1/273 2) 273 3) 2/273 4) zero

8. The graph between temperature in ºC and pressure of a perfect gas is

1) hyperbola

2) a straight line passing though the origin

3) A straight line parallel to pressure axis intercepting temperature axis as -273^{0}C

4) a straight line with +ve intercept on pressure axis and intercepting the temperature axis as -273^{0}C

9. A real gas can be approximated to an ideal gas at

1) low density 2) high pressure

3) high density 4) low temperature

10. The increase in volume of the bubble as it rises from the bottom of the beaker with water at constant temperature is due to

1) Charles's law 2) Boyle's law 3) Avogadro's law 4) Dalton's law

11.

LIST - I	**LIST - II**
a) P - V graph (T is constant)	e) St.line cutting emp. axis at -273^0C
b) P - T graph (V is constant)	f) Rectangular Hyperbola
c) V - t graph (P is constant)	g) A St line parallel to pressure axis
d) PV - P graph (T is constant)	h) st.line passing thorugh orgin

1) a - g , b - e, c - h, d - f 2) a - h, b - f, c - g, d - e

3) a - e, b - g, c - f, d - h 4) a - f, b - h, c - e, d - g

12. If a given mass of a gas occupies a volume 100 cc at one atmospheric pressure and a temperature of 100^0C. What will be its volume at 4 atmospheric pressure the temperature being the same?

1) 100 cm^3 2) 400 cm^3 3) 25 cm^3 4) 200 cm^3

13. A gas at 27^0C and pressure of 30 atm is allowed to expand to atmosphere pressure and volume 15 times larger. The final temperature of the gas is.....

1) -123^0C 2) 123^0C 3) -132^0C 4) 132^0C

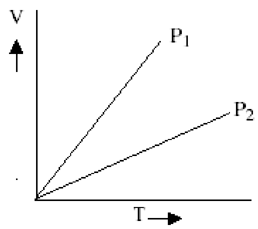
14. If the pressure of an ideal gas contains in a closed vessel is increased by 0.5%, the increase in temperature is 2^0C. The initial temperature of the gas is

1) 27^0C 2) 127^0C 3) 300^0C 4) 400^0C

15. At constant pressure, the ratio of increase in volume of an ideal gas per degree rise in Kelvin temperature to its original volume is

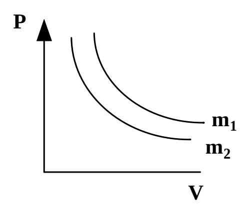
1) $\sqrt{3}$ 2) $\sqrt{273}$ 3) $\frac{1}{273}$ 4) $\frac{1}{\sqrt{3}}$

16. **For an ideal gas V-T curves as constant pressures P_1 & P_2 are shown in figure - from the figure**



1) $P_1 > P_2$ 2) $P_1 < P_2$ 3) $P_1 = P_2$ 4) $P_1 \geq P_2$

17. **Two different curves at const temperature. The relationship between volume V and the pressure P at a given temp of same ideal gas are shown for masses m_1 and m_2 of the gas respectively. Then**



1) $m_1 > m_2$ 2) $m_1 = m_2$ 3) $m_1 < m_2$ 4) $m_1 = 2\,m_2$

18. **A gas at a temperature 300 K and pressure 30 atm is allowed to expand to atmospheric pressure. If the volume becomes 10 times its initial volume, the final temperature becomes**

1) 100^0C 2) 373K 3) 373^0C 4) 100K

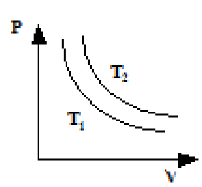
19. **To decrease the pressure of the gas by 10% at constant temperature then change in volume should be**

1) 10% decrease 2) 10% increase 3) 11.11% increase 4) 9.1% increase

20. **A gas is heated through 1^0C in a closed vessel. Its pressure is increased by 0.4%. The initial temperature of the gas is**

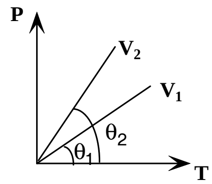
1) 250^0C 2) 100^0C 3) -75^0C 4) -23^0C

21. **The variation of pressure with volume for a given mass of a gas at two different temperatures T_1 and T_2 are represented as shown in the graph, then**



1) $T_1 > T_2$ 2) $T_2 > T_1$ 3) $T_1 = T_2$ 4) $T_1 \overset{>}{\underset{<}{=}} T_2$

22. From the following P – T diagram, the inference drawn is



1) $V_2 > V_1$ 2) $V_2 < V_1$ 3) $V_1 = V_2$ 4) none of these

23. 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 10m height of water column). If the temperature is constant and the surface tension is neglected, the depth of the lake is

1) 3.53 m 2) 6.53 m 3) 9.53 m 4) 12.53m

24. An ideal gas is trapped between mercury thread of 12cm and the closed lower end of a narrow vertical tube of uniform cross section. Length of the air column is 20.5 cm, when the open end is kept upward. If the tube is making 30º with the horizontal then the length of the air column is (assuming temperature to be constant and atmospheric pressure = 76cm of Hg)

1) 22 cm 2) 18 cm 3) 24 cm 4) 20.2 cm

25. Two thermally insulated vessels 1 and 2 are filled with air at temperature (T_1, T_2), volume (V_1, V_2) and pressure (P_1, P_2) respectively. If the valve joining the two vessels is opened, the temperature inside the vessel at equilibrium will be

1) $T_1 + T_2$

2) $T_1T_2 (P_1V_1 + P_2V_2) / (P_1V_1T_1 + P_2V_2T_2)$

3) $T_1T_2 (P_1V_1 + P_2V_2) / (P_1V_1T_2 + P_2V_2T_1)$

4) $(T_1+T_2) / 2$

26. During an experiment an ideal gas is found to obey an additional law VP^2 = constant. The gas is initially at a temperature 'T' and volume 'V'. When it expands to a volume 2V, the temperature becomes

1)T 2) 2T 3) $\sqrt{2}$ T 4) $\frac{T}{\sqrt{2}}$

27. One liter of oxygen at a pressure of 1 atm and two liters of nitrogen at a pressure of 0.5 atm are introduced into a vessel of volume 1litre. If there is no change in temperature, the final pressure of the gas in atm is

1) 1.5 2) 2.5 3) 2 4) 4

28. Two identical vessels A and B with frictionless pistons contain the same ideal gas at the same temperature and the same volume V. The masses of gas in A and B are respectively. The gases are allowed to expand isothermally to the same final volume 3 V. The change in pressures of the gas in A and B are found to be ΔP and 1.5 ΔP respectively. Then

1) $9m_A = 4m_B$ 2) $3m_A = 2m_B$ 3) $2m_A = 3m_B$ 4) $4m_A = 9m_B$

29. A horizontal uniform glass tube of 100cm length sealed at both ends contains 10cm mercury column in the middle. The temperature and pressure of air on either side of mercury column are respectively 0^0C and 80cm of mercury. If the air column at one end is kept at 0^0C and the other end at 273^0C, the pressure of air which is 0^0C is (in cm of Hg)

1) 76 2) 88.2 3) 120 4) 132

30. **A sample of an ideal gas occupies a volume V at a pressure P and absolute temperature T. The mass of each molecule is m. If K is the Boltzmann constant, then the density of the gas is**

1) $d = \frac{Pm}{KT}$ 2) $d = \frac{Pm}{T}$ 3) $d = \frac{PK}{mT}$ 4) $d = \frac{PT}{Km}$

KEY

1) 4	2) 3	3) 3	4) 1	5) 4	6) 1	7) 4	8) 4	9) 1	10) 2
11) 4	12) 3	13) 1	14) 2	15) 3	16) 2	17) 1	18) 4	19) 3	20) 4
21) 2	22) 2	23) 3	24) 1	25) 3	26) 2	27) 3	28) 2	29) 3	30) 1

HINTS

12. $p_1 V_1 = p_2 V_2$

$$V_2 = \frac{p_1 v_1}{p_2} = \frac{1\times100}{4} = 25cc$$

13. $\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2} = \frac{30\times V}{300} = \frac{1\times15V}{T_2}$

$T_2 = 150$ K = -123^0C

14. % Change in pressure $= \frac{T_2 - T_1}{T_1}\times100$

$$\therefore 0.5 = \frac{T+2-T}{T}\times100$$

$$\therefore T = \frac{200}{0.5} = 400k = 127^0C$$

15. $\frac{V_t - V_0}{V_0 t} = \alpha = \frac{1}{273}(^0C)^{-1}$

16. $\frac{PV}{T} = const$

P (slope) = const $\qquad P(\tan\theta) = const$

$P \propto \frac{1}{\tan\theta} \qquad \theta_1 < \theta_2$

$\therefore P_1 < P_2 \Rightarrow P_2 > P_1$

17. $\frac{PV}{mT} = const$

$\therefore \frac{PV}{m} = const[\therefore Tisconst]$

If we consider V const in fig, then

$m \propto p$

P is more for upper curve $m_1 > m_2$

18. $\frac{P_1V_1}{T_1}=\frac{P_2V_2}{T_2}$ $\quad\quad$ $\frac{30V}{300}=\frac{1\,x\,10V}{T_2}$

$T_2=100K$

19. % change in vol = $-\frac{100n}{100+n}=11.11\%$

$\therefore$ Volume increase by 11.11%

20 $\frac{T_1}{T_2}=\frac{P_1}{P_2}$

$\frac{100+0.4}{100}=\frac{T+1}{T}$

T= $=250K=-23°C$

21. $\frac{P_1V_1}{T_1}=\frac{P_2V_2}{T_2}$

$\therefore\frac{T_1}{T_2}=\frac{P_1}{P_2}$

Here $P_2>P_1$

$\therefore\frac{T_1}{T_2}<1$

$\therefore T_1<T_2 (or) T_2>T_1$

22. $\frac{PV}{T}=const$

$\therefore V\left(slope\right)=const$ $\quad\therefore V\alpha\frac{1}{slope}$

$\therefore V_2<V_1$

23. $P_1V_1=P_2V_2$

$\left(H+h\right)r_1^3=Hr_2^3$

$\left(10+h\right)r^3=10x\frac{125}{64}r^3$

$h=\frac{1250}{64}-10=9.53m$

24. $P_1 l_1 = P_2 l_2$

$(H+x) l_1 = (H + x\sin\theta) l_2$

$(76+12)20.5 = (H + x\sin\theta) l_2$

$(78+12)20.5 = \left(76+12\text{x}\frac{1}{2}\right) l_2$

$88 \text{ x } 20.5 = 82 l_2$

$l_2 = \frac{88 \text{ x } 20.5}{82} = 22\ cm$

25. $\frac{P_1V_1}{T_1} + \frac{P_2V_2}{T_2} = \frac{P_1V_1}{T} + \frac{P_2V_2}{T}$

$\therefore \frac{P_1V_1T_2 + P_2V_2T_1}{T_1T_2} = \frac{P_1V_1 + P_2V_2}{T}$

$\therefore T = \frac{T_1T_2(P_1V_1 + P_2V_2)}{P_1V_1T_2 + P_2V_2T_1}$

26. PV = RT and $\quad$ VP^2 = const

$\frac{V_1}{V_2} = \frac{T_1^2}{T_2^2} \Rightarrow \frac{V}{2V} = \frac{T^2}{T_2^2}\ T_2 = \sqrt{2}T$

27. $P_1V_1 + P_2V_2 = PV$

$\therefore$ 1 x 1 + 0.5 x 2 = P x 1

$\therefore$ P = 2 atm

28. $PV = \frac{m}{M}RT$ $V, m, T \rightarrow \text{const}$

$P \,\alpha\, m$ or $\Delta P \,\alpha\, m$

$\frac{\Delta P_A}{\Delta P_B} = \frac{m_A}{m_B} \text{ or } \frac{\Delta P}{1.5\Delta P} = \frac{m_A}{m_B}$

$\frac{2}{3} = \frac{m_A}{m_B}$

$\therefore 3m_A = 2m_B$

29. i) $\frac{P_1 l_1}{T_1} = \frac{P_2 l_2}{T_2}$

$\frac{80\text{x}45}{273} = \frac{P(45-x)}{273} \rightarrow 1$

ii) $\frac{80\text{x}45}{273} = \frac{P'(45+x)}{546} \rightarrow 2$

From (1) and (2)

$\frac{P(45-x)}{273} = \frac{P(45+x)}{546}$

$90-2x = 45+x$

$3x = 45$ or $x = 15cm$

$\therefore \text{P}' = 120\,\text{cm of Hg}$

30. PV = nRT $\Rightarrow$ P$\frac{m}{d}$ = nRT

Total mass = n N m

$\therefore \frac{P}{d} nNm = nRT \Rightarrow d = \frac{Pm}{KT} \quad \left(\because K = \frac{R}{N}\right)$