THERMAL EXPANSION OF GASES

SYNOPSIS

- A gas has neither unique shape nor unique volume.
- The gas completely occupies the vessel in which it is placed.
- The state of given mass of gas can be described in terms of three parameters like pressure, volume and temperature.
- Vapour and gas are two forms in which matter exist in gaseous condition.
- Vapour can be converted into a liquid by mere application of pressure.
- Gas can be converted into a liquid first by cooling the gas to a temperature less than its critical temperature and then applying high pressures.
- Critical temperature of a gas is the temperature at which the gas can be liquified by applying suitable pressures.

CRITICAL TEMPERATURE			
Helium	**-268^{0}C**	**(Or)**	**5K**
Hydrogen	**-240^{0}C**	**(Or)**	**33K**
Oxygen	**-118^{0}C**	**(Or)**	**115K**
Air	**-140^{0}C**	**(Or)**	**133K**

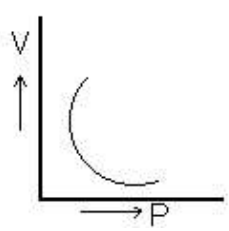
- Boyle's Law : At constant temperature, the volume of a given mass of gas is inversely proportional to its pressure.

$$P a \frac{1}{V} \Rightarrow PV = K \Rightarrow P_1V_1 = P_2V_2$$

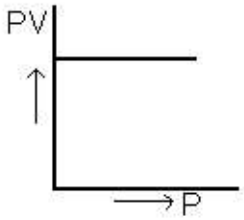
$$P a d \Rightarrow \frac{P}{d} = K \Rightarrow \frac{P_1}{d_1} = \frac{P_2}{d_2}$$

where d = density of the gas

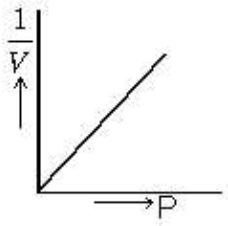
- In PV = K, the value of the constant 'K' depends on
  1. Mass of gas 2. Temperature of gas
  3. System of units
- Boyle's law generally holds good only at low pressure and high temperatures.A gas which obey Boyle's law under all conditions of temperature and pressure is called ideal gas.
- Boyle's law can be experimentally verified by Quill's tube (or) Boyle's law apparatus.
- P-V graph at constant temperature is a rectangular hyperbola.



- PV-P graph is a horizontal straight line parallel to pressure axis.



- P-1/v graph is a straight line passing through origin



- Two vesseles of volumes V_1 and V_2 containing a gas under pressures P1 and P_2 respectively are joined at the same temperature. Then the common pressure

$$P = \frac{P_1V_1 + P_2V_2}{V_1 + V_2}$$

- In Boyle's law apparatus h_1 , h_2 are the differences of levels in the two limbs when the lengths of air columns are l_1 and l_2 .
  Then $(P + h_1) l_1 = (P+h_2) l_2$ where P is atmospheric pressure.

  therefore $P = \frac{h_2l_2 + h_1l_1}{l_1 - l_2}$

  In the same experiment, (P + h) l= constant, k. $h = \frac{k}{l} - P$

  A graph between h and $\frac{1}{l}$ is a straightline

- A capillary tube closed at one end and open at the other, contains a mercury pellet of length h. The length of air column between closed end and mercury pellet is *l*.

Under constant temperature, Pl = constant.

When the tube is horizontal, pressure of air = P

When the tube is vertical with open end up, pressure of air = P+h.

When the tube is vertical with closed end up pressure of air = P-h.

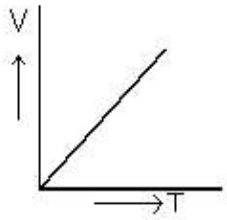
If the tube makes an angle q with the vertical, then the pressure of air is $P \pm h\cos q$ here P is atmospheric pressure.

CHARLE'S CONSTANT PRESSURE LAW:

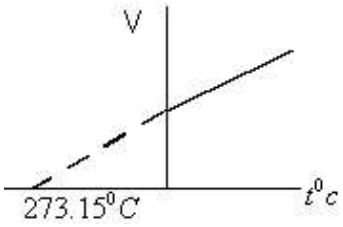
- The volume of a given mass of gas at constant pressure is directly proportional to the absolute temperature.

$$V \propto T = \frac{V_1}{T_1} = \frac{V_2}{T_2}$$

- V - T graph is a straight line passing through origin



- V - t graph is a straight line intersecting the temperature axis at -273.15^0 C. This temperature is called absolute zero.

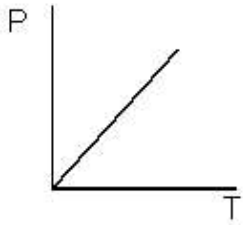


CHARLE'S CONSTANT VOLUME LAW:

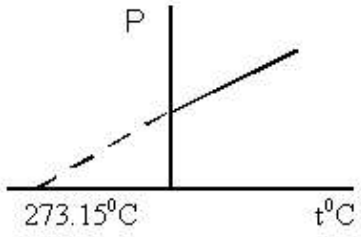
- The pressure of a given mass of a gass is directly proportional to the absolute temperature at constant volume. This law is also known as Gaylussac's law.

$$P \propto T \Rightarrow \frac{P_1}{T_1} = \frac{P_2}{T_2}$$

P-T graph is a straight line passing through orgin



- P-t^0 graph is a straight line intersecting the temperature axis at -273.15^0 C. This temperatuer is called absolute zero.



- The minimum temperature theoretically attainable is only -273^{0}15^0 C. The scale developed with this minimum temperature is known as absolute scale of temperature. (Kelvin scale of temperture).
- At absolute zero.

  t = -273.15^{0}C (or) T = 0 K

  $\Rightarrow$ T = t + 273.15^{0}C

  - The pressure and the volume of a gas becomes zero
  - The value of PV becomes zero
  - All the molecular vibrations cease.
  - Substances do not radiate energy.
  - There is no negative temperature on kelvin scale
- Real gases obey gas laws only at low pressure and high temperatures. All Gases are real gases only.
- Attraction between the molecules of perfect gas is zero.
- Ideal or perfect gas obey gas laws at all temperatures and pressures without any limitations.
- Hydrogen or Helium behaves closely as perfect gas. Hence it is preferred in constant volume gas thermometers.

GAS EQUATION:

- Combining Boyle's law and Charle's law, the resulting expression is an equation of state for ideal gas.

- For unit mass of a gas (1 gram (or) 1 Kg) PV=rt is called "GAS EQUATION" PV=mRT (for m grams)
- "r" is called gas constant (or) specific gas constant.
- The value of "r" depends on nature and mass of the gas.
- S.I.unit of "r" is J Kg^{-1} K^{-1}. Dimensional formula for "r" is LT^{-2} q^{-1}
- The value of "r" depends on nature and mass of the gas.
- For one mole of a gas PV=RT is called " UNIVERSAL (or) IDEAL (or) PERFECT GAS EQUATION".
- The value of "R" is same for all gasses irrespective of their nature.
- If M is gram molecular weight of the gas, then

$$r = \frac{R}{M}$$

$$PV = \frac{m}{M}RT \Rightarrow PV = nRT \qquad \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

where n=no. of moles of gas.

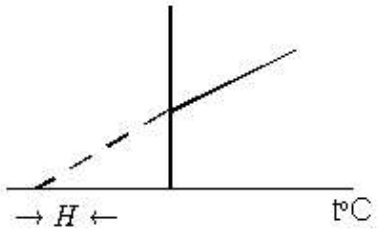
- S.I. unit of R is J *mole* $^{-1}$ K^{-1}
  values of "R" = 8.314 J *gm mole*$^{-1}$ K^{-1}
  R=8.314 J kg *mole* $^{-1}$ K^{-1}
  R=0.821 litre atmosphere *mole* $^{-1}$ K^{-1}
  R=8.314 X 10^7 *ergs mole* $^{-1}$ K^{-1}
  R = 1.987 cal *mole* $^{-1}$ K^{-1}

- **SIGNIFICIANCE OF R :**
  - The value of R gives the work done by one mole of any gas when it is heated under constant pressure through one degree Kelvin.
  - The value of "R" does not depend on the mass of gas or its chemical formula.
  - The fact that R is a constant for all gases is constant with Avaragadro's hypothesis that "equal volumes of all gases under same conditions of temperature and pressure contains equal number of molecules".
- The value of universal gas constant per molecule is 1.38 X 10^{-23} *J (molecule)*$^{-1}$ K^{-1}
  $R=N_0K$
  Where K=Boltzmann's constant
  N_0 = Avagadro's number
- The gas equation in terms of density

  $\frac{P}{dT}$ = constant. Where d= density of ideal gas.
- When pressure and volume are constant for given ideal gas.

$$m\,a\,\frac{1}{T}, m = \frac{K}{T}, \frac{m_1}{m_2} = \frac{T_2}{T_1}$$

- In Boyle's law experiment the graph drawn between excess pressure "h" and $\frac{1}{l}$ is a straight line which gives x-intercept indicating atmospheric pressure.
  $h = (h_2-h_1)$
  l = length of air column
  H= atmospheric pressure



- **NUMBER OF MOLECULES PER UNIT VOLUME:**

$$PV = nRT = (nN)\frac{R}{N}.T \text{ or } P = \left(\frac{nN}{V}\right)kT$$

So number of molecules per unit volume

$$= \frac{P}{kT}$$

- **AVOGADRO'S LAW:**
  Equal volumes of all gases under the same conditions of temperature and pressure contain the same number of molecules.
- When an air bubble is released at the bottom of lake, it rises and the volume increases as it approaches the surface. Assuming the temperature to be constant
  $(H + hdg)\ V_1 = HV_2$
  hdg = pressure due to water
  H = atmospheric pressure.
- If a gas with physical parameters (P_1,V_1,T_1) is mixed with another gas at (P_2,V_2,T_2) then the resultant mixture is at (P,V,T) then

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

- When a ballon goes up to higher altitudes its volume will increase because pressure outside will decrease.
- Air passengers are requested to empty their ink pens because at greater heights pressure decreases so ink tends to overflow.

- Soda bottle burst in summer as the pressure of gas inside the bottle increases due to more temperature.

COEFFICINETS OF EXPANSION OF GAS

- When a given mass of gas is heated under constant pressure, its volume increases with increase in temperature.
- When a given mass of gas is heated under constant volume its pressure increases with increase in temperature. Hence gases have two types of coefficients of expansions
  1. Volume expansion coefficient.
  2. Pressure expansion coefficient.
- **Volume expansion coefficient** : At constant pressure the ratio of the increases in volume of gas per 1^0 C rise in temperature to its volume at 0^0 C is called volume coefficient of expansion.

$$a = \frac{V_2 - V_1}{V_1 t_2 - V_2 t_1} / {}^{o}C$$

- If volumes of the gas are V_0 and V_1 at $0^{o}C$ and $t^{o}C$ tespectively, then

  $V_t = V_0 (1 + a \nabla t)$
- Volume expansion coefficient of gas can be experimentally determined by REGNAULT'S METHOD.
- **PRESSURE COEFFICIENT OF GAS :** At constant volume the ratio of the increse in pressure of gas per *1^0 C* rise in temperature to its pressure at *0^0 C* is called pressure coefficient of gas, $b = \frac{P_2 - P_1}{P_1 t_2 - P_2 t_1} / {}^{o}C$
- If pressures of the gas are P_0 and P_1 at 0^0 C and 1^0 C respectively, then $P_1 = P_0 (1 + b \nabla t)$
- Pressure coefficient of a gas air can be determined by JOLLY's BULB APPARATUS. It can also be used as gas thermometer.
- For all gases it is found that

$$a = b = \frac{1}{273} C^{-1} = 0.00366^{0} C^{-1}$$

CONCEPTUAL QUESTIONS

1. Boyle's law holds good for an ideal gas during
   1. Isobaric changes 2.Isothermal changes
   3. Isochoric changes 4.Isotopic changes
2. An ideal gas is that which
   1. Cannot be liquified
   2. Can be easily liquified
   3. Has strong inter molecular forces
   4. Has a large size of molecules.
3. The Product of pressure and volume has the same units as
   1. Temparature 2. Work
   3. Force 4. Power
4. The temparature of a gas is due to
   1. P.E. of its molecules
   2. K.E. of its molecules
   3. Attractive forces between molecules
   4. Repulsive forces between molecules
5. At constant pressure density of a gas is
   1. directly proportional to absolute temparature
   2.inversely proportional to absolute temperature
   3.independent of temparature
   4. directly proportional to square root of absolute temparatute
6. All gasses deviate from gas laws at
   1. High pressure and low temperature
   2. Low pressure and high temperature
   3. High pressure and high temperature
   4. Low pressure and low temperature
7. A gas can be liquified by applying pressure alone when it is cooled to
   1. 0^0 C 2. 273^0 C
   3. Critical Temperature 3. None.
8. Universal gas constant per molecule is called
   1. Rydberg constant 2. Kelvin constant
   3. Boltzman constant 4. Stefan's constant
9. If an air bubble rises from the bottom to the surcace of a lake at constant temparature its volume
   1. decreases 2. increases
   3. remain same 4. Zero
10. For perfect gas, the ratio of volume coefficent of expansion to pressure coefficient is
    1. equal to one 2. less than one
    3. more than one 4. an imaginary quantity
11. A closed vessel contains some gas at atmospheric pressure and room temperature. It is then given a high speed by placing it in a fast moving train. The temperature of the gas
    1. will increase 2. will decrease
    3. will remain uncharged
    4. increase or decrease depending on the chemical composition of gas

12. By increasing the temparature of liquid its
    1. Volume and density decreases
    2. Volume and density increases
    3. Volume increases and density decreases
    4. Volume decreases and density increases

13. An ideal gas is allowed to expand freely against a vaccum in a rigid insulated container. The gas undergoes:
    1. Increase in internal energy
    2. increase in temparature
    3. decrease in internal energy but increase in temparature
    4. neither an increase nor decrease in internal energy.

14. p - $\frac{1}{v}$ graph for a gas under constant temparature is
    1. Straight line 2. Circle
    3. hyperbola 4. parabola

15. The pressure of a given mass of gas at constant volume varies with temparature as
    1. $\frac{1}{T^2}$ 2. $\frac{1}{T}$ 3. $\frac{1}{T^3}$ 4. T

16. The universal gas constant has the units
    1. dyne/^{0}C 2. erg/mole/k
    2. erg-cm/k 4. Watt/k

17. The temperature at which the volume of all the gases is zero is
    1. +274 ^{0}k 2. -273^0 C 3. 273^0 C 4.-273^0 k

18. Which of the following methods will enable the volume of an ideal gas to be made four times
    1. double the absolute temperature and pressure
    2. halve the absolute temparture and double the pressure
    3. quadraple the absolute temperature at constant pressure
    4. quarter the absolute temperature at costant pressure

19. The pressure coefficeint of a gas is in /^{0}C
    1. 0.00367 2. -273
    3. 981 4. 3.14

20. The volume of 1.5 moles of a gas at S.T.P. is about
    1. 3 lit 2. 33.6 lit 3. 22.4 lit 4. 11.2lit

21. The temperature at which a body does not radiate energy
    1.0^{0}C 2. 0K 3. 273 K 4. 4^0 C

22. At constant temeperature and volume, the mass of a gas is related to pressure as
    1. m a $\frac{1}{p}$ 2. m a p 3.m a $\frac{-1}{p}$
    4. m does not have any relation

23. At constant temperature and pressure, the volume of a given gas is related to mass as
    1. volume is not related to mass
    2. $va\frac{1}{m}$ 3. va - $\frac{1}{m}$ 4. vam

24. In a gas equation, $PV = RT$, V refers to the volume of
    1. any amount of a gas
    2. one gram mass of a gas
    3. one gram mole of gas
    4. one litre of gas

25. As pressure increases, the slope of the T-V graph for a given mass of a gas
    1. increases 2. decreases
    3. does not change
    4. may increase or decrease

26. The slope of T-P graph for a given mass of a gas increases, the volume of the gas
    1. increases 2.decreases
    3. does not change
    4. may increase or decrease

27. When the volume of a gas is decreased at constant temparature the pressure increases because the molecules
    1. strike unit area of the walls of the container more often.
    2. strike the unit area of the walls of the container with higher speed
    3. strike the unit area of the wall of the container with lesser speed
    4. move with more kinetic energy

28. Boyle's law is represented by the equation PV=K
    (K is not constant), K depends on
    1. presssure of the gas 2. volume of the gas
    3. mass of the gas 4. all the above

29. For any gas the presure coefficient (b) is equal to the volume coefficient (a), This can be proved by
    1. charle's law 2. Boyle's law
    3. grahm's law 4. avagadro's number

KEY

1.2	2.1	3.2	4.2	5.2
6.1	7.3	8.3	9.2	10.1
11.3	12.3	13.4	14.1	15.4
16.2	17.2	18.3	19.1	20.2
21.2	22.2	23.4	24.3	25.2
26.2	27.1	28.3	29.2	

LEVEL - 1

1. A gas at 627^0 C is cooled that its pressure becomes 1/3 of its initial value at constant volume. Its final tempeature is
   1) 900 K 2) 600 K 3) 300 K 4)100K
2. At what temperature will the volume of a gas be twice the volume at 27^0 C at a given pressure.
   1) 373^0 C 2) 54^0 C 3) 127^0 C 4) 100^0C
3. At what temperature the pressure of a gas will be double that of its pressure at 270^0 C, if the volume remains constant
   1) 543^0 C 2) 813^0 C 3) 3^0 C 4) 270^0 C
4. The pressure of a gas is increased four times and its absolute temperature two times. The ratio of its final volume to its initial volume is
   1) 1:2 2) 2:1 3) 1:1 4) 3:1
5. At 27^0 C certain gas occupied a volume of 4 litres. If the volume of this is to be increased to 12 litres at the same pressure, to what temperature the gas is to be heated
   1) 300 K 2) 900 K 3) 600 K 4) 1200K
6. The volume of a gas at 27^0C and 2 atmospheric pressure is 2 litres. If the pressure is doubled and absolute temperature is made half, the new volume of gas is
   1) 50 ml 2) 500 ml 3) 1000 ml 4) 2000 ml
7. A given amount of gas is heated until both its pressure and volume are doubled. If initial temperature is 27^0 C, its final temperature is
   1) 300 K 2) 600 K 3) 1200 K 4) 900K
8. A gas is kept at 13^0C in a vessel, If the volume of the gas is kept constant and is heated, at what temperature the pressure will be doubled to its initial pressure
   1) 572 K 2) 286 K 3) 143 K 4) 73 K
9. The volume of a gas is 5 litres at N.T.P. what will be its volume at 273^0 C and at a pressure of four atmospheres
   1) 5litres 2) 2litres 3) 4litres 4) 2.5litres
10. At. N.T.P. 28 gm of Nitrogen occupies 22.4 litres. What is the mass of 5.6 litres of nitrozen at 38cm of Hg pressure and 273^0 C temperature
    1) 7 gm 2) 48 gm 3) 1.75 gm 4) 1.5 gm
11. A given amount of gas occupies 1000cc at 27^0 C and 1200cc and 87^0 c. What is its volume coefficient of expansion
    1. $\frac{1}{273^0}C^{-1}$ 2. $\frac{1}{173^0}C^{-1}$
    3. 173^0C^{-1} 4. 273^0C^{-1}
12. A vessel containing 9 litres of an ideal gas at 760 mm pressure is connected to an evacutated 9 litre vessel. The resultant pressure is
    1) 380 mm 2) 760 mm
    3) 190 mm 4) 1140 mm
13. The density of a gas at N.T.P. is 1.5 gm/lit. its density at a pressure of 152cm of Hg and temperature 27^0 C
    1. $\frac{273}{100}gm/ltr$ 2. $\frac{150}{273}gm/ltr$
    3. $\frac{1}{273}gm/ltr$ 4.1.5gm/lit
14. The density of air at N.T.P. is 1.293 gm/lit. If the pressure is tripled keeping its temperature constant its density becomes
    1) 3.87 gm/ltr 2)1.293gm/ltr
    3) 2.586 gm/ltr 4) 0.431 gm/ltr
15. Two vessels of volume 10 and 5 litres contain air at 5 atmospheres and X (Unknown) atmospheres. When they are connected together with a small tube the resultant pressure is '6' atmospheres find the value of 'X'
    1) 8 atm 2) 16 atm 3) 4 atm 4) 2 atm
16. At 0^0 C temperature and 1 atmospheric pressure a given mass of gas occupies a volume of 273cc. What is its volume at the same pressure and at 50^0 C
    1) 323cc 2)273cc 3) 546cc 4)112cc
17. At 20^0 C temperature and 1 atmosphere pressure if a gas has a volume of 293 ml . find its volume at NTP
    1) 546cc 2) 273cc 3) 293cc 4) 124cc
18. At constant pressure and at a temperature of 27^0 C, if the volume of a given amount of gas is to be raised three times find the temperature to which the gas should be heated.
    1) 27^0 C 2) 625^0 C 3) 627^0 C 4)273^0 C
19. The mass of a gas is1.293 gms at N.T.P. is taken in avessel of volume one litre. At what temperature its mass becomes one gram at a pessure of 72 cm. Hg
    1) 334K 2) 334^0C 3) 61K 4) 607K

20. The volume of a gas at constant pressure increases by 2% when the temperature is increased by 5K, It's initial temperature is
1) 100K 2) 250K 3) 500K 4) 1000K

21. An air bubble rises from the bottom of a lake and its radius is doubled on reaching the surface. If the temperature is constat the depth of the lake is. (1 atmospheric pressure = 10m height of water column)
1) 7m 2) 70m 3) 10m 4) 0.7m

22. A vessel containing 10 litre of air under a pressure of 1M Pa isconnected to a 4 litre empty vessel. The final air pressure in the vessel assuming that the process is isothermal.
1) 7/5 MPa 2) 5/7MPa 3) 1MPa 4) 10MPa

23. A vessel contains a gas under a pressure of $5X10^5$ pa. What will be the gas pressure if 3/5 of the mass of the gas is flown out, the temperature being maintained constant.
1) 50 MPa 2) 2MPa 3) 0.2MPa 4) 0.5MPa

24. What volume will a gas occupy at 343K if its volume at -25^0 C is 7.5 litre?. (The process is isobaric)
1) 10.29 ltrs 2) 102.9 ltrs
3) 1.029 ltrs 4) 1029 ltrs

25. A gas occupies a volume of 10 ltrs at 27^0 C. To what kelvin temperature should it be cooled isobarically to reduce its volume 0.25 of the initial value?
1) 75K 2) 300K 3) 150K 4) 150^0 C

26. If the temperature of a gas is increased by 1K at constant pressure its volume increases by 0.0035 of the initial volume. The temperature of the gas is
1. 100K 2. 150K 3. 300K 4. 273K

27. A cylinder contains a gas at temperture of 27^0C and a pressure 1MPa. If the temperature of the gas is lowered to -23^0 C , the change in pressure is
1) 1MPa 2. 5/6MPa 3. 1/6MPa 4. 5MPa

KEY

1.3	2.1	3.2	4.1	5.2
6.2	7.3	8.1	9.3	10.3
11.1	12.1	13.1	14.1	15.1
16.1	17.2	18.3	19.2	20.2
21.2	22.2	23.3	24.1	25.1
26.4	27.3			

LEVEL - II

1. What should be the percentage increase in the pressure so that the volume of a gas may decrease by 5% at constant teperature.
1) 5% 2) 10% 3) 5.26% 4) 4.26%

2. A spherical balloon rises up and the radius become twice that on the ground. Assuming temperature to be constant the pressure at that altitude is
1) 1/3rd of that on the earth
2) 1/9th that on the earth's surface
3) 1/8 times of that on the earth's surface
4) 3 times of that on the surface of the earth

3. A given amount of a gas is heated till the volume and pressure both increase by 2% each the percentage change in temperature of the gas is equal to nearly
1) 2% 2) 3% 3) 4% 4) 1%

4. At the top of a mountain a thermo meter read 7^0 C and barometer reads 70 cm of Hg. At the bottom of the mountain the barometer reads 76cm of Hg and thermometer reads 27^0 C. The density of air at the top of mountains is _____ times the density at the bottom.
1) 0.99 2) 0.9 3) 0.89 4) 0.95

5. At a given temperature and pressure 64 gm of Oxygen and X gm of H_2 occupy the same volume. Then x= .....gm
1) 1 2) 2 3) 3 4) 4

6. Two sample of Hydrogen and Oxygen of same mass possess same pressure and volume. The ratio of their temperature is
1) 1:8 2) 1:16 3) 8:1 4) 16:1

7. Two identical containers connected by a fine capillary tube contain air at N.T.P. if one of those containers is immersed in pure water, boilling under normal pressure then new pressure is
1) 76 cm of Hg 2) 152 cm of Hg
3) 57 cm of Hg 4) 87.76 cm of Hg

8. The volume occupied by 8 gm of oxygen at S.T.P. is
1) 11.2 lit 2) 22.4 lit 3) 2.8 lit 4) 5.6 lit

9. An electric bulb of 250cc was sealed off at a pressure 10^{-3} mm of Hg and temperature 27^0 C. The number of molecules present in the gas is
1) 8.02×10^{15} 2) 6.023×10^{23}
3) 8.021×10^{23} 4) 6×10^{22}

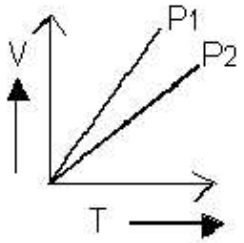
10. A closed vessesl contains 8 gms of oxygen and 7gm of Nitrogen. Total pressure at a certain temperature is 10 atm. When all the oxygen is removed from the system without chage in temperature then the pressure will be

    1) 10 x 7/15atm 2) 1 0 x 8 / 1 5 a t m
    3) 10 x 8/16 atm 4) 10 x 8/32 atm

11. During an experiment an ideal gas is found to obey an additional law V^2P= constant. The gas is initially at a temperature T and volume V. When it expand to a volume 2V, the temperature becomes.

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

12. For an ideal gas V-T curves at constant pressures $P_1 \& P_2$ are shown in figure, from the figure

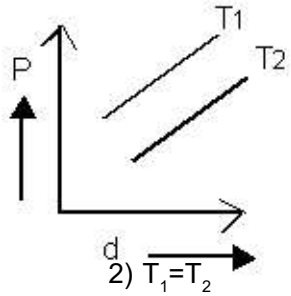


    1) $P_1>P_2$ 2) $P_1<P_2$ 3) $P_1=P_2$ 4) $P_1 \leq P_2$

13. A quill tube contains a mercury column of length 19cm. The length of air column is 24cm when it is held vertically. On inverting it with its open end downwards the length of air column will be_____cm. (atmospheric pressure = 76cm of Hg)

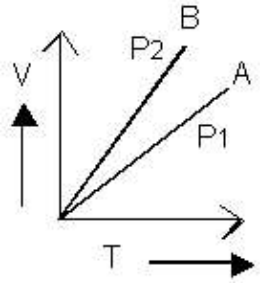
    1) 20cm 2) 30cm 3) 40cm 4) 35cm

14. The diagram shows graphs of pressure V_s density for a given mass of an idea gas at two temperature T_1 and T_2



    1) $T_1>T_2$ 2) $T_1=T_2$
    3) $T_1<T_2$ 2) any of three possible

15. A certain mass of gas is taken at pressure P_1 Keeping its pressure constant, variation of its volume with temperature is noted. The graph A is as shown in fig. The process is repeated at another pressure P_2. The corresponding graph is B. Then



    1) $P_1>P_2$ 2) $P_1 < P_2$
    3) $P_1=P_2$ 4) cannot be predicted

16. The pressures of a gas in the bulb of constant volume gas thermometer at O^0 C are 54.6 cm and 74.6cm of Hg respectively. The pressure at 50^0 C is

    1) 64.6cm of Hg 2) 60.6cm of Hg
    2) 58.6cm of Hg 4) 52.6cm of Hg

17. 1 litre of oxygen at a pressure of 1 atmosphere and 2 litres of nitrogen at a pressure of 0.5 atmosphere are introduced in a vessel of 1 litre capacity without any change in temperature. The total pressure in atmosphere is

    1) 1 2) 2 3) 3 4) 4

18. Two identical gas containers are placed are placed on the two pans of beam balance. One container is empty and open. Second tank is evacuated and then filled with helium until two containers balance. The pressure of Helium in atmospheres is nearly (mol. wt. of air is 28 and that of He is 4)

    1) 7 2) 15 3) 4 4)1

19. A drop of alcohol is introduced into the vaccum space of mercury barometer completely evaporates and then slightly lowers the height of the barometer. If the barometer tube is raised from this position, the height of the barometer will

    1) fall 2) rise 3) remains stationery
    4) falls first and then rises

20. A one litre sphere and a two litre sphere are connected with a capillary tube of neglicible volume. They contain an ideal gas at 27^0C at a pressure of 100cm of Hg. Keeping the temperature of one litre sphere constant at 27^0C, if temperature of two litre sphere is increased to 127^0C, then the final pressure is

    1) 110 cm of Hg 2) 120 cm of Hg
    3) 150 cm of Hg 4) 200 cm of Hg

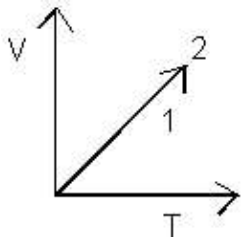
21. A barometer reads 75cm of Hg. When 2cc of air at atmpospheric pressure is introduced into the space above the mercury level, the volume of this space becomes 50cc. The length by which the mercury column descends is

    1) 3cm 2) 6cm 3) 1.5cm 4) 25cm

22. Two closed vessels of equal volume contain air at 105k Pa at 300K and are connected through a narrow tube. If one of the vessels is now maintained at 300K and the other at 400K then the pressure becomes.
1) 120kPa 2) 105kPa
3) 150kPa 4)300kPa

23. At constant temperature, if the pressure of given mass of gas is increased by 15% then the percentage change in its volume will be (nearly)
1) 11.1% 2)-16.6%
3) 18% 4) -13%

24. A Volume V absolute temperature T diagram was obtained when a given mass of gas was heated. During the heating process fro nm state 1 to 2, the pressure



1) Remains constant 2) Decreased
3) Changed eratically 4) Increased

25. At the bottom of a lake where temperature is 7^0 C the pressure is 2.8 atmosphere. An air bubble of radius1 cm at the bottom rises to the surface. Where the temperature is 27^0C. Radius of air bubble at the surface is
1) $3^{1/3}$ 2) $4^{1/3}$ 3) $5^{1/3}$ 4) $6^{1/3}$

26. 2 grams of monoatomic gas occupies a volume of 2 litres at a pressure of $8.3\times10^5 Pa$ and 127^0C. Find the molecular weight of the gas.
(R=8.3 joule/mole/K)
1) 2 gram/mole 2) 16 gram/mole
3) 4 gram/mole 4) 32 gram/mole

27. If ρ is the density, m is the mass of 1 molecule K Boltzman constant for a gas then the pressure of the gas is
1) $P=\frac{\rho KT}{m}$ 2) $P=\frac{mKT}{\rho}$
3) $P=\frac{\rho mT}{K}$ 4) $P=\rho KmT$

28. A piston pump has displacement of 500cc. It is used to fill a tyre to a volume of 35000cc. at 10 atmospheres. The number of strokes required are
1) 500 2) 600 3) 700 4) 350

29. A drop of alcohol introduced into the vaccum space of a mercury barometer completely evaporates and height of barometer slightly falls. If the barometer tube is raised further, the mercury level in barometer.
1) rises 2) falls
3) remains same 4) becomes 76cm

30. The volume of a gas at 0^0C is 546cc. At constant pressure it is heated from 30^0C to 50^0C the change in volume is
1) 20cc 2) 40cc 3) 10cc 4) 273cc

31. State the equation corresponding to 8gm of O_2 is
1) PV=8RT 2) PV=RT/4
3) PV=RT 4) PV=RT/2

32. How many times is the weight of the air filling a room in winter (7^0C) greater than weight in summer (37^0C) ?. Assume that pressure is constant.
1) 1.11 2) 0.90 3) 11.1 4) 9.0

33. A given mass of ideal gas has volume (V) at pressure (P) and the room temperature. If its pressure is first increased by 50% and then decreased by 50% (both at constant temperature only), the volume becomes.
1) 4V/3 2) 3V/4 3) V 4) 4V/5

34. A cylinder contains gas at a pressure of 2.5 atm. Due to leakage, the pressure falls to 2 atm, after sometime. The percentage of the gas which is leaked out is
1) 40 2) 15 3) 20 4) 25

KEY

1.3	2.3	3.3	4.1	5.4
6.2	7.4	8.4	9.1	10.2
11.4	12.2	13.3	14.1	15.1
16.1	17.2	18.1	19.2	20.2
21.1	22.1	23.4	24.1	25.1
26.3	27.3	28.3	29.3	30.2
31.2	32.1	33.1	34.3	

HINTS

1. $\frac{100X}{100-X}$, Where X is % decreases
2. $P_1V_1=P_2V_2$
$P_1r_1=P_2r_2$
3. $PV=nRT$
4. $\frac{P_1}{d_1T_1}=\frac{P_2}{d_2T_2}$
5. $\frac{m}{M}$ of Oxygen $=\frac{m}{M}$ of hydrogen
6. $\frac{T_1}{T_2}=\frac{M_1}{M_2}$

7. The number of moles remain same

$n_1 + n_2 = n_1^1 + n_2^1$

$$\frac{PV}{R\times 273}+\frac{PV}{R\times 273}=\frac{PV}{R\times 273}+\frac{PV}{R\times 373}$$

8. $\frac{v_1}{m_1}=\frac{v_2}{m_2}$ Where $v_1 = 224$ lit

9. PV=NKT

K = Boltzman's Constant = 1.38×10^{-23}J/K

10. $\frac{P_1}{P_2}=\frac{m_1M_2}{m_2M_1}$ V^2p = Constant

$V^2(RT/V)$ = Constant

VT= Constant

12. Slope of V-T curve is proportional to 1/p

13. $(H+h)l_1=(H+h)l_2$

14. Slope of P - d cuve Proportional ot T

15. Slope of V-d curve propotional to 1/p

16. $\beta=\frac{P_1-P_0}{P_0t}=\frac{P_{100}-P_0}{P_0\times 100}$

17. $P = (P_1V_1 + P_2V_2)/V$

18. $P_1M_1=P_2M_2$

20. Applying gas equztion before and after heating.

$$\frac{P(v_1+v_2)}{300}=P^1\left(\frac{v_1}{300}+\frac{v_2}{400}\right)$$

21. $P_1M_1 = P_2M_2$ Where $v_1 + 2 = 50 = v_2$

P_2P_1 = ?

22. $n_1 + n_2 = n_1^1 + n_2^1 \frac{P}{300}+\frac{P}{300}=\frac{P^1}{300}+\frac{P^1}{400}$

23. % of change in volume = 100x/(100+x)

Where x = % of increase in pressure

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

26. PV = (mRT)/M

27. PV = NKT, Where $v = m/\rho$, N = 1

28. $N[P_1V_1] = P_2V_2$

29. The level rises and becomes stedy for 76 cm of Hg

30. $\Delta V = V\ \alpha\ \alpha\Delta t$

Where $\alpha = 1/273^0C$

32. $m_1T_1=m_2T_2$

33. $P_1V_1 = 3(P_1^2V_2)$ V_2=2V/3

$3(P_1/2)V_2=\frac{1}{2}\left(\frac{3p_1}{2}\right)V_3$

$V_3=2V_2= 2 \times 2V/3$

34. $\frac{P_1}{d_1}=\frac{P_2}{d_2}$; $\frac{\Delta d}{d}\times 100 = ?$

LEVEL - III

1. An ideal gas is trapped between Hg thread of 12cm and the closed lower end of a narrow vertical tube of uniform cross section. Length of the air column is 20.5cm. When the open end is kept upward. If the tube is making 30^0 with the horizontal then the length of the air column is (assuming temperature to be constant and atmospheric pressure = 76cm of Hg)
   1) 22cm 2) 18cm 3) 24cm 4) 20.2cm
2. The pressure of a certain mass of gas at 27^0C is 84cm of Hg. If 25% of the gas is now introduced into the same vessel at the same temperature, the final pressure of the gas will be in cm of Hg
   1) 105 2) 100 3) 95 4) 90
3. Two identical containers A and B with frictionless pistons contain the same ideal gas at the same temperature and same volume V. The mass of the gas in A is m_A and that in B is m_B. The gas in each cylinder is now allowed to expand isothermally to the final volume2V. The changes in the pressure in A and B are found to be ΔP and $1.5\Delta P$ respectively. Then
   1) $4m_A = 9m_B$ 2) $2m_A = 3m_B$
   3) $3m_A = 2m_B$ 4) $9m_A = 4m_B$
4. Three flasks of identical volume are filled separately by (a) 1 gram of H_2 (b) 1 gram of O_2 (c) 1 gram of CO_2. They are immersed in a tank of water so that all of them attain same temperature. The pressures P_1, P_2 and P_3 have the relation.
   1) $P_1 > P_2 > P_3$ 2) $P_1 = P_2 = P_3$
   3) $P_1 < P_2 < P_3$ 4) $P_3 > P_1 > P_2$
5. Two containers of equal volume containing the same gas at pressure P_1 and P_2 and absolute temperature T_1 and T_2 respectively were connected with narrow capillary tube. The gas reaches a common pressure P and a commn temperature T. The ratio P/T is equal to
   1) $\frac{P_1}{T_1}+\frac{P_2}{T_2}$ 2) $\frac{1}{2}\left(\frac{P_1}{T_1}+\frac{P_2}{T_2}\right)$
   3) $\frac{P_1T_2+P_2T_1}{T_1+T_2}$ 4) $\frac{P_1T_2-P_2T_1}{T_1-T_2}$
6. A vessel of volume V contains n_1 moles of oxygen and n_2 moles of carbon dioxide at absolute temperature T. The pressure of the mixture is
   1) $\frac{(n_1+n_2)RT}{V}$ 2) $\frac{(n_1-n_2)RT}{V}$
   3) $\frac{n_1n_2RT}{V}$ 4) $\frac{n_1RT}{n_2V}$

7. An air bubble of volume v_0 is released by a fish at a depth h in a lake. The bubble rises to the surface. Assume constant temperature and standard atmospheric pressure P above the lake. The volume of the bubble just before reaching the surface is (d is the density of water).

1) $v_0 + \frac{hgd}{P}$ 2) $\frac{v_0(P+hgd)}{P}$

3) $\frac{v_0}{P} + hgd$ 4) $(v_0 + v_0 dg)$

8. A vessel contains 1 mole of an ideal monoatomic gas. The coefficient of volume expansion of the gas is α. 2 moles of a diatmoic; ideal gas is then introduced into the same vessel. The coefficient of the volume expansion of the mixture will be

1) $3\alpha/2$ 2) $2\alpha/3$ 3) α 4) $\alpha/3$

9. A reciever has a pressure of 144cm of Hg. After two strokes with an exhaust pump, the pressure is 36cm of Hg. After another two strokes the pressure will be.
1) 9cm of Hg 2) 2.4cm of Hg
3) 6cm of Hg 4) 3cm of Hg

10. During an experiment an ideal gas is found to obey an additional gas law VT =constant.
The gas is initially at temperature T and pressure P. When it is heated to the temperature2T, the resulting pressure is
1) 2P 2) P/2 3) 4P 4) P/4

11. Two glass bulbs of volumes $500cm^3$ and $200cm^3$ are connected with a narrow tube. Both of them are filled with air at 70mm of Hg and at 17^0C and sealed. The bulb of small volume is kept in ice and the other with larger volume is kept in steam. Then find the pressure of the gas in the bulb.
1) 200mm of Hg 2) 200cm of Hg
3) 873mm of Hg 4) 200m of Hg

12. The volume of an air bubble increases by x% as it rises from the bottom of a lake to its surface. If the height of the water barometer is H, the depth of the lake is

1) $\frac{Hx}{(100-x)}$ 2) $\frac{Hx}{(100+x)}$ 3) $\frac{Hx}{100}$ 4) 100H/x

13. The density of an air bubble decreases by x% as it rises from the bottom of a lake to its surface. If the height of the water barometer is H, the depth of the lake is

1) $\frac{Hx}{(100-x)}$ 2) $\frac{Hx}{(100+x)}$ 3) $\frac{Hx}{100}$ 4) 100H/x

14. If the pressure of a gas contained in a closed vessel increases by x% when heated by 1^0C, its initial temperature is
1) 100/x Kelvin 2) 100/x Celsius

3) $\frac{x+100}{x}$ *Kelvin* 4) $\frac{100-x}{x}$ *Celsius*

KEY

1.1	2.1	3.3	4.1	5.2
6.1	7.2	8.3	9.1	10.3
11.1	12.3	13.1	14.1	

HINTS

1. $P_1V_1 = P_1V_2$, $(H+h) = (H+h\cos\theta)\, l_2$
Where θ is the angle made with the vertical

2. $\frac{P_1}{m_1} = \frac{P_2}{m_2}$

3. $\frac{P_1}{m_1} = \frac{P_2}{m_2}$

4. $P_1M_1 = P_2M_2 = P_3M_3$

5. $\frac{P_1V_1}{T_1} + \frac{P_2V_2}{T_2} = \frac{Px2V}{T}$

6. $P = P_1 + P_2 = (n_1 + n_2)RT/V$

7. At the top PV_1
At the bottom $(P+hdg)V_0$
$PV_1 = (P+hdg)V_0$

8. Volume coefficient of gas is independent of number of moles

9. $Pn = Px^n$
Where x = volume = $100x(100 + x)$
$36 = 144\ x^2$ $x = 1/2$ $p^1{}_n = 144\ [1/2]^4 = 9$

10 VT = Constant

$\left(\frac{RT}{P}\right)T = \text{Constant}\ \frac{T^2}{P} = \text{Constant}$

11. $n_1 + n_2 = n_1^{\,1} + n_2^{\,1}$

$\frac{P_1V_1}{RT_1} + \frac{P_2V_2}{RT_2} = \frac{P_2V_1}{RT_{100}} + \frac{P_2V_2}{RT_0}$

12. $h = H\left(\frac{V_2}{V_1} - 1\right)$

13. $h = H\left(\frac{V_2}{V_1} - 1\right) = h = H\left(\frac{d_2}{d_1} - 1\right)$

14. $\frac{P_1}{T} = \frac{P_1\left(1 + \frac{x}{100}\right)}{T+1}$

PREVIOUS EAMCET QUESTIONS

1. The mass of oxygen gas occupying a volume of 11.2 lit at a temperature 27°C and a pressure of 76mm of mercury in Kilo grams is (molecular weight of oxygen = 32)
   1. 0.001456 2. 0.01456
   3. 0.1456 4. 1.1456 (2002 E)
2. A gas is heated through 1°C in a closed vessel. Its pressure is increased by 0.4%. The initial temperature of the gas is (2002 M)
   1. 250°C 2. 100°C 3. -75°C 4. -23°C
3. A closed hollow insulated cylinder is filled with gas at 0°C and also contains an insulated piston of negligible weight and negligible thickness at the middle point. The gas at one side of the piston is heated to 100 °C.If the piston moves 5cm, the length of the hollow cylinder is (2001)
   1) 13.65cm 2) 27.3cm 3) 38.6cm 4) 64.6 cm
4. 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 (2001)
   1) 3.53m 2) 6.53m 3) 9.53m 4)12.53m
5. A vessel is filled with an ideal gas at a pressure of 10 atmospheres and temp 27^0C. Half of the mass of the gas is removed from the vessel & the temp. of the remaining gas is increased to 87^0C. Then the pressure of the gas in the vessel will be
   1)5 atm 2)6 atm 3) 7 atm 4)8 atm
6. A flask is filled with 13 gm of an ideal gas at 27^oC its temperature is raised to 52^0C. The mass of the gas that has to be released to maintain the temperature of the gas in the flask at 52^0C and the pressure remaining the same is (EAMCET 2K, E)
   1)2.5 gm 2)2.0 g 3)1.5 g 4)1.0 g
7. A closed copper vessel contains water equal to half of its volume when the temperature. Of the vessel is raised to 447^oc the pressure of steam in the vessel is (Treat steam as an ideal gas, R=8310 J/k / mole, density of water =1000 kg/m^3 molecular weight of water =18) (EAMCET 2K,M)
   1) 33.24 x 10^7 pa 2) 16.62 x 10^7 pa
   3)10.31 x 10^7 pa 4) 8.31x 10^7 pa
8. A real gas can be approximated to an ideal gas at (EAMCET 98 E)
   1)low density 2) high pressure
   3)high density 4)low temperature
9. One litre of Helium gas at a pressure of 76 cm -Hg and temperature 27^0C is heated till its pressure and volume are doubled. The final temperature attained by the gas is (EAMCET 98 E)
   1) 900^0C 2) 927^0C 3) 627^0C 4) 327^0C
10. A cylinder contained 10kg of gas at pressure 10^7 N / m^2. The quantity of gas taken out of cylinder if final pressure is 2.5 x10^6 N/m^2 is (Assume temperature of gas is constant) (EAMCET 98 M)
    1) Zero 2) 7.5 Kg 3) 2.5 Kg 4) 5 Kg
11. Two gases A and B having same pressure p, volume V and temperature T are mixed. if the mixture has volume and temperature as V and T respectively the pressure of mixture is (AMCET 98 M)
    1)2P 2)P 3)P/2 4)4P
12. A gas at temperature 27^0C and pressure 30 atmospheres is allowed to expand to one atmospheric pressure. If the volume becomes 10 times its initial volumes, the final temperature becomes (EAMCET 97 M)
    1) 100^0C 2) 373^0K 3) 373^0C 4) -173^0C
13. For a constant volume gas thermometer one should fill the gas at (EAMCET 96 E)
    1)high temperature and high pressure
    2)high temperature and low pressure
    3)low temperature and low pressure
    4)low temperature and high pressure
14. A mole of gas occupies a volume of 100ml at 50 mm pressure. What is the volume occupied by 2 moles of gas at 100 mm pressure and at same temperature? (EAMCET 95 E)
    1)50 ml 2)100 ml 3)200ml 4)500 ml
15. A closed vessel contains certain mass of a gas. If the pressure is increased by 0.4% by 1° C rise in tempeature then the initial temperature is (EAMCET 95 E)
    1) 23^0C 2) 250^0C 3) -23^0C 4) $300K$
16. A bubble rises from the bottom of a lake 90m deep on reaching the surface, its volume becomes (take atmospheric pressure equals to 10 m of water)
    1)4 times 2)8 times 3)10 times 4) 3 times
17. An air bubble rises from the bottom to the surface of lake and it is found that its diameter is doubled. If the height of water barometer is 11m, the depth of the lake in meters is (93M)
    1)70m 2)77m 3)7.7m 4)78m
18. How much should the pressure of the gas be increased to decrease the volume by 10% at constant temperature ?
    1)10% 2)9.5% 3)11.11% 4)5.11%
19. A gas at a temperature of 27^0C is heated at a constant pressure to triple its volume. The final temperature of the gas will be
    1) 27^0C 2) 627^0C 3)627 K 4) 900^0C
20. A vessel is filled with an ideal gas at a pressure of 200 atm and is at a temperature of 27^0C. One half of the mass of the gas is removed from the vessel and the tempera ture of the remaining gas is increased to 87^0C. At this temperature., the pressure of the gas will be (92 M)
    1)6 atm 2)12 atm 3)36 atm 4) 24 atm

21. A car tyre has air at 1.5 atm at 300 K. If P increases to 1.75 atm with volume same, the temperature will be ____ (91 E)

1) 350^0C 2) $350K$ 3) 300^0C 4) $300K$

22. 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 equation for density is (1988)

1) mKT 2) $\frac{P}{KT}$ 3) $\frac{P}{KTV}$ 4) $\frac{Pm}{KT}$

23. If the volume of the gas is to be increased by 4 times (1988)

1) Temperature and pressure must be doubled.
2) At constant P, the temperature must be increased by 4 times
3) At constant T, the pressure must be increased by 4 times
4) It cannot be increased

24. A perfect gas at 27° C heated at constant pressure so as to double its volume. The final temperature of the gas will be (1987)

1) 327^0C 2) 327K 3) 600^0C 4) None

25. One litre of helium under a pressure of 2 atm and at 27^0C is heated until its pressure and volume are doubled. The final temperature attained by the gas is (96)

1) 927 K 2) 927^0C 3) 1200^0C 4) None

26. The graph between temperature in ^0C and pressure of a perfect gas is (1986)

1) hyperbola
2) a straight line passing through the origin
3) a straight line parallel to pressure axis intercepting temperature axis at -273^0C
4) a straight line with a+Ve intercept on pressure axis intercepting temperature axis at -273^0C.

27. A gas at 27^0C and pressure of 30atm is allowed to expand to atmospheric pressure and volume 15 times larger. The final temperature of gas is (1985)

1) 123^0C 2) -123^0C 3) $400K$ 4) None

28. 16 gm of O_2 gas and x gm of H_2 gas occupy the same volume at the same tempera ture and pressure. Then x= (1984)

1) 1/2gm 2) 1gm 3) 8gm 4) 16 gm

29. The pressure coefficient of a gas is

1) -273 2) 981 3) 3.14 4) $0.00367/^0C$

30. 1000.c.c of a permanent gas at constant pressure is heated from 27° C to 327° C. The new volume will be

1) 333.33 c.c 2) 1000 c.c
3) 2000 c.c 4) 3000 c.c

31. A sample of O_2 gas and a sample of hydrogen gas both have the same mass, the same volume and same pressure. Assuming them to be perfect gases, the ratio of temperature of oxygen gas to the temperature of hydrogen gas is (82)

1) 1:1 2) 1:2 3) 2:1 4) 1:4

32. A constant volume thermometer works on (1980)

1) charles law 2) pascals law
3) Boyles law 4) Archimedis priniciple

KEY

1.2	2.4	3.4	4.3	5.2
6.4	7.2	8.1	9.2	10.2
11.1	12.4	13.2	14.2	15.3
16.3	17.2	18.3	19.2	20.2
21.2	22.4	23.3	24.1	25.2
26.4	27.2	28.2	29.4	30.3
31.1	32.1			

NEW MODEL QUESTIONS

1. Match list I with list II

List - I	List - II
a) Dalton's Law	e) PV= constant (T = constant)
b) Charle's Law-I	f) P/T = constant (V = constant)
c) Charle's Law-II	g) V/T= constant (P = constant)
d) Boyle's Law	h) P = P1+P2+.....P a

1. a-f, b-h, c-g, d-e.
2. a-g, b-h c-e, d-f.
3. a-f, b-e, c-g, d-h.
4. a-h, b-g, c-f, d-e.

2. According to Boyle's Law PV=C the value of C depends on.
   a) Mass of the gas b) Type of gas
   c) Temperature
   1) a,b 2) b,c 3) a,c 4) a,b,c.
3. The Universal gas constant may be expressed as
   a) 8.31 J/mole-K c) 2.00 J/mole-K
   b) 8.31 cal/mole-K d) 2.00 cal/mole-K
   1) a,c 2) a,d
   3) b,c 4) b,d
4. Match List I with List II

List - I	List - II
a) Volume Coefficient of expansion of a gas	e) Jolly's apparatus
b) Pressure coefficeient of expansion of a gas	f) Brownian motion
c) Avagadro constant	g) elements and desonmes apparatus
d) Ratio of two specific heats of a gas	h) Regnaults apparatus

1. a-e, b-g, c-f, d-h.
2. a-f, b-h c-e, d-g.
3. a-h, b-e, c-f, d-g.
4. a-g, b-f, c-h, d-e.

5. Select the correct graphs
   a) the P-1/V graph at constant temperature is a rectangular hyperbola.
   b) the PV-V graph is a straight line parallel to the Y-axis.
   c) P-V graph at constant temperature is a straight line passing through the origion
   d) V-T graph at constant pressure is a straight line passing through the origion.
   1) a,b 2) b,d 3) c,d 4) a,d

6. Match List I with List II

List - I	List - II
a) 0.00366/^{0} C	e) Avogadro's Number
b) 6.023 x 10^{23} molecules	f) Universal gas constant
c) -273^0 C	g) Pressure coeffi-cient of a gas
d) 8.31 J/K-mole	h) Intercept of V-T graph at constant pressure

1. a-g, b-e, c-h, d-f.
2. a-f, b-g c-e, d-h.
3. a-g, b-e, c-f, d-h.
4. a-g, b-f, c-e, d-h.

7. Which of the following processes will quadruple the pressure
   a) Reduce V to half and double T
   b) Reduce V to 1/8th and reduce T to half
   c) Double V and half T
   d) Increase both V and T to double the values.
   1. b,c 2. a,b 3. c,d 4. a,d.
8. Follwing operation are carried out on a sample of ideal gas initially at pressure P volume V and kelvin temperature T.
   a) At constant volume, the pressure is increased fourfold.
   b) At constant pressure, the volume is doubled
   c) The volume is doubled and pressure halved.
   d) If heated in a vessel open to atmosphere, one-fourth of the gas escapes from the vessel.
   Arrange the above operations in the increasing order of final temperature
   1) a,b,c,d 2) c,b,a,d 3) b,a,d,c 4) d,c,b,a
9. An air bubble rises from the bottom of a deep lake the radius of the air bubble near the surface is 'r'; Its radius was
   a) r/2 at depth 30m b) r/2 at depth 70m
   c) r/3 at depth 140m d) r/3 at depth 260m
   1. a,c 2. a,d 3. b,c 4. b,d
10. Select the correct formula

    a) $k=RN_{av}$ b) $r = \frac{nM}{V}$

    c) $\frac{p}{r} = \frac{RT}{M}$ d) $R=kN_{av}$

    1. a,b,c 2. a,b,d 3. b,c,d 4. a,c,d

    Where k=Boltzman's constant
    R= gas constant, n= moles, r = density
    M= molucular weight p= pressure
    T= kelvin temperature V= volume

11. Boyle's law is valid for real gases at
a) low pressure b) high pressure
c) low temperature d) high temperature
1. a,c 2. a,d 3. b,c 4. b,d.

12. match List I and List II

List - I	List - II
a) P-V graph (T is constant)	e) St.line cutting temp axis at -273^0 C
b) P-T graph (V is constant)	f) Rectangular hyper-bola
c) V-T graph (P is constant)	g) A St. line parallel to pressure axis.
d) PV- P garph (T is constant)	h) St. line passing through origin

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.

13. match List I and List II

List - I	List - II
a) Real gas	e) Boltzmans constant
b) gas constant for 1 molecule of a gas	f) molecular forces are present
c) gas constant for 1 mole of gas	g) molecular forces are absent
d) ideal gas	f) universal gas constant

1. a-e, b-f, c-g, d-h.
2. a-f, b-e, c-h, d-g.
3. a-g, b-h, c-e, d-f.
4. a-h, b-g, c-f, d-e.

14. match List I and List II

List - I	List - II
a) Barometer	e) charles law
b) specific gas constant	f) J $mole^{-1}$ k^{-1}
c) gas thermometer	g) Boyle's law
d) universal gas constant	h) J kg^{-1} k^{-1}

1. a-h, b-e, c-f, d-g.
2. a-g, b-h, c-e, d-f.
3. a-f, b-g, c-h, d-e.
4. a-e, b-f, c-g, d-h.

15. match List I and List II

List - I	List - II
a) common pressure at constant temperature	e) $\frac{P_1T_2 + P_2T_1}{T_1 + T_2}$
b) atmospheric pressure by Quilltube	
c) density of a gas	f) $\frac{P_m}{KT}$
d) Common Pressure at constant volume	g) $\frac{(l_2 + l_1)h}{l_2 - l_1}$
	h) $\frac{P_1V_1 + P_2V_2}{V_1 + V_2}$

1. a-h, b-g, c-f, d-e.
2. a-e, b-h, c-g, d-f.
3. a-f, b-e, c-h, d-g.
4. a-g, b-f, c-e, d-h.

16. Real gasses approaches ideal gas at high temperature and low pressure because
a.inter atomic seperation is large
b. size of the molecule is negligible when compared to inter atomic seperation
1. a & b are true 2. onlyaistrue
3. only b is true 4. a & b are false

17. Boyle's Law can be verified by
a) Boyle's law apparatus
b) Quill tube apparatus
c) Regnaults apparatus
d) Jolly's bulb apparatus
1. a & b are true 2. a & c are true
3. b & d are true 4. b & c are true

18. Boyle's law is applicable when
a) temperature is constant
b) gas is at high temperature and low pressure
c) the vessel enclosing the gas is good conductor
d) the process is isothermal
1. a & b 2. b,c & d 3. a,b & c 4. a,b,c & d

19. In the equation PV=constant, the numerical value of constant depends upon
a) temperature b) mass of the gas
c) system of units used d) nature of the gas
1. a & b 2. b & c 3. c & d 4. All

20. PV = n RT holds good for
a) Isobaric process b) Iso choric process
c) Iso thermal process d) Adiabatic process
1. a & b 2. a,b & c 3. a,b & d 4. All

21. The perameter that determine the physical state of gas are :
a) Pressure b) Volume
c) Number of moles d) Temperature
1. a & b 2. a,b & c 3. a,b & d 4. a,c & d

22. According to kinetic theory of gasses at Zero kelvin

a) Pressure of ideal gas is zero
b) Volume of ideal gas is zero
c) Internal energy of ideal gas is zero
d) Matter exists in gaseous state only

1. a & d are true 2. a,b & d are true
3. a,b & c are true 3. All are true

KEY

1.4	2.3	3.2	4.3	5.2
6.1	7.2	8.4	9.4	10.3
11.2	12.4	13.2	14.2	15.1
16.4	17.1	18.4	19.4	20.4
21.3	22.3			

ASSERTION AND REASON

While answering the assertion and reason questions you are required to chose any one of the four followingresponses.

1. Both assertion (A) and reason (R) are correct and R gives the correct explanation
2. Both assertion (A) and reason (R) are correct but R does give the correct explanation
3. A is true but R is false
4. A is false but R is true

1. A: Real gases do not obey the ideal gas equation.
R: In the ideal gas equation, the volume occupied by the molecules as well as the inter molecular forces are ignored.
2. A: gases are characterised with two coefficients of expansion
R: when heated both volume and pressure increase with the rise in temperature.
3. A: As an air bubble rises from the bottom of a lake, its sizes increases.
R: The obervation is in accordance with Boyle's Law
4. A) PV/T=constant for 1 gram of gas. This constant varies from gas to gas.

R) 1 gram of different gases at NTP occupy different volumes.

5. A) PV/T=constant for 1 mole of gas. This constant is same for all gases.

R) 1 mole of different gases at NTP occupy same volume of 22.4 litres.

6. A) At constant pressure when a gas is heated from 40 to 41^0C, the increase in volumes is 1/273 of its intial volume at 273 K

R) Volume coefficient of gas is $\frac{1}{273}/^0C$

7. A) With increase in temperature, the pressure of given gas increases

R) Increase in temperature causes decrease in no. of collision of molecules with walls of container.

8. A) Volume of gas at 50^0C is 'V'. Keeping the pressure constant, the temperature is doubled. Volume becomes 2V.

R) AT constant pressure, the volume of gas is directly propontional its to absolute temperature.

9. A) In Jolly's bulb apparatus, as reservoir is moved up, the mercury level raises into the bulb.

R) The pressure on the enclosed gas increases.

10. A) Pressure of gas is same every where inside a closed container

R) the gas molecules under go elastic collisions among themselves and with walls

11. A) V-t graph for gas at constant pressure is a straight line passing through origion (t-temperature in celcius)

R) volume is directly proportional to temperature (kelvin) at constant pressure

12. A) P-V graph (at constant temperature) for ideal gas is rectangular perabola

R) ideal gas obeys Charle's law

13. A) gasses obey Boyle's law at high temperature and low pressure only.

R) At low pressure and high temperature, gasses would behave like ideal gasses.

KEY

1.2	2.1	3.1	4.1	5.1
6.1	7.3	8.1	9.1	10.1
11.4	12.2	13.1		