

**Class: 11**

**Subject: Chemistry**

**Topic: ASK15E11UT03**

**No. of Questions: 30**

Q1. At which of the four conditions, the density of nitrogen will be the largest?

- (a) STP
- (b) 273 K and 2 atm
- (c) 546 K and 1 atm
- (d) 546 K and 2 atm

Sol. (b)

Density of a gas is given  $\rho = \frac{PM}{RT}$ . Obviously the choice that has greater  $\frac{P}{T}$  would have greater density.

Q2. At which of the four conditions, the density of nitrogen will be the largest?

- (a) STP
- (b) 273 K and 2 atm
- (c) 546 K and 1 atm
- (d) 546 K and 2 atm

Sol. (b)

Density of a gas is given  $\rho = \frac{PM}{RT}$ . Obviously the choice that has greater  $\frac{P}{T}$  would have greater density.

Q3. Thermodynamics is concerned with

- (a) total energy in a system
- (b) energy changes in a system
- (c) rate of a chemical change
- (d) mass changes in nuclear reactions

Sol. (b)

Q4. A certain gas diffuses from two different vessels A and B. The vessel A has a circular orifice while vessel B has a square orifice of length equal to the radius of the orifice of vessel A. The ratio of the rates of diffusion of the gas from vessel A to vessel B, assuming same temperature and pressure is;

- (a)  $\pi$
- (b)  $1/\pi$
- (c) 1:1
- (d) 2:1

Sol. (a) The rate of diffusion is directly proportional to the area of orifice.

$$\therefore d_A \propto \pi r^2$$

$$d_B \propto r^2$$

$$\therefore \frac{d_A}{d_B} = \pi$$

Q5. Which of the following will fit into the blank?

When two phases of the same single substance remain in equilibrium with one another at a constant P and T, their molar \_\_\_\_\_ must be equal.

- (a) Internal energy
- (b) Enthalpy
- (c) Entropy
- (d) Free energy

Sol. (d)

Q6. The behaviour of a real gas is usually depicted by plotting compressibility factor Z versus P at a constant temperature. At high temperature and high pressure, Z is usually more than one. This fact can be explained by van der Waal's equation when

- (a) the constant 'a' is negligible and not 'b'
- (b) the constant 'b' is negligible and not 'a'
- (c) both constants 'a' and 'b' are negligible
- (d) both the constants 'a' and 'b' are not negligible.

Sol. (a)

$$\left( P + \frac{n^2 a}{V^2} \right) (V - nb) = nRT$$

At low pressures, 'b' can be ignored as the volume of the gas is very high. At high temperatures 'a' can be ignored as the pressure of the gas is high.

$$\therefore P(V-b) = nRT$$

$$PV - Pb = nRT \Rightarrow PV = nRT + Pb$$

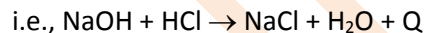
$$\frac{PV}{nRT} = Z = 1 + \frac{Pb}{nRT}$$

Q7. Heat of neutralization of a strong acid by a strong base is equal to  $\Delta H$  of

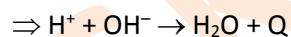
- (a)  $H^+ + OH^- \rightarrow H_2O$
- (b)  $H_2O + H^+ \rightarrow H_3O^+$
- (c)  $2H_2 + O_2 \rightarrow 2H_2O$
- (d)  $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

Sol. (a)

Since heat of neutralization of strong acid and strong base is equal to the heat of formation of water.



Where Q = heat of neutralization



Q8. An LPG cylinder contains 15 kg of butane gas at 27°C and 10 atmospheric pressure. It was leaking and its pressure fell down to 8 atmospheric pressure after one day. The gas leaked is:

- (a) 1 kg
- (b) 2 kg
- (c) 3 kg
- (d) 4 kg

Sol. (c)

For the cylinder  $V = \text{constant}$

$$\text{Hence } P_1V = n_1RT \text{ and } P_2V = n_2RT$$

$$\therefore \frac{P_1}{P_2} = \frac{n_1}{n_2} = \frac{\frac{w_1}{M}}{\frac{w_2}{M}} = \frac{w_1}{w_2}$$

$$\text{Hence } \frac{10}{8} = \frac{15}{w_2} \quad \therefore w_2 = 12 \text{ kg}$$

$$\therefore \text{Gas leaked out} = 15 - 12 = 3 \text{ kg}$$

Q9. Ionisation energy of Al = 5137 kJ mole<sup>-1</sup> ( $\Delta H$ ) hydration of Al<sup>3+</sup> = - 4665 kJ mole<sup>-1</sup>. ( $\Delta H$ )<sub>hydration</sub> for Cl<sup>-</sup> = - 381 kJ mole<sup>-1</sup>. Which of the following statement is correct?

- (a) AlCl<sub>3</sub> would remain covalent in aqueous solution
- (b) Only at infinite dilution AlCl<sub>3</sub> undergoes ionisation
- (c) In aqueous solution AlCl<sub>3</sub> becomes ionic
- (d) None of these

Sol. (c)

If AlCl<sub>3</sub> is present in ionic state in aqueous solution, therefore it has Al<sup>3+</sup> & 3Cl<sup>-</sup> ions

Standard heat of hydration of Al<sup>3+</sup> & 3Cl<sup>-</sup> ions

$$= -4665 + 3 \times (-381) \text{ kJ mole}^{-1} = -5808 \text{ kJ/mole}$$

Required energy of ionisation of Al = 5137 kJ mole<sup>-1</sup>

$\therefore$  Hydration energy overcomes ionisation energy

$\therefore$  AlCl<sub>3</sub> would be ionic in aqueous solution

Q10. How much should the pressure be increased in order to decrease the volume of the gas by 5% at constant temperature?

- (a) 5%
- (b) 5.26%
- (c) 10%
- (d) 4.26%

Sol. (b)

PV = constant at constant temperature

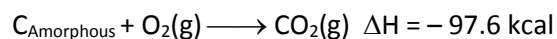
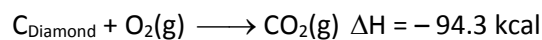
New volume = 0.95V

$$P_1V = P_2 \times 0.95V$$

$$\therefore P_2 = \frac{P_1}{0.95} = 1.0525P_1$$

$$\text{Increase in pressure} = 1.0526 P_1 - P_1 = 0.0526 P_1 = 5.26\% \text{ of } P_1$$

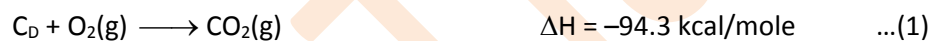
Q11. The heat of transition for carbon from the following is



- (a) 3.3 kJ / mol
- (b) 3.3 kcal / mol
- (c) -3.3 kJ / mol
- (d) -3.3 kcal / mol

Sol. (b)

Given



-----  
Subtracting equation (2) from equation (1):



Q12. In what ratio by mass carbon monoxide and nitrogen should be mixed so that partial pressure exerted by each is same?

- (a) 1:1
- (b) 1:2
- (c) 2:1
- (d) 3:4

Sol. (a)

$$CO = w_1g = \frac{w_1}{28} \text{ mol}, N_2 = w_2g = \frac{w_2}{28} \text{ mol}$$

$$P_{\text{CO}} = \frac{\frac{w_2}{28}}{\frac{w_1}{28} + \frac{w_2}{28}} = \frac{w_2}{w_1 + w_2}$$

$$\therefore P_{\text{N}_2} = \frac{w_1}{w_1 + w_2} \text{ as } P = P_{\text{N}_2}$$

Hence  $w_1 = w_2$

$$\therefore w_1 : w_2 = 1 : 1$$

Q13. From the reaction  $\text{P}(\text{white}) \longrightarrow \text{P}(\text{Red})$ :  $\Delta H = -18.4 \text{ kJ}$ , It follows that

- (a) Red P is readily formed from white P
- (b) White P is readily formed from red P
- (c) White P can not be converted to red P
- (d) White P can be converted into red P and red P is more stable

Sol. (d)

Q14. A box of 1 litre capacity is divided into two equal compartments by a thin partition which are filled with 6g  $\text{H}_2$  and 16g  $\text{CH}_4$  respectively. The pressure in each compartment is recorded as P atm. The total pressure when partition is removed will be

- (a) P
- (b) 2P
- (c) P/2
- (d) P/4

Sol. (a)

As pressure in each compartment is P atm, after the partition is removed the total pressure will be P atm.

Q15. Given that  $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \longrightarrow \text{H}_2\text{O}(\text{g})$ ,  $\Delta H = -115.4 \text{ kcal}$  the bond energy of H-H and O = O bond respectively is 104 kcal and 119 kcal, then the O-H bond energy in water vapour is

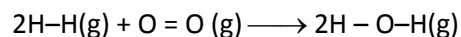
- (a) 110.6 kcal / mol
- (b) -110.6 kcal
- (c) 105 kcal / mol
- (d) None

Sol. (a)

We know that heat of reaction

$$\Delta H = \Sigma \text{B.E. (reactant)} - \Sigma \text{B.E. (product)}$$

For the reaction,



$$\Delta H = -115.4 \text{ kcal, B.E. of H-H} = 104 \text{ kcal}$$

$$\text{B.E. of O=O} = 119 \text{ kcal}$$

Since one  $\text{H}_2\text{O}$  molecule contains two O-H bonds

$$-115.4 = (2 \times 104) + 119 - 4 (\text{O-H}) \text{ bond energy}$$

$$\therefore 4 (\text{O-H}) \text{ bond energy} = (2 \times 104) + 119 + 115.4$$

$$\text{i.e., O-H bond energy} = \frac{(2 \times 104) + 119 + 115.4}{4} = 110.6 \text{ kcal mol}^{-1}$$

Q16. At  $27^\circ\text{C}$ , a gas is compressed to half of its volume. To what temperature it must now be heated so that gas occupies just its original volume?

- (a)  $54^\circ\text{C}$
- (b)  $600^\circ\text{C}$
- (c)  $327^\circ\text{C}$
- (d)  $327\text{K}$

Sol. (c)

$$PV = P_2 \times \frac{V}{2}$$

$$\therefore P_2 = 2P \text{ now; initial volume} = V_2$$

Final volume =  $V$

$$\text{Keeping pressure constant } \frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\therefore \frac{V}{300} = \frac{V}{T_2}, T_2 = 600\text{K} = 327^\circ\text{C}$$

- Q17. A system is taken from state A to state B along two different paths 1 and 2. The heat absorbed and work done by the system along these paths is  $Q_1$  and  $Q_2$  and  $W_1$  and  $W_2$  respectively. Then
- (a)  $Q_1 = Q_2$
  - (b)  $W_1 + Q_1 = Q_2 + W_2$
  - (c)  $W_1 = W_2$
  - (d)  $Q_1 - W_1 = Q_2 - W_2$

Sol. (d)

- Q18. The vapour density of a gas is 11.2. The volume occupied by 11.2g of this gas at N.T.P. is:
- (a) 1 litre
  - (b) 11.2 litre
  - (c) 22.4 litre
  - (d) 20 litre

Sol. (b)

Vapour Density = 11.2

Molecular weight = 22.4

Hence 22.4g = 22.4 litre

$\therefore$  11.2g = 11.2 litre

- Q19. In which of the following process does the entropy decrease?
- (a) dissolving of NaCl in water
  - (b) evaporation of water
  - (c) conversion of  $\text{CO}_2(\text{g})$  into dry ice
  - (d) none

Sol. (c)

- Q20. A gas is found to have a density of  $1.80\text{g litre}^{-1}$  at 760 mm of pressure and  $27^\circ\text{C}$ . The gas will be
- (a)  $\text{O}_2$
  - (b)  $\text{CO}_2$
  - (c)  $\text{NH}_3$
  - (d)  $\text{SO}_2$



Sol. (b)

$$M = \frac{dRT}{P} = \frac{1.8 \times 0.082 \times 300}{\frac{760}{760}} = 44$$

Hence the gas is CO<sub>2</sub>

Q21. In a reversible adiabatic change  $\Delta S$  is

- (a) infinity
- (b) zero
- (c) equal to  $C_v dT$
- (d) equal to  $nR \ln V_2/V_1$

Sol. (b)

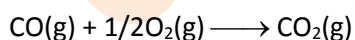
Q22. A mixture of He and Ar contains 8 mole of He for every 2 mole of Ar. The partial pressure of Ar is:

- (a) 2/3 the total pressure
- (b) 1/3 total pressure
- (c) 2/5 the total pressure
- (d) 1/5 the total pressure

Sol. (d)

$$P_{\text{Argon}} = \frac{2}{2+8} P = \frac{1}{5} P$$

Q23. At constant temperature and pressure which one of the following statements is correct for the reaction?



- (a)  $\Delta H = \Delta E$
- (b)  $\Delta H < \Delta E$
- (c)  $\Delta H > \Delta E$
- (d)  $\Delta H$  is independent physical state of reactant

Sol. (b)

Q24. The vapour densities of  $\text{CH}_4$ ,  $\text{O}_2$  are in the ratio 1:2. The ratio of diffusions of  $\text{O}_2$  and  $\text{CH}_4$  at same P and T is:

- (a) 1:2
- (b) 2:1
- (c) 1:1.424
- (d) 1.414 : 1

Sol. (c)

$$\frac{r_{\text{O}_2}}{r_{\text{CH}_4}} = \sqrt{\frac{16}{32}} = \sqrt{\frac{1}{2}} = \frac{1}{1.424}$$

Q25. For the reaction,  $\text{C}_7\text{H}_8(\text{l}) + 9\text{O}_2(\text{g}) \rightarrow 7\text{CO}_2(\text{g}) + 4\text{H}_2\text{O}(\text{l})$ , the calculated heat of reaction is 232 kJ/mol and observed heat of reaction is 50.4 kJ/mol, then the resonance energy is

- (a) - 182.2 kJ / mol
- (b) + 182.2 kJ / mol
- (c) 172 kJ / mol
- (d) None

Sol. (a)

As we know that,

$$\text{Resonance energy} = \Delta H^\circ (\text{observed}) - \Delta H^\circ (\text{calculated})$$

$$= (50.4 - 232.6) \text{ kJ / mol}$$

$$= - 182.2 \text{ kJ mol}^{-1}$$

Q26. A per weighed vessel was filled with oxygen at NTP and weighed. It was then evacuated, filled with  $\text{SO}_2$  at the same temperature and pressure and again weighed. The weight of oxygen is:

- (a) The same as that of  $\text{SO}_2$
- (b) 1/2 that of  $\text{SO}_2$
- (c) Twice that of  $\text{SO}_2$
- (d) 1/4 that of  $\text{SO}_2$

Sol. (b)

$$PV = nRT \ominus n_1 = n_2$$

$$\therefore \frac{w_1}{m_2} = \frac{w_2}{m_2} \text{ or } \frac{w_2}{32} = \frac{w_2}{64}$$

$$\therefore w_1 = \frac{1}{2}w_2$$

Q27. The gases are at absolute temperature 300K and 350 K respectively. The ratio of average kinetic energy of their molecules is:

- (a) 7:6
- (b) 6:7
- (c) 36:49
- (d) 49:36

Sol. (b)

$$\frac{KE_1}{KE_2} = \frac{T_1}{T_2} = \frac{300}{350} = \frac{6}{7}$$

Q28. Which of the following thermodynamic quantities is an outcome of the second law of thermodynamics?

- (a) enthalpy
- (b) internal energy
- (c) work
- (d) None

Sol. (b)

Q29. 5g of each of the following gases at 87°C and 750 mm pressure are taken. Which of them will have the least volume?

- (a) HF
- (b) HCl
- (c) HBr
- (d) Hi

Sol. (d)

$$PV = \frac{w}{m}RT . \text{ If other factors are same, } V \propto \frac{1}{m}$$

∴ Volume will be least in case of  $H_2$  because  $H_2$  has the lowest molecular weight.

Q30. The rms speed of hydrogen is  $\sqrt{7}$  times the rms speed 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)  $T_{H_2} < T_{N_2}$

(d)  $T_{H_2} > \sqrt{7}T_{N_2}$

Sol. (b)

$$u_{\text{rms}}(H_2) = \sqrt{7}u_{\text{rms}}(N_2)$$

$$\text{or, } \sqrt{\frac{2rT_{H_2}}{2}} = \sqrt{7} \times \sqrt{\frac{3RT_{N_2}}{28}}$$

$$\therefore T_{N_2} = 2T_{H_2} \text{ or } T_{N_2} > T_{H_2}$$