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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)

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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) π
(b) $1/\pi$
(c) 1:1
(d) 2:1

Sol. (a)

The rate of diffusion is directly proportional to the area of orifice.

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

$d_B \propto r^2$

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

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)

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

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) = RT

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

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

Q7. Heat of neutralization of a strong acid by a strong base is equal to ΔH of

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

Sol. (a)

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

i.e., $NaOH + HCl \rightarrow NaCl + H_2O + Q$

Were Q = heat of neutralization

$\Rightarrow Na^+ + OH^- + H^+ + Cl^- \rightarrow Na^+ + Cl^- + H_2O + Q$

$\Rightarrow H^+ + OH^- \rightarrow H_2O + Q$

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

Sol. (c)

For the cylinder V = constant

Hence $P_1V = n_1RT$ and $P_2V = n_2RT$

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

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

$\therefore$ Gas leaked out = 15 – 12 = 3 kg

Q9. Ionisation energy of Al = 5137 kJ $mole^{-1}$ (ΔH) hydration of Al^{3+} = – 4665 kJ $mole^{-1}$. $(\Delta H)_{hydration}$ for Cl^- = – 381 kJ $mole^{-1}$. Which of the following statement is correct?

(a) $AlCl_3$ would remain covalent in aqueous solution
(b) Only at infinite dilution $AlCl_3$ undergoes ionisation
(c) In aqueous solution $AlCl_3$ becomes ionic
(d) None of these

Sol. (c)

If $AlCl_3$ is present in ionic state in aqueous solution, therefore it has Al^{3+} & $3Cl^-$ ions

Standard heat of hydration of Al^{3+} & $3Cl^-$ ions

= – 4665 + 3 × (–381) kJ $mole^{-1}$ = -5808 kJ/mole

Required energy of ionisation of Al = 5137 kJ $mole^{-1}$

$\therefore$ Hydration energy overcomes ionisation energy

$\therefore$ $AlCl_3$ 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

$P_1V = P_2 \times 0.95V$

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

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

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

$C_{Diamond} + O_2(g) \longrightarrow CO_2(g)\ \ \Delta H = -94.3$ kcal

$C_{Amorphous} + O_2(g) \longrightarrow CO_2(g)\ \ \Delta H = -97.6$ kcal

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

Sol. (b)

Given

$C_D + O_2(g) \longrightarrow CO_2(g)\qquad \Delta H = -94.3$ kcal/mole ...(1)

$C_A + O_2(g) \longrightarrow CO_2(g)\qquad \Delta H = -97.6$ kcal/mole ...(2)

———————————————————————————————

Subtracting equation (2) from equation (1):

$C_D - C_A \longrightarrow 0;\qquad \Delta H = +3.3$ kcal/mole

$C_D \longrightarrow C_A\qquad \Delta H = +3.3$ kcal/mole

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)

$CO = w_1 g = \dfrac{w_1}{28}$ mol, $N_2 = w_2 g = \dfrac{w_2}{28}$ mol

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

$$\therefore\ P_{N_2} = \frac{w_2}{w_1 + w_2} \text{ as } P = P_{N_2}$$

Hence $w_1 = w_2$

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

Q13. From the reaction P(white) $\longrightarrow$ P (Red): ΔH = - 18.4 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 H_2 and 16g 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 $2H_2(g) + O_2(g) \longrightarrow H_2O(g)$, $\Delta H = -115.4$ 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

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

For the reaction,

$2H\text{–}H(g) + O=O\ (g) \longrightarrow 2H-O\text{–}H(g)$

$\Delta H = -115.4$ kcal, B.E. of H–H = 104 kcal

B.E. of O=O = 119 kcal

Since one H_2O molecule contains two O–H bonds

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

$\therefore 4$ (O–H) bond energy = $(2\times 104) + 119 + 115.4$

i.e., O–H bond energy = $\frac{(2\times104)+119+115.4}{4}$ = 110.6 kcal mol^{-1}

Q16. At 27°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°C
(b) 600°C
(c) 327°C
(d) 327K

Sol. (c)

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

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

Final volume = V

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

$\therefore \frac{\frac{V}{2}}{300} = \frac{V}{T_2}$, $T_2 = 600K = 327°C$

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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 CO_2(g) into dry ice
(d) none

Sol. (c)

Q20. A gas is found to have a density of 1.80g litre^{-1} at 760 mm of pressure and 27°C. The gas will be

(a) O_2
(b) CO_2
(c) NH_3
(d) SO_2

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Sol. (b)

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

Hence the gas is CO_2

Q21. In a reversible adiabatic change ΔS is

(a) infinity
(b) zero
(c) equal to $C_v dT$
(d) equal to nRln 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)

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

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

$$CO(g) + 1/2O_2(g) \longrightarrow CO_2(g)$$

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

Sol. (b)

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Q24. The vapour densities of CH_4, O_2 are in the ratio 1:2. The ratio of diffusions of O_2 and CH_4 at same P and T is:

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

Sol. (c)

$$\frac{r_{O_2}}{r_{CH_4}} = \sqrt{\frac{16}{32}} = \sqrt{\frac{1}{2}} = \frac{1}{1.424}$$

Q25. For the reaction, $C_7H_8(l) + 9O_2(g) \rightarrow 7CO_2(g) + 4H_2O(l)$, 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,

Resonance energy = $\Delta H°$ (observed) – $\Delta H°$ (calculated)

= (50.4 – 232.6) kJ / mol

= – 182.2 kJ mol^{-1}

Q26. A per weighed vessel was filled with oxygen at NTP and weighed. It was then evacuated, filled with SO_2 at the same temperature and pressure and again weighed. The weight of oxygen is:

(a) The same as that of SO_2
(b) 1/2 that of SO_2
(c) Twice that of SO_2
(d) 1/4 that of SO_2

Sol. (b)

$PV = nRT \; \Theta \; n_1 = n_2$

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

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

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)

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

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$\therefore$ Volume will be least in case of Hi because HI low the maximum 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)

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

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

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