BASIC EXERCISE

Introduction

1. Thermodynamics is concerned with :-

(1) Total energy of a system
(2) Energy changes in a system
(3) Rate of a chemical change
(4) Mass changes in nuclear reactions

Ans. **(2)**

2. A well stoppered thermos flask contains some ice cubes. This is an example of :–

(1) Closed system
(2) Open system
(3) Isolated system
(4) Non-thermodynamic system

Ans. **(3)**

3. In which of the following process work behaves as state function :

(1) Isothermal
(2) Isochoric
(3) Adiabatic
(4) Isobaric

Ans. **(3)**

4. When a gas is compressed adiabatically and reversibly, the final temperature is-

(1) Higher than the initial temperature
(2) Lower than the initial temperature
(3) The same as initial temperature
(4) Dependent upon the rate of compression

Ans. **(1)**

5. Which one is a state function :-

(1) Heat supplied at constant pressure
(2) Heat supplied at constant volume
(3) Enthalpy
(4) All of the above

Ans. **(4)**

6. Out of boiling point (I), entropy (II), pH (III) and emf of a cell (IV), intensive properties are :

(1) I, III, IV
(2) I, II
(3) I, II, III
(4) All of these

Ans. **(1)**

7. The work done by a weightless piston in causing an expansion ΔV (at constant temperature), when the opposing pressure P is variable, is given by :

(1) $W = -\int P\Delta V$
(2) $W = 0$
(3) $W = -P\Delta V$
(4) None

Ans. **(1)**

8. The work done by 100 calorie of heat in isothermal expansion of ideal gas is :-

(1) 418.4 J
(2) 4.184 J
(3) 41.84 J
(4) None

Ans. **(1)**

9. Temperature and heat are not :-

(1) Extensive properties
(2) Intensive properties
(3) Intensive and extensive properties respectively
(4) Extensive and intensive properties respectively

Ans. **(4)**

10. $q = -w$ is not true for :-

(1) Isothermal process
(2) Adiabatic process
(3) Cyclic process
(4) 1 and 3 both

Ans. **(2)**

11. The temperature of an ideal gas increase in an -

(1) Adiabatic compression
(2) Adiabatic expansion
(3) Isothermal expansion
(4) Isothermal compression

Ans. **(1)**

12. Enthalpy of 1 mole monoatomic ideal gas is equals to :–

(1) $\frac{3}{2}$RT (2) $\frac{5}{2}$RT (3) RT (4) 2 RT

Ans. **(2)**

FIRST LAW OF THERMODYNAMICS

($\Delta E = q + W$)

13. Both q & w are_ _ _ _ _ function & q + w is a _ _ _ _ _ function :-

(1) State, State (2) State, path (3) Path, state (4) Path, path

Ans. **(3)**

14. If work done by the system is 300 joule when 100 cal. heat is supplied to it. The change in internal energy during the process is :-

(1) – 200 J (2) 400 J (3) 720 J (4) 120 J

Ans. **(4)**

15 A system has internal energy equal to E_1, 450 J of heat is taken out of it and 600 J of work is done on it. The final energy of the system will be -

(1) $(E_1 + 150)$ (2) $(E_1 + 1050)$ (3) $(E_1 - 150)$ (4) None of these

Ans. **(1)**

16. If a gas absorbs 100 J of heat and expands by 500cm^3 against a constant pressure of 2×10^5 Nm^{-2}, the change in internal energy is:-

(1) - 300 J (2) - 100 J (3) + 100 J (4) None of these

Ans. **(4)**

ENTHALPY [$\Delta H = \Delta E + P\Delta V / \Delta H = \Delta E + \Delta n_g RT$]

17. Internal energy change during a reversible is isothermal expansion of an ideal gas is :-

(1) Always negative (2) Always positive

(3) Zero (4) May be positive or negative

Ans. **(3)**

18. Under which of the following conditions is the relation, $\Delta H = \Delta E + P\Delta V$ valid for a system :–

(1) Constant pressure (2) Constant temperature

(3) Constant temperature and pressure (4) Constant temperature, pressure and composition

Ans. **(1)**

19. Which of the following statements is correct for the reaction ;$CO(g) + \frac{1}{2} O_2(g) \longrightarrow CO_2(g)$ at constant temperature and pressure

(1) $\Delta H = \Delta E$ (2) $\Delta H < \Delta E$ (3) $\Delta H > \Delta E$ (4) None of the above

Ans. **(2)**

20. For the reaction $Ag_2O(s) \longrightarrow 2Ag(s) + \frac{1}{2} O_2(g)$, which one of the following is true :

(1) $\Delta H = \Delta E$ (2) $\Delta H = \frac{1}{2} \Delta E$ (3) $\Delta H < \Delta E$ (4) $\Delta H > \Delta E$

Ans. **(4)**

21. A mixture of 2 moles of carbon monoxide and one mole of oxygen in a closed vessel is ignited to get carbon dioxide. If ΔH is the enthalpy change and ΔE is the change in internal energy, then :–

(1) $\Delta H > \Delta E$ (2) $\Delta H < \Delta E$ (3) $\Delta H = \Delta E$ (4) Not definite

Ans. **(2)**

22. For the gaseous reaction involving the complete combustion of isobutane -

(1) $\Delta H = \Delta E$ (2) $\Delta H > \Delta E$ (3) $\Delta H = \Delta E = 0$ (4) $\Delta H < \Delta E$

Ans. **(2)**

23. For the reversible isothermal expansion of one mole of an ideal gas at 300 K, from a volume of 10 dm^3 to 20 dm^3, ΔH is-

(1) 1.73 KJ
(2) –1.73 KJ
(3) 3.46 KJ
(4) Zero

Ans. **(4)**

24. For $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ at 977°C, $\Delta H = 174$ KJ/mol ; then ΔE is :-

(1) 160 KJ
(2) 163.6 KJ
(3) 186.4 KJ
(4) 180 KJ

Ans. **(2)**

25. Heat of reaction for , $CO(g) + \frac{1}{2} O_2(g) \rightarrow CO_2(g)$ at constant V is –67.71 K cal at 17°C. The heat of reaction at constant P at 17°C is :-

(1) –68.0 K cal
(2) + 68.0 K cal
(3) – 67.42 K cal
(4) None

Ans. **(1)**

26. The reaction :-

$$NH_2CN(S) + \frac{3}{2} O_2(g) \rightarrow N_2(g) + CO_2(g) + H_2O(\ell)$$

was carried out in a bomb caloriemeter. The heat released was 743 KJ mol^{-1}. The value of ΔH_{300k} for this reaction would be :-

(1) – 740.5 KJ mol^{-1}
(2) – 741.75 KJ mol^{-1}
(3) – 743.0 KJ mol^{-1}
(4) – 744.25 KJ mol^{-1}

Ans. **(2)**

27. Which is true for the combustion of sucrose ($C_{12}H_{22}O_{11}$) at 25°C :-

(1) $\Delta H > \Delta E$
(2) $\Delta H < \Delta E$
(3) $\Delta H = \Delta E$
(4) None

Ans. **(3)**

28. The heat of combustion of ethanol determined in a bomb calorimeter is – 670.48 K. Cals mole^{-1} at 25°C. What is ΔH at 25°C for the reaction :–

(1) – 335.24 K. Cals.
(2) – 671.08 K. Cals.
(3) – 670.48 K Cals.
(4) + 670.48 K. Cals.

Ans. **(2)**

29. The difference in ΔH and ΔE for the combustion of methane at 25°C would be :–

(1) Zero
(2) $2 \times 298 \times -2$ Cals.
(3) $2 \times 298 \times -3$ Cals.
(4) $2 \times 25 \times -3$ Cals.

Ans. **(2)**

30. For which of the following reactions ΔH is less than ΔE :–

(1) $C_{12}H_{22}O_{11}(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(\ell)$
(2) $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$
(3) $N_2O_4(g) \rightarrow 2NO_2(g)$
(4) $N_2(g) + O_2(g) \rightarrow 2NO(g)$

Ans. **(2)**

31. For a reaction $2X(s) + 2Y(s) \rightarrow 2C(\ell) + D(g)$

The q_p at 27°C is – 28 K Cal. mol^{-1}.

The q_V is ----------- K. Cal. mol^{-1} :–

(1) – 27.4
(2) + 27.4
(3) – 28.6
(4) 28.6

Ans. **(3)**

WORK DONE IN DIFFERENT PROCESS

32. The work done in ergs for a reversible expansion of one mole of an ideal gas from a volume of 10 litres to 20 litres at 25^{0}C is :

(1) $-2.303 \times 8.31 \times 10^7 \times 298 \log 2$
(2) $-2.303 \times 0.0821 \times 298 \log 2$
(3) $-2.303 \times 0.0821 \times 298 \log 0.5$
(4) $-2.303 \times 2 \times 298 \log 2$

Ans. **(1)**

33. Two litre of N_2 at 0°C and 5 atm are expanded isothermally against a constant external pressure of 1 atm until the pressure of gas reaches 1 atm. Assuming the gas to be ideal calculate work of expansion ?

(1) –504.2 joule (2) –405.2 joule (3) +810.4 joule (4) –810.4 joule

Ans. **(4)**

34. One mole of a gas occupying $3 dm^3$ expands against a constant external pressure of 1 atm to a volume of 13 lit. The work done is :–

(1) – 10 atm dm^3 (2) – 20 atm dm^3 (3) – 39 atm dm^3 (4) – 48 atm dm^3

Ans. **(1)**

ENTROPY/SECOND LAW OF THERMODYNAMICS

35. An adiabatic reversible process is one in which :-

(1) Temperature of the system does not change (2) The system is not closed to heat transfer

(3) There is no entropy change (4) None of these

Ans. **(3)**

36. Entropy means

(1) Disorderness (2) Randomness (3) Orderness (4) both 1 & 2

Ans. **(4)**

37. Change in entropy is negative for

(1) Bromine (ℓ) $\longrightarrow$ Bromine (g) (2) $C(s) + H_2O(g) \longrightarrow CO(g) + H_2(g)$

(3) N_2(g, 10 atm) $\longrightarrow$ N_2 (g, 1 atm) (4) Fe(at 400 K) $\longrightarrow$ Fe(at 300 K)

Ans. **(4)**

38. In which reaction ΔS is positive :-

(1) $H_2O(\ell) \rightarrow H_2O(s)$ (2) $3O_2(g) \rightarrow 2O_3(g)$

(3) $H_2O(\ell) \rightarrow H_2O(g)$ (4) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

Ans. **(3)**

39. When the egg is hard boiled, there is-

(1) Increase in disorder (2) Decrease in disorder

(3) No change in disorder (4) ΔG is negative

Ans. **(1)**

40. If S^0 for H_2, Cl_2 and HCl are 0.13, 0.22 and 0.19 KJ K^{-1} mol^{-1} respectively. The total change in standard entropy for the reaction

$H_2 + Cl_2 \longrightarrow 2HCl$ is :

(1) 30 JK^{-1} mol^{-1} (2) 40 JK^{-1} mol^{-1} (3) 60 JK^{-1} mol^{-1} (4) 20 JK^{-1} mol^{-1}

Ans. **(1)**

41. Which has the least entropy :

(1) Graphite (2) Diamond (3) $N_2(g)$ (4) $N_2O(g)$

Ans. **(2)**

42. The enthalpy of vaporisation of per mole of ethanol (b.p. = 79.5^0C and $\Delta S = 109.8$ JK^{-1} mol^{-1}) is :–

(1) 27.35 KJ/mol (2) 32.19 KJ/mol (3) 38.70 KJ/mol (4) 42.37 KJ/mol

Ans. **(3)**

43. If 900J/g of heat is exchanged at boiling point of water, then what is increase in entropy?

(1) 43.4 J/K-mole (2) 87.2 J/K mole (3) 900 J/K-mole (4) Zero

Ans. **(1)**

44. 5 mole of an ideal gas expand reversibly from a volume of 8 dm^3 to 80dm^3 at a temperature of 27^0C. The change in entropy is :–

(1) 41.57 JK^{-1} (2) – 95.73 JK^{-1} (3) 95.73 JK^{-1} (4) – 41.57 JK^{-1}

Ans. **(3)**

45. The total entropy change for a system & its surroundings increases if the process is :

(1) Reversible (2) Irreversible (3) Exothermic (4) Endothermic

Ans. **(2)**

46. Calculate the entropy of $Br_2(g)$ in the reaction $H_2(g) + Br_2(g) \rightarrow 2HBr(g), \Delta S° = 20.1 JK^{-1}$ given, entropy of H_2 and HBr is 130.6 and 198.5 J $mol^{-1}K^{-1}$:-

(1) 246.3 JK^{-1} (2) 123.15 JK^{-1} (3) 24.63 JK^{-1} (4) 20 KJK^{-1}

Ans. **(1)**

47. Ammonium chloride when dissolved in water leads to cooling sensation. The dissolution of NH_4Cl at constant temperature is accompanied by :–

(1) Increase in entropy (2) Decrease in entropy

(3) No change in entropy (4) No change in enthalpy

Ans. **(1)**

48. In which of the following case entropy decreases–

(1) Solid changing to liquid (2) Expansion of a gas

(3) Crystals dissolve (4) Polymerisation

Ans. **(4)**

49. Which of the following state function is not zero at standard state :–

(1) Enthalpy (2) Entropy (3) Free energy (4) None

Ans. **(2)**

50. Entropy of an adiabatic reversible process is:-

(1) Positive (2) Zero (3) Negative (4) Constant

Ans. **(4)**

GIBBS FREE ENERGY

51. A gas is allowed to expand under reversible adiabatic conditions what is zero for such a process:-

(1) $\Delta G = 0$ (2) $\Delta T = 0$ (3) $\Delta S = 0$ (4) None of these

Ans. **(3)**

52. For a reaction at 25^0C enthalpy change (ΔH) and entropy change (ΔS) are -11.7×10^3 $Jmol^{-1}$ and –105 J mol^{-1} K^{-1} respectively. The reaction is :

(1) Spontaneous (2) Non spontaneous

(3) At equilibrium (4) Can't say anything

Ans. **(2)**

53. The enthalpy change for a given reaction at 298 K is –x cal/mol. If the reaction occurs spontaneously at 298 K, the entropy change at that temperature

(1) Can be negative but numerically larger than x/298 cal $K^{-1}mol^{-1}$

(2) Can be negative but numerically smaller than x/298 cal K^{-1} mol^{-1}

(3) Cannot be negative

(4) Cannot be positive

Ans. **(2)**

54. Which of the following is true for the reaction $H_2O(\ell) \rightleftharpoons H_2O(g)$ at 100^0C and 1 atmosphere

(1) $\Delta S = 0$ (2) $\Delta H = 0$ (3) $\Delta H = \Delta E$ (4) $\Delta H = T\Delta S$

Ans. **(4)**

55. For hypothetical reversible reaction

$\frac{1}{2} A_2(g) + \frac{3}{2} B_2(g) \longrightarrow AB_3(g)$; $\Delta H = -20$ KJ if standard entropies of A_2, B_2 and AB_3 are 60, 40 and 50 JK^{-1} $mole^{-1}$ respectively. The above reaction will be in equilibrium at :–

(1) 400K (2) 500K (3) 250K (4) 200K

Ans. **(2)**

56. For the precipitation of AgCl by Ag^+ ions and HCl

(1) $\Delta H = 0$ (2) $\Delta G = 0$ (3) $\Delta G = -ve$ (4) $\Delta H = \Delta G$

Ans. **(3)**

57. What is the free energy change ΔG, when 1.0 mole of water at 100ºC and 1 atm pressure is converted into steam at 100°C and 1 atm pressure :–

(1) 540 Cal (2) –9800 Cal (3) 9800 Cal (4) 0 Cal

Ans. **(4)**

58. A reaction $A + B \longrightarrow C + D + q$ is found to have a positive entropy change, the reaction will be -

(1) Possible at high temperature (2) Possible only at low temperature

(3) Not possible at any temperature (4) Possible at any temperature

Ans. **(4)**

59. Equilibrium constant of a reaction is related to :

(1) Standard free energy change ΔG^0 (2) Free energy change ΔG

(3) Entropy change (4) None

Ans. **(1)**

60. The Vant Hoff equation is :

(1) $\Delta G° = RT \log_e K_P$ (2) $-\Delta G° = RT \log_e K_P$ (3) $\Delta G° = RT^2 \ell n K_P$ (4) None

Ans. **(2)**

61. If $\Delta G^0 > 0$ for a reaction then :

(1) $K_P > 1$

(2) $K_P < 1$

(3) The products predominate in the equilibrium mixture

(4) None

Ans. **(2)**

62. If the equilibrium constant for a reaction is 10, then the value of ΔG^0 will be

($R = 8JK^{-1} mol^{-1}$, $T = 300$ K)

(1) + 5.527 KJ mol^{-1} (2) – 5.527 KJ mol^{-1}

(3) +55.27 KJ mol^{-1} (4) – 55.27 KJ mol^{-1}

Ans. **(2)**

63. The process of evaporation of a liquid is accompanied by :

(1) Increase in enthalpy (2) Decrease in free energy

(3) Increase in entropy (4) All

Ans. **(4)**

64. For the process, $CO_2(s) \longrightarrow CO_2(g)$:

(1) Both ΔH and ΔS are +ve
(2) ΔH is negative and ΔS is +ve
(3) ΔH is +ve and ΔS is –ve
(4) Both ΔH and ΔS are –ve

Ans. **(1)**

65. Which of the following provide exceptions to third law of thermodynamics

(1) CO
(2) ice
(3) CO_2
(4) All the above

Ans. **(4)**

66. The Gibbs free energy change of a reaction at 27°C is –26 Kcal. and its entropy change is – 60 Cals/K. ΔH for the reaction is :–

(1) – 44 K. Cals.
(2) – 18 K. Cals.
(3) 34 K. Cals.
(4) – 24 K. Cals.

Ans. **(1)**

67. Which of the following reaction is expected never to be spontaneous :–

(1) $2O_3 \rightarrow 3O_2$
$\Delta H = -Ve, \Delta S = +Ve$

(2) $Mg + H_2 \rightarrow MgH_2$
$\Delta H = -Ve, \Delta S = -Ve$

(3) $Br_2(I) \rightarrow Br_2(g)$
$\Delta H = +Ve, \Delta S = +Ve$

(4) $2Ag + 3N_2 \rightarrow 2AgN_3$
$\Delta H = +Ve, \Delta S = -Ve$

Ans. **(4)**

ANALYTICAL EXERCISE

1. For one mole of an ideal gas

(C_p and C_v are molar heat capacities at constant pressure and constant volume respectively)

(1) $C_p - C_v = R$ (2) $C_p - C_v = \frac{R}{2}$ (3) $C_p - C_v = 2R$ (4) $C_p - C_v = 0$

Ans. (1)

2. $\Delta S°$ will be highest for the reaction

(1) $Ca + \frac{1}{2}O_2(g) \rightarrow CaO(s)$ (2) $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

(3) $C(s) + O_2(g) \rightarrow CO_2(g)$ (4) $N_2(g) + O_2(g) \rightarrow 2NO(g)$

Ans. (2)

3. A closed flask contains a substance in all its three states, solids, liquids and vapour at its triple point. In this situation the average KE of the water molecule will be

(1) Maximum in vapour state

(2) Maximum in solid state

(3) Greater in the liquid than in vapour state

(4) Same in all the three states

Ans. (4)

4. In thermodynamics a process is called reversible when

(1) System and surrounding change into each other

(2) There is no boundary between system and surrounding

(3) The surroundings are always in equilibrium with the system

(4) The system changes into the surroundings spontaneously

Ans. (3)

5. The molar heat capacity of water at constant pressure P is 75 J K^{-1} mol^{-1}. When 1.0 kJ of heat is supplied to 1000 g of water, which is free to expand, the increase in temperature of water is

(1) 1.2 K (2) 2.4 K (3) 4.8 K (4) 0.24 K

Ans. (4)

6. 16 kg oxygen gas expands at STP (1 atm) isobarically to occupy double of its original volume. The work done during the process is nearly

(1) 260 kcal (2) 180 kcal (3) 130 kcal (4) 271 kcal

Ans. (4)

7. The enthalpy and entropy change for a chemical reaction are -2.5×10^3 cal and 7.4 cal K^{-1} respectively. Predict the nature of reaction at 298 K is

(1) Spontaneous (2) Reversible (3) Irreversible (4) Non-spontaneous

Ans. (1)

8. The temperature at which the given reaction is at equilibrium

$$Ag_2O(s) \rightarrow 2Ag(s) + \frac{1}{2}O_2(g)$$

$\Delta H = 30.5$ kJ mol^{-1} and $\Delta S = 0.06$ kJ mol^{-1} K^{-1}

(1) 462.12 K (2) 362.12 K (3) 262.12 K (4) 562.12 K

Ans. (1)

9. One mole of a non ideal gas undergoes a change of state (2.0 atm, 3.0 L, 95 K) $\rightarrow$ (4.0 atm, 5.0 L, 245 K) with a change in internal energy $\Delta U = 30.0$ L atm. The change in enthalpy of the process in L atm is

(1) 40.0 (2) 42.3 (3) 44.0 (4) 56.0

Ans. **(3)**

10. Which of the following can be zero for isothermal reversible expansion ?

(1) ΔE (2) ΔH (3) ΔT (4) All of these

Ans. **(4)**

11. In an insulated container water is stirred with a rod to increase the temperature. Which of the following is true ?

(1) $\Delta U = W \neq 0, q = 0$ (2) $\Delta U = W = q \neq 0$ (3) $\Delta U = 0, W = q \neq 0$ (4) $W = 0, \Delta U = q \neq 0$

Ans. **(1)**

12. Two atoms of hydrogen combine to form a molecule of hydrogen gas the energy of the H_2 molecule is

(1) Greater than that of separate atoms (2) Equal to that of separate atoms

(3) Lower than that of separate atoms (4) Sometimes lower and sometimes higher

Ans. **(3)**

13. The temperature of 15 ml of a strong acid increases by 2°C when 15 ml of a strong base is added to it. If 5 ml of each are mixed, temperature should increase by

(1) 0.6°C (2) 0.3°C (3) 2°C (4) 6°C

Ans. **(3)**

14. If x mole of ideal gas at 27°C expands isothermally and reversibly from a volume of y to 10 y, then the work done is

(1) $w = x R 300 \ln y$ (2) $w = -300 x R \ln \frac{y}{10y}$

(3) $w = -300 x R \ln 10$ (4) $w = 100 x R \ln \frac{1}{y}$

Ans. **(3)**

15. A system X undergoes following changes

$$\underset{(P_1V_1T_1)}{X} \longrightarrow \underset{(P_2V_2T_1)}{W} \longrightarrow \underset{(P_3V_2T_2)}{Z} \longrightarrow \underset{(P_1V_1T_1)}{X}$$

The overall process may be called as

(1) Reversible process (2) Cyclic process (3) Cyclic reversible process (4) Isochoric process

Ans. **(2)**

16. The work done in an open vessel at 300 K, when 112 g iron reacts with dil HCl to give $FeCl_2$, is nearly

(1) 1.1 kcal (2) 0.6 kcal (3) 0.3 kcal (4) 0.2 kcal

Ans. **(1)**

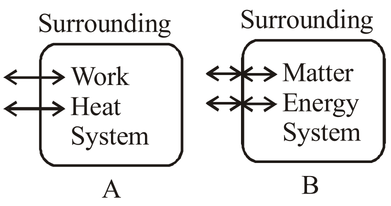
17. Which statement is correct ?

(1) $\left(\frac{dH}{dT}\right)_P < \left(\frac{dE}{dT}\right)_V$ (2) $\left(\frac{dH}{dT}\right)_P + \left(\frac{dE}{dT}\right)_V = R$

(3) $\left(\frac{dE}{dV}\right)_T$ for ideal gas is zero (4) All of these

Ans. **(3)**

18. Different types of systems are given below



The A and B systems respectively are

(1) Open system, Closed system
(2) Isolated system, Closed system
(3) Adiabatic system, Isolated system
(4) Closed system, Isolated system

Ans. **(4)**

19. Set of intensive properties is shown by

(1) Mole fraction, standard electrode potential, heat capacity.
(2) Viscosity, refractive index, specific heat.
(3) Density, Gibbs free energy, internal energy.
(4) Number of moles, molarity, electrode potential.

Ans. **(2)**

20. For the expansion occurring from initial to final stage in finite time, which is incorrect ?

(1) Equilibrium exist in initial and final stage
(2) Work obtained is maximum
(3) Driving force is much greater than the opposing force
(4) Both (1) & (2)

Ans. **(2)**

21. Consider the reaction : $N_2 + 3H_2 \rightarrow 2NH_3$ carried out at constant temperature and pressure. If ΔH and ΔU are the enthalpy and internal energy changes for the reaction, which of the following expressions is true ?

(1) $\Delta H < \Delta U$
(2) $\Delta H > \Delta U$
(3) $\Delta H = 0$
(4) $\Delta H = \Delta U$

Ans. **(1)**

22. For a reversible process at T = 300K, the volume is increased from $V_i = 1L$ to $V_f = 10L$. Calculate ΔH if the process is isothermal -

(1) 11.47 kJ
(2) 4.98 kJ
(3) 0
(4) –11.47 kJ

Ans. **(3)**

23. The conversion A to B is carried out by the following path :

$$\begin{tikzcd} C \arrow[r] & D \arrow[d] \\ A \arrow[u] & B \end{tikzcd}$$

Given : $\Delta S_{(A \rightarrow C)} = 50$ e.u. ,

$\Delta S_{(C \rightarrow D)} = 30$ e.u., $\Delta S_{(B \rightarrow D)} = 20$ e.u.

where e.u. is entropy unit then $\Delta S_{(A \rightarrow B)}$ is

(1) + 100 e.u.
(2) + 60 e.u.
(3) – 100 e.u.
(4) – 60 e.u.

Ans. **(2)**

24. For the process $H_2O(\ell)$ (1 bar , 373K) $\rightarrow$ $H_2O(g)$ (1 bar , 373K), the correct set of thermodynamic parameters is:

(1) $\Delta G = 0, \Delta S = +ve$ (2) $\Delta G = 0, \Delta S = -ve$ (3) $\Delta G = +ve, \Delta S = 0$ (4) $\Delta G = -ve, \Delta S = +ve$

Ans. **(1)**

25. The entropy change involved in the isothermal reversible expansion of 2 moles of an ideal gas from a volume of 10 dm^3 to a volume of 100 dm^3 at 27°C is :-

(1) 32.3 $J\ mol^{-1}\ K^{-1}$ (2) 42.3 $J\ mol^{-1}\ K^{-1}$ (3) 38.3 $J\ mol^{-1}\ K^{-1}$ (4) 35.8 $J\ mol^{-1}\ K^{-1}$

Ans. **(3)**

26. The incorrect expression among the following is :-

(1) $K = e^{-\Delta G^\circ/RT}$ (2) $\dfrac{\Delta G_{system}}{\Delta S_{total}} = -T$

(3) In isothermal process, $W_{reversible} = -nRT \ln \dfrac{V_f}{V_i}$ (4) $\ln K = \dfrac{\Delta H^\circ - T\Delta S^\circ}{RT}$

Ans. **(4)**

ASSERTION & REASON QUESTIONS EXERCISE–4

These questions consist of two statements each, printed as *Assertion* and *Reason.* While answering these Questions you are required to choose any one of the following four responses.

A. **If both *Assertion* & *Reason* are True & the *Reason* is a correct explanation of the *Assertion*.**

B. **If both *Assertion* & *Reason* are True but *Reason* is not a correct explanation of the Assertion.**

C. **If *Assertion* is True but the *Reason* is False.**

D. **If both *Assertion* & *Reason* are False.**

1. ***Assertion :–*** The heat absorbed during the isothermal expansion of an ideal gas against vacuum is zero.

Reason :– The volume occupied by the molecules of an ideal gas is zero. **[AIIMS 2002]**

Ans. **(C)**

2. ***Assertion :–*** For an isothermal reversible process Q = –w i.e. work done by the system equals the heat absorbed by the system.

Reason :– Enthalpy change (ΔH) is zero for isothermal process.

Ans. **(C)**

3. ***Assertion :-*** The increase in internal energy (ΔE) for the vapourization of one mole of water at 1 atm and 373 K is zero. **[AIIMS-2003]**

Reason :- For all isothermal processes $\Delta E=0$

Ans. **(D)**

4. ***Assertion:–*** Water in liquid state is more stable than ice at room temperature. **[AIIMS-2006]**

Reason:– Water in liquid from has higher entropy than ice.

Ans. **(B)**

5. ***Assertion:–*** In an isolated system the entropy increases due to spontaneous process. **[AIIMS-2006]**

Reason:– The processes in an isolated system are adiabatic.

Ans. **(A)**

6. ***Assertion :–*** Absolute value of enthalpy can not be determined.

Reason :– Enthalpy is defined as H=E+PV, and value of internal energy can not be determined absolutely therefore absolute value of enthalpy can not be determined.

Ans. **(A)**

7. ***Assertion :–*** When a rubber band is stretched entropy increases.

Reason :– During expansion entropy increases.

Ans. **(D)**

8. ***Assertion :–*** At constant pressure for the change $H_2O(s) \rightarrow H_2O(g)$ work done is negative.

Reason :– During phase transition work done is always negative.

Ans. **(C)**

9. ***Assertion :–*** The enthalpy of formation of gaseous oxygen molecules at 298K and under a pressure of one atm. is zero.

Reason :– The entropy of formation of gaseous oxygen molecules under the same condition is zero.

Ans. **(C)**

10. ***Assertion :–*** Many endothermic reactions that are not spontaneous at room temp. becomes spontaneous at high temp.

Reason :– Entropy of the system increases with increase in temperature.

Ans. **(B)**

11. ***Assertion :–*** Mass, Volume and pressure are extensive properties.

Reason :– Extensive properties depend upon the amount of the substance.

Ans. **(D)**

12. ***Assertion :–*** At constant temp 0°C and 1atm, the change $H_2O(s) \rightarrow H_2O(l)$ ΔH and ΔE both are zero.

Reason :– During isothermal process H and E both remains constant.

Ans. **(D)**

13. **Assertion :-** Entropy is always constant for a closed system. **[AIIMS-2011]**
Reason :- Closed system is always reversible

Ans. **(D)**

14. ***Assertion :–*** The change in entropy during melting of ice is negligible in comparison to change in entropy during vaporization **[AIIMS 2015]**

Reason :– The volume occupied by solid and liquid is too less in comparison to volume occupied by gas.

Ans. **(A)**