CLASS: 13th RENEET **SUBJECT: CHEMISTRY** **DPP: CHEMICAL THERMODYNAMICS**

EXERCISE-I (Conceptual Questions)

INTRODUCTION

1. The extensive property among the following is/ are :

(1) G (2) H

(3) S (4) All the above

2. Out of temperature, pressure, refractive index, viscosity, density, surface tension, specific heat, freezing point, boiling point and internal energy which is not an intensive property :

(1) Internal energy (2) Surface tension

(3) Refractive index (4) All the above

3. Which of the following is not a state function ?

(1) Work (2) Potential energy

(3) Both (1) and (2) (4) Neither (1) and (2)

4. Which of the following represents an isolated system ?

(1) $CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(S)} + CO_{2(g)} \uparrow$

(2) $CaCO_{3(s)} \rightleftharpoons CaO_{(s)} + CO_{2(g)}$

(3) $H_2O_{(\ell)} \overset{\Delta}{\rightleftharpoons} H_2O_{(g)}$ in a vaccuum flask.

(4) $Zn_{(s)} + 2HCl_{(aq)} \rightarrow ZnCl_{2(aq)} + H_2\uparrow_{(g)}$

5. 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

6. 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

7. For an adiabatic process which of the following relations is correct

(1) $\Delta E = 0$ (2) $P\Delta V = 0$

(3) $q = 0$ (4) $q = + W$

8. 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

9. 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

10. Temperature and heat are not :-

(1) Extensive properties

(2) Intensive properties

(3) Intensive and extensive properties respectively

(4) Extensive and intensive properties respectively

11. Which statement is true for reversible process :–

(1) It takes place in single step

(2) Driving force is much greater than opposing force

(3) Work obtain is minimum

(4) None

12. Choose the correct answer. A thermodynamic state function is a quantity :

(1) Used to determine the heat changes

(2) Whose value is independent of path

(3) Used to determine pressure volume work

(4) Whose value depends on temperature only

FIRST LAW OF THERMODYNAMICS ($\Delta E = q + W$)

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

(1) Isothermal (2) Isochoric

(3) Adiabatic (4) Isobaric

14. 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

15. q = –w is not true for :-

(1) Isothermal process (2) Adiabatic process

(3) Cyclic process (4) 1 and 3 both

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

(1) State, State (2) State, path

(3) Path, state (4) Path, path

17. 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 Joul (2) 400 Joul

(3) 720 Joul (4) 120 Joul

18. If 100 calorie of heat are added to system and a work of 50 calorie is done on the system, calculate the energy change of the system.

(1) –150 Joul (2) +150 cal.

(3) +50 cal (4) –50 Joule

19. 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

20. A gas absorbs 250 J of heat and expands from 1 litre to 10 litre at constant temperature against external pressure of 0.5 atm. The values of q, w and ΔE will be respectively :

(1) 250 J, 455 J, 710 J

(2) 250 J, –455 J, –205 J

(3) –250 J, –455 J, –205 J

(4) –250 J, 455 J, 205 J

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

21. 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

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

(1) Always negative

(2) Always positive

(3) Zero

(4) May be positive or negative

23. 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

24. The difference between heats of reaction at constant pressure and constant volume for the reaction

$2C_6H_6(l) + 15O_2(g) \longrightarrow 12CO_2(g) + 6\,H_2O(l)$ at 25^{0}C in KJ is

(1) + 7.43 (2) +3.72

(3) – 7.43 (4) – 3.72

25. For a gaseous reaction,

$A(g) + 3B(g) \longrightarrow 3C(g) + 3D(g)$

ΔE is 17 Kcal at 27^{0}C assuming R = 2 cal K^{-1} mol^{-1}, the value of ΔH for the above reaction is:

(1) 15.8 Kcal (2) 18.2 Kcal

(3) 20.0 Kcal (4) 16.4 Kcal

26. 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) $\Delta H = \Delta U$

27. For a reversible process at T = 300K, the volume of an ideal gas 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

28. A mixture of 2 moles of carbon monoxide and one mole of oxygen in a closed vessel is ignited to get carbon dioxide. If Δ H is the enthalpy change and Δ E 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

29. For the gaseous reaction involving the complete combustion of isobutane at 100°C temperature -

(1) $\Delta H = \Delta E$ (2) $\Delta H > \Delta E$

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

30. Heat of reaction for , $CO(g) + ½\ O_2(g) \rightarrow CO_2(g)$ 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

31. 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}

32. For the system $S(s) + O_2(g) \rightarrow SO_2(g)$:–

(1) $\Delta H = \Delta E$ (2) $\Delta H > \Delta E$

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

33. 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

34. 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.

35. 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.

36. 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

37. For which of the following reaction ΔH is greater than ΔE ?

(1) $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

(2) $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(\ell)}$

(3) $PCl_{5(s)} \rightarrow PCl_{3(g)} + Cl_{2(g)}$

(4) $HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(\ell)}$

38. For the reaction

$B_2H_{6(g)} + 3O_{2(g)} \rightarrow B_2O_{3(s)} + 3H_2O(\ell)$

ΔE = –2143.2 kJ. Calculate ΔH for the reaction at 25ºC :

(1) – 2153.1 kJ mol^{-1} (2) –2133.6 kJ $mole^{-1}$

(3) –21.33 kJ $mole^{-1}$ (4) –2143.2 kJ $mole^{-1}$

HEAT CAPACITY & WORK DONE IN DIFFERENT PROCESS

39. Temperature of 1 mol of a gas is increased by 1º at constant pressure. Work done is :

(1) R (2) 2R

(3) R/2 (4) 3R

40. 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 25ºC 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) $-2.303 \times 2 \times 298 \log 2$

41. 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

42. Two moles of an ideal gas expand spontaneouly into vacuum. The work done is :–

(1) Zero (2) 2 J

(3) 4 J (4) 8 J

43. 8 gm of O_2 at STP is expanded so that the volume is doubled. The maximum work done is :

(1) –3.8 lit. atm (2) –5.6 lit. atm

(3) –2.6 lit. atm (4) –4.8 lit. atm

44. 5.6 dm^3 of an unknown gas at STP requires 52.25 J of heat of raise its temperature by 10°C at constant volume. Calculate atomicity of the gas.

(1) monoatomic (2) diatomic

(3) triatomic (4) polymatic

45. Calculate the number of kJ necessary to raise the temperature of 60.0 g of aluminium from 35° to 55°C. Molar heat capacity of aluminium is 24 J mol^{-1} K^{-1} :

(1) 2.14 kJ (2) 1.07 kJ

(3) 0.535 kJ (4) 1.605 kJ

46. A 1.250 g sample of octane (C_8H_{18}) is burned in excess of oxygen in a bomb calorimeter. The temperature of the calorimeter rises from 294.05 K to 300.78 K. If heat capacity of the calorimeter is 8.93 kJ/K, find the internal energy change for combustion of the sample of octane.

(1) 60.1 kJ mol^{-1} (2) 5481.1 kJmol^{-1}

(3) 54.81 kJ mol^{-1} (4) 66.2 kJ mol^{-1}

47. 5 mole of oxygen are heated at constant volume from 10°C to 20°C. What will be the change in the internal energy of gas? The molar heat of oxygen at constant pressure, C_P = 7.03 cal mol^{-1} deg^{-1} and R = 8.31 J mol^{-1} deg^{-1}

(1) zero (2) 5.04 cal

(3) 252 cal (4) 21 cal.

ENTROPY/SECOND LAW OF THERMODYNAMICS

48. 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

49. Entropy means

(1) Disorderness (2) Randomness

(3) Orderness (4) both 1 & 2

50. ΔS for the reaction;

$MgCO_3(s) \longrightarrow MgO(s) + CO_2(g)$ will be :

(1) 0 (2) –ve

(3) +ve (4) ∞

51. 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)

52. 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}

53. Which has the least entropy :

(1) Graphite (2) Diamond

(3) N_2(g) (4) N_2O(g)

54. When two gases are mixed the entropy :–

(1) Remains constant (2) Decreases

(3) Increases (4) Becomes zero

55. The enthalpy of vaporisation of per mole of ethanol (b.p. = 79.5°C and ΔS = 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

56. 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

57. In a spontaneous irreversible process the total entropy of the system and surroundings

(1) Remains constant (2) Increases

(3) Decreases (4) Zero

58. Calculate the entropy of $Br_2(g)$ in the reaction $H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$, $\Delta S° = 20.1 JK^{-1}$ 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}

59. 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

60. In which of the following case entropy decreases–

(1) Solid changing to liquid

(2) Expansion of a gas

(3) Crystals dissolve

(4) Polymerisation

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

(1) Enthalpy (2) Entropy

(3) Free energy (4) None

62. Which of the following processes is accompanied by an increase in entropy ?

(1) Normal rubber band to stretched rubber band

(2) Normal egg to hard boiled egg

(3) Decomposition of HI into H_2 and I_2

(4) Formation of NH_3 from N_2 and H_2

63. 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 $mol^{-1} K^{-1}$

64. 2 mole of an ideal gas at 27ºC temperature is expanded reversibly from 2 lit to 20 lit. Find entropy change (R = 2 cal/mol K) :

(1) 92.1 (2) 0

(3) 4 (4) 9.2

65. Predict in which of the following entropy decreases.

(1) A liquid crystallizes into a solid

(2) Temperature of a crystalline solid is raised from 0K to 115 K

(3) $2 NaHCO_3 (s) \longrightarrow Na_2CO_3 (s) + CO_2 (g) + H_2O (g)$

(4) $H_2 (g) \longrightarrow 2H (g)$

GIBBS FREE ENERGY

66. For a reaction at 25°C 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

67. The spontaneous nature of a reaction is impossible if :

(1) Δ H is +ve, Δ S is also +ve

(2) Δ H is – ve; Δ S is also – ve

(3) Δ H is –ve ; Δ S is +ve

(4) Δ H is +ve; Δ S is –ve

68. The temperature at which the reaction

$Ag_2O(s) \longrightarrow 2Ag(s) + ½ O_2(g)$

is at equilibrium is .....;

Given $\Delta H = 30.5$ KJ mol^{-1}

and $\Delta S = 0.066$ KJK^{-1} mol^{-1} :

(1) 462.12 K (2) 362.12 k

(3) 262.12 k (4) 562.12k

69. 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

70. 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) $\Delta H = T\Delta S$

71. 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

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

(1) $\Delta H = 0$ (2) $\Delta G = 0$

(3) ΔG = –ve (4) $\Delta H = \Delta G$

73. What is the sign of ΔG for the process of ice melting at 283 K ?

(1) $\Delta G > 0$ (2) $\Delta G = 0$

(3) $\Delta G < 0$ (4) None of these

74. 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

75. A reaction A + B ⟶ 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

76. 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

77. 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

78. 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

79. 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

80. 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

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

(1) CO (2) ice

(3) CO_2 (4) All the above

82. 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.

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

(1) $2O_3 \rightarrow 3O_2$ ΔH = – Ve, ΔS = + Ve

(2) $Mg + H_2 \rightarrow MgH_2$ ΔH = – Ve, ΔS = – Ve

(3) $Br_2(l) \rightarrow Br_2(g)$ ΔH = + Ve, ΔS = + Ve

(4) $2Ag + 3N_2 \rightarrow 2AgN_3$ ΔH = + Ve, ΔS = – Ve

84. Identify the correct statement regarding a sponateous process :-

(1) For a spontaneous process in an isolated system, the change in entropy is positive

(2) Endothermic processes are never spontaneous

(3) Exothermic processes are always spontaneous

(4) Lowering of energy in the reaction process is the only criterion for spontaneity

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

(1) $\Delta G = 0$, ΔS =+ve (2) $\Delta G = 0$, ΔS = –ve

(3) ΔG = +ve, ΔS=0 (4) ΔG = –ve, ΔS = +ve

86. Which of the following conditions is not favourable for the feasibility of a process ?

(a) ΔH = –ve, $T\Delta S$ = –ve and $T\Delta S < \Delta H$

(b) ΔH = +ve, $T\Delta S$ = +ve and $T\Delta S = \Delta H$

(c) ΔH = –ve, $T\Delta S$ = +ve and $\Delta H > T\Delta S$

(d) ΔH = +ve, $T\Delta S$ = +ve and $\Delta H > T\Delta S$

(1) b,d (2) a, c

(3) a,b,d (4) all

87. If the equilibrium constant K for Daniell cell is 10^{-3}, then ΔG^o for the reaction at 300 K (assume R = 8 JK^{-1} mol^{-1}) is :

(1) 74.1713 J (2) 16.582 kJ

(3) 165.82 kJ (4) 16582 kJ

88. Calculate the equilibrium constant, K for the following reaction at 400 K?

$2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$

Given that $\Delta_r H° = 80.0$ kJ mol^{-1} and

$\Delta_r S° = 120$ J K^{-1} mol^{-1} at 400 K.

(1) 6.6×10^{-5} (2) $6.6 \times 10^{+5}$

(3) 32×10^{3} (4) 66×10^{-7}

89. For the homogeneous reactions :

$xA + yB \longrightarrow lY + mZ$

ΔH = – 30 kJ mol^{-1}, ΔS = – 100 J K^{-1} mol^{-1}.

At what temperature the reaction is at equilibrium?

(1) 50°C (2) 100 K

(3) 27°C (4) 300 °C

90. For the reaction $CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$,

ΔH and ΔS are –283 kJ and – 87 J K^{-1} mol^{-1} respectively. It was intended to carry out this reaction at 1000, 1500, 3000 and 3500 K. At which of these temperatures would this reaction be thermodynamically spontaneous.

(1) 1500 and 3500 K

(2) 3000 and 3500 K

(3) 1000, 1500 and 3000 K

(4) At all of the above temperatures

ENERGETICS

EXOTHERMIC/ENDOTHERMIC REACTION/ THERMOCHEMICAL EQUATION

91. The formation of water from $H_2(g)$ and $O_2(g)$ is an exothermic process because :

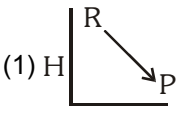
(1) The chemical energy of $H_2(g)$ and $O_2(g)$ is more than that of water

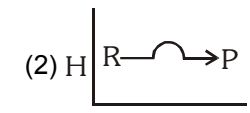
(2) The chemical energy of $H_2(g)$ and $O_2(g)$ is less than that of water

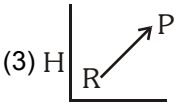
(3) The temperature of $H_2(g)$ and $O_2(g)$ is higher than that of water

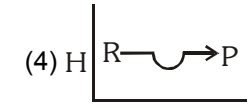
(4) The temperature of $H_2(g)$ and $O_2(g)$ is lower than that of water

92. Which plot represents for an exothermic reaction:

(1) 

(2) 

(3) 

(4) 

93. Which one of the following is not applicable for a thermochemical equation :

(1) It tells about physical state of reactants and products

(2) It tells whether the reaction is spontaneous

(3) It tells whether the reaction is exothermic or endothermic

(4) It tells about the allotropic form (if any) of the reactants

94. The correct thermochemical equation is :

(1) $C + O_2 \longrightarrow CO_2$; $\Delta H = -94$ Kcal

(2) $C + O_2 \longrightarrow CO_2$; $\Delta H = +94.0$ Kcal

(3) $C(s) + O_2(g) \longrightarrow CO_2(g)$; $\Delta H = -94$ Kcal

(4) $C(s) + O_2(g) \longrightarrow CO_2(g)$; $\Delta H = +94$ Kcal

95. The enthalpy changes of formation of the gaseous oxide of nitrogen (N_2O and NO) are positive because of :

(1) The high bond energy of the nitrogen molecule

(2) The high electron affinity of oxygen atoms

(3) The high electron affinity of nitrogen atoms

(4) The tendency of oxygen to form O^{2-}

96. ΔH for transition of carbon in the diamond form to carbon in the graphite form is – 453.5 cal. This suggests that :

(1) Graphite is chemically different from diamond

(2) Graphite is as stable as diamond

(3) Graphite is more stable than diamond

(4) Diamond is more stable than graphite

97. Which of the following values of heat of formation indicates that the product is least stable

(1) – 94 K cal (2) – 231.6 K cal

(3) + 21.4 K cal (4) + 64.8 K cal

98. Heat of formation, ΔH_f° of an explosive compound like NCl_3 is –

(1) Positive (2) Nagative

(3) Zero (4) Positive or negative

99. According to the following reaction

$C(S) + 1/2\ O_2(g) \rightarrow CO(g)$, $\Delta H = -26.4$ Kcal

(1) CO is an endothermic compound

(2) CO is an exothermic compound

(3) The reaction is endothermic

(4) None of the above

100. Which of the following represents an exothermic reaction:-

(1) $N_2(g) + O_2(g) \rightarrow 2NO(g)$, $\Delta H = 180.5$ KJ

(2) $H_2O(g) + C(s) \rightarrow CO(g) + H_2(g)$, $\Delta E = 131.2$KJ

(3) $2HgO(s) + 180.4\ KJ \rightarrow 2Hg(\ell) + O_2(g)$

(4) $2Zn(s) + O_2(g) \rightarrow 2ZnO(s)$, $\Delta E = -693.8$ KJ

101. The heat change during the reaction 24g C and 128g S following the change $C+S_2 \rightarrow CS_2$; ΔH=22K cal

(1) 22 K cal (2) 11 K cal

(3) 44 K cal (4) 32 K cal

102. Consider the reaction $3O_2 \rightarrow 2O_3$; ΔH = + Ve, from the reaction, we can say that :–

(1) Ozone is more stable then oxygen

(2) Ozone is less stable then oxygen and ozone decomposes forming oxygen readily

(3) Oxygen is less stable than ozone and oxygen decomposes forming ozone readily

(4) None of the above

103. From the reaction P(White) $\rightarrow$ P(Red) ; $\Delta H = -18.4$KJ, it follows that :-

(1) Red P is readily formed from white P

(2) White P is readily formed from red P

(3) White P can not be converted to red p

(4) White P can be converted into red P and red P is more sable

FACTORS AFFECTING HEAT OF THE REACTION

104. In Kirchoff's equation which factor affects the heat of reaction :

(1) Pressure (2) Temperature

(3) Volume (4) Atomicity

105. For the reaction; $H_2(g) + ½\ O_2(g) = H_2O(\ell)$, $\Delta C_p = 7.63$ cal/deg; $\Delta H_{25^0C} = 68.3$ Kcal, what will be the value (in Kcal) of ΔH at 100^0C :

(1) $7.63 \times (373 - 298) - 68.3$

(2) $7.63 \times 10^{-3} (373 - 298) - 68.3$

(3) $7.63 \times 10^{-3} (373 - 298) + 68.3$

(4) $7.63 \times (373 - 298) + 68.3$

106. The enthalpy of a reaction at 273 K. is – 3.57 KJ. what will be the enthalpy of reaction at 373 K if ΔC_p = zero :–

(1) – 3.57 (2) Zero

(3) $-3.57 \times \frac{373}{273}$ (4) – 375

107. For the reactions,

(i) $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g) + xKJ$

(ii) $H_2(g) + Cl_2(g) \longrightarrow 2HCl(\ell) + yKJ$

Which one of the following statement is correct :

(1) x > y (2) x < y

(3) x = y (4) More data required

HEAT OF FORMATION

108. Since the enthalpy of the elements in their standard states is taken to be zero. The heat of formation (ΔH_f) of compounds :

(1) Is always negative

(2) Is always positive

(3) Is zero

(4) May be positive or negative

109. Reaction $H_2(g) + I_2(g) \longrightarrow 2HI$; $\Delta H = 12.40$ Kcal. According to this, heat of formation of HI will be –

(1) 12.40 Kcal (2) – 12.40 Kcal

(3) – 6.20 Kcal (4) 6.20 Kcal

110. At 300K the satandard enthalpies of formation of $C_6H_5COOH_{(s)}$, $CO_{2(g)}$ and $H_2O_{(l)}$ are –408, –393 and –286 kJ mol^{-1} respectively. Calculate the heat of combustion of benzoic acid at contant volume :

(1) +3201 kJ (2) +3199.75 kJ

(3) –3201 kJ (4) –3199.75 kJ

111. Enthalpy of a compound is equal to its :-
(When it is formed from constituent particles)

(1) Heat of combustion (2) Heat of formation

(3) Heat of reaction (4) Heat of solution

112. The enthalpy of formation of ammonia is –46.0 KJ mol^{-1}. The enthalpy change for the reaction $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$ is :

(1) 46.0 KJ mol^{-1} (2) 92.0 KJ mol^{-1}

(3) – 23.0 KJ mol^{-1} (4) – 92.0 KJ mol^{-1}

113. Given enthalpy of formation of $CO_2(g)$ and CaO(s) are – 94.0 KJ and – 152 KJ respectively and the enthalpy of the reaction :

$CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$ is 42 KJ. The enthalpy of formation of $CaCO_3(s)$ is

(1) – 42 KJ (2) – 202 KJ

(3) +202 KJ (4) – 288KJ

114. The standard molar heat of formation of ethane, CO_2 and water(ℓ) are respectively –21.1, –94.1 and – 68.3 Kcal. The standard molar heat of combustion of ethane will be

(1) –372 Kcal (2) –162 Kcal

(3) – 240 Kcal (4) –183.5 Kcal

115. 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 seperate atoms

(2) Equal to that of seperate atoms

(3) Lower than that of seperate atoms

(4) Some times lower and some times higher

116. The ΔH_f° for $CO_{2(g)}$, $CO_{(g)}$ and $H_2O_{(g)}$ are –393.5, –110.5 and –241.8 KJ mol^{-1}respectively the standard enthalpy change (in KJ) for the reaction $CO_{2(g)} + H_{2(g)} \rightarrow CO_{(g)} + H_2O_{(g)}$ is -

(1) 524.1 (2) 41.2

(3) –262.5 (4) –41.2

117. The enthalpies of combustion of carbon and carbon monoxide are –393.5 KJ and –283 KJ, respectively the enthalpy of formation of carbon monoxide is :

(1) –676.5 KJ (2) –110.5 KJ

(3) 110.5 KJ (4) 676.5 KJ

118. The standard heat of formation of $CS_2(\ell)$ will be; given that the standard heat of combustion of carbon (s), sulphur(s) and $CS_2(\ell)$ are –393.3, –293.72 and –1108.76 KJ mol^{-1} respectively is

(1) – 128.02 KJ $mole^{-1}$ (2) + 12.802 KJ mol^{-1}

(3) +128.02 KJ mol^{-1} (4) –12.802 KJ mol^{-1}

119. The heat of combustion of $CH_{4\,(g)}$, $C_{(s)}$ and $H_{2\,(g)}$ at 25 °C are –212.4 K cal, –94.0 K cal and –68.4 K cal respectively, the heat of formation of CH_4 will be -

(1) +54.4 K cal (2) –18.4 K cal

(3) –375.2 K cal (4) +212.8 K cal

120. Standard enthalpy of formation is zero for .

(1) $C_{diamond}$ (2) $Br_{2(g)}$

(3) $C_{graphite}$ (4) $O_{3(g)}$

121. M is a metal that forms an oxide

M_2O, $\frac{1}{2}M_2O \rightarrow M + \frac{1}{4}O_2$ ΔH = 120 K. Cal.

When a sample of metal M reacts with one mole of oxygen what will be the ΔH in that case

(1) 240 K. Cal. (2) – 240 K. Cal.

(3) 480 K. Cal. (4) – 480 K. Cal.

122. When ethyne is passed through a red hot tube, then formation of benzene takes place :

$\Delta H^{\circ}_{f(C_2H_2)(g)} = 230\,kJ\ mol^{-1}$

$\Delta H^{\circ}_{f(C_6H_6)(g)} = 85\,kJ\ mol^{-1}$

Calculate the standard heat of trimerisation of ethyne to benzene.

$3C_2H_2(g) \longrightarrow C_6H_6(g)$

(1) 205 kJ mol^{-1} (2) 605 kJ mol^{-1}

(3) – 605 kJ mol^{-1} (4) – 205 kJ mol^{-1}

123. Enthalpy of formation of FeO and Fe_2O_3 are 65 kcal and –197 kcal, respectively. The heat of the reaction $2FeO + ½O_2 \rightarrow Fe_2O_3$ will be :

(1) –50 kcal (2) –327 kcal/mole

(3) –0.5 kJ (4) –5 kJ

HEAT OF COMBUSTION

124. According to equation,

$C_6H_6(\ell) + 15/2\ O_2(g) \longrightarrow 6CO_2(g) + 3H_2O(\ell)$; $\Delta H = -3264.4$ KJ mol^{-1} the energy evolved when 7.8 g benzene is burnt in air will be -

(1) 163.22 KJ (2) 32.64 KJ

(3) 3.264 KJ (4) 326.4 KJ

125. Heat of combustion of CH_4,C_2H_6, C_2H_4 and C_2H_2 gases are –212.8, –373.0, –337.0 and –310.5 Kcal respectively at the same temperature. The best fuel among these gases is :

(1) CH_4 (2) C_2H_6

(3) C_2H_4 (4) C_2H_2

126. Given standard enthalpy of formation of CO (–110 KJ mol^{-1}) and CO_2(–394 KJ mol^{-1}). The heat of combustion when one mole of graphite burns is

(1) – 110 KJ (2) – 284 KJ

(3) – 394 KJ (4) – 504 KJ

127. The enthalpy of formation for $C_2H_4(g)$, $CO_2(g)$ and $H_2O(\ell)$ at 25^0C and 1 atm. pressure are 52, - 394 and - 286 KJ $mole^{-1}$ respectively. The enthalpy of combustion of C_2H_4 will be:-

(1) + 1412 KJ $mole^{-1}$ (2) - 1412 KJ $mole^{-1}$

(3) + 142.2 KJ $mole^{-1}$ (4) - 141.2 KJ $mole^{-1}$

128. If heat of combustion of ethylene is 1411 KJ when a certain amount of ethylene was burnt 6226 KJ heat was evolved. Then the volume of O_2 (at NTP) that entered into the reaction is :–

(1) 296.5 ml (2) 296.5 litre

(3) 6226 × 22.4 litre (4) 22.4 litre

129. A person requires 2870 Kcal of energy to lead normal daily life. If heat of combustion of cane sugar is –1349 Kcal, then his daily consumption of sugar is :

(1) 728g (2) 0.728g

(3) 342g (4) 0.342g

130. On complete combustion of 2 gm methane 26575 cals heat is generated. The heat of formation of methane will be (given heat of formation of CO_2 and H_2O are – 97000 and – 68000 cals respectively) :

(1) + 20400 cals (2) + 20600 cals

(3) – 20400 cals (4) – 2000 cals

131. X gm of ethanal was subjected to combustion in a bomb calorimeter and the heat produced is YJoules. Then -

(1) $\Delta E_{(combustion)} = -XJ$

(2) $\Delta E_{(combustion)} = -YJ$

(3) $\Delta E_{(combustion)} = -\frac{44Y}{X}$ J mol^{-1}

(4) $\Delta H_{(combustion)} = -\frac{44Y}{X}$ J mol^{-1}

132. The following are the heats of reactions -

(i) ΔH_f° of $H_2O_{(\ell)} = -68.3$ K cal mol^{-1}

(ii) $\Delta H_{comb.}^\circ$ of $C_2H_2 = -337.2$ K cal mol^{-1}

(iii) $\Delta H_{comb.}^\circ$ of $C_2H_4 = -363.7$ K cal mol^{-1}

Then heat change for the reaction $C_2H_2 + H_2 \rightarrow C_2H_4$ is -

(1) –716.1 K cal (2) + 337.2 K cal

(3) –41.8 K cal (4) –579.5 K cal

133. The heat of combustion of a substance is :-

(1) Always positive

(2) Always negative

(3) Numerically equal to the heat of formation

(4) 1 and 3 both

134. The value of ΔH for the combustion of C(s) is –94.4 Kcal. The heat of formation of $CO_2(g)$ is :-

(1) –49.5 K cal (2) –94.4 K cal

(3) –188.0 K cal (4) More data required

135. In the combustion of 0.4 g. of CH_4, 0.25 Kcal. of heat is liberated. The heat of combustion of CH_4 is

(1) – 20 K. Cals. (2) – 10 K. Cals.

(3) – 2.5 K. Cals. (4) – 5 K. Cals.

136. If $C_6H_{12}O_6(s) + 9O_2(g) \rightarrow 6CO_2(g) + 6H_2O(g)$; ΔH= - 680 Kcal The weight of $CO_2(g)$ produced when 170 Kcal of heat is evolved in the combustion of glucose is:-

(1) 265 gm (2) 66 gm

(3) 11 gm (4) 64 gm

137. Which of the following equations corresponds to the enthalpy of combustion at 298 K :-

(1) $C_2H_6(g) + 7/2\ O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$

(2) $2C_2H_6(g) + 7\ O_2(g) \rightarrow 4CO_2(g) + 6H_2O(g)$

(3) $C_2H_6(g) + 7/2\ O_2(g) \rightarrow 2CO_2(g) + 3H_2O(\ell)$

(4) $2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(\ell)$

138. Heat of formation of CO_2 is - 94.0 K. cal. What would be the quantity of heat liberated, when 3 g of graphite is burnt in excess of oxygen:-

(1) 23.5 K cals (2) 2.35 K cals

(3) 94.0 K cals (4) 31.3 K cals

139. Equal volumes of H_2 and C_2H_2 are combusted under identical conditions. The ratio of their heats of combustion is :

$H_{2(g)} + ½O_{2(g)} \rightarrow H_2O_{(g)}$; $\Delta H = -241.8$ kJ

$C_2H_{2(g)} + 2½O_{2(g)} \rightarrow 2CO_{2(g)} + H_2O_{(l)}$; $\Delta H = -1300$kJ

(1) 5.37/1 (2) 1/5.37

(3) 1/1 (4) None of these

HEAT OF NEUTRILIZATION

140. The amount of heat liberated when one mole of NH_4OH reacts with one mole of HCl is

(1) 13.7 Kcal (2) More than 13.7 Kcal

(3) Less than 13.7 Kcal (4) Cannot be predicted

141. If $H^+ + OH^- = H_2O$ + 13.7 Kcal, then heat of complete neutralisation of one gram mol of H_2SO_4 with strong base will be :

(1) 13.7 Kcal (2) 27.4 Kcal

(3) 6.85 Kcal (4) 3.425 Kcal

142. Heat of neutralisation of a strong dibasic acid in dilute solution by NaOH is nearly :

(1) – 27.4 Kcal/eq (2) – 13.7 Kcal / eq

(3) 13.7 Kcal / eq. (4) – 13.7 Kcal/mol

143. The temperature of a 5 ml of strong acid increases by 5^0C when 5 ml of a strong base is added to it. If 10 ml of each are mixed temperature should increase by :

(1) 5^0 C (2) 10^0C

(3) 15^0C (4) Cannot be known

144. The heat of neutralization of HCl by NaOH is –55.9 KJ/ mol. If the heat of neutralization of HCN by NaOH is – 12.1 KJ/mol. The energy of dissociation of HCN is

(1) – 43.8 KJ (2) 43.8 KJ

(3) 68 KJ (4) – 68 KJ

145. If water is formed from H^+ ions and OH^- the heat of formation of water is :

(1) – 13.7 Kcal (2) 13.7 KCal

(3) –63.4 Kcal (4) More data required

146. The change in the enthalpy of

$NaOH + HCl \longrightarrow NaCl + H_2O$ is called :

(1) Heat of neutralisation

(2) Heat of reaction

(3) Heat of hydration

(4) Heat of solution

147. Heat of neutralisation of oxalic acid is –106.7 $KJmol^{-1}$ using NaOH hence ΔH of :

$H_2C_2O_4 \longrightarrow C_2O_4^{2-} + 2H^+$ is :-

(1) 5.88 KJ (2) –5.88 KJ

(3) –13.7 K cal (4) 7.5 KJ

148. The amount of energy releasd when 20 ml of 0.5 M NaOH are mixed with 100 ml of 0.1 M HCl is x kJ. The heat of neutralisation (in kJ mol^{-1}) is :

(1) –100 x (2) –50 x

(3) +100 x (4) +50 x

149. Enthalpy of neutralisation of HCl with NaOH is x. The heat evolved when 500 ml of 2N HCl are mixed with 250 ml of 4 N NaOH will be :

(1) 500 x (2) 100 x

(3) x (4) 10 x

150. The enthalpy change ΔH for the neutralisation of 1 M HCl by caustic potash in dilute solution at 298 K is :

(1) 68 kJ (2) 65 kJ

(3) 57.3 kJ (4) 50 kJ

HEAT OF HYDROGENATION

151. The heat of combustion of C_2H_4, C_2H_6 and H_2 are –1409.5 KJ, –1558.3 KJ and –285.6 KJ. The heat of hydrogenation of ethene is -

(1) –136.8 KJ (2) –13.68 KJ

(3) 273.6 KJ (4) 1.368 KJ

152. The enthalpy of combustion of cyclohexane, cyclohexene and H_2 are respectively - 3920, - 3800 and - 241 KJ mol^{-1}. The heat of hydrogenation of cyclohexene is:-

(1) –121 KJ mol^{-1} (2) 121 KJ mol^{-1}

(3) –242 KJ mol^{-1} (4) 242 KJ mol^{-1}

BOND ENERGY / RESONANCE ENERGY

153. Bond energy of a molecule :

(1) Is always negative

(2) Is always positive

(3) Either positive or negative

(4) Depends upon the physical state of the system

154. Among the following for which reaction heat of reaction represents bond energy of HCl

(1) $HCl(g) \longrightarrow H^+(g) + Cl^-(g)$

(2) $HCl(g) \longrightarrow \frac{1}{2} H_2(g) + \frac{1}{2} Cl_2(g)$

(3) $2HCl(g) \longrightarrow H_2(g) + Cl_2(g)$

(4) $HCl(g) \longrightarrow H(g) + Cl(g)$

155. The bond energies of F_2, Cl_2, Br_2 and I_2 are 155.4, 243.6, 193.2 and 151.2 $KJmol^{-1}$ respectively. The strongest bond is :

(1) F – F (2) Cl – Cl

(3) Br – Br (4) I – I

156. Energy required to dissociate 4g of gaseous hydrogen into free gaseous atoms is 208 Kcal at 25^0C. The bond energy of H—H bond will be :

(1) 1.04 Kcal (2) 10.4 Kcal

(3) 104 Kcal (4) 1040 Kcal

157. Heat evolved in the reaction $H_2 + Cl_2 \longrightarrow 2HCl$ is 182 KJ. Bond energies of H–H and Cl–Cl are 430 and 242 KJ/ mol respectively. The H – Cl bond energy is :

(1) 245 KJ mol^{-1} (2) 427 KJ mol^{-1}

(3) 336 KJ mol^{-1} (4) 154 KJ mol^{-1}

158. The enthalpy change for the reaction

$H_2(g) + C_2H_4(g) \rightarrow C_2H_6(g)$ is..... . The bond energies are,

H – H = 103, C – H = 99, C – C = 80 &

C = C =145 K cal mol^{-1}

(1) –10 K cal mol^{-1} (2) +10 K cal mol^{-1}

(3) – 30 K cal mol^{-1} (4) +30 K cal mol^{-1}

159. Bond dissociation enthalphies of $H_2(g)$ and $N_2(g)$ are 436.0 kJ mol^{-1} and 941.8 kJ mol^{-1} respectively and enthalpy of formation of $NH_3(g)$ is –46 kJ mol^{-1}. What is enthalpy of atomization of $NH_3(g)$?

(1) 390.3 kJ mol^{-1} (2) 1170.9 kJ mol^{-1}

(3) 590 kJ mol^{-1} (4) 720 kJ mol^{-1}

160. From the reactions :

$C(s) + 2H_2(g) \rightarrow CH_4(g)$ ΔH = - X Kcal

$C(g) + 4H(g) \rightarrow CH_4(g)$, ΔH = - X_1 Kcal

$CH_4(g) \rightarrow CH_3(g) + H(g)$ ΔH = + Y(Kcal)

Bond energy of C–H bond is –

(1) $\frac{X}{4}$ K cal. mol^{-1} (2) Y K cal. mol^{-1}

(3) $\frac{X_1}{4}$ K cal. mol^{-1} (4) X_1 K cal. mol^{-1}

161. The enthalpy changes at 298 K in successive breaking of O–H bonds of water are

$H_2O \longrightarrow H(g) + OH(g)$; ΔH = 498 KJ mol^{-1}

$OH(g) \longrightarrow H(g) + O(g)$; ΔH = 428 KJmol^{-1}

the bond enthalpy of O–H bond is

(1) 498 KJ mol^{-1} (2) 428 KJ mol^{-1}

(3) 70 KJ mol^{-1} (4) 463 KJ mol^{-1}

162. If ΔH_f° of $ICl_{(g)}$, $Cl_{(g)}$, and $I_{(g)}$ is 17.57, 121.34 and 106.96 J mol^{-1} respectively. Then bond dissociation energy of ICl bond is -

(1) 35.15 J mol^{-1} (2) 106.69 J mol^{-1}

(3) 210.73 J mol^{-1} (4) 420.9 J mol^{-1}

163. Heat of dissociation of benzene to elements is 5535 KJ mol^{-1}. The bond enthalpies of C – C, C = C and C – H are 347.3, 615.0 and 416.2 KJ respectively. Resonance energy of benzene is

(1) 1.51 KJ (2) 15.1 KJ

(3) 151 KJ (4) 1511 KJ

164. What is the ΔH in the reaction

$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O(\ell)$. Bond energies of (H–H), (O=O) and (O–H) are 105, 120 and 110 kcals per mole respectively :

(1) –100 Kcal $mole^{-1}$ (2) –120 Kcal $mole^{-1}$

(3) –11 Kcal $mole^{-1}$ (4) –110 Kcal $mole^{-1}$

SOME OTHER HEAT OF REACTIONS

165. If $H_2(g) = 2H(g)$; ΔH = 104 Kcal, than heat of atomisation of hydrogen is :

(1) 52 Kcal (2) 104 Kcal

(3) 208 Kcal (4) None of these

166. The heat of combustion of yellow phosphorous and red phosphorous are – 9.91 KJ and –8.78 KJ respectively. The heat of transition of yellow phosphorous to red phosphorous is

(1) –18.69 KJ (2) +1.13 KJ

(3) +18.69 KJ (4) –1.13 KJ

167. For the change C (diamond) $\longrightarrow$ C(graphite) ; Δ H = – 1.89 KJ, if 6 g of diamond and 6g of graphite are seperately burnt to yield CO_2 the heat liberated in first case is :

(1) Less than in the second case by 1.89 KJ

(2) Less than in the second case by 11.34 KJ

(3) Less than in the second case by 14.34KJ

(4) More than in the second case by 0.945KJ

168. $2CO_{(g)} + O_{2(g)} \longrightarrow 2CO_{2(g)} + X$ KJ

In the above equation X KJ refers to :

(1) Heat of formation of CO_2

(2) Heat of vapourisation

(3) Heat of reaction

(4) Heat of sublimation

169. Which of the following reactions represents ΔH (hydration) :–

(1) $CuSO_4(s) + (aq) \rightarrow CuSO_4(aq)$; $\Delta H = – xKJ$

(2) $BaCl_2(s) + 2H_2O(\ell) \rightarrow BaCl_2 . 2H_2O(s)$; $\Delta H = – x'$ KJ

(3) $CuSO_4(s) + 5H_2O(\ell) + (aq) \rightarrow CuSO_4 . 5H_2O(aq)$; $\Delta H = – y'$ KJ

(4) None of the above

170. Given that :

$A(s) \rightarrow A(\ell)$; $\Delta H = x$, $A(\ell) \rightarrow A(g)$ - y

The heat of sublimation of A will be:-

(1) x + y (2) x - y

(3) x or y (4) - (x + y)

171. $S_{(rhombic)} + O_{2(g)} \longrightarrow SO_{2(g)}$; $\Delta H = –297.5$ KJ

$S_{(monoclinic)} + O_{2\ (g)} \longrightarrow SO_{2(g)}$; $\Delta H = –300$ KJ

The data can predict that –

(1) Rhombic sulphur is yellow in colour

(2) Monoclinic sulphur has metallic lusture.

(3) Monoclinic sulphur is more stable

(4) Δ H transition of S_R to S_M is endothermic

HESS'S LAW

172. The enthalpy change of a reaction does not depend on

(1) State of reactants and products

(2) Nature of reactants and products

(3) Different intermediate reactions

(4) Initial and final enthalpy change of reaction

173. From the thermochemical reactions,

C(graphite) + ½ $O_2 \longrightarrow$ CO ; $\Delta H = – 110.5$ KJ

CO + ½ $O_2 \longrightarrow CO_2$; $\Delta H = – 283.2$ KJ

the heat of reaction of C(graphite) + $O_2 \longrightarrow CO_2$ is

(1) 393.7 KJ (2) – 393.7 KJ

(3) – 172.7 KJ (4) + 172.7 KJ

174. If H_2 + ½ $O_2 \longrightarrow H_2O$; $\Delta H = – 68.39$ Kcal

K + H_2O + water $\longrightarrow$ KOH (aq) + ½ H_2;

$\Delta H = –48.0$ Kcal

KOH + water $\longrightarrow$ KOH (aq) $\Delta H = – 14.0$ Kcal

the heat of formation of KOH is -

(1) – 68.39 + 48 – 14.0

(2) – 68.39 – 48.0 +14.0

(3) +68.39 – 48.0 + 14.0

(4) + 68.39 + 48.0 – 14.0

175. Given $C(s) + O_2(g) \longrightarrow CO_2(g) + 94.2$ Kcal

$H_2(g) + ½\ O_2(g) \longrightarrow H_2O(\ell) + 68.3$ Kcal

$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(\ell) + 210.8$ Kcal

The heat of formation of methane in Kcal will be

(1) –45.9 (2) –47.8

(3) –20.0 (4) –47.3

176. From the following data, the heat of formation of $Ca(OH)_2(s)$ at 18^0C is ..... Kcal.

(i) $CaO(s) + H_2O(\ell) = Ca(OH)_2(s)$;

$\Delta H_{18^0C} = – 15.26$ Kcal.....

(ii) $H_2O(\ell) = H_2(g) + ½\ O_2(g)$;

$\Delta H_{18^0C} = 68.37$ Kcal ...

(iii) $Ca(s) + ½\ O_2(g) = CaO(s)$;

$\Delta H_{18^0C} = –151.80$ Kcal .....

(1) – 98.69 (2) – 235.43

(3) 194.91 (4) 98.69

177. If, $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$; $\Delta H^0 = -44$ Kcal

$2Na(s) + 2HCl(g) \longrightarrow 2NaCl(s) + H_2(g)$;

$\Delta H = -152$ Kcal

Then, $Na(s) + 0.5\ Cl_2(g) \longrightarrow NaCl(s)$; $\Delta H^0 = ?$

(1) 108 Kcal (2) 196 Kcal

(3) – 98 Kcal (4) 54 Kcal

178. (i) $S(s) + 3/2\ O_2(g) = SO_3(g) + 2x$ Kcal

(ii) $SO_2(g)$ ½ + $O_2(g) = SO_3(g) + y$ Kcal find out the heat of formation of SO_2 :

(1) (2x + y) (2) –(2x – y)

(3) x + y (4) 2x / y

179. If $S + O_2 \longrightarrow SO_2$; $\Delta H = -298.2$

$SO_2 + ½\ O_2 \longrightarrow SO_3$; $\Delta H = -98.7$

$SO_3 + H_2O \longrightarrow H_2SO_4$; $\Delta H = -130.2$

$H_2 + ½\ O_2 \longrightarrow H_2O$; $\Delta H = -287.3$

Then the enthalpy of formation of H_2SO_4 at 298 K is -

(1) –814.4 KJ (2) –650.3 KJ

(3) –320.5 KJ (4) –433.5 KJ

180. Given that :

$Zn + ½\ O_2 \rightarrow ZnO + 84000$ cal 1

$Hg + ½\ O_2 \rightarrow HgO + 21700$ cal 2

The heat of reaction (ΔH) for,

$Zn + HgO \rightarrow ZnO + Hg$ is :-

(1) 105700 cal (2) 62300 cal

(3) –105700 cal (4) – 62300 cal

181. Find the heat change in the reaction :

$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$

from the following data

$NH_3(g) + aq \rightarrow NH_3(aq)$, $\Delta H = -8.4$ K. Cal.

$HCl(g) + aq \rightarrow HCl(aq)$, $\Delta H = -17.3$ K. Cal.

$NH_3(aq) + HCl(aq) \rightarrow NH_4Cl(aq)$, $\Delta H = -12.5$ K. Cals.

$NH_4Cl(s) + aq \rightarrow NH_4Cl(aq)$, $\Delta H = +3.9$ K.Cal.

(1) – 42.1 (2) – 34.3

(3) + 34.3 (4) + 42.1

182. The heat of reaction for

$A + \frac{1}{2} O_2 \rightarrow AO$ is - 50 K cal and

$AO + \frac{1}{2} O_2 \rightarrow AO_2$ is 100 Kcal. The heat of reaction for $A + O_2 \rightarrow AO_2$ is:-

(1) - 50 K cal. (2) + 50 K cal.

(3) 100 K cal. (4) 150 K cal.

183. $C(s) + O_2(g) \rightarrow CO_2(g) + 94.0$ K cal.

$CO(g) + \frac{1}{2} O_2(g) \rightarrow CO_2(g)$, $\Delta H = -67.7$ K cal.

from the above reactions find how much heat (Kcal $mole^{-1}$) would be produced in the following reaction: $C(s) + \frac{1}{2} O_2(g) \rightarrow CO(g)$

(1) 20.6 (2) 26.3

(3) 44.2 (4) 161.6

184. Using the following thermochemical data:

$C(S) + O_2(g) \rightarrow CO_2(g)$, $\Delta H = -94.0$ Kcal

$H_2(g) + 1/2O_2(g) \rightarrow H_2O(\ell)$, $\Delta H = -68.0$ Kcal

$CH_3COOH\ (\ell) + 2O_2(g) \rightarrow 2CO_2(g) + 2H_2O(\ell)$, $\Delta H = -210.0$ Kcal

The heat of formation of acetic acid is:-

(1) 116.0 Kcal (2) - 116.0 Kcal

(3) - 114.0 Kcal (4) + 114.0 K cal

185. The enthalpy of vapourisation of liquid water using the data:

$H_2(g) + 1/2\ O_2(g) \rightarrow H_2O(\ell)$; $\Delta H = -285.77 KJmol^{-1}$

$H_2(g) + 1/2\ O_2(g) \rightarrow H_2O(g)$; $\Delta H = -241.84 KJmol^{-1}$

(1) + 43.93 KJ mol^{-1} (2) - 43.93 KJ mol^{-1}

(3) + 527.61 KJ mol^{-1} (4) - 527.61 KJ mol^{-1}

186. $H_2(g) + ½\ O_2(g) = H_2O\ (\ell)$; $\Delta H_{298K} = -68.32$Kcal. Heat of vapourisation of water at 1 atm and 25^0C is 10.52 Kcal. The standard heat of formation (in Kcal) of 1 mole of water vapour at 25^0C is

(1) 10.52 (2) –78.84

(3) +57.80 (4) –57.80

187. The heat of solution of anhydrous $CuSO_4$ and $CuSO_4.5H_2O$ are – 15.89 and 2.80 Kcal mol^{-1} respectively. What will be the heat of hydration of anhydrous $CuSO_4$?

(1) –18.69 KCal (2) 18.69 Kcal

(3) –28.96 Kcal (4) 28.96 Kcal

188. One mole of anhydrous salt AB dissolves in water and librates 21.0 J mol^{-1} of heat. The value of $\Delta H_{(hydration)}$ of AB is –29.4 J mol^{-1}. The heat of dissolution of hydrated salt $AB.2H_2O_{(s)}$ is -

(1) 50.4 J mol^{-1} (2) 8.4 J mol^{-1}

(3) –50.4 J mol^{-1} (5) –8.4 J mol^{-1}

189. Which of the following expressions is true:-

(1) H_f^0 (CO,g) = $\frac{1}{2}$ ΔH_f^0 (CO_2,g)

(2) ΔH_f^0 (CO,g)=ΔH_f^0 (C,graphite) + $\frac{1}{2}$ ΔH_f^0(O_2,g)

(3) ΔH_f^0 (CO,g)=ΔH_f^0 (CO_2,g) - $\frac{1}{2}$ ΔH_f^0 (O_2,g)

(4) ΔH_f^0 (CO,g)=ΔH_{comb}^0 (C,graphite)-ΔH_{comb}^0 (CO,g)

190. For the two equations given below

$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(\ell)} + x_1$ kJ

$H_{2(g)} + ½O_{2(g)} \rightarrow H_2O_{(\ell)} + x_2$ kJ

Select the correct answer :

(1) $x_1 > x_2$ (2) $x_2 > x_1$

(3) $x_1 = x_2$ (4) $x_1 + x_2 = 0$

ANSWER KEY [EXERCISE-I]

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	4	1	1	3	2	3	3	4	1	4	4	2	3	1	2
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	3	4	2	4	2	2	3	1	3	2	1	3	2	2	1
Que.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	2	1	3	2	2	3	3	1	1	1	4	1	1	2	2
Que.	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	2	3	3	4	3	4	1	2	3	3	1	2	1	1	4
Que.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Ans.	2	2	3	4	1	2	4	1	2	4	2	3	3	4	4
Que.	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Ans.	1	2	2	4	1	4	1	4	1	1	1	2	1	3	3
Que.	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
Ans.	1	1	2	3	1	3	4	1	2	4	3	2	4	2	3
Que.	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	1	2	4	4	4	2	2	4	1	3	2	2	3	2	3
Que.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
Ans.	4	3	2	4	1	3	2	2	1	3	3	3	2	2	2
Que.	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
Ans.	2	3	1	2	3	2	2	1	2	1	1	4	1	3	3
Que.	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165
Ans.	1	1	2	4	2	3	2	3	2	3	4	3	3	4	2
Que.	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	4	4	3	2	1	4	3	2	2	3	2	3	2	1	4
Que.	181	182	183	184	185	186	187	188	189	190					
Ans.	1	2	2	3	1	4	1	2	4	1					