EXERCISE-I (Conceptual Questions) Build Up Your Understanding

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

2. A well stoppered thermos flask contains some ice cubes. This is an example of :-
(1) Closed system (2) Isolated system
(3) Isolated (4) Non-thermodynamic system

3. Identify the intensive quantity from the following-
(1) Enthalpy and temperature (2) Volume and temperature
(3) Enthalpy and volume (4) Temperature and refractive index

4. Which of the following is an extensive property
(1) Mass (2) Enthalpy (3) Energy (4) All of these

5. For an adiabatic process which of the following relations is correct
(1) $\Delta E = 0$ (2) $P\Delta V = 0$ (3) $q = 0$ (4) $q = +W$

6. In which of the following process work behaves as state function :
(1) Isothermal (2) Isochoric (3) Adiabatic (4) Isobaric

7. 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

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. Out of boiling point (I), entropy (II) and emf of a cell (IV), intensive properties are :
(1) I, III, IV (2) I, II (3) I, II, III (4) All of these

10. The work done by a weightless piston in causing an expansion DV (at constant temperature), when the opposing pressure P is variable, is given by :
(1) $W = -\int PdV$ (2) $W = 0$ (3) $W = -P\Delta V$ (4) None

11. Temperature and heat are not :-
(1) 418.4 J (2) 4.184 J (3) 41.84 J (4) None

12. Temperature and heat are not :-
(1) Extensive
(2) Intensive properties
(3) Intensive and extensive properties respectively

(4) Extensive and intensive properties respectively

13. q = –w is not true for :-
(1) Isothermal process
(2) Adiabatic process
(3) Cyclic
(4) 1 and 3 both

14. The temperature of an ideal gas increase in an -
(1) Adiabatic compression
(2) Adiabatic process
(3) Cyclic process
(4) 1 and 3 both

15. Enthalpy of 1 mole monoatomic ideal gas is equals to :-
(1) $\frac{3}{2}$ RT
(2) $\frac{5}{2}$ RT
(3) RT
(4) 2RT

16. 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

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

17. Both q & w are _ _ _ _ function & q + w is a _ _ _ _ function :-
(1) State, State
(2) State, path
(3) Path, state
(4) Path, path

18. 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 Joule
(2) 400 Joule
(3) 720 Joule
(4) 120 Joule

19. A system has internal energy equal to E_1, 450 J of heat is taken out of it and 600 J or 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

20. The work done by a system is 8 J when 40 J heat is supplied to it. The change in internal energy of the system during the process :
(1) 32 J
(2) 40 J
(3) 48 J
(4) –32 J

21. If a gas absorbs 100 J of heat and expands by 500 cm^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

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

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 an constant volume for the reaction $2C_6H_6(\lambda) + 15O_2(g) \longrightarrow 12CO_2(g) + 6H_2O(\lambda)$ at 25°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°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. Which of the following statements is correct for the reaction ; $CO(g) + ½O_2(g)$ 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

27. For the reaction $Ag_2O(s) \longrightarrow 2Ag(s) + ½O_2g(g)$, which one of the following is true :

(1) $\Delta H = \Delta E$ (2) $\Delta H = ½\Delta E$ (3) $\Delta H < \Delta E$ (4) $\Delta H > \Delta E$

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 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

29. For the gaseous reaction involving the complete combustion of isobutene-

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

30. 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) 163.6 KJ (3) 3.46 KJ (4) 180KJ

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

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

32. Heat of reaction for, $CO(g) + ½O_2(g) \rightarrow CO_2(g)$ at constant V is –67.71 Kcal at 17°C. The heat of reaction at constant P at 17°C is :-

(1) –68.0 Kcal (2) +68.0 Kcal (3) –67.42 Kcal (4) None

33. The reaction :-

$$NH_2CN_{(s)} + \frac{3}{2}O_{2(g)} \rightarrow N_{2(g)} + CO_{2(g)} + H_2O_{(\lambda)}$$

was carried out in a bomb calorimeter. The heat released was 743 KJ mol^{-1}. The value of $\Delta H_{300\%}$ 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}

34. The enthalpy of vaporization of water at 100°C is 40.63 $KJmol^{-1}$. The value ΔE for this process would be :-

(1) 37.53 KJ mol^{-1} (2) 39.08 KJ mol^{-1}

(3) 42.19 KJ mol^{-1} (4) 43.73 KJ mol^{-1}

35. 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) $\Delta H = 0$

36. For the reaction $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$ Which one of the statement is correct at constant Ta and P?

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

(2) $\Delta H < \Delta E$

(3) $\Delta H > \Delta E$

(4) DH is independent of physical state of reactants

37. 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

38. For which change $\Delta H \neq \Delta E$:-

(1) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ (2) $HCl(\lambda) + NaOH(\lambda) \rightarrow NaCl(s) + H_2O(\lambda)$

(3) $C(s) + O_2(g) \rightarrow CO_2(g)$ (4) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

39. The heat of combustion of ethanol determined in a bomb colorimeter is –670.48 Kcal $mole^{-1}$ at 25°C for the reaction :-

(1) –335.24 Kcal (2) –671.08 Kcal

(3) –670.48 Kcal (4) +670.48 Kcal

40. The difference in ΔH and ΔE for the combustion of methane at 25°C for the reaction :-

(1) Zero (2) 2×298×–2 Cals

(3) 2×298×–3 Cals (4) 2×25×–3 Cals

41. For which of the following reactions ΔH is less than ΔE :-

(1) $C_{12}H_{22}O_{11}(s)\ 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(\lambda)$

(2) $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

(3) $N_2O_4(g) \rightarrow 2NO_2(g)$

(4) $N_2(g) + O_2(g) \rightarrow 2NO(g)$

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

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

WORK DONE IN DIFFERENT PROCES

43. 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°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) $-2.303 \times 2 \times 298 \log 2$

44. Two litre of N_2 at 0°C and 5 atm are expanded isothermally again 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

45. Two moles of an ideal gas expand spontaneously into vacuum. The work done is :-

(1) Zero (2) 2 J (3) 4 J (4) 8 J

46. One mole of a gas occupying 3 dm^3 expands against a constant external pressure of 1 atm to a volume of 13 litre. The work done is :-

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

47. For which reaction from the following, ΔS will be maximum ?

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

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

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

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

52. In which reaction ΔS is positive :-

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

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

53. 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

54. 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 chnge 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}

55. Which has the least entropy :

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

56. When two gases are mixed the entropy :-

(1) Remains constant (2) Decreases

(3) Increases (4) Becomes zero

57. The enthalpy of vaporization for water is 186.5 KJ mol^{-1}, the entropy of its vaporization will be:-

(1) 0.5 KJ K^{-1} mol^{-1} (2) 1.0 KJ K^{-1} mol^{-1}

(3) 1.5 KJ K^{-1} mol^{-1} (4) 2.0 KJ K^{-1} mol^{-1}

58. The enthalpy of vaporization of per mole of ethanol (b.p. = 79.5°C and ΔS = 109.8 JK^{-1} $mole^{-1}$) is:-

(1) 27.35 KJ/mol (2) 32.19 KJ/mol

(3) 32.70 KJ/mol (4) 42.37 KJ/mol

59. If 900 J/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

60. 5 mole of an ideal gas expand reversibly from a volume of 8 dm^3 to 80 dm^3 at a temperature of 27°C. 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}

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

(1) Remains constant (2) Increases

(3) Decreases (4) Zero

62. The total entropy change for a system & its surrounding increases if the process is :-

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

63. 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 KJ K^{-1}

64. 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

65. In which of the following case entropy decreases -
(1) Solid changing to liquid (2) Expansion
(3) Crystals dissolve (4) Polymerisation

66. Which of the following state function is not zero at standard state :-
(1) Enthalpy (2) Entropy (3) Free energy (4) None

67. Entropy of an adiabatic reversible process is :-
(1) Positive (2) Zero (3) Negative (4) Constant

GIBBS FREE ENERGY

68. 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

69. 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

70. The spontaneous nature of a reaction is impossible if :
(1) ΔH is +ve; ΔS is also +ve (2) ΔH is –ve; ΔS is also –ve
(3) ΔH is –ve; ΔS is +ve (4) ΔH is +ve; ΔS is –ve

71. If $\Delta H > 0$ and $\Delta S > 0$ and $\Delta S > 0$, the reaction proceeds spontaneously when :-
(1) $\Delta H > 0$ (2) $\Delta H < T\Delta S$
(3) $\Delta H = T\Delta S$ (4) None

72. The temperature at which the reaction $Ag_2O(s) \longrightarrow 2Ag(s) + \frac{1}{2}O_2(g)$ is at equilibrium is….;
Given $\Delta H = 30.5$ KJ mol^{-1} and $\Delta S = 0.066$ KJ K^{-1} mol^{-1} :
(1) 462.12 K (2) 362.12 K (3) 262.12 K (4) 562.12 K

73. 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

74. Which of the following is true for the reaction $H_2O(\lambda) \rightleftharpoons H_2O(g)$ at 100°C and 1 atmosphere
(1) $\Delta S = 0$ (2) $\Delta H = 0$ (3) $\Delta H = \Delta E$ (4) $\Delta S = T\Delta S$

75. For the reaction $Ag_2O(s) \longrightarrow 2Ag(s) + \frac{1}{2}O_2(g)$ the value of $\Delta H = 30.56$ KJ mol^{-1} and $\Delta S = 66$ JK^{-1} mol^{-1}. The temperature at which the free energy change for the reaction will be zero is :-

(1) 373 K (2) 413 K (3) 463 K (4) 493 K

76. For hypothetical reversible reaction

$\frac{1}{2}A_2(g) + \frac{3}{2}B_2(g) \longrightarrow AB_3(g)$; DH = –20 KJ if standard entropies o0f 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) 400 K (2) 500 K (3) 250 K (4) 200 K

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

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

78. 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

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

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

80. 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

81. Equilibrium constant of a reaction is related to :

(1) Standard free energy change $\Delta G°$
(2) Free energy change ΔG
(3) Entropy
(4) None

82. The Vant Hoff equation is :-

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

83. If $\Delta G° > 0$ for a reaction then :

(1) $K_P > 1$
(2) $K_P < 1$
(3) The products predominate in the equilibrium mixture
(4) None

84. If the equilibrium constant for a reaction is 10, then the value of $\Delta G°$ will be (R = 8 JK^{-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}

85. 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

86. 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

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

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

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

(1) –44 Kcals (2) –18 K cals (3) 34 Kcals (4) –24 Kcals

89. Which of the following reaction is expected never to be spontaneous :-

(1) $2O_3(g) \rightarrow 3O_2(g)$ $\Delta H = -ve, \Delta S = +ve$
(2) $Mg(s) + H_2(g) \rightarrow MgH_2(g)$ $\Delta H = -ve, \Delta S = -ve$
(3) $Br_2(I) \rightarrow Br_2(g)$ $\Delta H = +ve, \Delta S = +ve$
(4) $2Ag(s) + 3N_2(g) \rightarrow 2AgN_3(g)$ $\Delta H = +ve, \Delta S = -ve$

THERMOCHEMICAL REACTION

90. 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 or water
(2) The chemical energy of $H_2(g)$ 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 $O_2g)$ is lower than that of water

91. Which plot represents for an exothermic reaction :

Figure

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

92. 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

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

94. 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-}

95. ΔH for transition of Carbon in the diamond form to carbon in ht 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

96. Which of the following values of heat of formation indicates that the product is least stable
(1) –94 Kcal (2) –231.6 Kcal (3) +21.4 Kcal (4) +64.8 Kcal

97. Heat of formation, ΔH_f° of an explosive compound like NCl_3 is -
(1) Positive (2) Negative (3) Zero (4) Positive or negative

98. According to the following reaction
$C(s) + 1/2O_2(g) \rightarrow CO(g), \Delta H = -26.4$ Kcal
(1) CO is an endothermic compound (2) CO is an exothermic compound
(3) The reaction is endothermic (4) None of the above

99. 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) $2HgO(s) + 180.4\ KJ \rightarrow 2Hg(\lambda) + O_2(g)$
(4) $2Zn(s) + O_2(g) \rightarrow 2ZnO(s), \Delta E = -693.8$ KJ

100. The heat change during the reaction 24 g C and 128 g S following the change $C + S_2 \rightarrow CS_2$; $\Delta H = 22K$ cal
(1) 22 Kcal (2) 11 Kcal (3) 44 Kcal (4) 32 Kcal

101. 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 decompose forming oxygen readily
(3) Oxygen is less stable than ozone and oxygen decomposes forming ozone readily
(4) None of the above

102. From the reaction P(White) → 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 stable

FACTORS AFFECTING HEAT OF REACTION

103. In Kirchoff's equation which factor affects the heat of reaction :
(1) Pressure (2) Temperature (3) Volume (4) Atomicity

104. For the reaction; $H_2(g) + ½O_2(g) = H_2O(\lambda)$, $\Delta C_P = 7.63$ cal/deg; $\Delta H_{25°C} = 68.3$ Kcal, what will be the value (in Kcal) of ΔH at 100°C :
(1) $7.63\times(373 - 298) - 68.3$ (2) $7.63\times10^{-3}(373 - 298) - 68.3$
(3) $7.63\times10^{-3}(373 - 298) + 68.3$ (4) $7.63\times(373 - 298) + 68.3$

105. The enthalpy of reaction at 273 K. is –357 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

106. For the reactions,
(i) $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g) + xKJ$
Which one of the following statement is correct
(1) $x > y$ (2) $x < y$ (3) $x = y$ (4) More data required

HEAT OF FORMATION

107. 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

108. Reaction $H_2(s) + I_2(g) \longrightarrow 2HI$; $\Delta H = 12.40$ 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

109. At 300 K the standard enthalpies of formation of C_6H_5COOH (s), CO_2 (g) and H_2O (λ) are –408, –393 and –286 KJ mol^{-1} respectively. Calculate the heat of combustion of benzoic acid at constant volume :-
(1) +3201 KJ (2) +3199.5 KJ (3) –3201 KJ (4) –3199.75 KJ

110. Enthalpy of a compound is equal to its :-
(When it is formed form constituent particles)
(1) Heat of combustion (2) Heat of formation
(3) Heat of reaction (4) Heat of solution

111. Which of the following equations represents standard heat of formation of CH_4?
(1) $C_{(diamond)} + 2H_{2(g)} \longrightarrow CH_{4(g)}$ (2) $C_{(graphite)} + 2H_{2(g)} \longrightarrow CH_{4(g)}$
(3) $C_{(diamond)} + 4H_{(g)} \longrightarrow CH_{4(g)}$ (4) $C_{(graphite)} + 4H_{(g)} \longrightarrow CH_{4(g)}$

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 the reaction

(1) –42 KJ (2) –202 KJ (3) +202 KJ (4) –288 KJ

114. Given that standard heat enthalpy of CH_4, C_2H_4 and C_3H_8 are –17.9, 12.5, –24.8 Kcal/mol. The ΔH for $CH_4 + C_2H_4 \rightarrow C_3H_8$ is :-

(1) –55.2 Kcal (2) –30.2 Kcal (3) 55.2 Kcal (4) –19.4 Kcal

115. The standard molar heat of formation of ethane, CO_2 and water (λ) 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

116. 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) Some times lower and some times higher

117. 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

118. 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) –110.5KJ (3) 110.5 KJ (4) 676.5 KJ

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

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

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

120. The heat of combustion of $CH_4(g)$, C(s) and $H_2(g)$ at 25°C are –212.4 Kcal, –94.0 Kcal and 68.4 K cal respectively, the heat of formation of CH_4 will be -

(1) +54.4 Kcal (2) –18.4 Kcal (3) –375.2 Kcal (4) +212.8 Kcal

121. Standard enthalpy of formation is zero for

(1) $C_{diamond}$ (2) $Br_{(g)}$ (3) $C_{graphite}$ (4) $O_{3(g)}$

122. The standard heats of formation of $NO_2(g)$ and $N_2O_4(g)$ are 8.0 and 2.0 Kcal mol^{-1} respectively the heat of dimerization of NO_2 in Kcal is

(1) 10.0 (2) –6.0 (3) –12.0 (4) –14.0

123. M is a metal that forms an oxide

M_2O, $\frac{1}{2} M_2O \rightarrow M + \frac{1}{4} O_2 \quad \Delta H = 120$ Kcal

When a sample of metal M reacts with one mole of oxygen what will be the ΔH in that case
(1) 240 Kcal (2) –240 Kcal (3) 480 Kcal (4) –480 Kcal

HEAT OF COMBUSTION

124. According to equation,
$C_6H_6(\lambda) + 15/2\ O_2(g) \longrightarrow 6CO_2(g) + 3H_2O(\lambda)$; $\Delta H = -3264.4$ 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 $H_2O(\lambda)$ at 25°C 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. The heat of combustion of carbon and carbon monoxide are –394 and –285 KJ mol^{-1} respectively. The heat of formation of CO in KJ mol^{-1} is :-
(1) +109 (2) –109 (3) +218 (4) –218

129. 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

130. The heat evolved during the combustion of 112 litre of water gas at STP (mixture of equal volume of H_2 and CO) is :
Given
$H_2(g) + \frac{1}{2}O_2(g) = H_2O\ (g)$; $\Delta H = -241.8$ KJ
$CO(g) + \frac{1}{2}O_2(g) = CO_2(g)$; $\Delta H = -283$ KJ
(1) 241.8 KJ (2) 283 KJ (3) 1312 KJ (4) 1586 KJ

131. 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) 728 g (2) 0.728 g (3) 342 g (4) 0.342 g

132. 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

133. X gm of ethanol was subjected to combustion in a bomb calorimeter and the heat produced is Y joules. Then :-

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

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

134. The following are the heats of reaction :-

(i) ΔH_f° of $H_2O(\lambda) = -68.3$ K cal mol^{-1}

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

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

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

(1) –716.1 Kcal (2) +337.2 Kcal (3) –41.8 Kcal (4) –579.5 Kcal

135. 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

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

(1) –49.6 Kcal (2) –94.4 Kcal
(3) –188.0 Kcal (4) More data required

137. 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 Kcals (2) –10 Kcals (3) –2.5 Kcals (4) –5 Kcals

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

(1) 265 gm (2) 66 gm (3) 11 gm (4) 64 gm

139. Which of the following equation s corresponds to the enthalpy of combustion oat 298 K :-

(1) $C_2H_6(g) + 7/2O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$
(2) $2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(g)$
(3) $C_2H_6(g) + 7/2O_2(g) \rightarrow 2CO_2(g) + 3H_2O(\lambda)$
(4) $2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(\lambda)$

140 Heat of formation of CO_2 is –94K cal. What would be the quantity of heat liberated, when 3g of graphite is burnt in excess of oxygen :-

(1) 23.5 K cals (2) 2.35 Kcals (3) 94.0 K cals (4) 31.3 K cals

HEAT OF NEUTRAIZTION

141. 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 predicated

142. If $H^+ + OH^- = H_2O + 13.7$ Kcal, then heat of complete neutralization of one gram mole 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

143. Heat of neutralization of a strong dibasic acid in dilute solution by 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

144. The temperature of a 5 ml of strong acid increases by 5°C when 5 ml of a strong base is added to it. If 10 ml of each are mixed temperature should increase by :-
(1) 5°C (2) 10°C (3) 15°C (4) Cannot be known

145. 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

146. 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

147. 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

148. Heat of neutralization of oxalic acid is –106.7 KJ mol^{-1} using NaOH hence DH of :-
$H_2C_2O_4 \rightarrow C_2H_4^{2-} + 2H^+$ is :-
(1) 5.88 KJ (2) –5.88 KJ (3) –13.7 Kcal (4) 7.5 KJ

HEAT OF HYDROGENATION

149. The heat of combustion of C_2H_4, and H_2 are –1409.5 JK, –1558.3 KJ and –285.6 KJ. The heat of hydrogenation of ethane is :-
(1) –136.8 KJ (2) –13.68 KJ (3) 273.6 KJ (4) 1.368 KJ

150. 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

151. 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

152. Among the following for whch reaction heat of reaction represents bond energy of HCl
(1) $HCl(g) \longrightarrow H^+(g) + Cl^-(g)$ (2) $HCl(g) \longrightarrow H^+(g) + Cl^-(g)$
(3) $2HCl(g) \longrightarrow H_2(g) + Cl_2(g)$ (4) $HCl(g) \longrightarrow H(g) + Cl(g)$

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

(1) F – F (2) Cl – Cl (3) Br – Br (4) I – I

154. Energy required to dissociate 4g of gaseous hydrogen into free gaseous atoms is 208 Kcal at 25°C. The bond energy of H–H bon will be :-

(1) 1.04 Kcal (2) 10.4 Kcal (3) 104 Kcal (4) 1040 Kcal

155. 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–CK bond energy is :

(1) 245 KJ mol^{-1} (2) 427 KJ mol^{-1} (3) 336 KJ mol^{-1} (4) 154 KJ mol^{-1}

156. The enthalpy change for the reaction $H_2(g) + C_2H_4(g) \rightarrow C_2H_6(g)$ is …… The bon energies are, H–H = 103, C–H = 99, C–C = 80 & C= C = 145 Kcal mol^{-1}

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

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

157. Bond dissociation enthalpies 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}

158. From the reactions :

$C(s) + 2H_2(g) \rightarrow CH_4(g)$, $\Delta H = -X$ Kcal
$C(g) + 4H(g) \rightarrow CH_4(g)$, $\Delta H = -X_1$ Kcal
$CH_4(g) \rightarrow CH_3(g) + H(g)$, $\Delta H = +Y$ Kcal

Bond energy of C–H bond is -

(1) $\frac{X}{4}$ Kcal mol^{-1} (2) Y Kcal mol^{-1}

(3) $\frac{X_1}{4}$ Kcal mol^{-1} (4) X_1 Kcal mol^{-1}

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

$H_2O \longrightarrow H(g) + OH(g)$; DH = 498 KJ mol^{-1}
$OH(g) \longrightarrow H(g) + O(g)$; DH = 428 KJ mol^{-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}

160. 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}

161. 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

SOME OTHER HEAT OF REACTIONS

162. The enthalpy change for the reaction $2C(graphite) + 3H_2(g) \longrightarrow C_2H_6(g)$ is called

(1) Enthalpy of formation (2) Enthalpy of combustion

(3) Enthalpy of hydrogenation (4) Enthalpy of vaporization

163. $Cl_2(g) \longrightarrow 2Cl(g)$, In this process value of ΔH will be-

(1) Positive (2) Negative

(3) Zero (4) Nothing can be predicted

164. The magnitude of heat of solution…..on addition of solvent to solution

(1) Decreases (2) Increases

(3) Remains constant (4) Increases or decreases

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

(1) 52 Kcal (2) 104 Kcal (3) 208 Kcal (4) None of these

166. $S(rhombic) + O_2(g) \longrightarrow SO_2(g)$; $\Delta H = -297.5$ KJ

$S(monoclinic) + O_2(g) \longrightarrow SO_2$; $\Delta H = -300$ 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) DH transition of S_R to S_M is endothermic

167. The heat of combustion of yellow phosphorous and red phosphorus 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

168. For the change $C(diamond) \longrightarrow C(graphite)$; $\Delta H = -1.89$ KJ, if 6 g of diamond and 6g of graphite are separately 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 14.34 KJ

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

169. $2CO(g) + O_2(g) \longrightarrow 2CO_2(g) + X$ 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

170. Which of the following reaction represents ΔH (Hydration) :-

(1) $CuSO_4(s) + (aq) \rightarrow CuSO_4(aq)$; $\Delta H = -x$KJ

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

(3) $CuSO_4(s) + 5H_2O(\lambda) + (aq) \rightarrow CuSO_4.5H_2O(aq)$; ΔH = –y' KJ
(4) None of the above

171. ΔH for the reaction, $I(g) + I(g) \rightarrow I_2(g)$ will be :-
(1) Zero (2) –ve (3) +ve (4) ∞

172. Given that :
$A(s) \rightarrow A(\lambda)$; ΔH = x, $A(\lambda) \rightarrow A(g)$ – y
The heat of sublimation of A will be :-
(1) x + y (2) x – y (3) x or y (4) –(x + y)

HESS LAW

173. 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

174. Form the thermochemical reactions,
$C(graphite) + ½O_2 \longrightarrow CO$; ΔH = –110.5 KJ
$CO + ½O_2 \longrightarrow CO_2$; ΔH = –2983.2 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

175. If $H_2 + ½O_2 \longrightarrow H_2O$; ΔH = –68.39 Kcal
$K + H_2O + water \longrightarrow KOH (aq) + ½H_2$; ΔH = –48.0 Kcal
$KOH + water \longrightarrow KOH (aq)$ ΔH = –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

176. Given $C(s) + O_2(g) \longrightarrow CO_2(g)$ + 94.2 Kcal
$H_2(g) + ½O_2(g) \longrightarrow H_2O(\lambda)$ + 68.3 Kcal
$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(\lambda)$ + 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

177. From the following data, the heat of formation of $Ca(OH)_2$ (s) at 18°C is ……Kcal.
(i) $CaO(s) + H_2O(\lambda) = Ca(OH)_2 (s)$; ΔH18°C = –15.26 Kcal……
(ii) $H_2O(\lambda) = H_2(g) + ½O_2(g)$; ΔH18°C = –68.37 Kcal……
(i) $Ca(s) + ½O_2(g) = CaO(s)$; ΔH18°C = –151.80 Kcal……
(1) –98.69 (2) –235.43 (3) 194.91 (4) 98.69

178. If, $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$; ΔH° = –44 Kcal
$2Na(s) + 2HCl(g) \longrightarrow 2NaCl(s) + H_2(g)$; ΔH° = –152 Kcal
(1) 108 Kcal (2) 196 Kcal (3) –98 Kcal (4) 54 Kcal

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

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

(1) (2x + y) (2) –(2x – y) (3) x + y (4) 2x / y

180. If $S + O_2 \longrightarrow SO_2$; $\Delta H = –298.2$

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

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

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

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

181. Given that :

$Zn + ½O_2 \rightarrow ZnO + 84000$ cal ……….(1)

$Hg + ½O_2 \rightarrow HgO + 21700$ 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

182. Given that-

$2C(s) + 2O_2(g) \rightarrow 2CO_2(g)$ $\Delta H = –787$ KJ

$H_2(g) + ½O_2(g) \rightarrow 2H_2O(\lambda)$ $\Delta H = –286$ KJ

$C_2H_2(g) + \frac{5}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(\lambda)$ $\Delta H = –1310$ KJ

Heat of formation of acetylene is :-

(1) +1802 KJ (2) –1802 KJ (3) –800 KJ (4) +237 KJ

183. Find the heat change in the reaction :

$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$ from the following data

$NH_3(g) + aq \rightarrow NH_3(aq)$, $\Delta H = –8.4$ Kcal

$HCl(g) + aq \rightarrow HCl(aq)$, $\Delta H = –17.3$ Kcal

$NH_3(aq) + HCl(aq) \rightarrow NH_4Cl(aq)$, $\Delta H = –12.5$ Kcal

$NH_4Cl(s) + aq \rightarrow NH_4Cl(aq)$, $\Delta H = +3.9$ Kcal

(1) –42.1 (2) –34.3 (3) +34.3 (4) +42.1

184. The heat of reaction for

$A + \frac{1}{2}O_2 \rightarrow AO$ is –50 Kcal 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 Kcal (2) +50 Kcal (3) 100 Kcal (4) 150 Kcal

185. $C(s) + O_2(g)$ ® $CO_2(g)$, DH = –67.7 Kcal, 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

186. Using the following thermochemical data :

$C(s) + O_2(g) \rightarrow CO_2(g)$, $\Delta H = -94.0$ Kcal
$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\lambda)$, $\Delta H = -68.0$ Kcal
$CH_3COOH(\lambda) + 2O_2(g) \rightarrow 2CO_2(g) + 2H_2O(\lambda)$, $\Delta H = -210.0$ Kcal
The heat of formation of acetic acid is :-
(1) 116.0 Kcal (2) –116.0 Kcal (3) –114.0 Kcal (4) +114.0 Kcal

187. The enthalpy of vaporurisation of liquid water using the data :

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\lambda); \quad \Delta H = -285.77 \text{ KJ mol}^{-1}$$

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)\ ; \quad \Delta H = -241.84 \text{ KJ mol}^{-1}$$

(1) 43.93 KJ mol^{-1} (2) –43.93 KJ mol^{-1}
(3) +527.61 KJ mol^{-1} (4) –527.61 KJ mol^{-1}

188. $H_2(g) + \frac{1}{2}O_2(g) = H_2O(\lambda)$; $\Delta H_{298K} = -68.32$ Kcal. Heat of vapourisation of water at 1 atm and 25°C is 10.52 Kcal. The standard heat of formation (in Kcal) of 1 mole of water vapour at 25°C is :-
(1) 10.52 (2) –78.84 (3) +57.80 (4) –57.80

189. 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

190. 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 H mol^{-1}. The heat of dissolution of hydrated salt $AB.2H_2O$ is -
(1) 50.4 J mol^{-1} (2) 8.4 J mol^{-1}
(3) –50.4 J mol^{-1} (4) –8.4 J mol^{-1}

191. Which of the following expressions is true :-

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

(2) $\Delta H_f^\circ (CO, g) = \Delta H_f^\circ (C, \text{graphite} + \frac{1}{2}\ \Delta H_f^\circ (O_2, g)$

(3) $\Delta H_f^\circ (CO, g) = \Delta H_f^\circ (CO_2, g) - \frac{1}{2}\ \Delta H_f^\circ (O_2, g)$

(4) $\Delta H_f^\circ\ (CO, g) = \Delta H^\circ_{comb}\ (C, \text{graphite}) - \Delta H^\circ_{comb}\ (CO, g)$

ANSWER KEY

EXERCISE-I (Conceptual Questions)

1.	(2)	**2.**	(3)	**3.**	(4)	**4.**	(4)	**5.**	(3)	**6.**	(3)	**7.**	(1)
8.	(4)	**9.**	(1)	**10.**	(1)	**11.**	(1)	**12.**	(4)	**13.**	(2)	**14.**	(1)
15.	(2)	**16.**	(4)	**17.**	(3)	**18.**	(4)	**19.**	(1)	**20.**	(1)	**21.**	(4)
22.	(3)	**23.**	(1)	**24.**	(3)	**25.**	(2)	**26.**	(2)	**27.**	(4)	**28.**	(2)

29.	(2)	**30.**	(4)	**31.**	(2)	**32.**	(1)	**33.**	(2)	**34.**	(1)	**35.**	(1)
36.	(2)	**37.**	(3)	**38.**	(4)	**39.**	(2)	**40.**	(2)	**41.**	(2)	**42.**	(3)
43.	(1)	**44.**	(4)	**45.**	(1)	**46.**	(1)	**47.**	(2)	**48.**	(3)	**49.**	(4)
50.	(3)	**51.**	(4)	**52.**	(3)	**53.**	(1)	**54.**	(1)	**55.**	(2)	**56.**	(3)
57.	(1)	**58.**	(3)	**59.**	(1)	**60.**	(3)	**61.**	(2)	**62.**	(2)	**63.**	(1)
64.	(1)	**65.**	(4)	**66.**	(2)	**67.**	(4)	**68.**	(3)	**69.**	(2)	**70.**	(4)
71.	(2)	**72.**	(1)	**73.**	(2)	**74.**	(4)	**75.**	(3)	**76.**	(2)	**77.**	(3)
78.	(3)	**79.**	(4)	**80.**	(4)	**81.**	(1)	**82.**	(2)	**83.**	(2)	**84.**	(2)
85.	(4)	**86.**	(1)	**87.**	(4)	**88.**	(1)	**89.**	(4)	**90.**	(1)	**91.**	(1)
92.	(2)	**93.**	(3)	**94.**	(1)	**95.**	(3)	**96.**	(4)	**97.**	(1)	**98.**	(2)
99.	(4)	**100.**	(3)	**101.**	(2)	**102.**	(4)	**103.**	(2)	**104.**	(3)	**105.**	(1)
106.	(2)	**107.**	(4)	**108.**	(4)	**109.**	(4)	**110.**	(2)	**111.**	(2)	**112.**	(2)
113.	(4)	**114.**	(4)	**115.**	(1)	**116.**	(3)	**117.**	(2)	**118.**	(2)	**119.**	(3)
120.	(2)	**121.**	(3)	**122.**	(4)	**123.**	(4)	**124.**	(4)	**125.**	(1)	**126.**	(3)
127.	(2)	**128.**	(2)	**129.**	(2)	**130.**	(3)	**131.**	(1)	**132.**	(3)	**133.**	(3)
134.	(3)	**135.**	(2)	**136.**	(2)	**137.**	(2)	**138.**	(2)	**139.**	(3)	**140.**	(1)
141.	(3)	**142.**	(2)	**143.**	(2)	**144.**	(1)	**145.**	(2)	**146.**	(1)	**147.**	(1)
148.	(4)	**149.**	(1)	**150.**	(1)	**151.**	(2)	**152.**	(4)	**153.**	(2)	**154.**	(3)
155.	(2)	**156.**	(3)	**157.**	(2)	**158.**	(3)	**159.**	(4)	**160.**	(3)	**161.**	(3)
162.	(1)	**163.**	(1)	**164.**	(3)	**165.**	(2)	**166.**	(4)	**167.**	(4)	**168.**	(4)
169.	(3)	**170.**	(2)	**171.**	(2)	**172.**	(1)	**173.**	(3)	**174.**	(2)	**175.**	(2)
176.	(3)	**177.**	(2)	**178.**	(3)	**179.**	(2)	**180.**	(1)	**181.**	(4)	**182.**	(4)
183.	(1)	**184.**	(2)	**185.**	(2)	**186.**	(3)	**187.**	(1)	**188.**	(4)	**189.**	(1)
190.	(2)	**191.**	(4)										