

Chapter 6

Thermodynamics

- For a given reaction, $\Delta H = 35.5 \text{ kJ mol}^{-1}$ and $\Delta S = 83.6 \text{ J K}^{-1} \text{ mol}^{-1}$. The reaction is spontaneous at (Assume that ΔH and ΔS do not vary with temperature.)
 (a) $T > 425 \text{ K}$ (b) all temperatures
 (c) $T > 298 \text{ K}$ (d) $T < 425 \text{ K}$
 (NEET 2017)
- A gas is allowed to expand in a well insulated container against a constant external pressure of 2.5 atm from an initial volume of 2.50 L to a final volume of 4.50 L. The change in internal energy ΔU of the gas in joules will be
 (a) -500 J (b) -505 J
 (c) +505 J (d) 1136.25 J
 (NEET 2017)
- For a sample of perfect gas when its pressure is changed isothermally from p_i to p_f , the entropy change is given by
 (a) $\Delta S = nR \ln \left(\frac{p_f}{p_i} \right)$ (b) $\Delta S = nR \ln \left(\frac{p_i}{p_f} \right)$
 (c) $\Delta S = nRT \ln \left(\frac{p_f}{p_i} \right)$ (d) $\Delta S = RT \ln \left(\frac{p_i}{p_f} \right)$
 (NEET-II 2016)
- The correct thermodynamic conditions for the spontaneous reaction at all temperatures is
 (a) $\Delta H < 0$ and $\Delta S > 0$
 (b) $\Delta H < 0$ and $\Delta S < 0$
 (c) $\Delta H < 0$ and $\Delta S = 0$
 (d) $\Delta H > 0$ and $\Delta S < 0$ (NEET-I 2016)
- Consider the following liquid-vapour equilibrium.
 Liquid \rightleftharpoons Vapour
 Which of the following relations is correct?
 (a) $\frac{d \ln P}{dT^2} = \frac{-\Delta H_v}{T^2}$ (b) $\frac{d \ln P}{dT} = \frac{\Delta H_v}{RT^2}$
 (c) $\frac{d \ln G}{dT^2} = \frac{\Delta H_v}{RT^2}$ (d) $\frac{d \ln P}{dT} = \frac{-\Delta H_v}{RT}$
 (NEET-I 2016)
- The heat of combustion of carbon to CO_2 is -393.5 kJ/mol . The heat released upon formation of 35.2 g of CO_2 from carbon and oxygen gas is
 (a) +315 kJ (b) -630 kJ
 (c) -3.15 kJ (d) -315 kJ (2015)
- Which of the following statements is correct for the spontaneous adsorption of a gas?
 (a) ΔS is negative and, therefore ΔH should be highly positive.
 (b) ΔS is negative and therefore, ΔH should be highly negative.
 (c) ΔS is positive and therefore, ΔH should be negative.
 (d) ΔS is positive and therefore, ΔH should also be highly positive. (2014)
- For the reaction, $X_2O_4(l) \longrightarrow 2XO_2(g)$
 $\Delta U = 2.1 \text{ kcal}$, $\Delta S = 20 \text{ cal K}^{-1}$ at 300 K
 Hence, ΔG is
 (a) 2.7 kcal (b) -2.7 kcal
 (c) 9.3 kcal (d) -9.3 kcal (2014)
- A reaction having equal energies of activation for forward and reverse reactions has
 (a) $\Delta H = 0$ (b) $\Delta H = \Delta G = \Delta S = 0$
 (c) $\Delta S = 0$ (d) $\Delta G = 0$
 (NEET 2013)
- When 5 litres of a gas mixture of methane and propane is perfectly combusted at 0°C and 1 atmosphere, 16 litres of oxygen at the same temperature and pressure is consumed. The amount of heat released from this combustion in kJ ($\Delta H_{\text{comb.}}(\text{CH}_4) = 890 \text{ kJ mol}^{-1}$, $\Delta H_{\text{comb.}}(\text{C}_3\text{H}_8) = 2220 \text{ kJ mol}^{-1}$) is
 (a) 38 (b) 317 (c) 477 (d) 32
 (Karnataka NEET 2013)
- Three thermochemical equations are given below
 (i) $\text{C}_{(\text{graphite})} + \text{O}_{2(g)} \rightarrow \text{CO}_{2(g)}$; $\Delta_r H^\circ = x \text{ kJ mol}^{-1}$
 (ii) $\text{C}_{(\text{graphite})} + \frac{1}{2}\text{O}_{2(g)} \rightarrow \text{CO}_{(g)}$; $\Delta_r H^\circ = y \text{ kJ mol}^{-1}$
 (iii) $\text{CO}_{(g)} + \frac{1}{2}\text{O}_{2(g)} \rightarrow \text{CO}_{2(g)}$; $\Delta_r H^\circ = z \text{ kJ mol}^{-1}$

Based on the above equations, find out which of the relationship given below is correct.

- (a) $z = x + y$ (b) $x = y + z$
 (c) $y = 2z - x$ (d) $x = y - z$

(Karnataka NEET 2013)

12. In which of the following reactions, standard reaction entropy change (ΔS°) is positive and standard Gibb's energy change (ΔG°) decreases sharply with increasing temperature?

- (a) $C_{(\text{graphite})} + \frac{1}{2}O_{2(g)} \rightarrow CO_{(g)}$
 (b) $CO_{(g)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{2(g)}$
 (c) $Mg_{(s)} + \frac{1}{2}O_{2(g)} \rightarrow MgO_{(s)}$
 (d) $\frac{1}{2}C_{(\text{graphite})} + \frac{1}{2}O_{2(g)} \rightarrow \frac{1}{2}CO_{2(g)}$

(2012)

13. The enthalpy of fusion of water is 1.435 kcal/mol. The molar entropy change for the melting of ice at 0°C is

- (a) 10.52 cal/(mol K) (b) 21.04 cal/(mol K)
 (c) 5.260 cal/(mol K) (d) 0.526 cal/(mol K)

(2012)

14. Standard enthalpy of vaporisation $\Delta_{\text{vap}}H^\circ$ for water at 100°C is $40.66 \text{ kJ mol}^{-1}$. The internal energy of vaporisation of water at 100°C (in kJ mol^{-1}) is

- (a) +37.56 (b) -43.76
 (c) +43.76 (d) +40.66

(Assume water vapour to behave like an ideal gas)

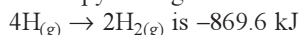
(2012)

15. If the enthalpy change for the transition of liquid water to steam is 30 kJ mol^{-1} at 27°C , the entropy change for the process would be

- (a) $10 \text{ J mol}^{-1} \text{ K}^{-1}$ (b) $1.0 \text{ J mol}^{-1} \text{ K}^{-1}$
 (c) $0.1 \text{ J mol}^{-1} \text{ K}^{-1}$ (d) $100 \text{ J mol}^{-1} \text{ K}^{-1}$

(2011)

16. Enthalpy change for the reaction,



The dissociation energy of H - H bond is

- (a) -434.8 kJ (b) -869.6 kJ
 (c) +434.8 kJ (d) +217.4 kJ

(2011)

17. Which of the following is correct option for free expansion of an ideal gas under adiabatic condition?

- (a) $q = 0, \Delta T \neq 0, w = 0$
 (b) $q \neq 0, \Delta T = 0, w = 0$
 (c) $q = 0, \Delta T = 0, w = 0$
 (d) $q = 0, \Delta T < 0, w \neq 0$

(2011)

18. Consider the following processes:

	ΔH (kJ/mol)
$1/2A \rightarrow B$	+150
$3B \rightarrow 2C + D$	-125
$E + A \rightarrow 2D$	+350

For $B + D \rightarrow E + 2C$, ΔH will be

- (a) 525 kJ/mol (b) -175 kJ/mol
 (c) -325 kJ/mol (d) 325 kJ/mol

(Mains 2011)

19. For an endothermic reaction, energy of activation is E_a and enthalpy of reaction is ΔH (both of these in kJ/mol). Minimum value of E_a will be

- (a) less than ΔH (b) equal to ΔH
 (c) more than ΔH (d) equal to zero

(2010)

20. Standard entropies of X_2 , Y_2 and XY_3 are 60, 40 and $50 \text{ J K}^{-1} \text{ mol}^{-1}$ respectively. For the reaction $1/2X_2 + 3/2Y_2 \rightleftharpoons XY_3$, $\Delta H = -30 \text{ kJ}$, to be at equilibrium, the temperature should be

- (a) 750 K (b) 1000 K
 (c) 1250 K (d) 500 K

(2010)

21. Match List I (Equations) with List II (Type of processes) and select the correct option.

List I Equations	List II Type of processes
A. $K_p > Q$	(i) Non-spontaneous
B. $\Delta G^\circ < RT \ln Q$	(ii) Equilibrium
C. $K_p = Q$	(iii) Spontaneous and endothermic
D. $T > \frac{\Delta H}{\Delta S}$	(iv) Spontaneous

- (a) A - (i), B - (ii), C - (iii), D - (iv)
 (b) A - (iii), B - (iv), C - (ii), D - (i)
 (c) A - (iv), B - (i), C - (ii), D - (iii)
 (d) A - (ii), B - (i), C - (iv), D - (iii)

(Mains 2010)

22. Three moles of an ideal gas expanded spontaneously into vacuum. The work done will be

- (a) infinite (b) 3 Joules
 (c) 9 Joules (d) zero

(Mains 2010)

23. For vaporization of water at 1 atmospheric pressure, the values of ΔH and ΔS are $40.63 \text{ kJ mol}^{-1}$ and $108.8 \text{ JK}^{-1} \text{ mol}^{-1}$, respectively. The temperature when Gibb's energy change (ΔG) for this transformation will be zero, is

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- (a) 273.4 K (b) 393.4 K
(c) 373.4 K (d) 293.4 K
(Mains 2010)

24. The following two reactions are known
 $\text{Fe}_2\text{O}_3(\text{s}) + 3\text{CO}(\text{g}) \rightarrow 2\text{Fe}(\text{s}) + 3\text{CO}_2(\text{g}); \Delta H = -26.8 \text{ kJ}$
 $\text{FeO}(\text{s}) + \text{CO}(\text{g}) \rightarrow \text{Fe}(\text{s}) + \text{CO}_2(\text{g}); \Delta H = -16.5 \text{ kJ}$
 The value of ΔH for the following reaction
 $\text{Fe}_2\text{O}_3(\text{s}) + \text{CO}(\text{g}) \rightarrow 2\text{FeO}(\text{s}) + \text{CO}_2(\text{g})$ is
 (a) +10.3 kJ (b) -43.3 kJ
 (c) -10.3 kJ (d) +6.2 kJ
 (Mains 2010)

25. The values of ΔH and ΔS for the reaction,
 $\text{C}(\text{graphite}) + \text{CO}_2(\text{g}) \rightarrow 2\text{CO}(\text{g})$
 are 170 kJ and 170 J K^{-1} , respectively. This reaction will be spontaneous at
 (a) 910 K (b) 1110 K
 (c) 510 K (d) 710 K (2009)

26. From the following bond energies:
 H—H bond energy : 431.37 kJ mol⁻¹
 C=C bond energy : 606.10 kJ mol⁻¹
 C—C bond energy : 336.49 kJ mol⁻¹
 C—H bond energy : 410.50 kJ mol⁻¹
 Enthalpy for the reaction,

$$\begin{array}{c} \text{H} & \text{H} & & \text{H} & \text{H} \\ | & | & & | & | \\ \text{C} = & \text{C} + \text{H} - \text{H} \longrightarrow & \text{H} - & \text{C} - & \text{C} - \text{H} \\ | & | & | & | & | \\ \text{H} & \text{H} & \text{H} & \text{H} & \end{array}$$

 will be
 (a) -243.6 kJ mol⁻¹ (b) -120.0 kJ mol⁻¹
 (c) 553.0 kJ mol⁻¹ (d) 1523.6 kJ mol⁻¹
 (2009)

27. Bond dissociation enthalpy of H₂, Cl₂ and HCl are 434, 242 and 431 kJ mol⁻¹ respectively. Enthalpy of formation of HCl is
 (a) -93 kJ mol⁻¹ (b) 245 kJ mol⁻¹
 (c) 93 kJ mol⁻¹ (d) -245 kJ mol⁻¹
 (2008)

28. For the gas phase reaction,
 $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$
 which of the following conditions are correct?
 (a) $\Delta H < 0$ and $\Delta S < 0$
 (b) $\Delta H > 0$ and $\Delta S < 0$
 (c) $\Delta H = 0$ and $\Delta S < 0$
 (d) $\Delta H > 0$ and $\Delta S > 0$
 (2008)

29. Which of the following are not state functions?
 (I) $q + w$ (II) q
 (III) w (IV) $H - TS$

- (a) (I), (II) and (III) (b) (II) and (III)
 (c) (I) and (IV) (d) (II), (III) and (IV)
 (2008)

30. Consider the following reactions:
 (i) $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) = \text{H}_2\text{O}(\text{l}), \Delta H = -X_1 \text{ kJ mol}^{-1}$
 (ii) $\text{H}_2(\text{g}) + 1/2\text{O}_2(\text{g}) = \text{H}_2\text{O}(\text{l}), \Delta H = -X_2 \text{ kJ mol}^{-1}$
 (iii) $\text{CO}_2(\text{g}) + \text{H}_2(\text{g}) = \text{CO}(\text{g}) + \text{H}_2\text{O}(\text{l}), \Delta H = -X_3 \text{ kJ mol}^{-1}$
 (iv) $\text{C}_2\text{H}_2(\text{g}) + 5/2\text{O}_2(\text{g}) = 2\text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l}), \Delta H = +X_4 \text{ kJ mol}^{-1}$
 Enthalpy of formation of H₂O(l) is
 (a) +X₃ kJ mol⁻¹ (b) -X₄ kJ mol⁻¹
 (c) +X₁ kJ mol⁻¹ (d) -X₂ kJ mol⁻¹.
 (2007)

31. Given that bond energies of H—H and Cl—Cl are 430 kJ mol⁻¹ and 240 kJ mol⁻¹ respectively and ΔH_f for HCl is -90 kJ mol⁻¹, bond enthalpy of HCl is
 (a) 380 kJ mol⁻¹ (b) 425 kJ mol⁻¹
 (c) 245 kJ mol⁻¹ (d) 290 kJ mol⁻¹
 (2007)

32. Identify the correct statement for change of Gibb's energy for a system (ΔG_{system}) at constant temperature and pressure.
 (a) If $\Delta G_{\text{system}} < 0$, the process is not spontaneous.
 (b) If $\Delta G_{\text{system}} > 0$, the process is spontaneous.
 (c) If $\Delta G_{\text{system}} = 0$, the system has attained equilibrium.
 (d) If $\Delta G_{\text{system}} = 0$, the system is still moving in a particular direction.
 (2006)

33. Assume each reaction is carried out in an open container. For which reaction will $\Delta H = \Delta E$?
 (a) $2\text{CO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g})$
 (b) $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{HBr}(\text{g})$
 (c) $\text{C}(\text{s}) + 2\text{H}_2\text{O}(\text{g}) \rightarrow 2\text{H}_2(\text{g}) + \text{CO}_2(\text{g})$
 (d) $\text{PCl}_5(\text{g}) \rightarrow \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$
 (2006)

34. The enthalpy and entropy change for the reaction:
 $\text{Br}_2(\text{l}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{BrCl}(\text{g})$
 are 30 kJ mol⁻¹ and $105 \text{ J K}^{-1} \text{ mol}^{-1}$ respectively. The temperature at which the reaction will be in equilibrium is
 (a) 300 K (b) 285.7 K
 (c) 273 K (d) 450 K (2006)

35. The enthalpy of hydrogenation of cyclohexene is $-119.5 \text{ kJ mol}^{-1}$. If resonance energy of benzene is $-150.4 \text{ kJ mol}^{-1}$, its enthalpy of hydrogenation would be
 (a) $-358.5 \text{ kJ mol}^{-1}$ (b) $-508.9 \text{ kJ mol}^{-1}$
 (c) $-208.1 \text{ kJ mol}^{-1}$ (d) $-269.9 \text{ kJ mol}^{-1}$ (2006)
36. Which of the following pairs of a chemical reaction is certain to result in a spontaneous reaction?
 (a) Exothermic and increasing disorder
 (b) Exothermic and decreasing disorder
 (c) Endothermic and increasing disorder
 (d) Endothermic and decreasing disorder (2005)
37. A reaction occurs spontaneously if
 (a) $T\Delta S < \Delta H$ and both ΔH and ΔS are +ve
 (b) $T\Delta S > \Delta H$ and ΔH is +ve and ΔS is -ve
 (c) $T\Delta S > \Delta H$ and both ΔH and ΔS are +ve
 (d) $T\Delta S = \Delta H$ and both ΔH and ΔS are +ve (2005)
38. The absolute enthalpy of neutralisation of the reaction:
 $\text{MgO}_{(s)} + 2\text{HCl}_{(aq)} \rightarrow \text{MgCl}_{2(aq)} + \text{H}_2\text{O}_{(l)}$ will be
 (a) $-57.33 \text{ kJ mol}^{-1}$
 (b) greater than $-57.33 \text{ kJ mol}^{-1}$
 (c) less than $-57.33 \text{ kJ mol}^{-1}$
 (d) $57.33 \text{ kJ mol}^{-1}$ (2005)
39. If the bond energies of H-H, Br-Br, and H-Br are 433, 192 and 364 kJ mol^{-1} respectively, the ΔH° for the reaction $\text{H}_{2(g)} + \text{Br}_{2(g)} \rightarrow 2\text{HBr}_{(g)}$ is
 (a) -261 kJ (b) $+103 \text{ kJ}$
 (c) $+261 \text{ kJ}$ (d) -103 kJ (2004)
40. Standard enthalpy and standard entropy changes for the oxidation of ammonia at 298 K are $-382.64 \text{ kJ mol}^{-1}$ and $-145.6 \text{ kJ mol}^{-1}$, respectively. Standard Gibb's energy change for the same reaction at 298 K is
 (a) $-221.1 \text{ kJ mol}^{-1}$ (b) $-339.3 \text{ kJ mol}^{-1}$
 (c) $-439.3 \text{ kJ mol}^{-1}$ (d) $-523.2 \text{ kJ mol}^{-1}$ (2004)
41. Considering entropy (S) as a thermodynamic parameter, the criterion for the spontaneity of any process is
 (a) $\Delta S_{\text{system}} + \Delta S_{\text{surroundings}} > 0$
 (b) $\Delta S_{\text{system}} - \Delta S_{\text{surroundings}} > 0$
 (c) $\Delta S_{\text{system}} > 0$ only
 (d) $\Delta S_{\text{surroundings}} > 0$ only. (2004)
42. The work done during the expansion of a gas from a volume of 4 dm^3 to 6 dm^3 against a constant external pressure of 3 atm is ($1 \text{ L atm} = 101.32 \text{ J}$)
 (a) -6 J (b) -608 J
 (c) $+304 \text{ J}$ (d) -304 J (2004)
43. For the reaction,
 $\text{C}_3\text{H}_{8(g)} + 5\text{O}_{2(g)} \rightarrow 3\text{CO}_{2(g)} + 4\text{H}_2\text{O}_{(l)}$
 at constant temperature, $\Delta H - \Delta E$ is
 (a) $+RT$ (b) $-3RT$ (c) $+3RT$ (d) $-RT$ (2003)
44. The densities of graphite and diamond at 298 K are 2.25 and 3.51 g cm^{-3} , respectively. If the standard free energy difference (ΔG°) is equal to 1895 J mol^{-1} , the pressure at which graphite will be transformed into diamond at 298 K is
 (a) $9.92 \times 10^8 \text{ Pa}$ (b) $9.92 \times 10^7 \text{ Pa}$
 (c) $9.92 \times 10^6 \text{ Pa}$ (d) $9.92 \times 10^5 \text{ Pa}$ (2003)
45. What is the entropy change (in $\text{J K}^{-1} \text{ mol}^{-1}$) when one mole of ice is converted into water at 0°C ? (The enthalpy change for the conversion of ice to liquid water is 6.0 kJ mol^{-1} at 0°C .)
 (a) 20.13 (b) 2.013 (c) 2.198 (d) 21.98 (2003)
46. Formation of a solution from two components can be considered as
 (i) Pure solvent \rightarrow separated solvent molecules, ΔH_1
 (ii) Pure solute \rightarrow separated solute molecules, ΔH_2
 (iii) Separated solvent and solute molecules \rightarrow solution, ΔH_3
 Solution so formed will be ideal if
 (a) $\Delta H_{\text{soln}} = \Delta H_1 + \Delta H_2 + \Delta H_3$
 (b) $\Delta H_{\text{soln}} = \Delta H_1 + \Delta H_2 - \Delta H_3$
 (c) $\Delta H_{\text{soln}} = \Delta H_1 - \Delta H_2 - \Delta H_3$
 (d) $\Delta H_{\text{soln}} = \Delta H_3 - \Delta H_1 - \Delta H_2$ (2003)
47. For which one of the following equations is $\Delta H_{\text{react}}^\circ$ equal to $\Delta H_{\text{f}}^\circ$ for the product?
 (a) $\text{N}_{2(g)} + \text{O}_{3(g)} \rightarrow \text{N}_2\text{O}_{3(g)}$
 (b) $\text{CH}_{4(g)} + 2\text{Cl}_{2(g)} \rightarrow \text{CH}_2\text{Cl}_{2(l)} + 2\text{HCl}_{(g)}$
 (c) $\text{Xe}_{(g)} + 2\text{F}_{2(g)} \rightarrow \text{XeF}_{4(g)}$
 (d) $2\text{CO}_{(g)} + \text{O}_{2(g)} \rightarrow 2\text{CO}_{2(g)}$ (2003)

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48. The molar heat capacity of water at constant pressure, C_p , is $75 \text{ J K}^{-1} \text{ mol}^{-1}$. When 1.0 kJ of heat is supplied to 100 g of water which is free to expand, the increase in temperature of water is
 (a) 1.2 K (b) 2.4 K (c) 4.8 K (d) 6.6 K (2003)
49. Unit of entropy is
 (a) $\text{J K}^{-1} \text{ mol}^{-1}$ (b) J mol^{-1}
 (c) $\text{J}^{-1} \text{K}^{-1} \text{ mol}^{-1}$ (d) J K mol^{-1} (2002)
50. In a closed insulated container a liquid is stirred with a paddle to increase the temperature which of the following is true?
 (a) $\Delta E = W \neq 0, q = 0$ (b) $\Delta E = W = q \neq 0$
 (c) $\Delta E = 0, W = q \neq 0$ (d) $W = 0, \Delta E = q \neq 0$. (2002)
51. Heat of combustion ΔH for $\text{C}_{(s)}$, $\text{H}_{2(g)}$ and $\text{CH}_{4(g)}$ are -94 , -68 and -213 kcal/mol , then ΔH for $\text{C}_{(s)} + 2\text{H}_{2(g)} \rightarrow \text{CH}_{4(g)}$ is
 (a) -17 kcal (b) -111 kcal
 (c) -170 kcal (d) -85 kcal (2002)
52. Which reaction is not feasible?
 (a) $2\text{KI} + \text{Br}_2 \rightarrow 2\text{KBr} + \text{I}_2$
 (b) $2\text{KBr} + \text{I}_2 \rightarrow 2\text{KI} + \text{Br}_2$
 (c) $2\text{KBr} + \text{Cl}_2 \rightarrow 2\text{KCl} + \text{Br}_2$
 (d) $2\text{H}_2\text{O} + 2\text{F}_2 \rightarrow 4\text{HF} + \text{O}_2$ (2002)
53. 2 mole of ideal gas at 27°C temperature is expanded reversibly from 2 lit. to 20 lit. Find entropy change. ($R = 2 \text{ cal/mol K}$)
 (a) 92.1 (b) 0 (c) 4 (d) 9.2 (2002)
54. Change in enthalpy for reaction,
 $2\text{H}_2\text{O}_{2(l)} \rightarrow 2\text{H}_2\text{O}_{(l)} + \text{O}_{2(g)}$
 if heat of formation of $\text{H}_2\text{O}_{2(l)}$ and $\text{H}_2\text{O}_{(l)}$ are -188 and -286 kJ/mol respectively, is
 (a) -196 kJ/mol (b) $+196 \text{ kJ/mol}$
 (c) $+948 \text{ kJ/mol}$ (d) -948 kJ/mole (2001)
55. When 1 mol of gas is heated at constant volume temperature is raised from 298 to 308 K. Heat supplied to the gas is 500 J. Then which statement is correct?
 (a) $q = w = 500 \text{ J}, \Delta E = 0$
 (b) $q = \Delta E = 500 \text{ J}, w = 0$
 (c) $q = w = 500 \text{ J}, \Delta E = 0$
 (d) $\Delta E = 0, q = w = -500 \text{ J}$ (2001)
56. Enthalpy of $\text{CH}_4 + 1/2 \text{O}_2 \rightarrow \text{CH}_3\text{OH}$ is negative. If enthalpy of combustion of CH_4 and CH_3OH are x and y respectively. Then which relation is correct?
 (a) $x > y$ (b) $x < y$
 (c) $x = y$ (d) $x^3 = y$ (2001)
57. $\text{PbO}_2 \rightarrow \text{PbO}; \Delta G_{298} < 0$
 $\text{SnO}_2 \rightarrow \text{SnO}; \Delta G_{298} > 0$
 Most probable oxidation state of Pb and Sn will be
 (a) $\text{Pb}^{4+}, \text{Sn}^{4+}$ (b) $\text{Pb}^{4+}, \text{Sn}^{2+}$
 (c) $\text{Pb}^{2+}, \text{Sn}^{2+}$ (d) $\text{Pb}^{2+}, \text{Sn}^{4+}$ (2001)
58. Cell reaction is spontaneous when
 (a) ΔG° is negative (b) ΔG° is positive
 (c) $\Delta E^\circ_{\text{red}}$ is positive (d) $\Delta E^\circ_{\text{red}}$ is negative. (2000)
59. $2\text{Zn} + \text{O}_2 \rightarrow 2\text{ZnO}; \Delta G^\circ = -616 \text{ J}$
 $2\text{Zn} + \text{S}_2 \rightarrow 2\text{ZnS}; \Delta G^\circ = -293 \text{ J}$
 $\text{S}_2 + 2\text{O}_2 \rightarrow 2\text{SO}_2; \Delta G^\circ = -408 \text{ J}$
 ΔG° for the following reaction
 $2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2$ is
 (a) -731 J (b) -1317 J
 (c) -501 J (d) $+731 \text{ J}$ (2000)
60. At 27°C latent heat of fusion of a compound is 2930 J/mol . Entropy change is
 (a) 9.77 J/mol-K (b) 10.77 J/mol-K
 (c) 9.07 J/mol-K (d) 0.977 J/mol-K (2000)
61. For the reaction,
 $\text{C}_2\text{H}_5\text{OH}_{(l)} + 3\text{O}_{2(g)} \rightarrow 2\text{CO}_{2(g)} + 3\text{H}_2\text{O}_{(l)}$ which one is true
 (a) $\Delta H = \Delta E - RT$ (b) $\Delta H = \Delta E + RT$
 (c) $\Delta H = \Delta E + 2RT$ (d) $\Delta H = \Delta E - 2RT$ (2000)
62. In an endothermic reaction, the value of ΔH is
 (a) negative (b) positive
 (c) zero (d) constant. (1999)
63. In the reaction: $\text{S} + 3/2 \text{O}_2 \rightarrow \text{SO}_3 + 2x \text{ kcal}$ and $\text{SO}_2 + 1/2 \text{O}_2 \rightarrow \text{SO}_3 + y \text{ kcal}$, the heat of formation of SO_2 is
 (a) $(2x + y)$ (b) $(x - y)$
 (c) $(x + y)$ (d) $(2x - y)$ (1999)
64. Identify the correct statement regarding entropy.
 (a) At absolute zero of temperature, the entropy of all crystalline substances is taken to be zero.
 (b) At absolute zero of temperature, the entropy of a perfectly crystalline substance is +ve.
 (c) At absolute zero of temperature, entropy of a perfectly crystalline substance is taken to be zero.
 (d) At 0°C , the entropy of a perfectly crystalline substance is taken to be zero. (1998)

65. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 litre to 10 litres. The ΔE for this process is
($R = 2 \text{ cal mol}^{-1}\text{K}^{-1}$)
(a) 1381.1 cal (b) zero
(c) 163.7 cal (d) 9 L atm (1998)
66. Given that $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$, $\Delta H^\circ = -x \text{ kJ}$
 $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$, $\Delta H^\circ = -y \text{ kJ}$
The enthalpy of formation of carbon monoxide will be
(a) $\frac{y-2x}{2}$ (b) $2x-y$
(c) $y-2x$ (d) $\frac{2x-y}{2}$ (1997)
67. Which of the following is the correct equation?
(a) $\Delta U = \Delta W + \Delta Q$ (b) $\Delta U = \Delta Q - W$
(c) $\Delta W = \Delta U + \Delta Q$ (d) None of these (1996)
68. If enthalpies of formation for $\text{C}_2\text{H}_4(\text{g})$, $\text{CO}_2(\text{g})$ and $\text{H}_2\text{O}(\text{l})$ at 25°C and 1 atm pressure are 52, -394 and -286 kJ/mol respectively, then enthalpy of combustion of $\text{C}_2\text{H}_4(\text{g})$ will be
(a) +141.2 kJ/mol (b) +1412 kJ/mol
(c) -141.2 kJ/mol (d) -1412 kJ/mol (1995)
69. A chemical reaction is catalyzed by a catalyst X. Hence X
(a) reduces enthalpy of the reaction
(b) does not affect equilibrium constant of reaction
(c) decreases rate constant of the reaction
(d) increases activation energy of the reaction. (1995)
70. Standard state Gibb's free energy change for isomerization reaction *cis*-2-pentene \rightleftharpoons *trans*-2-pentene is -3.67 kJ/mol at 400 K. If more *trans*-2-pentene is added to the reaction vessel, then
(a) equilibrium remains unaffected
(b) equilibrium is shifted in the forward direction
(c) more *cis*-2-pentene is formed
(d) additional *trans*-2-pentene is formed. (1995)
71. For a reaction to occur spontaneously
(a) ΔH must be negative
(b) ΔS must be negative
(c) $(\Delta H - T\Delta S)$ must be negative
(d) $(\Delta H + T\Delta S)$ must be negative. (1995)
72. During isothermal expansion of an ideal gas, its
(a) internal energy increases
(b) enthalpy decreases
(c) enthalpy remains unaffected
(d) enthalpy reduces to zero. (1994, 91)
73. Following reaction occurring in an automobile
 $2\text{C}_8\text{H}_{18}(\text{g}) + 25\text{O}_2(\text{g}) \rightarrow 16\text{CO}_2(\text{g}) + 18\text{H}_2\text{O}(\text{g})$
The sign of ΔH , ΔS and ΔG would be
(a) -, +, + (b) +, +, -
(c) +, -, + (d) -, +, - (1994)
74. For the reaction $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$, $\Delta H = ?$
(a) $\Delta E + 2RT$ (b) $\Delta E - 2RT$
(c) $\Delta H = RT$ (d) $\Delta E - RT$ (1991)
75. If ΔH is the change in enthalpy and ΔE , the change in internal energy accompanying a gaseous reaction, then
(a) ΔH is always greater than ΔE
(b) $\Delta H < \Delta E$ only if the number of moles of the products is greater than the number of moles of the reactants
(c) ΔH is always less than ΔE
(d) $\Delta H < \Delta E$ only if the number of moles of products is less than the number of moles of the reactants. (1990)

Answer Key

1. (a) 2. (b) 3. (b) 4. (a, c) 5. (b) 6. (None) 7. (b) 8. (b) 9. (a)
10. (b) 11. (b) 12. (a) 13. (c) 14. (a) 15. (d) 16. (c) 17. (c) 18. (b) 19. (c)
20. (a) 21. (c) 22. (d) 23. (c) 24. (d) 25. (b) 26. (b) 27. (a) 28. (d) 29. (b)
30. (d) 31. (b) 32. (c) 33. (b) 34. (b) 35. (c) 36. (a) 37. (c) 38. (c) 39. (d)
40. (b) 41. (a) 42. (b) 43. (b) 44. (None) 45. (d) 46. (a) 47. (c) 48. (b)
49. (a) 50. (a) 51. (a) 52. (b) 53. (d) 54. (a) 55. (b) 56. (a) 57. (d) 58. (a)
59. (a) 60. (a) 61. (a) 62. (b) 63. (d) 64. (c) 65. (b) 66. (a) 67. (b) 68. (d)
69. (b) 70. (c) 71. (c) 72. (c) 73. (d) 74. (b) 75. (d)