Thermochemistry:

1. In an endothermic reaction, the value of ΔH is :
(A) zero (B) positive (C) negative (D) constant

2. For the reaction, $C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$
at constant temperature, $\Delta H - \Delta E$ is :
(A) + 3RT (B) – RT (C) + RT (D) – 3RT

3. Consider the following changes :

(i) $\frac{1}{2} H_2(g) + aq. \longrightarrow H^+(aq.)$ (ii) $2O(g) \longrightarrow O_2(g)$

(iii) $NH_4^+(g) + Cl^-(g) \longrightarrow NH_4Cl(s)$ (iv) P_4 (black) $+ 5O_2(g) \longrightarrow P_4O_{10}(s)$

Which of the above does not represent $\Delta H^\circ_{formation}$ of the product :
(A) II,III (B) I, IV (C) I, II, III (D) II , III, IV

4. Given that $S_{(s)} + \frac{3}{2} O_{2(g)} \longrightarrow SO_{3(g)} + 2x$ KCal; $SO_{2(g)} + \frac{1}{2} O_{2(g)} \longrightarrow SO_{3(g)} + y$ KCal

What would be the enthalpy of formation of SO_2 :
(A) – 2x + y (B) 2x – y (C) – x + y (D) x – y

5. The combustion of 0.2 mole of liquid carbon disulphide CS_2 at constant pressure to give $CO_2(g)$ and $SO_2(g)$ releases 215 kJ of heat. What is ΔH_f° for $CS_{2(l)}$ in kJ mol^{-1} :

ΔH_f°	kJ mol^{-1}
$CO_{2(g)}$	–393.5
$SO_{2(g)}$	–296.8

(A) 772.1 (B) 87.9 (C) 384.7 (D) – 2062.1

6. Calculate the heat of combustion of carbon monoxide at 17ºC at constant volume from the given enthalpy of reactions at 17ºC :
(i) $C(s) + O_2(g) \longrightarrow CO_2(g)$; $\Delta H_1 = -97000$ Cal
(ii) $CO_2(g) + C(s) \longrightarrow 2\,CO(g)$; $\Delta H_2 = 39000$ Cal
(A) – 136000 Cal (B) – 135420 Cal (C) – 68000 Cal (D) – 67710 Cal

7. The enthalpy of neutralization of a strong base and strong acid is 57.0 kJ eq^{-1}. The heat evolved when 0.5 mole of HNO_3 are added to 1 L of 0.2 M NaOH solution is :
(A) ≈20 kJ (B) 28.5 kJ (C) 11.4 kJ (D) 34.9 kJ

8. The heat evolved in neutralizing a solution containing 1 mole of HCN with a strong alkali is 3 KCal. The enthalpy of dissociation of HCN is :
(A) 54.1 KCal/mol (B) 60.1 KCal/mol (C) 10.7 KCal/mol (D) 16.7 KCal/mol

9. Consider the following reactions :

(i) $H^+(aq) + OH^-(aq) = H_2O(\ell) - x_1$ kJ mol^{-1} (ii) $H_2(g) + \frac{1}{2} O_2(g) = H_2O(\ell) - x_2$ kJ mol^{-1}

(iii) $CO_2(g) + H_2(g) = CO(g) + H_2O(\ell) - x_3$kJ mol^{-1}

(iv) $C_2H_2(g) + \frac{5}{2} O_2(g) = 2CO_2(g) + H_2O(\ell) + x_4$ kJ mol^{-1}

Enthalpy of formation of $H_2O(\ell)$ is :
(A) + x_2 kJ mol^{-1} (B) + x_3 kJ mol^{-1} (C) – x_4 kJ mol^{-1} (D) + x_1 kJ mol^{-1}

10. The value of heat of formation of SO_2 and SO_3 are –298.2 kJ and –98.2 kJ. The heat of reaction of the following reaction will be $SO_2 + \frac{1}{2} O_2 \rightarrow SO_3$

(A) – 200 kJ (B) –356.2 kJ (C) +200 kJ (D) –396.2 kJ

11. In the combustion of 2.0 gm of methane 25 kcal heat is liberated, heat of combustion of methane would be-

(A) 100 kcal (B) 200 kcal (C) 300 kcal (D) 400 kcal

12. For the equations : $C(diamond) + 2H_2(g) \rightarrow CH_4(g)$; ΔH_1 and $C(g) + 4H(g) \rightarrow CH_4(g)$; ΔH_2

Select the correct option (Magnitude) :

(A) $\Delta H_1 = \Delta H_2$ (B) $\Delta H_1 > \Delta H_2$ (C) $\Delta H_1 < \Delta H_2$ (D) Nothing can be said with certainty.

13. Consider the following changes :

$Na^+(g) \longrightarrow Na^+(aq)\ \Delta H_1$ .... (1)

$Na(s) \longrightarrow Na^+(g) \Delta H_2$ .... (2)

$Cl^-(g) \longrightarrow Cl^-(aq)\ \Delta H_3$ .... (3)

$Cl_2(g) \longrightarrow 2Cl^-(g)\ \Delta H_4$ .... (4)

$Na^+(g) + Cl^-(g) \longrightarrow NaCl(s)\ \Delta H_5$ .... (5)

$NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq)\ \Delta H_6$ .... (6)

Hydration enthalpy of NaCl can be defined by sum of the following :

(A) $\Delta H_1 + \Delta H_2 + \Delta H_3 + \Delta H_4/2$ (B) ΔH_6 only

(C) $\Delta H_1 + \Delta H_3$ (D) $\Delta H_2 + \Delta H_4/2 + \Delta H_5 + \Delta H_6$

14. Enthalpy of atomisation of NH_3 and N_2H_4 are x KCal mol^{-1} and y KCal mol^{-1} respectively. Calculate average bond energy of N—N bond :

(A) $\frac{4y-3x}{3}$ KCal mol^{-1} (B) $\frac{2y-3x}{3}$ KCal mol^{-1} (C) $\frac{4y-3x}{4}$ KCal mol^{-1} (D) $\frac{3y-4x}{3}$ KCal mol^{-1}

***15.** If for reaction :

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$, $\Delta H_1^\circ = -30$ kJ/mole at temperature 300 K and if specific heat capacities of different species are $S_{P,\,N_2} = 1$ J/g°C, $S_{P,\,H_2} = 10$ J/g°C and $S_{P,\,NH_3} = 2$ J/g °C, then ΔH_2° at 400 K for the same reaction will be : (assume heat capacities to be constant in given temperature range)

(A) – 32 kJ/mole (B) – 28 kJ/mole (C) – 32.7 kJ/mole (D) – 27.3 kJ/mole

16. For which one of the following equation ΔH°_r not equal to ΔH°_f for the product ?

(A) $Xe(g) + 2F_2(g) \longrightarrow XeF_4(g)$ (B) $2CO(g) + O_2(g) \longrightarrow 2CO_2(g)$

(C) $N_2(g) + O_3(g) \longrightarrow N_2O_3(g)$ (D) $CH_4(g) + 2Cl_2(g) \longrightarrow CH_2Cl_2(\ell) + 2HCl(g)$

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

(A) $\Delta G = 0$ (B) $\Delta S > 0$ (C) $\Delta H > 0$ (D) ΔG = –ve

18. At 300 K, the reaction which have the following values of thermodynamic parameter, occur spontaneously.

(A) $\Delta G^\circ = -400$ kJ mol^{-1} (B) $\Delta H^\circ = 200$ kJ mol^{-1}, $\Delta S^\circ = -4$ JK^{-1} mol^{-1}

(C) $\Delta H^\circ = -200$ kJ mol^{-1}, $\Delta S^\circ = 4$ JK^{-1} mol^{-1} (D) $\Delta H^\circ = 200$ kJ mol^{-1}, $\Delta S^\circ = -40$ JK^{-1} mol^{-1}

Answers

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1. (B) **2.** (D) **3.** (D) **4.** (A) **5.** (B) **6.** (D) **7.** (C) **8.** (C) **9.** (A) **10.** (C)
11. (B) **12.** (B) **13.** (C) **14.** (D) **15.** (A) **16.** (BCD) **17.** (ABC) **18.** (AC)