

THERMOCHEMISTRY

Q.1 If $\Delta G^\circ > 0$, for a reaction then :

- (A) $K_p > 1$
- (B) $K_p < 1$
- (C) The products predominate in the equilibrium mixture
- (D) None

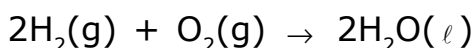
Q.2 Which is not a spontaneous process -

- (A) Expansion of a gas into vacuum
- (B) Water flowing down hill
- (C) Heat flowing from colder body to a hotter body
- (D) Evaporation of water from clothes during drying

Q.3 Work done in reversible adiabatic process is given by

- (A) $2.303 RT \log \frac{V_1}{V_2}$
- (B) None
- (C) $2.303 RT \log \frac{V_2}{V_1}$
- (D) $\frac{nR}{(\gamma-1)} (T_2 - T_1)$

Q.4 The entropy change for the reaction given below is



is at 300 K. Standard entropies of $\text{H}_2(\text{g})$, $\text{O}_2(\text{g})$ and $\text{H}_2\text{O}(\ell)$ are 126.6, 201.20 and 68.0 $\text{JK}^{-1} \text{mol}^{-1}$ respectively-

- (A) $- 318.4 \text{ JK}^{-1} \text{ mol}^{-1}$
- (B) $318.4 \times \text{JK}^{-1} \text{ mol}^{-1}$
- (C) $31.84 \times \text{JK}^{-1} \text{ mol}^{-1}$
- (D) None of these

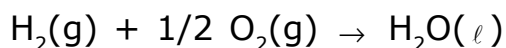
Q.5 For spontaneous reaction the value of change of Gibbs free energy, ΔG is-

- (A) Negative
- (B) Positive
- (C) Greater than one
- (D) One

Q.6 Heat of reaction of constant p or constant v varies with temperature as given by Kirchoff's equation is/are-

- (A) $\Delta H_2 = \Delta H_1 + \Delta C_p (T_2 - T_1)$ (B) $\Delta E_2 = \Delta E_1 + \Delta C_p (T_2 - T_1)$
 (C) $H_2 = H_1 + \Delta C_p (T_2 - T_1)$ (D) $\Delta E_2 = \Delta E_1 + C_p (T_2 - T_1)$

Q.7 For the combustion reaction at 298 K



Which of the following alternative(s) is/are correct

- (A) $\Delta H = \Delta E$ (B) $\Delta H > \Delta E$ (C) $\Delta H < \Delta E$
 (D) ΔH & ΔE has no relation with each there

Q.8 Heat of combustion of CH_4 , C_2H_4 , C_2H_6 are - 890, - 1411 and - 1560 kJ/mol respectively. Which has the lowest calorific fuel value in kJ/g -

- (A) CH_4 (B) C_2H_4 (C) C_2H_6 (D) All same

Q.9 ΔH for $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ is 176 kJ mol⁻¹ at 1240 K. The ΔE for the change is equal to-

- (A) 160 kJ (B) 165.6 kJ (C) 186.3 kJ (D) 180.0 kJ

Q.10 $C_{\text{diamond}} + O_2(g) \rightarrow CO_2(g); \quad \Delta H = - 395 \text{ kJ} \quad \dots\dots\dots (i)$
 $C_{\text{graphite}} + O_2(g) \rightarrow CO_2(g); \quad \Delta H = - 393.5 \text{ kJ} \quad \dots\dots\dots (ii)$

Then ΔH , when diamond is formed from graphite is-

- (A) - 1.5 kJ (B) + 1.5 kJ (C) + 3.0 kJ (D) - 3.0 kJ

ANSWER KEY

| Thermochemistry | | | | | | | | | | |
|-----------------|---|---|---|---|---|---|---|---|---|----|
| Q.No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Ans. | B | C | D | A | A | A | C | A | B | A |

SOLUTIONS

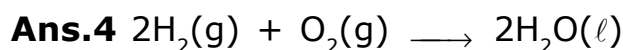
Ans.1 - $\Delta G^{\circ} = 2.303 RT \log K_p$

Ans.2 Heat cannot be it self pass from colder to hotter body.

Sol.3 Work done in an adiabatic process is given by

$$W = \frac{P_2V_2 - P_1V_1}{\gamma - 1} \text{ in term of } (P, V)$$

$$W = \frac{nR(T_2 - T_1)}{\gamma - 1} \text{ in term of 'T'}$$



$$\begin{aligned} \Rightarrow \Delta S &= [2\Sigma S_{H_2O} - [2\Sigma S_{N_2} + \Sigma S_{O_2}]] \\ &= [2 \times 68 - (2 \times 126.6 + 201.20)] \\ &= [138 - (253.2 + 201.20)] = - 318.4 \text{ J/k mol} \end{aligned}$$

Ans.5 For a spontaneous process

Gibbs free energy is always negative

$$\Delta G < 0$$

$$\Rightarrow \text{(A)}$$

Ans.6 $\frac{\Delta H_2 - \Delta H_1}{T_2 - T_1} = \Delta C_p$

$$\Delta H_2 - \Delta H_1 = \Delta C_p (T_2 - T_1)$$

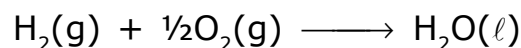
$$\Delta H_2 = \Delta H_1 + \Delta C_p (T_2 - T_1)$$

Ans.7 We know that enthalpy of a reaction is given by

$$\Delta H = \Delta E + \Delta nRT$$

$$\Delta H = \Delta E + \Delta nRT$$

For given equation



$$\Delta H = 0 - (1 + \frac{1}{2}) = - \frac{3}{2}$$

$$\Delta H = \Delta E - \frac{3}{2}RT$$

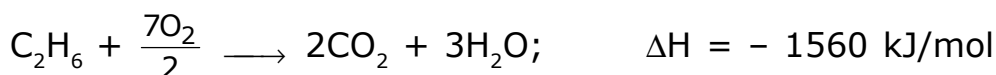
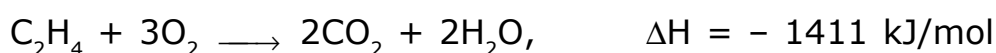
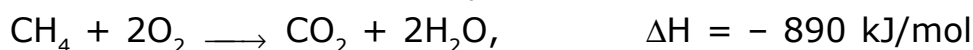
$$\Rightarrow \Delta H < \Delta E$$

Ans. (C)

Ans.8 Heat of combustion of $\text{CH}_4 = - 890 \text{ kJ/mol}$

Heat fo combustion of $\text{C}_2\text{H}_4 = - 1411 \text{ kJ/mol}$

Heat of combustion of $\text{C}_2\text{H}_6 = - 1560 \text{ kJ/mol}$



So heat evolved for 16 gm $\text{CH}_4 = - 890 = \frac{-890}{16} = - 55.625 \text{ kJ/mol}$

Heat evolve for 28 gm $\text{C}_2\text{H}_4 = - 1411$

\therefore heat evolve 1gm $\text{C}_2\text{H}_4 = - \frac{1411}{28} = - 50.39 \text{ kJ/mol}$

Heat for 30 gm of $\text{C}_2\text{H}_6 = - 1560 \text{ kJ/mol}$

\therefore heat for 1 gm of $\text{C}_2\text{H}_6 = - \frac{1500}{30} = 52 \text{ kJ/mol}$

So heat evolved for CH_4 is max. so highest calorities value is (CH_4).

Ans. (A)

Ans.9 $\text{CaCO}_3(\text{s}) \longrightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$

$$\Delta H = 1 - 0 = 1$$

$$\Delta H = \Delta E + \Delta nRT$$

$$176 = \Delta E + 1 \times \frac{8.314}{1000} \times 1240$$

$$176 = \Delta E + \frac{8.314 \times 124}{100} \text{ kJ}$$

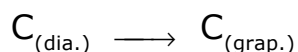
$$176 = \Delta E + 10.309 \text{ kJ}$$

$$\Delta E = 176 - 10.309$$

$$\Delta E = 165.69 \text{ kJ} \quad \text{Ans. (B)}$$

Ans.10 $\text{C}_{\text{diamond}} + \text{O}_2(\ell) \longrightarrow \text{CO}_2(\text{g}), \quad \Delta H = - 395 \text{ kJ}$

$\text{C}_{\text{graphite}} + \text{O}_2(\ell) \longrightarrow \text{CO}_2(\text{g}), \quad \Delta H = - 393.5 \text{ kJ}$



$$\Delta H = (\Delta H_{\text{g}} - \Delta H_{\text{dia.}})$$
$$= 393.5 - 395$$

$$\Delta H = - 1.5 \text{ kJ}$$