

Chapter Name



Thermodynamics

NCERT Exercise

Q.1. >

(C) fact

Q.2. >

(C) fact

Q.3. >

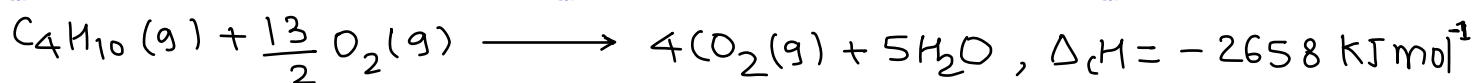
(d) P, V, T & mass

Q.4. >

(C) Remain constant.

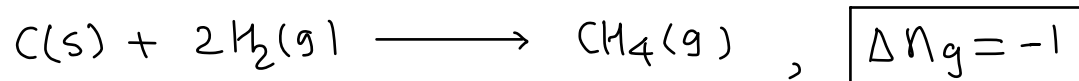
Q.5. >

(C)

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Q.6. >

(b)



$$\Delta H = \Delta U + \Delta n_g RT$$

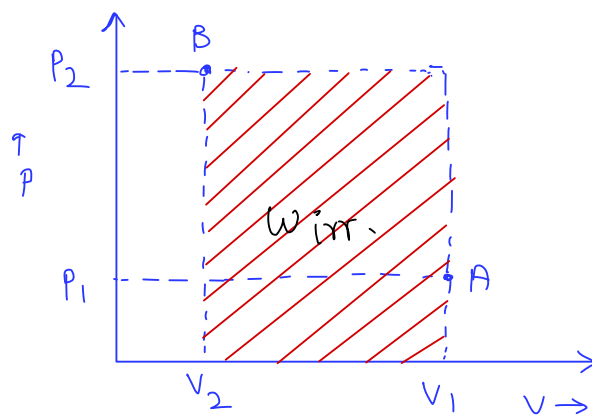
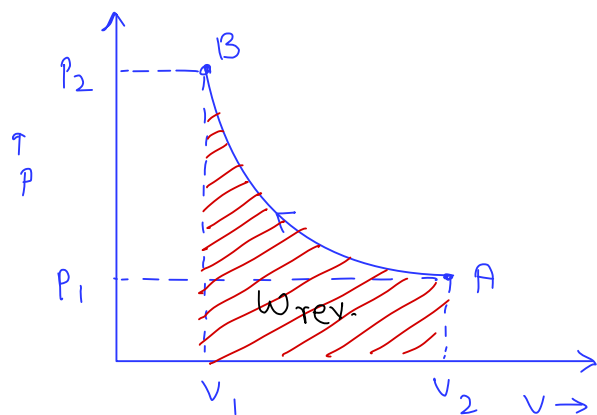
$$\Delta H < \Delta U$$

Q.7. >

(C) $q = 0$, $\Delta T = 0$, $w = 0$

Q.8.→

(b) Compression



$$W_{irr} = -P_{ext} \Delta V$$

$$= -P_2 (V_2 - V_1)$$



$$W_{irr} > W_{rev.}$$



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Q.9.→

(c) $\Delta S_{system} \downarrow$ es but $\Delta S_{surr} \uparrow$ es

Q.10.→

(c) eq. a = eq. b + eq. c

$$x = y + z$$

Q.11.→

(c) $x > y$

Q.12.→

(c) may be positive or Negative

Q.13.→

(a)

$$\Delta H_{\text{sub.}} = \Delta H_{\text{fusion}} + \Delta H_{\text{vap.}}$$

Q.14.→

(b) True statement

↓

$$\Delta G < 0 \quad \text{for a spontaneous Rx}^{\text{?}}$$

Q.15.→ (a)

(i) → b

(ii) → c

(iii) → a

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Q.16.→ (c)

(i) → c

(ii) → a

(iii) → b

Q.17.→

(b) Both A & R are true but R is not the correct explanation of A.

Q.18. >

- (b) Both A & R are true but R is not the correct explanation of A.

Q.19. >

- (a) Both A & R are true and R is the correct explanation of A.

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Q.20. >

- (d) fact

Q.21. >

- (b) $\Delta H < 0$ ← Exothermic

$$\left\{ \begin{array}{l} \Delta H = E_p - E_R \end{array} \right.$$

Q.22. >

- (b) $\Delta H = \Delta U + \Delta n_g RT$ $\left\{ \begin{array}{l} \Delta n_g = 1 \end{array} \right.$

$$-310 = \Delta U + 1 \times (8.314 \times 10^{-3}) \times 298$$

$$\Delta U = -125.03 \text{ kJ}$$

Q.23. >

- (d) when $\Delta n_g RT = 0$ then $\Delta H = \Delta U$

Q.24.→

(d) fact

Q.25.→

$$\textcircled{a} \quad \Delta U = q + w$$

$$q = \Delta U = n C_v \Delta T$$

$$q = 0$$

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Q.26.→

(b) Decomposition of CaCO_3 is an endothermic process and heat is provided for decomposition.

Q.27.→

$$\textcircled{c} \quad \Delta H_r^\circ = [2 \times (\Delta H_f^\circ)_{\text{Fe}} + 3 \times (\Delta H_f^\circ)_{\text{H}_2\text{O}}] - [(\Delta H_f^\circ)_{\text{Fe}_2\text{O}_3} + 3 \times (\Delta H_f^\circ)_{\text{H}_2}]$$

$$\Delta H_r^\circ = [2 \times 0 + 3 \times (-285.83)] - [-824.2 + 0]$$

$$\Delta H_r^\circ = -33.3 \text{ kJ mol}^{-1}, \text{ exothermic}$$

Q.28.→

$$\textcircled{a} \quad \Delta S_{\text{Total}} = \Delta S_{\text{system}} + \Delta S_{\text{surr}} > 0$$

Q. 29 →

(c) $\Delta G < 0$, the process is spontaneous

Q. 30 →

(b) adiabatic

Q. 31 →

(c) volume \Rightarrow extensive

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Q. 32 →

(d)

$$\Delta H_r^\circ = [2 \epsilon_{O-F} + 2 \epsilon_{H-O}] - [\epsilon_{O=O} + 2 \epsilon_{H-F}]$$

$$\Delta H_r^\circ = 79 \text{ Kcal}$$



Q. 33 →

(a)

$$\Delta H_r^\circ = [(\Delta H_f^\circ)_{Al_2O_3} + 2 \times (\Delta H_f^\circ)_{Fe}] - [(\Delta H_f^\circ)_{Fe_2O_3} + 2(\Delta H_f^\circ)_{Al}]$$

$$\Delta H_r^\circ = -836 \text{ KJ mol}^{-1}$$

Q. 34 →

(a)

$$\Delta H = n C_p \Delta T$$

$$10 \times 10^3 \text{ J} = \frac{1000}{18} \times 75 \text{ J K}^{-1} \times \Delta T$$

$$\left. \begin{array}{l} \\ \\ \end{array} \right\} n = \frac{1000}{18}$$

$$\Delta T = 2.4 \text{ K}$$

Q. 35. >

(a)

$$q = 2.303 nRT \log \frac{V_2}{V_1}$$

$$\left\{ \begin{array}{l} \Delta U = q + w = 0 \\ q = -w \end{array} \right.$$

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Q. 36. >

(a)

from eq. (1)

$$\Delta H_r = 2 \epsilon_{O-H} - \epsilon_{O-H} = 497.8 \text{ kJ}$$

from eq. (2)

$$\Delta H_r = \epsilon_{O-H} = 428.5 \text{ kJ}$$

So,

$$2 \times \epsilon_{O-H} - 428.5 = 497.8$$

$$\epsilon_{O-H} = 463.15 \text{ kJ mol}^{-1}$$

Q. 37. >

(b)

$$Q = Q_1 + Q_2$$

Q. 38. >

$$(b) \quad w = -P_{ext}(V_2 - V_1) = -3(6 - 4) \Rightarrow -6 \text{ Latm}$$

$$\Rightarrow -6 \times 101.32 \Rightarrow -608 \text{ J}$$

Q. 39.→

$$\textcircled{c} \quad w_{\text{rev}} = -2.303 nRT \log \frac{V_2}{V_1}$$

$$w_{\text{rev}} = -2.303 \times 1 \times 1.98 \times 298 \log\left(\frac{50}{15}\right)$$

$$w_{\text{rev.}} = -718 \text{ cal}$$

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Q. 40.→

 \textcircled{c} fact.

Q. 41.→

 \textcircled{c} Hess's law of constant heat summation.

Q. 42.→

 \textcircled{b} Reverse of given equation

i.e. $\Delta H_r = +91.8 \text{ kJ mol}^{-1}$

Q. 43.→

- \textcircled{d}
- A. \longrightarrow (iii)
 - B. \longrightarrow (iv)
 - C. \longrightarrow (ii)
 - D. \longrightarrow (i)

Q. 44. >

(c)

$$\Delta H^{\circ}_{\text{solution}} = \Delta H^{\circ}_{\text{lattice}} + \Delta H^{\circ}_{\text{hyd.}}$$

$$u = \Delta H^{\circ}_{\text{lattice}} - 784$$

$$\Delta H^{\circ}_{\text{lattice}} = 788 \text{ kJ mol}^{-1}$$

Q. 45. >

(d)

$$\Delta S = -\frac{\Delta H}{T} = -\frac{42.6 \times 10^3 \text{ J mol}^{-1}}{373}$$

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$$\Delta S = -114.2 \text{ J K}^{-1} \text{ mol}^{-1}$$

Q. 46. >

(b)

$$\Delta H^{\circ}_{\text{r}} = (\Delta H^{\circ}_{\text{c}})_{\text{C}_6\text{H}_6} = -780.0 \text{ kcal}$$

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Q. 47. >

(c) isolated

Q. 48. >

(c)

$$\Delta H^{\circ}_{\text{solution}} = \Delta H^{\circ}_{\text{lattice}} + \Delta H^{\circ}_{\text{hyd.}}$$

Q.49.>

(d) $\Delta G = 0$ ← at equilibrium

Q.50.>

(b) fact ← addition $R \times n$.

Q.51.>

(a) FLOT

Q.52.>

(d) $\Delta H < 0$ & $\Delta S > 0$

Q.53.>

(a) $\Delta U = q + w$

$$\Delta U = -2 + 12 = 10 \text{ KJ}$$

Q.54.>

(b) fact

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Q.55.7

$$\textcircled{a} \quad \Delta U = q + w = 0$$

$$q = -w$$

$$w_{\text{rev}} = -2.303 nRT \log \frac{V_2}{V_1}$$

$$w_{\text{rev}} = -2.303 \times 1 \times 8.314 \times 300 \log \left(\frac{100}{10} \right)$$

$$w_{\text{rev}} = -19.14 \times 300 \text{ J}$$

Now

$$\Delta S = - \frac{q_{\text{rev}}}{T} = + \frac{19.14 \times 300}{300}$$

$$\Delta S = +19.14 \text{ J K}^{-1}$$

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Q.56.7

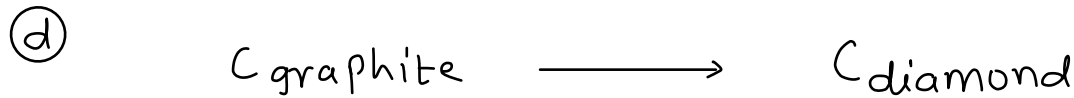
- \textcircled{b} Both A & R are true but R is not the correct explanation of A.

Q.57.7

$$\textcircled{b} \quad \Delta G_r^\circ = (\Delta G^\circ)_p - (\Delta G^\circ)_R < 0$$

so R_x^n is spontaneous in Forward direction.

Q. 58. >



$$\Delta H_r = (\Delta H_c)_{\text{graphite}} - (\Delta H_c)_{\text{diamond}}$$

$$\Delta H_r = -1.87 \text{ KJ}$$

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Q. 59. >

(a) $\Delta U = q + w = 50 - 20 \Rightarrow +30 \text{ KJ}$ ↑ es

Q. 60. >

(d) $(\Delta U)_{\text{cyclic}} = 0$

Q. 61. >

(a) $\Delta S = - \frac{\Delta H}{T}$

$$T = - \frac{\Delta H}{\Delta S} = + \frac{30 \times 10^3 \text{ J mol}^{-1}}{100 \text{ J mol}^{-1}}$$

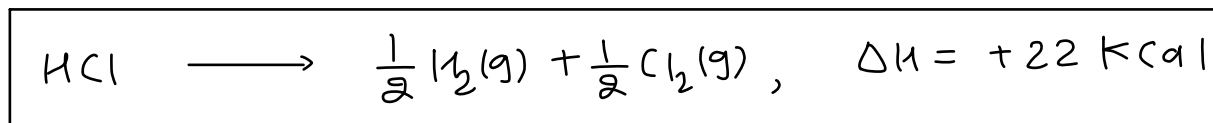
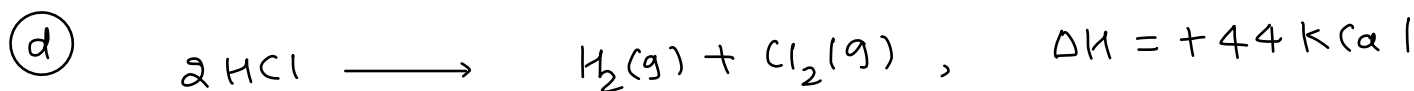
$$T = 300 \text{ K} = 27^\circ \text{C}$$

Q.62.→

(a)
$$\Delta S_r = (\Delta S^\circ)_p - (\Delta S^\circ)_R$$




$$\Delta S_r = 291.7 \text{ J K}^{-1}$$

Q.63.→



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Q.64.→

- (a)  A. \longrightarrow (iii)  B. \longrightarrow (i)  C. \longrightarrow (iv) D. \longrightarrow (ii)

Q.65.→

(a) fact.

Q.66.→

(b) SA + SB

Q.67.→

(c) All are correct statements.

Q.68.→

(b)

$$T = \frac{\Delta H}{\Delta S} = \frac{40.73}{0.109} = 373.6 \text{ K}$$

Q.69.→

(a) Both A & R are true and R is the correct explanation of A.

Q.70.→

(c)

$$T = \frac{\Delta H}{\Delta S} = \frac{7.25}{0.007}$$

$$T = 1035.7 \text{ K}$$

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Q.71.→

(b)

$$\Delta H = \Delta H_p - \Delta H_R > 0$$

$$\Delta H_p > \Delta H_R$$

Q.72.→

(b) fact.



Q.73. >

(b)

A. \longrightarrow (iii)B. \longrightarrow (iv)C. \longrightarrow (i)D. \longrightarrow (ii)

Q.74. >

(d) isochoric change

Q.75. >

(d) work done by the system then



$$\Delta U = q - w$$



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Q.76. >

(d)

A. \longrightarrow (iii)B. \longrightarrow (iv)C. \longrightarrow (i)D. \longrightarrow (ii)

Q.77. >



$$\begin{aligned} \Delta H_r^\circ &= (\Delta H_f^\circ)_{\text{CS}_2} = (\Delta H_c^\circ)_{\text{C}} + 2(\Delta H_c^\circ)_{\text{S}} - (\Delta H_c^\circ)_{\text{CS}_2} \\ &= -128.02 \text{ kJ} \end{aligned}$$

Q.78. >

(b)
$$\Delta H^\circ_r = [2 \text{ E C-Cl} + 4 \text{ E O-H}] - [4 \text{ E H-Cl} + \text{E O=C}]$$

$$\Delta H^\circ_r = 172.4 \text{ kJmol}^{-1}$$

Q.79. >

(c) TLOT

Q.80. >

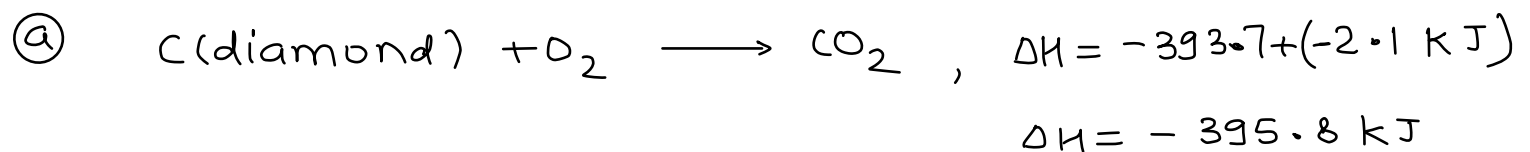
(c)
$$\Delta H^\circ_r = \sum (\Delta H^\circ_f)_p - \sum (\Delta H^\circ_f)_R$$

Q.81. >

(c) eq. (1) - eq. (2), $\Delta H = -110.4 \text{ kJ}$

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Q.82. >



\therefore 395.8 kJ energy evolve by \Rightarrow 12 gm diamond

\therefore 1 kJ " " $\Rightarrow \frac{12}{395.8}$ gm "

\therefore 800 kJ " " $\Rightarrow \frac{12}{395.8} \times 800 = \underline{\underline{24.25 \text{ gm}}}$

Q.83.>

(d) Hess's Law

Q.84.>

(a) $\Delta n_g = 1 - 1.5 = -0.5$

so,
$$\Delta H = \Delta E - 0.5RT$$

Q.85.>

(b)
$$\Delta H = \Delta U + \Delta n_g RT \quad \left\{ \begin{array}{l} \Delta n_g = 0.5 \end{array} \right.$$

$$-726 = \Delta U - 0.5 \times 8.314 \times 10^{-3} \times 298$$

$$\Delta U = -724.7 \text{ kJ mol}^{-1}$$

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Q.86.>

(c) fact

Q.87.>

(b)
$$\Delta U = q + w = 200 + 0 = 200 \text{ J}$$

Q.88.→

$$\textcircled{c} \quad \Delta S^\circ_r = 2 \times (\Delta S^\circ_z) - [\Delta S^\circ_x + 3 \times \Delta S^\circ_y]$$

$$\Delta S^\circ_r = 2 \times 50 - [60 + 3 \times 40]$$

$$\Delta S^\circ_r = 100 - [60 + 120] = -80 \text{ J K}^{-1}$$

Now

$$T = - \frac{\Delta H^\circ}{\Delta S^\circ} = \frac{40 \times 1000 \text{ J}}{80 \text{ J K}^{-1}} \Rightarrow \underline{\underline{500 \text{ K}}}$$

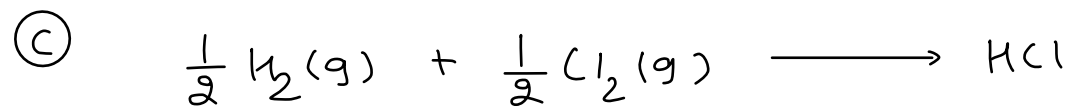
Q.89.→

\textcircled{a} For i) $\Delta H < \Delta E$, $\Delta n_g < 0$

For ii) $\Delta H > \Delta E$, $\Delta n_g > 0$

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Q.90.→



$$\Delta H^\circ_r = (\Delta H^\circ_f)_{\text{HCl}} = \frac{1}{2} \epsilon_{\text{H-H}} + \frac{1}{2} \epsilon_{\text{Cl-Cl}} - \epsilon_{\text{H-Cl}}$$

$$91 = \frac{1}{2} \times 430 + \frac{1}{2} \times 242 - \epsilon_{\text{H-Cl}}$$

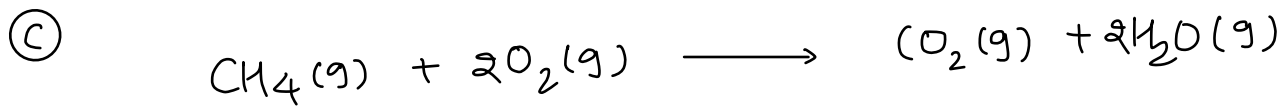
$$\boxed{\epsilon_{\text{H-Cl}} = 245 \text{ KJ}}$$

Q.91.→

$$\textcircled{a} \quad \Delta S = \frac{-q_{\text{rev}}}{T} = \frac{40.98 \times 10^3 \text{ J mol}^{-1}}{373}$$

$$\Delta S = 109.8 \text{ J K}^{-1}$$

Q.92.→



$$\Delta H_r^\circ = (\Delta H_f^\circ)_{\text{CO}_2} + 2(\Delta H_f^\circ)_{\text{H}_2\text{O}} - (\Delta H_f^\circ)_{\text{CH}_4}$$

$$\Delta H_r^\circ = -398.8 + 2 \times (-241.6) - (-76.2)$$

$$\Delta H_r^\circ = -882 + 76.2 \Rightarrow 805.8 \text{ KJ by } 22.4 \text{ L}$$

$$\therefore 10 \text{ L CH}_4 \text{ gives } \Rightarrow \frac{805.8}{22.4} \times 10$$

$$\Rightarrow 359.7 \text{ KJ } \underline{\underline{\text{Ans.}}}$$

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Q.93.→

$$\textcircled{a} \quad \Delta G^\circ = -2.303 RT \log K_{\text{eq}}$$

$$\Delta G^\circ = -5.74 \text{ KJ}$$



Q. 94. >

(b) Ethane, 52 kJ g^{-1}

Q. 95. >

(d) L.R. $\Rightarrow \text{NaOH}$ $\therefore 1 \text{ gm eq. gives } \Rightarrow 57.1 \text{ kJ}$ $\therefore 0.30 \text{ " " } \Rightarrow 57.1 \times 0.3$
 $\Rightarrow 17.13 \text{ kJ}$

Q. 96. >

(c) $\Delta H_r = \sum B.E._R - \sum B.E._P$

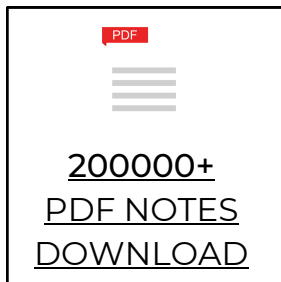
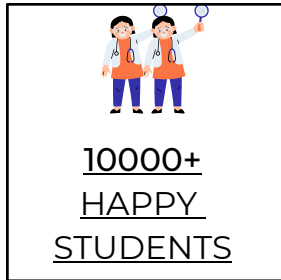
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Q. 97. >

(a) $\frac{1}{2} \text{N}_2(\text{g}) + \frac{3}{2} \text{H}_2(\text{g}) \longrightarrow \text{NH}_3(\text{g})$

$$\Delta H_r^\circ = (\Delta H_f^\circ)_{\text{NH}_3} = \frac{1}{2} \epsilon_{\text{N} \equiv \text{N}} + \frac{3}{2} \epsilon_{\text{H}-\text{H}} - 3 \epsilon_{\text{N}-\text{H}}$$
$$= -41.82 \text{ kJ mol}^{-1}$$

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