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) $C_4H_{10}(g) + \frac{13}{2}O_2(g) \longrightarrow 4(O_2(g) + 5H_2O$, $\Delta_cH = -2658\ kJ\ mol^{-1}$

Q.6.>

(b)

$$C(s) + 2H_2(g) \longrightarrow CH_4(g), \quad \boxed{\Delta n_g = -1}$$

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

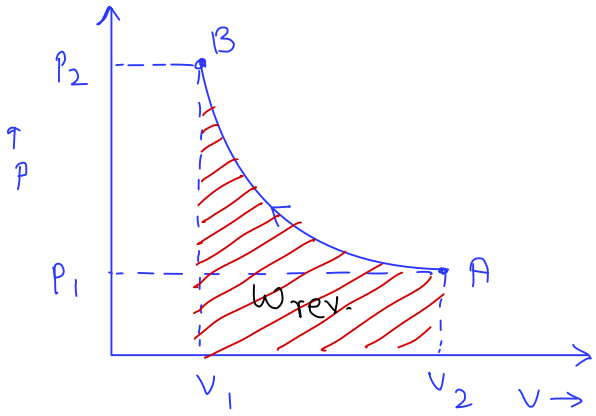
$$\boxed{\Delta H < \Delta U}$$

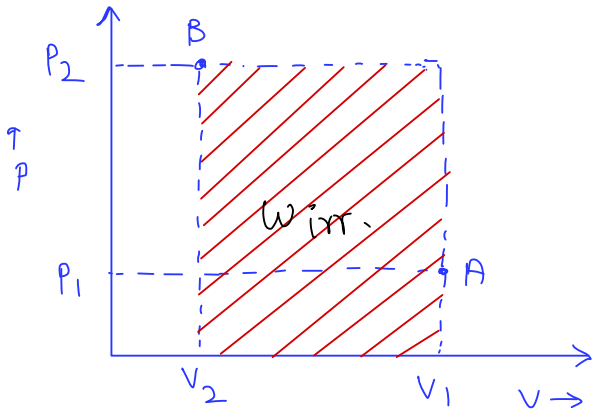
Q.7.>

(c) $\boxed{q = 0}$, $\boxed{\Delta T = 0}$, $\boxed{w = 0}$

Q.8->

(b) compression





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

$= -P_2 (V_2 - V_1)$

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

Q.9->

(c) ΔS_{system} ↓es but ΔS_{surr} ↑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)

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

Q.14.>

(b) True statement

↓

$\Delta G < 0$ for a spontaneous Rx^n.

Q.15.> (a)

(i) ⟶ b

(ii) ⟶ c

(iii) ⟶ a

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.

Q.20.>

(d) fact

Q.21.>

(b) $\boxed{\Delta H < 0}$ ← Exothermic

{ $\Delta H = E_P - E_R$

Q.22.>

(b)

$$\Delta H = \Delta U + \Delta n_g RT \qquad \{ \Delta n_g = 1$$

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

$$\boxed{\Delta U = -125.03\ KJ}$$

Q.23.>

(d) when $\Delta n_g RT = 0$ then $\boxed{\Delta H = \Delta U}$

Q.24.>

(d) Fact

Q.25.>

(a) $\Delta U = q + W$ ($W = 0$)

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

$\boxed{q = 0}$

Q.26.>

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

Q.27.>

(c) $\Delta H^\circ_r = [2 \times (\Delta H^\circ_f)_{Fe} + 3 \times (\Delta H^\circ_f)_{H_2O}] - [(\Delta H^\circ_f)_{Fe_2O_3} + 3 \times (\Delta H^\circ_f)_{H_2}]$ ($(\Delta H^\circ_f)_{Fe} = 0$, $(\Delta H^\circ_f)_{H_2} = 0$)

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

$\boxed{\Delta H^\circ_r = -33.3 \text{ KJ mol}^{-1}, \text{ exothermic}}$

Q.28.>

(a) $\Delta S_{Total} = \Delta S_{system} + \Delta S_{surr} > 0$

Q. 29 >

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

Q. 30 >

(b) adiabatic

Q. 31 >

[c] volume ⇒ extensive

Q. 32 >

(d)

$$\Delta H^\circ_r = [2\,\varepsilon_{O-F} + 2\,\varepsilon_{H-O}] - [\varepsilon_{O=O} + 2\,\varepsilon_{H-F}]$$

$\boxed{\Delta H^\circ_r = -79\ kcal}$

Q. 33 ->

(a)

$$\Delta H^\circ_r = [(\Delta H^\circ_f)_{Al_2O_3} + 2 \times (\Delta H^\circ_f)_{Fe}] - [(\Delta H^\circ_f)_{Fe_2O_3} + 2(\Delta H^\circ_f)_{Al}]$$

($(\Delta H^\circ_f)_{Fe}$ and $(\Delta H^\circ_f)_{Al}$ are 0)

$\boxed{\Delta H^\circ_r = -836\ kJ\,mol^{-1}}$

Q. 34 ->

(a)

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

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

$$n = \frac{1000}{18}$$

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

Q.35.>

(a)

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

$\Delta U = q + w = 0$

$q = -w$

Q.36.>

(a)

from eq. ①

$$\Delta H^\circ_r = 2E_{O-H} - E_{O-H} = 497.8\ kJ$$

from eq. ②

$$\Delta H^\circ_r = E_{O-H} = 428.5\ kJ$$

so,

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

$$E_{O-H} = 463.15\ kJ\,mol^{-1}$$

Q.37.>

(b)

$$Q = Q_1 + Q_2$$

Q.38.>

(b) $w = -P_{ext}(V_2 - V_1) = -3(6-4) \Rightarrow -6\ L\,atm$

$\Rightarrow -6 \times 101.32 \Rightarrow -608\ J$

Q. 39.->

(c) $w_{rev} = -2.303\, nRT \log \frac{V_2}{V_1}$

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

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

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Q. 40.->

(c) fact.

Q. 41.->

(c) Hess's law of constant heat summation.

Q. 42.->

(b) Reverse of given equation

i.e. $\boxed{\Delta H^\circ_r = +91.8 \text{ KJ mol}^{-1}}$

Q. 43.->

(d)

A. ⟶ (iii)
B. ⟶ (iv)
C. ⟶ (ii)
D. ⟶ (i)

Q.44.>

(c)

$$\Delta H^\circ_{solution} = \Delta H^\circ_{lattice} + \Delta H^\circ_{Hyd.}$$

$$4 = \Delta H^\circ_{lattice} - 784$$

$$\boxed{\Delta H^\circ_{lattice} = 788\ KJ\,mol^{-}}$$

Q.45.>

(d)

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

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

Q.46.>

(b)

$$\boxed{\Delta H^\circ_r = (\Delta H^\circ_c)_{C_6H_6} = -780.0\ Kcal}$$

Q.47.>

(c) isolated

Q.48.>

(c)

$$\Delta H^\circ_{solution} = \Delta H^\circ_{lattice} + \Delta H^\circ_{Hyd.}$$

Q.49.>

(d) $\boxed{\Delta G = 0}$ ← at equilibrium

Q.50.>

(b) fact ⇐ addition Rxn.

Q.51.>

(a) FLOT

Q.52.>

[d] $\Delta H < 0$ & $\Delta S > 0$

Q.53.>

(a)

$$\Delta U = q + w$$

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

Q.54.>

(b) fact

Q.55.>

(a) $\Delta U = q + w = 0$

$$\boxed{q = -w}$$

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

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

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

Now

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

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

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Q.56.>

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

Q.57.>

(b) $\Delta G^\circ_r = (\Delta G^\circ)_P - (\Delta G^\circ)_R < 0$

so Rxn is spontaneous in Forward direction.

Q.58.->

(d)

$$C_{graphite} \longrightarrow C_{diamond}$$

$$\Delta H^{\circ}_r = (\Delta H^{\circ}_c)_{graphite} - (\Delta H^{\circ}_c)_{diamond}$$

$$\boxed{\Delta H^{\circ}_r = -1.87\ KJ}$$

Q.59.->

(a)

$$\Delta U = q + W = 50 - 20 \Rightarrow +30\ KJ \uparrow es$$

Q.60.->

(d)

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

Q.61.->

(a)

$$\Delta S = -\frac{\Delta H}{T}$$

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

$$\boxed{T = 300\ K = 27^{\circ}c}$$

Q.62.>

(a)

$$\Delta S^\circ_r = (\Delta S^\circ)_P - (\Delta S^\circ)_R$$

$$\Delta S^\circ_r = 291.7\ J\ K^{-1}$$

Q.63.>

(d) $2HCl \longrightarrow H_2(g) + Cl_2(g)$, $\Delta H = +44$ Kcal

$$HCl \longrightarrow \frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g), \quad \Delta H = +22 \text{ Kcal}$$

Q.64.>

(a)

A. ⟶ (iii)

B. ⟶ (i)

C. ⟶ (iv)

D. ⟶ (ii)

Q.65.>

(a) fact.

Q.66.>

(b) SA + SB

Q.67.>

(c) All are correct Statements.

Q.68.>

(b)

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

Q.69.>

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

Q.70.>

(c)

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

$$T = 1035.7\,K$$

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. ⟶ (iii)

B. ⟶ (iv)

C. ⟶ (i)

D. ⟶ (ii)

Q.74.>

(d) isochoric change

Q.75.>

(d) work done by the system then

$$\Delta U = q - w$$

Q.76.>

(d)

A. ⟶ (iii)

B. ⟶ (iv)

C. ⟶ (i)

D. ⟶ (ii)

Q.77.>

(a) $C(s) + 2S \longrightarrow CS_2(g)$

$$\Delta H^\circ_r = (\Delta H^\circ_f)_{CS_2} = (\Delta H^\circ_c)_C + 2(\Delta H^\circ_c)_S - (\Delta H^\circ_c)_{CS_2}$$

$$= -128.02\ kJ$$

Q.78.>

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

$\boxed{\Delta H^\circ_r = 172.4\ KJmol^{-1}}$

Q.79.>

(c) TLOT

Q.80.>

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

Q.81.>

(c) eq.① − eq② , $\Delta H = -110.4\ KJ$

Q.82.>

(a) $C(diamond) + O_2 \longrightarrow CO_2$, $\Delta H = -393.7 + (-2.1\ KJ)$

$\Delta H = -395.8\ KJ$

∵ 395.8 KJ energy evolve by ⇒ 12 gm diamond

∴ 1 KJ ,, ,, ⇒ $\frac{12}{395.8}$ gm ,,

∴ 800 KJ ,, ,, ⇒ $\frac{12}{395.8} \times 800 \Rightarrow \underline{24.25\ gm}$

Q.83.>

(d) Hess's Law

Q.84.>

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

so, $\boxed{\Delta H = \Delta E - 0.5RT}$

Q.85.>

(b) $\Delta H = \Delta U + \Delta n_g RT$ $\left\{ \Delta n_g = 0.5 \right.$

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

$\boxed{\Delta U = -724.7 \text{ KJmol}^{-1}}$

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Q.86.>

(c) fact

Q.87.>

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

Q.88.->

(c) $\Delta S^\circ_r = 2\times(\Delta S^\circ_Z) - [\Delta S^\circ_X + 3\times \Delta S^\circ_Y]$

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

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

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

Q.89.->

(a) For i> $\Delta H < \Delta E$, $\Delta n_g < 0$

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

Q.90.->

(c) $\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \longrightarrow HCl$

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

$91 = \frac{1}{2}\times 430 + \frac{1}{2}\times 242 - \mathcal{E}_{H-Cl}$

$\boxed{\mathcal{E}_{H-Cl} = 245\ KJ}$

Q.91.>

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

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

Q.92.>

(c) $CH_4(g) + 2O_2(g) \longrightarrow (O_2(g) + 2H_2O(g)$

$\Delta H^\circ_r = (\Delta H^\circ_f)_{CO_2} + 2(\Delta H^\circ_f)_{H_2O} - (\Delta H^\circ_f)_{CH_4}$

$\Delta H^\circ_r = -398.8 + 2\times(-241.6) - (-76.2)$

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

$\because$ 10 L CH_4 gives $\Rightarrow \frac{805.8}{22.4} \times 10$

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

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Q.93.>

(a) $\Delta G^\circ = -2.303 RT \log K_{eq}$

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

Q.94.>

(b) Ethane, $52\ KJ\ g^{-1}$

Q.95.>

(d) L.R. => NaOH

$\because$ 1 gm eq. gives $\Rightarrow$ $57.1\ KJ$

$\therefore$ 0.30 " " $\Rightarrow$ 57.1×0.3

$\Rightarrow$ $17.13\ KJ$.

Q.96.>

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

Q.97.>

(a) $\frac{1}{2} N_2(g) + \frac{3}{2} H_2(g) \longrightarrow NH_3(g)$

$$\Delta H^\circ_r = (\Delta H^\circ_f)_{NH_3} = \frac{1}{2} \varepsilon N \equiv N + \frac{3}{2} \varepsilon H-H - 3\ \varepsilon N-H$$

$$= -11.82\ KJ\ mol^{-1}$$

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