Q1 2021 (01 Sep Shift 2)

For the reaction $2NO_2(g) \rightleftharpoons N_2O_4(g)$, when

$\Delta S = -176.0 JK^{-1}$ and $\Delta H = -57.8$ kJ mol^{-1},

the magnitude of ΔG at 298 K for the reaction is ____ $kJmol^{-1}$. (Nearest integer)

Q2 2021 (31 Aug Shift 2)

The *incorrect* expression among the following is:

(1) $\frac{\Delta G_{System}}{\Delta S_{Total}} = -T$(at constant P)

(2) $\ln K = \frac{\Delta H^\circ - T\Delta S^\circ}{RT}$

(3) $K = e^{-\Delta G^\circ/RT}$

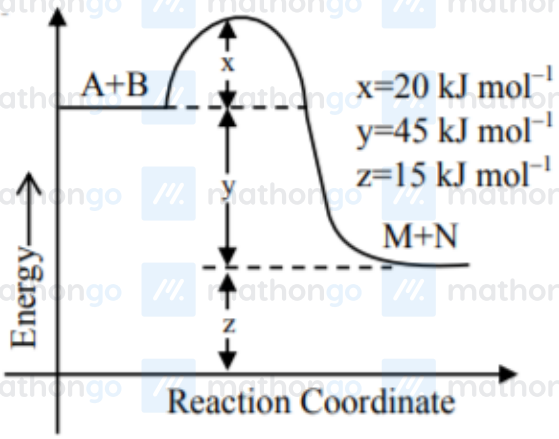
(4) For isothermal process $w_{revesible} = -nRT \ln \frac{V_f}{V_i}$

Q3 2021 (31 Aug Shift 1)

According to the following figure, the magnitude of the enthalpy change of the reaction

$A + B \rightarrow M + N$ in kJ mol^{-1}

is equal to ____. (Integer answer)



Q4 2021 (27 Aug Shift 2)

Data given for the following reaction is as follows:

$FeO_{(s)} + C_{(graphite)} \longrightarrow Fe_{(s)} + CO_{(g)}$

Substance	ΔH° ($kJ\ mol^{-1}$)	ΔS° ($J\ mol^{-1}K^{-1}$)
$FeO_{(s)}$	–266.3	57.49
$C_{(graphite)}$	0	5.74
$Fe_{(s)}$	0	27.28
$CO_{(g)}$	–110.5	197.6

The minimum temperature in K at which the reaction becomes spontaneous is ____. (Integer answer)

Q5 2021 (27 Aug Shift 1)

200 mL of 0.2 M HCl is mixed with 300 mL of 0.1 M NaOH. The molar heat of neutralization of this reaction is -57.1 kJ. The increase in temperature in $^\circ C$ of the system on mixing is $x \times 10^{-2}$. The value of x is ____. (Nearest integer)

[Given : Specific heat of water $= 4.18\ J\ g^{-1}\ K^{-1}$

Density of water $= 1.00\ g\ cm^{-3}$]

(Assume no volume change on mixing)

Q6 2021 (26 Aug Shift 2)

For water $\Delta_{vap} H = 41\ kJ\ mol^{-1}$ at 373 K and 1 bar pressure. Assuming that water vapour is an ideal gas that occupies a much larger volume than liquid water, the internal energy change during evaporation of water is ____ $kJmol^{-1}$

[Use : $R = 8.3\ J\ mol^{-1}\ K^{-1}$]

Q7 2021 (26 Aug Shift 1)

The Born-Haber cycle for KCl is evaluated with the following data :

$\Delta_f H^\ominus$ for $KCl = -436.7\ kJ\ mol^{-1}$

$\Delta_{sub}H^{\ominus}$ for $K = 89.2$ kJ mol^{-1}

$\Delta_{ionization}$ $H^{\ominus}$ for $K = 419.0$ kJ mol^{-1}; $\Delta_{electron\ gain}$ $H^{\ominus}$ for $Cl_{(g)}$

$= -348.6$ kJ mol^{-1}; $\Delta_{lond}H^{\circ}$ for $Cl_2 = 243.0$ kJ mol^{-1}

The magnitude of lattice enthalpy of KCl in kJmol^{-1} is ____.(Nearest integer)

Answer Key

Q1 (5) **Q2** (2) **Q3** (45) **Q4** (964)

Q5 (82) **Q6** (38) **Q7** (718)

Q1 (5)

$$\Delta G = \Delta H - T\Delta S$$

$$\Delta G = 57.8 - \frac{298(-176)}{1000}$$

$$\Delta G = -5.352 \text{ kJ/mole}$$

$$|\text{ Nearest integer value }| = 5$$

Q2 (2)

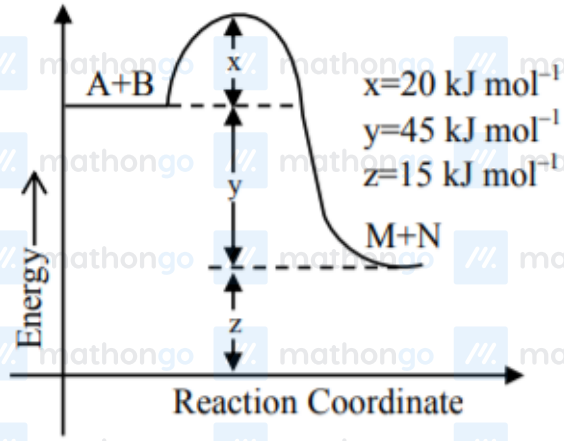
Option (2) is incorrect

$$\Delta G^\circ = -RT\ell nK$$

$$\Delta H^\circ - T\Delta S^\circ = -RT\ \ell nK$$

$$\ell nK = -\left[\frac{\Delta H^\circ - \Delta S^\circ}{RT}\right]$$

Q3 (45)



$$\Delta H = E_{a_t} - E_{a_b}$$

$$= 20 - 65$$

$$= -45 KJ/mol$$

$$|\Delta H| = 45 KJ/mol$$

Q4 (964)

$T_{min} = \left(\frac{\Delta^0 H}{\Delta^0 S}\right)$

$\Delta^0 H_{rxn} = \left[\Delta_f^0 H(Fe) + \Delta_f^0 H(CO)\right] -$

$= \left[\Delta_f^0 H(FeO) + \Delta_f^0 H\left(C_{(graphite)}\right)\right]$

$= [0 - 110.5] - [-266.3 + 0]$

$= 155.8\ kJ/mol$

$\Delta^0 S_{rxn} = \left[\Delta^0 S(Fe) + \Delta^0 S(CO)\right] -$

$\left[\Delta^0 S(FeO) + \Delta^0 S\left(C_{(graphite)}\right)\right]$

$= [27.28 + 197.6] - [57.49 + 5.74]$

$= 161.65\ J/mol - K$

$T_{min} = \frac{155.8 \times 10^3\ J/mol}{161.65\ J/mol - K} = 963.8\ K$

$\simeq 964$ k (nearest integer)

Q5 (82)

$\Rightarrow$ Millimoles of $HCl = 200 \times 0.2 = 40$

$\Rightarrow$ Millimoles of $NaOH = 300 \times 0.1 = 30$

$\Rightarrow$ Heat released $= \left(\frac{30}{1000} \times 57.1 \times 1000\right) = 1713\ J$

$\Rightarrow$ Mass of solution $= 500ml \times 1gm/ml = 500gm$

$\Rightarrow \Delta T = \frac{q}{m \times C} = \frac{1713\ J}{500\ g \times 4.18 \frac{J}{g-K}} = 0.8196\ K$

$= 81.96 \times 10^{-2}\ K$

Q6 (38)

Given equation is

$H_2O(\ell) \longrightarrow H_2O(g) : \Delta H = 41 \frac{kJ}{mol}$

$\Rightarrow$ From the relation : $\Delta H = \Delta U + \Delta n_g RT$

$\Rightarrow 41 \frac{kJ}{mol} = \Delta U + (1) \times \frac{8.3}{1000} \times 373$

$\Rightarrow DU = 41 - 3.0959$

$= 38\ kJ/mol$

Q7 (718)

$\Delta_{\mathrm{f}} \mathrm{H}_{\mathrm{KCl}}^{\ominus}=\Delta_{\text {sub }} \mathrm{H}_{(\mathrm{K})}^{\ominus}+\Delta_{\text {ionization }} \mathrm{H}_{(\mathrm{K})}^{\Theta}+\frac{1}{2} \Delta_{\text {bond }} \mathrm{H}_{\left(\mathrm{Cl}_2\right)}^{\Theta}$

$+\Delta_{\text {electron gain }} \mathrm{H}_{(\mathrm{Cl})}^{\ominus}+\Delta_{\text {lattice }} \mathrm{H}_{(\mathrm{KCl})}^{\ominus}$

$\Rightarrow-436.7=89.2+419.0+\frac{1}{2}(243.0)+\{-348.6\}$

$+\Delta_{\text {lattice }} \mathrm{H}_{(\mathrm{KCl})}^{\ominus}$

$\Rightarrow \Delta_{\text {lattice }} \mathrm{H}_{(\mathrm{KCl})}^{\ominus}=-717.8 \mathrm{~kJ} \mathrm{~mol}^{-1}$

The magnitude of lattice enthalpy of KCl in kJmol^{-1} is 718 (Nearest integer).