Q1 - 2024 (01 Feb Shift 1)

Choose the correct option for free expansion of an ideal gas under adiabatic condition from the following :

(1) $q=0, \Delta T \neq 0, w=0$

(2) $q=0, \Delta T<0, w \neq 0$

(3) $q \neq 0, \Delta T=0, w=0$

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

Q2 - 2024 (01 Feb Shift 2)

For a certain reaction at 300 K, $\mathrm{K}=10$, then $\Delta \mathrm{G}^{\circ}$ for the same reaction is _____ $\times 10^{-1}$ kJ mol^{-1}. (Given $\mathrm{R}=8.314 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$)

Q3 - 2024 (27 Jan Shift 1)

If three moles of an ideal gas at 300 K expand isotherrnally from $30 \mathrm{dm}^3$ to $45 \mathrm{dm}^3$ against a constant opposing pressure of 80kPa, then the amount of heat transferred is _____ J.

Q4 - 2024 (27 Jan Shift 2)

For a certain thermochemical reaction $\mathrm{M} \rightarrow \mathrm{N}$ at $\mathrm{T}=400 \mathrm{~K}, \Delta \mathrm{H}^{\ominus}=77.2 \mathrm{~kJ} \mathrm{~mol}^{-1}, \Delta \mathrm{S}=122 \mathrm{JK}^{-1}$, log equilibrium constant $(\log \mathrm{K})$ is _____ $\times 10^{-1}$.

Q5 - 2024 (29 Jan Shift 1)

Which of the following is not correct?

(1) $\Delta \mathrm{G}$ is negative for a spontaneous reaction

(2) $\Delta \mathrm{G}$ is positive for a spontaneous reaction

(3) $\Delta \mathrm{G}$ is zero for a reversible reaction

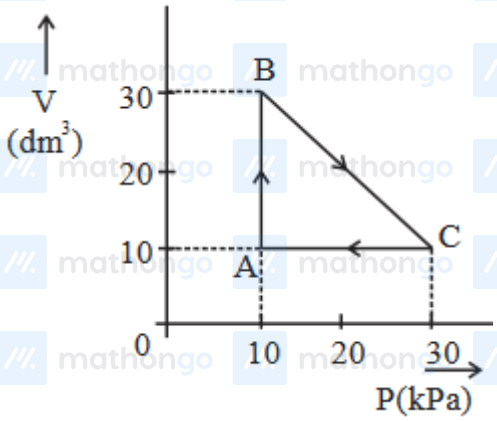
(4) $\Delta \mathrm{G}$ is positive for a non-spontaneous reaction

Q6 - 2024 (29 Jan Shift 2)

Standard enthalpy of vapourisation for CCl_4 is 30.5 kJ mol^{-1}. Heat required for vapourisation of 284 g of CCl_4 at constant temperature is _____ kJ.

(Given molar mass in $gmol^{-1}$; C = 12, Cl = 35.5)

Q7 - 2024 (30 Jan Shift 1)



An ideal gas undergoes a cyclic transformation starting from the point A and coming back to the same point by tracing the path $A \rightarrow B \rightarrow C \rightarrow A$ as shown in the diagram. The total work done in the process is _____ J.

Q8 - 2024 (30 Jan Shift 2)

Two reactions are given below:

$2Fe_{(s)} + \frac{3}{2}O_{2(g)} \rightarrow Fe_2O_{3(s)}, \Delta H^\circ = -822\ kJ/mol$

$C_{(s)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{(g)}, \Delta H^\circ = -110\ kJ/mol$

Then enthalpy change for following reaction

$3C_{(s)} + Fe_2O_{3(s)} \rightarrow 2Fe_{(s)} + 3CO_{(g)}$

Q9 - 2024 (31 Jan Shift 1)

Consider the following reaction at 298 K.

$\frac{3}{2}O_{2(g)} \rightleftharpoons O_{3(g)} \cdot K_P = 2.47 \times 10^{-29}$.

$\Delta_r G^\oplus$ for the reaction is _____ kJ. (Given $R = 8.314 JK^{-1}\ mol^{-1}$)

Q10 - 2024 (31 Jan Shift 2)

If 5 moles of an ideal gas expands from 10 L to a volume of 100 L at 300 K under isothermal and reversible condition then work, w, is $-x$ J. The value of x is _____

(Given $R = 8.314$ J K^{-1} mol^{-1})

Answer Key

Q1 (4) **Q2** (57) **Q3** (1200) **Q4** (37)

Q5 (2) **Q6** (56) **Q7** (200) **Q8** (492)

Q9 (163) **Q10** (28721)

Q1

During free expansion of an ideal gas under adiabatic condition $q = 0, \Delta T = 0, w = 0$.

Q2

$$\Delta G^{\circ} = -RT\ell nK$$
$$= -8.314 \times 300 \ln(10)$$
$$= 5744.14 \text{ J/mole}$$
$$= 57.44 \times 10^{-1} \text{ kJ/mole}$$

Q3

Using, first law of thermodynamics,

$\Delta U = Q + W$,

$\Delta U = 0:$ Process is isothermal

$Q = -W$

$W = -P_{ext}\Delta V:$ Irreversible

$$= -80 \times 10^3 (45 - 30) \times 10^{-3}$$
$$= -1200 \text{ J}$$

Q4

$$\Delta G^{\circ} = \Delta H^{\circ} - T\Delta S^{\circ}$$
$$= 77.2 \times 10^3 - 400 \times 122 = 28400 \text{ J}$$
$$\Delta G^{\circ} = -2.303RT \log K$$
$$\Rightarrow 28400 = -2.303 \times 8.314 \times 400 \log K$$
$$\Rightarrow \log K = -3.708 = -37.08 \times 10^{-1}$$

Q5

$(\Delta G)_{P,T} = (+)$ ve for non-spontaneous process

Q6

$\Delta H^0_{vap}\ CCl_4 = 30.5 \text{ kJ/mol}$

Mass of $CCl_4 = 284\text{gm}$

Molar mass of $CCl_4 = 154 \text{ g/mol}$

Moles of $CCl_4 = \frac{284}{154} = 1.844$ mol

$\Delta H_{vap}{}^{\circ}$ for 1 mole $= 30.5$ kJ/mol

$\Delta H_{vap}{}^{\circ}$ for 1.844 mol $= 30.5 \times 1.844$

$= 56.242$ kJ

Q7

rk done is given by area enclosed in the P vs V cyclic graph or V vs P cyclic graph.

Sign of work is positive for clockwise cyclic process for V vs P graph.

$W = \frac{1}{2} \times (30-10) \times (30-10) = 200 kPa - dm^3$

$= 200 \times 1000$ Pa $-$ L $= 2$ L $-$ bar $= 200$ J

Q8

$2Fe_{(s)} + \frac{3}{2}O_{2(g)} \rightarrow Fe_2O_{3(s)}, \Delta H^{\circ} = -822$ kJ/mol ...(1)

$C_{(s)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{(g)}, \Delta H^{\circ} = -110$ kJ/mol ...(2)

$3C_{(s)} + Fe_2O_{3(s)} \rightarrow 2Fe_{(s)} + 3CO_{(g)}, \Delta H_3 = ?$

$(3) = 3 \times (2) - (1)$

$\Delta H_3 = 3 \times \Delta H_2 - \Delta H_1$

$= 3(-110) + 822$

$= 492$ kJ/mole

Q9

$\frac{3}{2}O_{2(g)} \rightleftharpoons O_{3(g)} \cdot K_p = 2.47 \times 10^{-29}$.

$\Delta_r G^{\oplus} = -RT \ln K_P$

$= -8.314 \times 10^{-3} \times 298 \times \ln(2.47 \times 10^{-29})$

$= -8.314 \times 10^{-3} \times 298 \times (-65.87)$

$= 163.19$ kJ

Q10

It is isothermal reversible expansion, so work done negative

$W = -2.303 nRT \log\left(\frac{V_2}{V_1}\right)$

$= -2.303 \times 5 \times 8.314 \times 300 \log\left(\frac{100}{10}\right)$

$= -28720.713$ J

$\equiv -28721$ J