Q1 - 2024 (04 Apr Shift 1)

The enthalpy of formation of ethane (C_2H_6) from ethylene by addition of hydrogen where the bond-energies of $C-H, C-C, C=C, H-H$ are 414 kJ, 347 kJ, 615 kJ and 435 kJ respectively is ____ kJ

Q2 - 2024 (04 Apr Shift 2)

Three moles of an ideal gas are compressed isothermally from 60 L to 20 L using constant pressure of 5 atm. Heat exchange Q for the compression is - ______ Lit. atm.

Q3 - 2024 (05 Apr Shift 1)

Given below are two statements : One is labelled as Assertion (A) and the other is labelled as Reason (R)

Assertion (A) : Enthalpy of neutralisation of strong monobasic acid with strong monoacidic base is always -57 kJ mol^{-1}.

Reason (R) : Enthalpy of neutralisation is the amount of heat liberated when one mole of H^+ ions furnished by acid combine with one mole of OH^- ions furnished by base to form one mole of water.

In the light of the above statements, choose the correct answer from the options given below.

(1) (A) is true but (R) is false

(2) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(3) Both (A) and (R) are true and (R) is the correct explanation of (A)

(4) (A) is false but (R) is true

Q4 - 2024 (05 Apr Shift 1)

The heat of combustion of solid benzoic acid at constant volume is -321.30 kJ at $27^\circ C$. The heat of combustion at constant pressure is $(-321.30 - x\text{R})$kJ, the value of x is _______.

Q5 - 2024 (05 Apr Shift 2)

Combustion of 1 mole of benzene is expressed at

$C_6H_6(l) + \frac{15}{2}O_2(g) \rightarrow 6CO_2(g) + 3H_2O(l)$.

The standard enthalpy of combustion of 2 mol of benzene is $-'x'$kJ.

$x =$ ______

Given:

1. standard Enthalpy of formation of 1 mol of $C_6H_6(l)$, for the reaction 6C (graphite) $+3H_2(g) \rightarrow C_6H_6(l)$ is 48.5 kJ mol^{-1}.

2. Standard Enthalpy of formation of 1 mol of $CO_2(g)$, for the reaction C (graphite) $+O_2(g) \rightarrow CO_2(g)$ is $-393.5 \text{ kJ mol}^{-1}$.

3. Standard and Enthalpy of formation of 1 mol of $H_2O(l)$, for the reaction $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$ is -286 kJ mol^{-1}.

Q6 - 2024 (06 Apr Shift 1)

An ideal gas, $\overline{C}_v = \frac{5}{2}R$, is expanded adiabatically against a constant pressure of 1 atm untill it doubles in volume. If the initial temperature and pressure is 298 K and 5 atm, respectively then the final temperature is ______ K (nearest integer).

[$\overline{C}_v$ is the molar heat capacity at constant volume]

Q7 - 2024 (06 Apr Shift 2)

For the reaction at 298 K, $2A + B \rightarrow C$. $\Delta H = 400 \text{ kJ mol}^{-1}$ and $\Delta S = 0.2 \text{ kJ mol}^{-1} \text{ K}^{-1}$. The reaction will become spontaneous above ______ K.

Q8 - 2024 (06 Apr Shift 2)

Consider the two different first order reactions given below

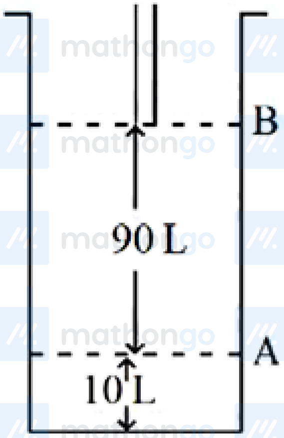
$A + B \rightarrow C$ (Reaction 1)

$P \rightarrow Q$ (Reaction 2)

The ratio of the half life of Reaction 1 : Reaction 2 is 5 : 2. If t_1 and t_2 represent the time taken to complete $2/3^{rd}$ and 45^{th} of Reaction 1 and Reaction 2, respectively, then the value of the ratio $t_1 : t_2$ is ______ $\times 10^{-1}$ (nearest integer).

[Given : $\log_{10}(3) = 0.477$ and $\log_{10}(5) = 0.699$]

Q9 - 2024 (08 Apr Shift 1)



Consider the figure provided.

1 mol of an ideal gas is kept in a cylinder, fitted with a piston, at the position A, at $18^{\circ}C$. If the piston is moved to position B, keeping the temperature unchanged, then ' x ' L atm work is done in this reversible process.

$x =$ ______ L atm. (nearest integer)

[Given : Absolute temperature $= {}^{\circ}C + 273.15, R = 0.08206$ L atm mol^{-1} K^{-1}]

Q10 - 2024 (08 Apr Shift 2)

$\Delta_{vap} H^{\ominus}$ for water is $+40.79$ kJ mol^{-1} at 1 bar and $100^{\circ}C$. Change in internal energy for this vapourisation under same condition is ______ $kJmol^{-1}$. (Integer answer) (Given $R = 8.3 JK^{-1}$ mol^{-1})

Q11 - 2024 (09 Apr Shift 1)

When equal volume of 1MHCl and $1MH_2SO_4$ are separately neutralised by excess volume of 1M NaOH solution. x and y kJ of heat is liberated respectively. The value of y/x is ______

Q12 - 2024 (09 Apr Shift 1)

The heat of solution of anhydrous $CuSO_4$ and $CuSO_4 \cdot 5H_2O$ are -70 kJ mol^{-1} and $+12$ kJ mol^{-1} respectively.

The heat of hydration of $CuSO_4$ to $CuSO_4 \cdot 5H_2O$ is $-x$ kJ. The value of x is ______ (nearest integer).

Q13 - 2024 (09 Apr Shift 2)

When $\Delta H_{vap} = 30\ kJ/mol$ and $\Delta S_{vap} = 75\ J\ mol^{-1}\ K^{-1}$, then the temperature of vapour, at one atmosphere is _______ K.

Answer Key

Q1 (125) **Q2** (200) **Q3** (3) **Q4** (150)

Q5 (6535) **Q6** (274) **Q7** (2000) **Q8** (17)

Q9 (55) **Q10** (38) **Q11** (2) **Q12** (82)

Q13 (400)

Q1

$$C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$$
$$\Delta H = BE(C=C) + 4BE(C-H) + BE(H-H)$$
$$-BE(C-C) - 6BE(C-H)$$
$$\Delta H = BE(C=C) + BE(H-H) - BE(C-C)$$
$$-2BE(C-H)$$
$$= 615 + 435 - 347 - 2 \times 414$$
$$= -125\ kJ$$

Q2

As isothermal $\Delta U = 0$

and process is irreversible

$$Q = -W = -[-P_{ext}\ (V_2 - V_1)]$$
$$Q = 5(20-60) = -200\ atm - L$$

Q3

Enthalpy of neutralization of SA & SB is always $-57\ kJ/mol$ because strong monoacid gives one mole of H^+ and strong mono base gives one mole of OH^- which form one mole of water.

Q4

$$C_6H_5COOH(S) + \frac{15}{2}O_2(g) \rightarrow 7CO_2(g) + 3H_2O(\ell)$$
$$\Delta H = \Delta U + \Delta n_g RT$$
$$= -321.30 - \frac{1}{2}\frac{R}{100} \times 300$$
$$= (-321.30 - 150R) kJ$$

Q5

$$6C(\text{ graphite }) + 3H_2(g) \rightarrow C_6H_6(\ell); \Delta H = 48.5\ kJ/mol$$
$$C(\text{ graphite }) + O_2(g) \rightarrow CO_2(g); \Delta H = -393.5\ kJ/mol$$
$$H_2^{(g)} + \frac{1}{2}(g) \longrightarrow H_2O(\ell); \Delta H = -286\ kJ/mol$$
$$\text{equation } -(1) \times 1 + (2) \times 6 + (3) \times 3$$
$$-48.5 - 6 \times 393.5 - 3 \times 286$$
$$= -3267.5\ kJ \text{ for } 1 \text{ mol}$$
$$= -6535\ kJ \text{ for } 2 \text{ mol}$$
$$\text{Ans. } 6535\ kJ$$

Q6

$\Delta U = q + w(q = 0)$
$nC_V\Delta T = -P_{ext}(V_2 - V_1)$
$V_2 = 2V_1$
$\frac{nRT_2}{P_2} = \frac{2nRT_1}{P_1}$
$P_1 = 5, T_1 = 298$
$P_2 = \frac{5T_2}{2 \times 298}$
$n\frac{5}{2}R(T_2 - T_1) = -1\left(\frac{nRT_2}{P_1} - \frac{nRT_1}{P_1}\right)$

Put $T_1 = 298$

and $P_2 = \frac{5T_2}{2\times298}$

Solve and we get $T_2 = 274.16$ K

$T_2 \approx 274$ K

Q7

$\Delta G = 0$
$T = \frac{\Delta H}{\Delta S} = \frac{400}{0.2} = 2000$ K

Q8

$\frac{(t_{1/2})_1}{(t_{1/2})_{II}} = \frac{K_2}{K_1} = \frac{5}{2}$

$\therefore K_1t_1 = \ln\frac{1}{1-\frac{2}{3}} = \ln 3$

$K_2t_2 = \ln\frac{1}{1-\frac{4}{5}} = \ell n5$

$\Rightarrow \frac{K_1}{K_2} \times \frac{t_1}{t_2} = \frac{0.477}{0.699}$

$\Rightarrow \frac{t_1}{t_2} = \frac{0.477}{0.699} \times \frac{5}{2} = 1.7 = 17 \times 10^{-1}$

Q9

$\omega = -nRT \ln\left(\frac{V_2}{V_1}\right)$

$= -1 \times \cdot 08206 \times 291 \cdot 15 \ln\left(\frac{100}{10}\right)$

$= -55.0128$

Work done by system ≈ 55 atm lit.

Q10

$H_2O(\ell) \rightleftharpoons H_2O(g) \quad \Delta H^0_{vap} = 40.79 \text{ kJ/mole}$

$\Delta H^0_{vap} = \Delta U^0_{vap} + \Delta n_g RT$

$40.79 = \Delta U^0_{vap} + \frac{1 \times 8.3 \times 373.15}{1000}$

$\Delta U^0_{vap} = 40.79 - 3.0971$

$= 37.6929$

$\Delta U^0_{vap} \simeq 38$

Q11

$H^+ + OH^- \rightarrow H_2O \Rightarrow x$

$2H^+ + 2OH^- \rightarrow 2H_2O \Rightarrow 2x = y$

$y/x = 2$

Q12

(1) $CuSO_4(s) + 5H_2O \xrightarrow{x} CuSO_4.5H_2O$

(2) $CuSO_4.5H_2O + H_2O \xrightarrow{12} CuSO_4(aq)$

$CuSO_4 + H_2O \xrightarrow{-70} CuSO_4(aq)$

from (1)&(2)

$-70 = x + 12$

$x = -82$

Q13

At equilibrium $\Delta G_{PT} = 0$

$\Delta H_{vap} = T\Delta S_{vap}$

$30 \times 1000 = T \times 75$

$T = 400 \text{ K}$