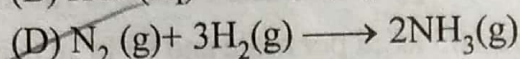
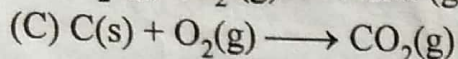
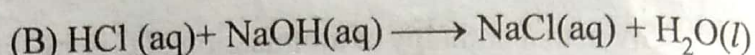
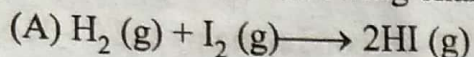
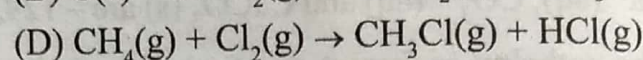
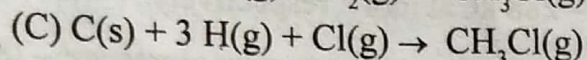
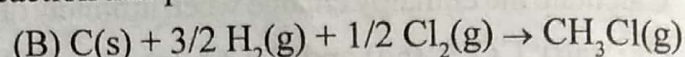
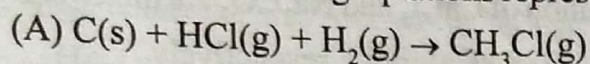


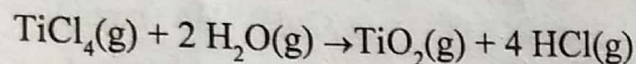
Q.1 For which of the following change $\Delta H \neq \Delta U$?



Q.2 Which of the following equations represents a reaction that provides the heat of formation of CH_3Cl ?



Q.3. Use the given standard enthalpies of formation to determine the heat of reaction of the following reaction:



$\Delta H_f^\circ TiCl_4(g) = -763.2 \text{ kJ/mole}$

$\Delta H_f^\circ TiO_2(g) = -944.7 \text{ kJ/mole}$

$\Delta H_f^\circ H_2O(g) = -241.8 \text{ kJ/mole}$

$\Delta H_f^\circ HCl(g) = -92.3 \text{ kJ/mole}$

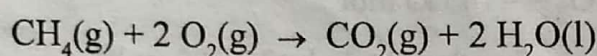
(A) -278.1

(B) $+369.2$

(C) $+67.1$

(D) -67.1

Q.4 Using the following information calculate the heat of formation of CH_4 .



$\Delta H^\circ = -890.4 \text{ kJ}$

$\Delta H_f^\circ CO_2(g) = -393.5 \text{ kJ/mole}$

$\Delta H_f^\circ H_2O(l) = -285.9 \text{ kJ/mole}$

(A) -98.6

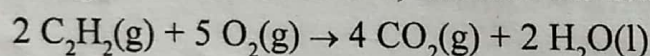
(B) -65.5

(C) -74.9

(D) -43.5

Q.5 The heats of formation of $CO_2(g)$ and $H_2O(l)$ are -394 kJ/mole and -285.8 kJ/mole respectively

Using the data for the following combustion reaction, calculate the heat of formation of $C_2H_2(g)$.



$\Delta H^\circ = -2601 \text{ kJ}$

(A) -238.6

(B) 253.2

(C) 238.7

(D) 226.7

Q.6 The heats of formation of $CO_2(g)$ and $H_2O(l)$ are -394 kJ/mole and -285.8 kJ/mole respectively &

$\Delta H_{\text{Combustion}}^\circ [C_3H_8(g)] = -2221.6 \text{ kJ}$. Then calculate the heat of formation of $C_3H_8(g)$.

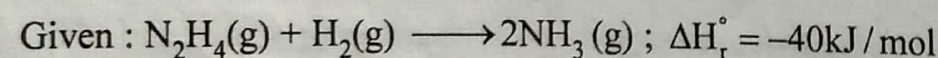
(A) 212.2

(B) -143.3

(C) 185.4

(D) -103.6

Q.7 The standard enthalpy of formation of ammonia gas is -



$\Delta H_f^\circ [N_2H_4(g)] = -120 \text{ kJ/mol}$

(A) -60

(B) -180

(C) 40

(D) -80

Q.8 $2NO_2(g) \rightarrow N_2O_4(g)$

$\Delta U_f^\circ [N_2O_4(g)] = 2 \text{ kcal/mole}$

and $\Delta U_{\text{reaction}}^\circ = -16 \text{ kcal/mol}$ then calculate $\Delta H_{\text{formation}}^\circ$ of NO_2 at $727^\circ C$

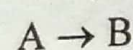
(A) 9 kcal/mol

(B) 4.5 kcal/mol

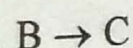
(C) 8 kcal/mol

(D) 10 kcal/mol

Q.9 Study the following thermochemical equations :



; $\Delta H = +100 \text{ kcal}$



; $\Delta H = -80 \text{ kcal}$

The correct order of enthalpies of formation of A, B and C is -

(A) $A < B < C$

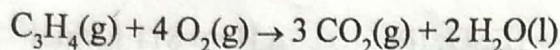
(B) $A < C < B$

(C) $C < A < B$

(D) $B < C < A$

Q.10 What amount of heat energy (kJ) is released in the combustion of 12.0 g of C_3H_4 at 1 atm constant pressure.

(Atomic weights: C = 12, H = 1, O = 16).



$$\Delta H^\circ = -1939.1 \text{ kJ}$$

(A) 725

(B) 504

(C) 783

(D) 581.73

Q.11 The bond dissociation energy of gaseous H_2 , Cl_2 and HCl are 104, 58 and 103 kcal mol⁻¹ respectively.

The enthalpy of formation for HCl gas will be :-

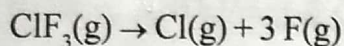
(A) -44.0 kcal

(B) -22.0 kcal

(C) 22.0 kcal

(D) 44.0 kcal

Q.12 The enthalpy change for the following reaction is 513 kJ. Calculate the average Cl-F bond energy.



(A) 1542

(B) 88

(C) 171

(D) 514

Q.13 The reaction $CH_4(g) + Cl_2(g) \rightarrow CH_3Cl(g) + HCl(g)$ has $\Delta H = -25 \text{ kCal}$.

Bond	Bond Enthalpy kCal
E_{C-Cl}	84
E_{H-Cl}	103
E_{C-H}	x
E_{Cl-Cl}	y
x : y = 9 : 5	

$$\Delta H = \left[\frac{1}{2} (C-H) + \frac{1}{2} (Cl-Cl) \right] - (H-Cl)$$

$$CH_4(g) + Cl_2(g) \rightarrow CH_3Cl(g) + HCl(g)$$

$$-25 = [4(C-H) + (Cl-Cl)] - [3(C-H) + (C-Cl) + (H-Cl)]$$

$$-25 = [4x + y] - [3x + 84 + 103]$$

$$\frac{x}{y} = \frac{9}{5}$$

From the given data, what is the bond enthalpy of Cl-Cl bond

(A) 70 kCal

(B) 80 kCal

(C) 67.75 kCal

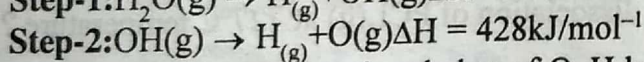
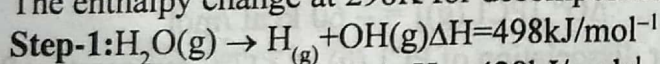
(D) 57.75 kCal

Q.14 If x_1 , x_2 and x_3 are enthalpies of H-H, O=O and O-H bonds respectively, and x_4 is the enthalpy of vaporisation of water, estimate the standard enthalpy of combustion of hydrogen

$$H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(l)$$

$$(A) x_1 + \frac{x_2}{2} - 2x_3 + x_4 \quad (B) x_1 + \frac{x_2}{2} - 2x_3 - x_4 \quad (C) x_1 + \frac{x_2}{2} - x_3 + x_4 \quad (D) 2x_3 - x_1 - \frac{x_2}{2} - x_4$$

Q.15 The enthalpy change at 298K for decomposition is given in following steps-



Then value of mean bond enthalpy of O-H bond will be -

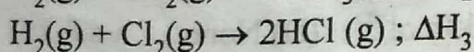
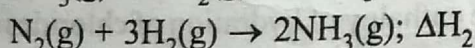
(A) 498 kJ/mol

(B) 463 kJ/mol

(C) 428 kJ/mol

(D) 70 kJ/mol

Q.16 $NH_3(g) + 3Cl_2(g) \rightarrow NCl_3(g) + 3HCl(g)$; $-\Delta H_1$



The enthalpy of formation of $NCl_3(g)$ in the terms of ΔH_1 , ΔH_2 and ΔH_3 is

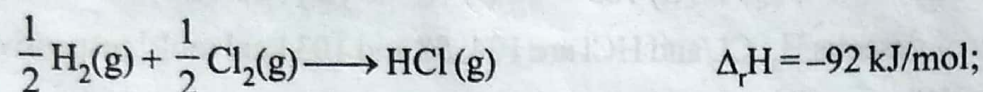
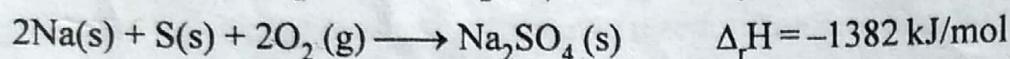
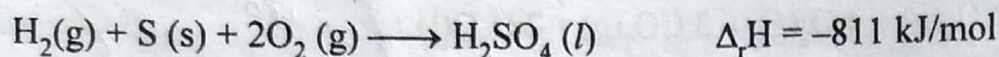
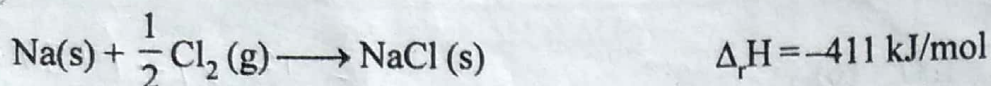
(A) $\Delta H_f = -\Delta H_1 + \frac{\Delta H_2}{2} - \frac{3}{2} \Delta H_3$

(B) $\Delta H_f = \Delta H_1 + \frac{\Delta H_2}{2} - \frac{3}{2} \Delta H_3$

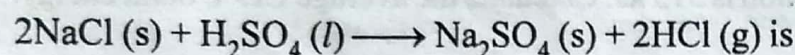
(C) $\Delta H_f = \Delta H_1 - \frac{\Delta H_2}{2} - \frac{3}{2} \Delta H_3$

(D) None

Q.17 The enthalpy changes of the following reactions at 27°C are

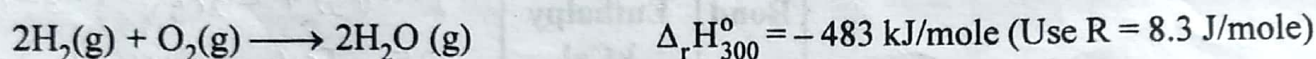
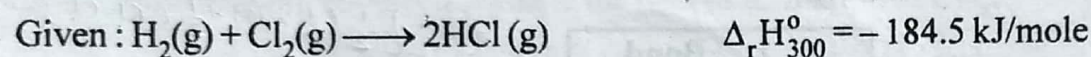


from these data, the heat change of reaction at constant volume (in kJ/mol) at 27°C for the process (R = 8.3 J/K-mol)



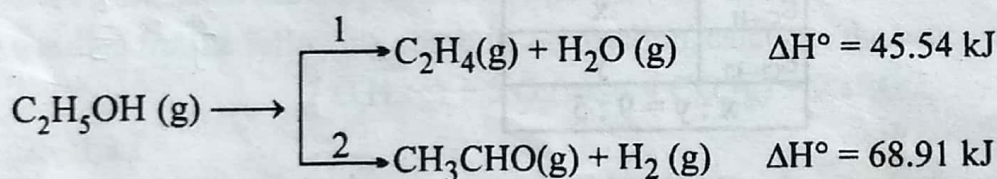
- (A) 67 (B) 62.02 (C) 71.98 (D) None

Q.18 Find $\Delta_r U^\circ$ for the reaction $4\text{HCl(g)} + \text{O}_2(\text{g}) \rightleftharpoons 2\text{Cl}_2(\text{g}) + 2\text{H}_2\text{O(g)}$ at 300 K. Assume all gases are ideal.



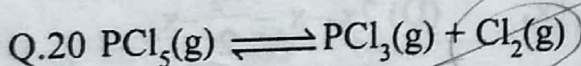
- (A) 111.5 kJ/mole (B) -109.01 kJ/mole (C) -111.5 kJ/mole (D) None

Q.19 Ethanol can undergoes decomposition to form two sets of products



if the molar ratio of C_2H_4 to CH_3CHO is 8 : 1 in a set of product gases, then the enthalpy involved in the decomposition of 1 mole of ethanol is

- (A) 65.98 kJ (B) 48.137 kJ (C) 48.46 kJ (D) 57.22 kJ



$$\Delta G_f^\circ [\text{PCl}_5(\text{g})] = -74 \text{ kcal/mol}$$

$$\Delta G_f^\circ [\text{PCl}_3(\text{g})] = -60 \text{ kcal/mol}$$

then calculate value of equilibrium constant for dissociation of $\text{PCl}_5(\text{g})$ at 727°C temperature ?

$$(\ln 2 = 0.7)$$

- (A) 2^{10} (B) 2^{-10} (C) 2^{-20} (D) 2^{+20}

Q.21 The lattice enthalpy of solid NaCl is 772 kJmol^{-1} and enthalpy of solution is 2 kJmol^{-1} . If the hydration enthalpy of Na^+ & Cl^- ions are in the ratio of 3:2.5, what is the enthalpy of hydration of chloride ion?

- (A) -140 kJmol^{-1} (B) -350 kJmol^{-1} (C) $-351.81 \text{ kJmol}^{-1}$ (D) None

Q.22 ΔH_f° of water is $-285.8 \text{ kJ mol}^{-1}$. If enthalpy of neutralisation of monoacid strong base is $-57.3 \text{ kJ mol}^{-1}$, ΔH_f° of OH^- ion will be

- (A) $-228.5 \text{ kJ mol}^{-1}$ (B) $228.5 \text{ kJ mol}^{-1}$ (C) $114.25 \text{ kJ mol}^{-1}$ (D) $-114.25 \text{ kJ mol}^{-1}$

Q.22 ΔH_f° of water is $-285.8 \text{ kJ mol}^{-1}$. If enthalpy of neutralisation of monoacid strong base is $-57.3 \text{ kJ mol}^{-1}$, ΔH_f° of OH^- ion will be

- (A) $-228.5 \text{ kJ mol}^{-1}$ (B) $228.5 \text{ kJ mol}^{-1}$ (C) $114.25 \text{ kJ mol}^{-1}$ (D) $-114.25 \text{ kJ mol}^{-1}$

Q.23 If bond enthalpy of C-C and C=C are 348 kJ/mole and 615 kJ/mole respectively then calculate enthalpy change (in kJ/mole) which occurs during the isomerisation of cyclopropane (g) into propene (g)

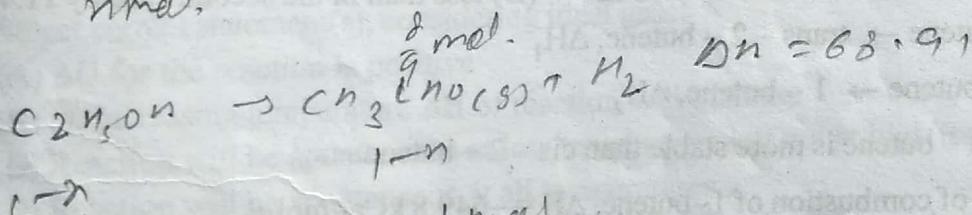
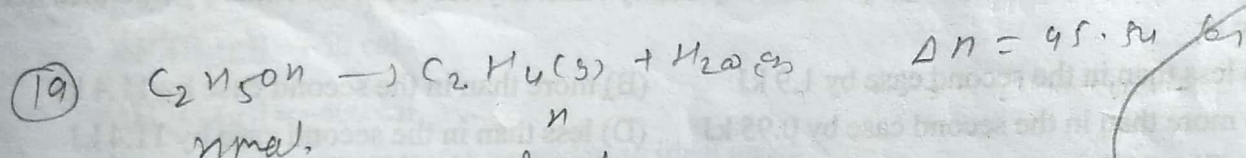
- (A) 19 (B) 81 (C) 1 (D) 20

Q.24 The molar heat capacities at constant pressure (assume constant with respect to temperature) of A, B and C are in ratio of $1.5 : 3.0 : 2.0$. If enthalpy change for the exothermic reaction $\text{A} + 2\text{B} \rightarrow 3\text{C}$ at 300 K is -10 kJ/mol & $C_{p,m}$ (B) is 300 J/mol then enthalpy change at 310 K is :

- (A) -8.5 kJ/mol (B) 8.5 kJ/mol (C) -11.5 kJ/mol (D) none of these

Q.25 If enthalpy change for hydrogenation of ethylene is -132 kJ/mole and enthalpy of formation 1,3-butadiene (g) and butane (g) are 115 kJ and -140 kJ/mole respectively then calculate resonance energy of 1,3-butadiene (in kJ).

- (A) 9 (B) 18 (C) 4 (D) 10



$\Delta n = \frac{8}{1} = n = \frac{8}{9}$ $45.54 \times \frac{8}{9} + \frac{1}{9} \times 68.91$



$\Delta H^\circ = [\Delta H_f^\circ(\text{PCl}_3(\text{g})) + \Delta H_f^\circ(\text{Cl}_2(\text{g}))] - \Delta H_f^\circ(\text{PCl}_5(\text{g}))$

$= -60 + 74 = 14 \text{ kcal/mol}$

$\Delta H^\circ = -RT \ln K_{eq}$

$14 = -\frac{2}{1000} \times 1000 \ln K_{eq}$ $\ln K_{eq} = -7$

$\log K_{eq} = \frac{2}{1000} e = -7$ $(\log \frac{2}{e}) \log_2 K_{eq} = -7$

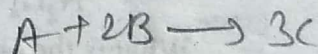
$0.7 \log_2 K_{eq} = -7$

$\log_2 K_{eq} = -10$

$K_{eq} = 2^{-10}$

(23) $6(C-H) + 3(C-C) - [6(C-H) + (C=C) + C-C]$

(24) Krichoff's



$\Delta_r C_p = (3 \times 200) - (150 + 600)$

$\Delta H_{310} - \Delta H_{300} = \Delta_r C_p (310 - 300)$

