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Class XI	**Department of Science 2020-2021** **SUBJECT : CHEMISTRY**	**Date of completion :** **III week of June 2020**
Work sheet No.: 2 **With answers**	**Chapter: Thermodynamics**	**Note: A4 File format**
Name of the student:	**Class & Section:**	**Roll No.**

Objective type Questions (1 mark)

1. Which of the following reaction defines $\Delta_f H^0$?
   (a) $C_{diamond} + O_2 \rightarrow CO_{2_g}$
   (b) $\frac{1}{2}H_{2_g} + \frac{1}{2}F_{2_g} \rightarrow HF_g$
   (c) $N_2 + 3\,H_2 \rightarrow 2NH_{3_g}$
   (d) $CO_g + \frac{1}{2}O_2 \rightarrow CO_{2_g}$
2. Predict the sign of ΔS^0 for the following reaction:
   $$2H_2S_g + 3O_{2_g} \rightarrow 2H_2O_g + 2SO_{2_g}$$
3. Which of the following are state functions?
   (i) Height of a hill
   (ii) Distance travelled in climbing the hill
4. What is a thermodynamic state function?
5. For the reaction 2Cl(g) → Cl_{2_g} What will be the sign of ΔH and ΔS?
6. State Hess 's Law for constant heat summation?
7. Define extensive properties.
8. Give the relationship between ΔH and ΔU for a reaction in gaseous state.
9. Which among the following is an intensive property?
   (a) Mass
   (b) Volume
   (c) Temperature
   (d) Specific heat
10. Which of the following represents the first law of thermodynamics?
    (a) q= ΔU – w (b) ΔH =q+w (c) ΔU = ΔH +pΔV (d) ΔU = pΔV

11. If enthalpies of formation of $NH_{3\,(g)}$ and $H_2O_{(l)}$ at 298 K and one atm pressure are -45 and1 -286 $kJmol^{-1}$respectively, calculate the standard enthalpy change of the following reaction.

$$NH_{3(g)} + \tfrac{3}{4}\, O_{2\,(g)} \rightarrow \tfrac{1}{2}\, N_{2(g)} + 3/2\, H_2O_{(l)}$$

a. -384 $kJmol^{-1}$ b. -192 $kJmol^{-1}$

c. 384 $kJmol^{-1}$ d. -331 $kJmol^{-1}$

12. . ΔH and ΔU are related as

a. ΔH = ΔU b. ΔH = ΔU - nRT

c. ΔH = ΔU + RT d. ΔH = ΔU + ΔnRT

Question 12

(A) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.

(B) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.

(C) Assertion is correct, but reason is wrong statement.

(D) Assertion is wrong, but reason is correct statement.

13.Assertion: Enthalpy of combustion is always negative.

Reason: Combustion reaction proceeds with evolution of heat

<u>Five marks Questions</u>

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14. The reaction between gaseous Hydrogen and Chlorine is

$H_{2_g} + Cl_{2_g} \rightarrow 2HCl_g$; $\Delta H^0{}_r$ = -184KJ

(i) What is the enthalpy of formation of HCl?

(ii) How much heat will be liberated at 298K and 1 atm for the formation of 365 g of HCl?

15. Calculate the enthalpy of combustion of Glucose from the following data :

$$C_{(graphite)} + O_{2(g)} \longrightarrow CO_{2(g)} \; ; \Delta H_r^0 = -395KJ$$

$$H_{2(g)} + \tfrac{1}{2}\, O_{2(g)} \longrightarrow H_2O_{(l)} \; ; \Delta H_r^0 = -269\ KJ$$

$$6C_{(graphite)} + 6\, H_{2(g)} + 3O_{2(g)} \longrightarrow C_6H_{12}O_{6\,(s)} \; ; \Delta H_r^0 = -1170\ KJ$$

16. a. For a reaction, ΔH is –ve, ΔS is +ve. Is this reaction spontaneous?

b. Calculate the ΔH for the reaction

$2N_2$ (g) + $5O_2$ (g) → $2N_2O_5$ using the following data

H_2 (g) + ½ O_2 (g) → H_2O (l) ΔH = -285.5 $KJmol^{-1}$

N_2O_5 (g) + H_2O (l) → $2HNO_3$ (l) ΔH = -76.6 $KJmol^{-1}$

½ N_2 (g) + 3/2 O_2 (g) + ½ H_2(g) → HNO_3 (l) ΔH = -174.1 $KJmol^{-1}$

17. (a) For the reaction,

N_2 (g) + $3H_2$ (g) →$2NH_3$ (g)

ΔH = -95kJ and ΔS = -200JK^{-1}

Calculate the temperature at which Gibbs energy change is equal to zero.

b. Derive the relation Cp – Cv = R

Answers :

1. b
2. $\Delta S^0 = -ve$
3. (i) $Height\ of\ the\ hill$
4. The property which depends only on state of system not upon path is called state function e.g. P, V, T, E, H, S etc.
5. ΔH = = ve ; Δ S = −ve
6. The change of enthalpy of reaction remains same, whether the reaction is carried out in one step or several steps.
7. Properties which depends upon amount of substance called extensive properties. Volume, enthalpy, entropy
8. ΔH = ΔU + Δ n_g RT.
9. (c)
10. (a)
11. (a)
12. (d)
13. (a)
14. The reaction between gaseous Hydrogen and Chlorine is $H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl_{(g)}$;

$\Delta H0_r$ =184KJ

(i) -91KJ/mol (ii) 36.5g= -92KJ/mol Therefore 365 g=-920KJ

15. $C_6H_{12}O_{6\,(s)} \rightarrow 6C_{(graphite)} + 6\,H_{2(g)}) + 3O_{2(g)}$ $\Delta H_r^{\,0} = +1170$ KJ ---(1)

$C_{(graphite)} + O_{2(g)} \rightarrow CO_{2(g)}$; $\Delta H_r^{\,0} = -395$KJ x6=-2370 KJ ---------- (2)

$H_{2(g)} + ½\,O_{2(g)} \rightarrow H_2O_{(l)}$; $\Delta H_r^{\,0} =$ -269 KJ x 6 = -1614KJ ----(3)

Adding equations 1,2 and 3

$C_6H_{12}O_{6\,(s)} \rightarrow 6CO2_{(g)} + 6H_2O_{(l)}$ = -2814 KJ

16. a. Reaction spontaneous at all temperature

b. $4HNO_3 \rightarrow 2N_2O_5 + 2H_2O$ ΔH = 153.2 kJmol-1

$2N_2 + 6O_2 + 2H_2 \rightarrow 4HNO_3$ ΔH = -696.4 kJmol-1

$2H_2O \rightarrow 2H_2 + O_2$ ΔH = -571 kJmol-1

ΔH = -1114.2 kJmol-1

17. a) $\Delta G = \Delta H - T\,\Delta S$

$\Delta H = T\,\Delta S$

T = -95 × 1000 / -200 = 475 K

b)

Heat (q) at constant volume is given as

$$q_v = C_v \Delta T = \Delta U$$

Heat (q) at constant pressure is given as

$$q_p = C_p \Delta T = \Delta H$$

But

H = U + PV

and PV = RT [for one mole of an ideal gas]

$\therefore$ H = U + RT

$\therefore$ $\Delta H = \Delta U + \Delta(RT)$

or $\Delta H = \Delta U + R\Delta T$

or $\Delta H - \Delta U = R\Delta T$ ...(1)

Substituting the values of ΔH and ΔU in eq. (1), we get,

$C_p\Delta T - C_v\,\Delta T = R\Delta T$ or $C_p - C_v = R$ (for one mole of an ideal gas)

Thus C_p is greater than C_v by the gas constant R i.e. approximately 2 calories or 8.314 Joules.

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