Chapter: 07

Thermochemistry

Objective

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1. Burning of coal is the example of:
   - (A) Irreversible reaction
   - (B) Spontaneous reaction
   - (C) Reversible reaction
   - (D) Non spontaneous reaction

2. The exothermic process is:
   - (A) Respiration
   - (B) Boiling
   - (C) Sublimation
   - (D) Evaporation

3. In endothermic reaction ΔH is taken as:
   - (A) May be any value
   - (B) Positive
   - (C) Negative
   - (D) Zero

4. In endothermic reactions, the heat content of the:
   - (A) Products is more than that of reactants
   - (B) Reactants and products are equal
   - (C) Reactants is more than that of products
   - (D) Both A & C

5. Which of the following is not a state function:
   - (A) Heat
   - (B) Temperature
   - (C) Volume
   - (D) Pressure

6. Standard enthalpy change is measured at:
   - (A) 273K
   - (B) 298K
   - (C) 373K
   - (D) 273°C

7. For a given process, the heat changes at constant pressure (q_p) and at constant volume (q_v) are related to each other as:
   - (A) $(q_p)^2 = q_v$
   - (B) $q_p < q_v$
   - (C) $q_p = q_v$
   - (D) $q_p > q_v$

8. For reaction $NaOH + HCl \longrightarrow NaCl + H_20$, the change in enthalpy is:
   - (A) Heat of formation of NaCl
   - (B) Heat of neutralization
   - (C) Heat of reaction
   - (D) Heat of formation of water

9. For the reaction, H^+ & OH^- the change in enthalpy is called heat of:
   - (A) Solution
   - (B) Neutralization
   - (C) Combustion
   - (D) Reaction

10. The internal energy of a system is equal to:
    - (A) Kinetic energy of the particles
    - (B) Sum of K.E and P.E
    - (C) P.E. of the particles
    - (D) Enthalpy

11. The change in heat energy of a chemical reaction at constant temperature and pressure is called:
    - (A) Bond energy
    - (B) Enthalpy change
    - (C) Internal energy change
    - (D) Heat of sublimation

12. Heat of combustion can be determined by:
    - (A) Heat calorimeter
    - (B) Copper calorimeter
    - (C) Glass calorimeter
    - (D) Bomb calorimeter

13. In bomb calorimeter the reactions are carried out at:
    - (A) Constant temperature
    - (B) Constant volume
    - (C) Constant pressure
    - (D) Constant enthalpy

14. Calorie is equivalent to:

(A) 4.184J (B) 418.4J (C) 41.84J (D) 0.418J

15. The net heat change in a chemical reaction is same, whether it is brought about in one or several steps. It is known as:

(A) Charle's law (B) Hesse's law (C) Boyle's law (D) Henry's law

16. If an endothermic reaction is allowed to take place very rapidly in the air, the temperature of the surrounding air:

(A) Increase (B) Remain unchanged (C) Remain constant (D) Decrease

17. The change in the heat energy of a chemical reaction at constant temperature and pressure is called:

(A) Heat of sublimation (B) Enthalpy change
(C) Internet energy change (D) Bond energy

18. The pressure of oxygen inside the bomb calorimeter is:

(A) 20 atm (B) 25 atm (C) 50 atm (D) 100 atm

19. $\sum \Delta H$ (Cycles) = 0 The above law is known as:

(A) Hess's law (B) Darwin's law (C) Kohlrausch law (D) Henry's law

20. The enthalpy of solution of sodium carbonate is:

(A) $-285.8\ KJmol^{-1}$ (B) $-25.0\ KJmol^{-1}$ (C) $-16.2\ KJmol^{-1}$ (D) $+16.2\ KJmol^{-1}$

21. At constant volume q_v is equal to:

(A) ΔP (B) ΔV (C) ΔH (D) ΔE

22. Enthalpy of atomization of Na-metal is:

(A) $108\ KJmol^{-1}$ (B) $90\ KJmol^{-1}$ (C) $120\ KJmol^{-1}$ (D) $130\ KJmol^{-1}$

23. The heat of atomization of chlorine is:

(A) $110\ KJmol^{-1}$ (B) $121\ KJmol^{-1}$ (C) $95\ KJmol^{-1}$ (D) $90\ KJmol^{-1}$

24. The study of heat changes accompanying a chemical reactions is known as:

(A) Analytical chemistry (B) Thermochemistry
(C) Physical chemistry (D) Electrochemistry

25. When a bond is formed energy is:

(A) Remains constant (B) Released
(C) Absorbed (D) Neither absorbed nor released

26. Units of energy in which heat changes in S.l system are:

(A) Newton (B) Erg (C) Torr (D) Joule

27. Spontaneous reactions are:

(A) Irreversible (B) Reversible (C) No irreversible (D) None of these

28. The study of heat changes accompanying a chemical reaction is known as:

(A) Biochemistry (B) Chemistry (C) Physical chemistry (D) Thermochemistry

29. The number of fundamental ways of transferring energy into or out of system is:

(A) One (B) Two (C) Three (D) Four

30. ..... is not state function.

Ⓐ Heat Ⓑ Temperature Ⓒ Volume **Ⓓ Pressure**

31. The Born-Haber cycle is the best application of ..... law.

Ⓐ Graham's **Ⓑ Hess's** Ⓒ Dalton's Ⓓ Boyle's

32. The amount of heat absorbed when one mole of gaseous atoms are formed from the element is called enthalpy of:

Ⓐ Reaction Ⓑ Combustion Ⓒ Formation **Ⓓ Atomization**

33. The property of a system which has some definite values for initial and final states is called:

Ⓐ State function Ⓑ State Ⓒ Surroundings Ⓓ System

34. Energy of universe remains constant it is called:

Ⓐ First law of thermochemistry **Ⓑ First law of thermodynamics**
Ⓒ Second law of thermodynamics Ⓓ Second law of thermochemistry

Fill in the blanks

Q1: The substance undergoing a physical or a chemical change forms a chemical.
Q2: The change in internal energy ..... be measured.
Q3: Repeated solvent extractions using small portions of solvent are ..... than using a single extraction with larger volume of the solvent.
Q4: A ..... is a macroscopic property of a system which is ..... of the path adopted to bring about that change

Answers

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1.	System	**2.**	Can	**3.**	Different	**4.**	State function ; Independent

Chapter : 07 Thermochemistry

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Subjective

Q1: ***What is thermochemistry?***

Ans: *The study of heat changes along-with a chemical reaction is known as thermochemistry.*

Q2: ***Differentiate between spontaneous and non-spontaneous reactions.***

Ans: *The difference between spontaneous and non-spontaneous reactions is:*

Spontaneous reaction	Non-spontaneous reaction
A process which takes place on its own without external help and move from non-equilibrium state to equilibrium state is called spontaneous reaction.	*A process which does not take place on its own is called non-spontaneous reactions.*
Examples:	*Examples:*
➢ *Water flows from higher level to lower.*	➢ *Pumping of* H_2O *uphill.*
➢ $NaOH + HCl \longrightarrow NaCl + H_2O$	➢ $N_2 + O_2 \longrightarrow 2NO$

Q3: ***Is it necessary that spontaneous reactions are exothermic in nature? Explain.***

Ans: ***No,*** *it is not necessary that a spontaneous reaction should be exothermic because there are some reactions which are spontaneous but endothermic in nature.*

For example:

$$H_2O_{(l)} \longrightarrow H_2O_{(g)} \qquad \Delta H = +40.7\ KJmol^{-1}$$

Q4: ***Burning of a candle is a spontaneous process. Justify.***

Ans: *A reaction will also be called spontaneous process if it needs energy to start with. Burning of candle is also a spontaneous process which needs energy to start. Once the candle is made to lit with match spark. It continues to burn afterward. Therefore burning of candle is a spontaneous process.*

Q5: ***Is it true that a non-spontaneous process never happen in universe? Explain it.***

Ans: ***No,*** *it is not true. Some reactions which happen in the universe are non-spontaneous e.g. When there is lightening the atmospheric nitrogen and oxygen combine to make NO.*

$$N_2 + O_2 \rightleftharpoons 2NO$$

Q6: ***Spontaneous reaction always proceeds in the forward direction. Give reason?***

Ans: *Spontaneous processes are unidirectional, irreversible and real processes. These can take place without any external assistance. That's why these reactions always proceed in forward direction.*

Q7: ***Why in exothermic reaction, heat is released from the system?***

Ans: *In a chemical change if enthalpy of product is less than the enthalpy of reactant. Heat is released from the system to surrounding. Hence heat is released in an exothermic reaction.*

Q8: ***Describe system and surrounding?*** ***OR***
Differentiate system and surrounding. ***OR***
Differentiate between system and surrounding.

Ans: *The difference between system and surrounding is:*

System	Surrounding
The part of universe which is under your observation is called system.	*Everything that is not a part of system is called surrounding. e.g. water in a glass is a system and all around is surrounding.*

Q9: ***Define system with an example.***

Ans: The part of universe that is under consideration or observation or under test is called system.

For example:

A reaction is occurring in a beaker.

This diagram is just for information.

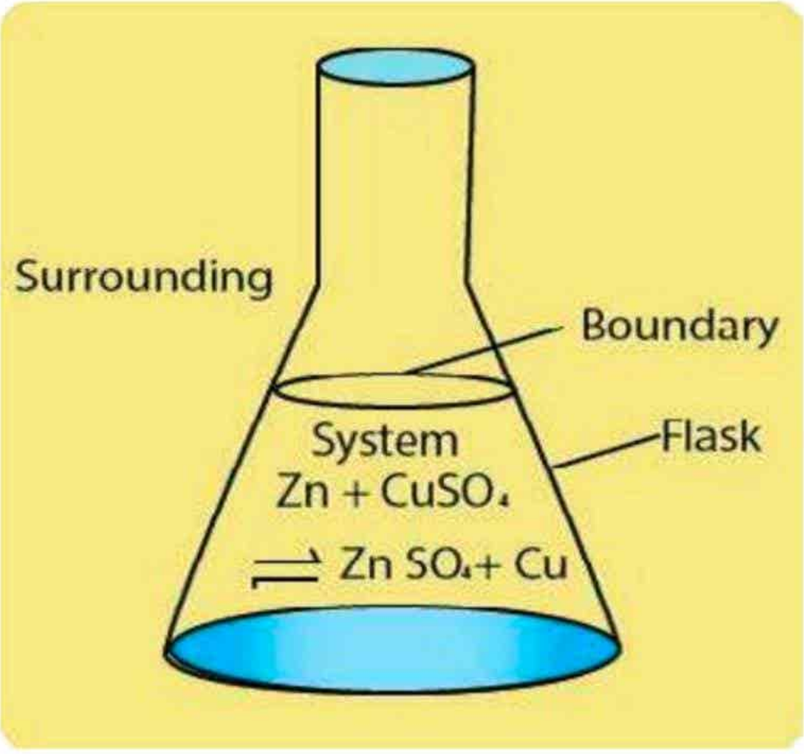

Fig System and surroundings

Q10: ***Define state function. OR What is state function?***

Ans: State function:

It is macroscopic property of system which has some definite value for initial and final states and which is independent of the path adopted to bring about the change takes place. For example:

Let T_1 *and* T_2 *are the temperature at initial and final state then change in temperature* $\Delta T = T_2 - T_1$ *volume, enthalpy, and internal energy are state functions.*

Q11: ***What is difference between state and state function? OR Define state and state function with one example of each.***

Ans: The difference between state and state function is:

State	State function
The state of the system is the condition of a system. When any process is performed on a system its state is altered. *Example:* *Temperature and volume.*	*The state function is macroscopic property of a system which has some definite values for initial and final states, and which is independent of the path adopted to bring about a change.* *Example:* *Volume,* $\Delta V = V_2 - V_1$

Q12: ***Differentiate between internal energy and enthalpy.***

Ans: The difference between internal energy and enthalpy is:

Internal energy	Enthalpy
The sum of all possible energies of atoms, ions or molecules in a system. It is not possible to measure the absolute value of internal energy of a system. However change in energy can be measured $\Delta E = E_2 - E_1$	*Total heat content of a system or sum of internal energy and product of pressure and volume is called enthalpy.* $H = E + PV$

Q13: ***Prove that*** $\Delta E = q_v$.

Ans: According to first law of thermodynamics

$$\Delta E = E_2 - E_1 = q + w$$

Where $w = P\Delta V$

So, $\Delta E = q + P\Delta V$

When volume change is zero then $\Delta V = 0$

$$\Delta E = q + P(0)$$

$$\Delta E = q$$

At constant volume $\Delta E = q_v$

Q14: ***State first law of thermodynamics with its mathematical form.***

Ans: *First law of Thermodynamic:*

It states that "Energy can neither be created nor be destroyed but it can change from one form to other. Or Energy of system and surrounding remains constant".

Mathematical form:

According to first law of thermodynamics

$$\Delta E = E_2 - E_1 = q + w$$

Where $w = P\Delta V$

So, $\Delta E = q + P\Delta V$

When volume change is zero then $\Delta V = 0$

$$\Delta E = q + P(0)$$

$$\Delta E = q$$

At constant volume $\Delta E = q_v$

Q15: ***What is meant by heat (q) and work (w) in thermochemistry?***

Ans: *There are two fundamental ways of transferring energy to or from a system. These are heat and work. Heat is not a property of a system. It is therefore not a state function. Heat evolved or absorbed by the system is represented by a symbol q. Work is also a form in which energy is transferred from one system to another.*

Q16: ***Define standard enthalpy of atomization with an example.***

Ans: *The enthalpy change when one mole of gaseous atoms is formed from the elements under standard conditions is called standard enthalpy of atomization.*

Example:

$$\frac{1}{2}H_{2(g)} \longrightarrow H_{(g)} \qquad \Delta H^{\circ}_{at} = +218\ KJmol^{-1}$$

Q17: ***How enthalpy of formation of CO is determined from graphite?***

Ans: *Enthalpy of formation of CO can be determined by Hess's Law*

$$C + O_2 \longrightarrow CO_2 \qquad \Delta H \text{ of } CO_2 = -393.7\ KJmol^{-1}$$

$$C + \frac{1}{2}O_2 \longrightarrow CO \qquad \Delta H_1 \text{ of } CO = ?$$

$$CO + \frac{1}{2}O_2 \longrightarrow CO_2 \qquad \Delta H_2 = -283\ KJmol^{-1}$$

According to Hess's Law

$$\Delta H = \Delta H_1 + \Delta H_2$$

$$\Delta H_1 = \Delta H - \Delta H_2$$

$$\Delta H_1 = -393.7\ KJmol^{-1} - (-283\ KJmol^{-1})$$

$$\Delta H_1 = -393.7\ KJmol^{-1} + 283\ KJmol^{-1}$$

$$\Delta H_1 = -110.7\ KJmol^{-1}$$

Q18: ***Acid-base neutralization process is always exothermic. Give reason.***

Ans: The standard enthalpy of neutralization is the amount of heat evolved when one mole of hydrogen ions H^+ *from an acid, react with one mole of hydroxide ions from a base to form one mole of water.*

For example, the enthalpy of neutralization of sodium hydroxide by hydrochloric acid is $-57.4\ KJmol^{-1}$.

Thus heat is evolved in acid base neutralization process is always exothermic.

Q19: ***Enthalpy is a state function Justify.***

Ans: The total heat content of a system is called enthalpy.

Equation $H = E + PV$

E, P and V are state functions so enthalpy is also a state function. It is not possible to measure the enthalpy of a system in a given state.

However change in enthalpy can be measured for a change in the state of system.

Q20: ***Define enthalpy of combustion and enthalpy of solution.*** ***OR***
State with one example, enthalpy of combustion.

Ans: Enthalpy of combustion:

The amount of heat evolved when one mole of a substance is completely burnt in excess of oxygen at STP is called enthalpy of combustion.

Example:

$$C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O \qquad \Delta H_C = -1368\ KJmol^{-1}$$

Enthalpy of solution:

The amount of heat absorbed or evolved when 1 mole of a substance is dissolved in so much solvent that further dilution results in no detectable heat change is called enthalpy of solution.

Example:

Enthalpy of solution of NH_4Cl *is* $+16.2\ KJmol^{-1}$

Q21: ***Define the following with one example in each case.***
(a) Standard enthalpy of reaction.
(b) Standard enthalpy of combustion.

Ans: (a) Standard enthalpy of reaction:

The standard enthalpy of a reaction ΔH° *is the enthalpy change which occurs when the certain number of moles of reactants as indicated by the balanced chemical equation, react together completely to give the products under standard conditions, i.e.* 25 °C (298K) *and one atmosphere pressure.*

For example:

$$2H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(g)} \qquad \Delta H^\circ = -285.8KJmol^{-1}$$

$-285.8KJmol^{-1}$ *is standard enthalpy of reaction.*

(b) Standard enthalpy of combustion:

The standard enthalpy of combustion is defined as "The enthalpy change when one mole of a substance is completely burnt in excess of oxygen under standard conditions.
It is denoted by ΔH_C°.

For example:

$$C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O \qquad \Delta H_C^\circ = -1368\ KJmol^{-1}$$

Q22: ***Define enthalpy change. Either it be positive or negative.***

Ans: *The enthalpy change is actually the heat change which occurs when certain number of moles of reactants as indicated in balanced chemical equation reacts together completely to give the products under standard conditions.*

ΔH *is Positive:*

In endothermic reaction, the enthalpy of products is greater than that of reactants and the enthalpy change is positive.

ΔH *is negative:*

In exothermic reaction, the enthalpy of products is less than that of reactants; the system has lost heat so enthalpy change is negative.

Q23: ***What does the symbol*** ΔH_n° ***denotes. Define this quantity?*** ***OR*** ***Enthalpy of neutralization is for an aid and base, Explain with example.*** ***OR*** ***What is meant by standard Enthalpy of Neutralization?***

Ans: *The symbol* ΔH_n° *denotes the standard enthalpy of neutralization.*

The standard enthalpy of neutralization is the amount of heat evolved when one mole of hydrogen ion H^+ *from an acid, reacts with one mole of hydroxide ion* H^- *from a base to form one mole of water.*

For example:

$$HCl \rightleftharpoons H^+ + Cl^-$$

$$NaOH \rightleftharpoons Na^+ + OH^-$$

$$H^+ + Cl^- + Na^+ + OH^- \rightleftharpoons Na^+ + Cl^- + H_2O$$

$$H^+ + OH^- \rightleftharpoons H_2O \qquad \Delta H^\circ = 57.4 KJmol^{-1}$$

Q24: ***Why the enthalpy of neutralization has the same value for any strong acid with any strong base?***

Ans: *When a strong acid and base are mixed together in solution form, the only change is the formation of water from* H^+ *and* OH^- *ions.*

The net reaction is;

$$H^+ + OH^- \longrightarrow H_2O$$

Therefore heat of neutralization of strong base by strong acid is approximately same.

Q25: ***Why is it necessary to mention the physical state of reactants and products in thermochemical reactions?***

Ans: *Physical state of reactants and products are necessary for thermochemical reactions. Different physical states have different enthalpies. e.g the enthalpy of formation of liquid water and water vapours different from each other.*

$$H_{2(g)} + \frac{1}{2} O_{2(g)} \longrightarrow H_2O_{(l)} \qquad \Delta H_f = -285.8\ KJmol^{-1}$$

$$H_{2(g)} + \frac{1}{2} O_{2(g)} \longrightarrow H_2O_{(g)} \qquad \Delta H_f = -245.1\ KJmol^{-1}$$

Q26: ***Define standard enthalpy of formation with two examples.***

Ans: *Standard enthalpy of formation:*

The standard enthalpy of formation of a compound is the amount of heat absorbed or evolved when one mole of the compound is formed from its elements.

It is denoted by ΔH_f° *.All the substances involved are in their standard physical states and the reaction is carried out under standard condition i.e. at* 25°C (298K) *and one atm pressure.*

Its units are $KJmol^{-1}$.

$$Mg_{(s)} + \frac{1}{2}\ O_{2(g)} \longrightarrow MgO_{(s)} \qquad \Delta H_f^\circ = -692\ KJmol^{-1}$$

$$C_{(s)} + \ O_{2(g)} \longrightarrow CO_{2(g)} \qquad \Delta H_f^\circ = -393.7\ KJmol^{-1}$$

Q27: ***Draw labeled diagram of bomb calorimeter.***

Ans:

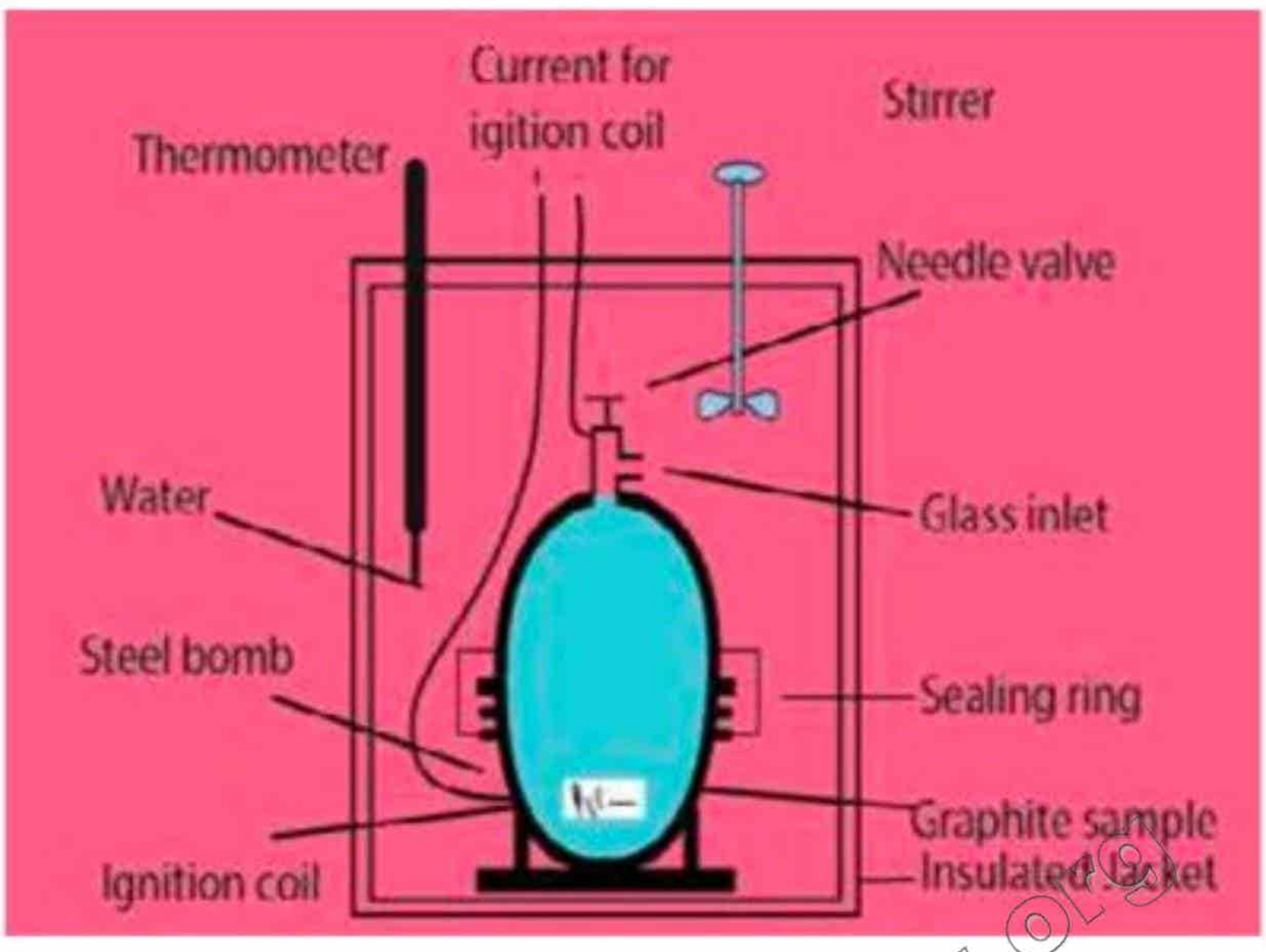

Fig Bomb calorimeter

Q28: ***Define the term "Joule" and convert 15 calories to joules.***

Ans: The energy expanded when a force of one Newton move an object one meter in the direction in which force is applied.

Where one joule is equal 10^7 *ergs and* 1 cal = 4.184J and 15 cal = 4.184J × 15 = 62.76J

Q29: ***State the Hess's law of constant heat summation.***

Ans: Hess's law of constant heat summation:

It states "If a chemical reaction takes place by different ways, the net change in energy is same regardless of the route by which the chemical change occurs. Provided the initial and final states are the same.

$$\Delta H = \Delta H_1 + \Delta H_2 + \Delta H_3$$

Q30: ***Justify Hess's law with an example.*** ***OR***
State Hess's Law and writes is mathematical form.

Ans: If a chemical reaction takes place by several different routes, the overall energy change is the same, regardless of the route by which the chemical change occurs, provided the initial and final conditions are the same.

Example:

$$C + O_2 \longrightarrow CO_2 \qquad \Delta H = -393.7\ KJmol^{-1}$$

$$C + \frac{1}{2}\ O_2 \longrightarrow CO \qquad \Delta H_1 = ?$$

$$CO + \frac{1}{2}\ O_2 \longrightarrow CO_2 \qquad \Delta H_2 = -283\ KJmol^{-1}$$

According to Hess's Law

$$\Delta H = \Delta H_1 + \Delta H_2$$

$$\Delta H_1 = \Delta H - \Delta H_2$$

$$\Delta H_1 = -393.7\ KJmol^{-1} - (-283\ KJmol^{-1})$$

$$\Delta H_1 = -393.7\ KJmol^{-1} + 283\ KJmol^{-1}$$

Q31: ***Burning of natural gas is a spontaneous process, justify.***

Ans: *Burning of natural gas is a spontaneous process. Natural gas does not burn in air on its own rather the reaction is initiated by a spark. Once the natural gas starts burning, then the reaction goes spontaneously to completion.*

Q32: ***Explain the term "Atomization energy" with an example.***

Ans: *The standard enthalpy of atomization of an element is defined as the amount of heat absorbed when one mole of gaseous atoms are formed from the element under standard conditions.*

It is denoted by H°_{at}.

For example, the standard enthalpy of atomization of hydrogen is given below.

$$\frac{1}{2}H_{2(g)} \longrightarrow H_{(g)} \qquad \Delta H^{\circ}_{at} = 218\ KJmol^{-1}$$

A wide range of experimental techniques, are available for determining enthalpies of atomization of elements.

Q33: ***Define Born-Haber cycle and lattice energy.*** ***OR***

What is difference between Born-Haber cycle and lattice energy?

Ans: *The difference between Born-Haber cycle and lattice energy is:*

Born-Haber cycle	***Lattice energy***
The sum of energy changes for a closed cyclic process is zero, If the initial and final states are same.	*The amount of energy released when gaseous ions of opposite charges combine to give one mole of a crystalline ionic compound.*

Just for information.

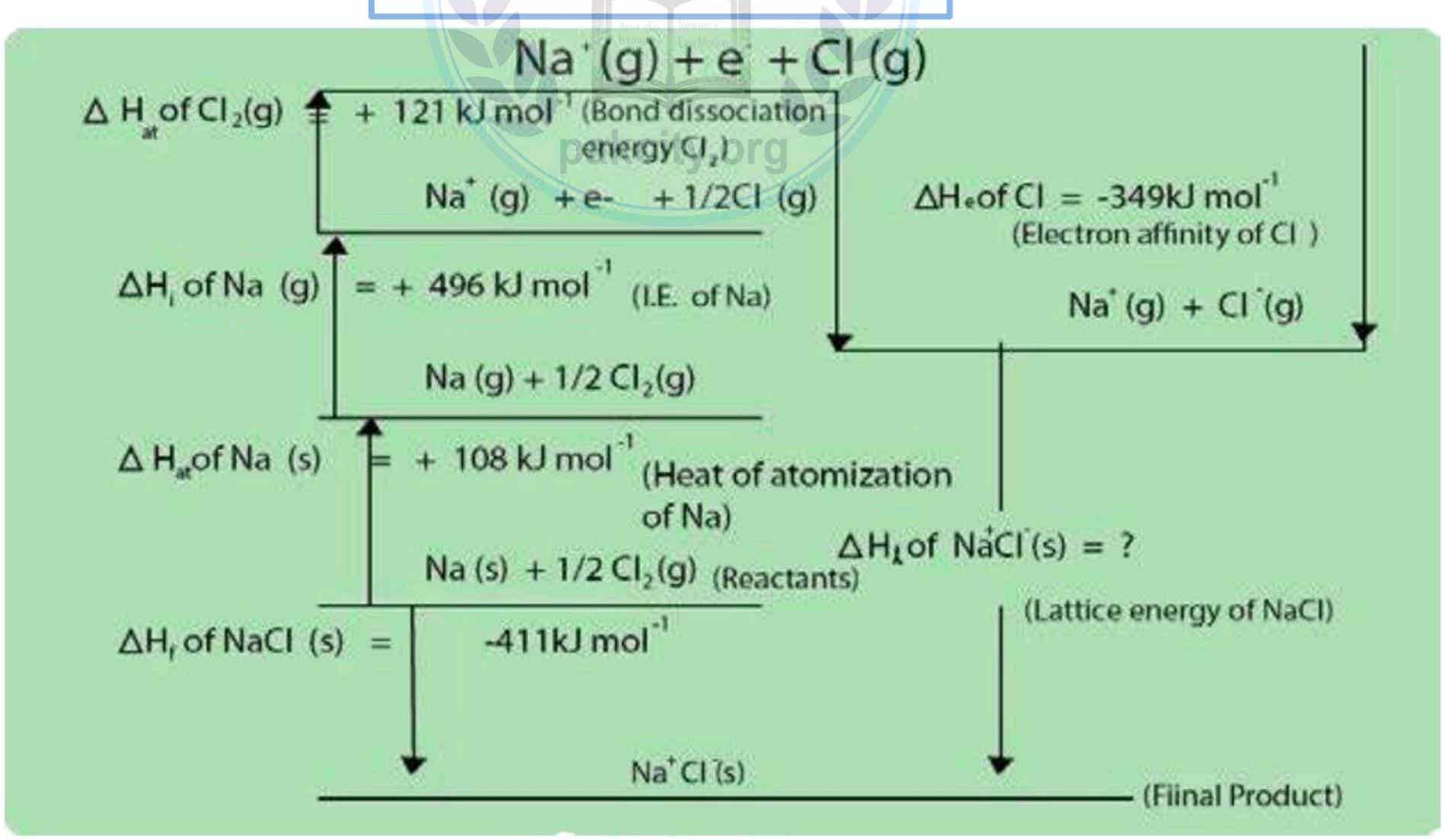

Fig Born-Haber cycle

Q34: ***Define internal energy and point out; is it a state function or not?***

Ans: *The total of all the possible kinds of energies of the system is called its internal energy.*

It is denoted by E.

The change in internal energy of system ΔE is the state function.

Q35: ***Differentiate between law of conservation of energy and Hess's law.***

Ans: The difference between law of conservation of energy and Hess's law is:

Law of conservation of energy	***Hess's law***
Energy can neither be created nor destroyed, but can be changed from one form to another is called Law of Conservation of Energy.	*If a chemical change takes place by several different routes, the overall energy change the same, regardless of the route by which the chemical change occurs, provided the initial and final conditions are the same is known as Hess's Law.*

Q36: ***What is thermochemical reaction, give their types?*** ***OR***
Define Thermochemical equation.

Ans: A balanced chemical equation which mentions physical states of the reactants and the products and also the amount of heat energy absorbed or released during the reaction is known as thermochemical equation.

$$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)} \qquad \Delta H = -393.7\ KJmol^{-1}$$

$$N_{2(g)} + O_{2(g)} \longrightarrow 2NO_{(g)} \qquad \Delta H = +180.5\ KJmol^{-1}$$

Q37: ***Differentiate between exothermic reaction and endothermic reaction.***

Ans: The difference between exothermic reaction and endothermic reaction is:

Exothermic reactions	***Endothermic reactions***
A chemical reaction in which heat energy is released is called as exothermic reaction. *Example:* $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ $\Delta H = -393.7\ KJmol^{-1}$	*A chemical reaction in which heat energy is absorbed is called as endothermic reaction.* *Example:* $N_{2(g)} + O_{2(g)} \longrightarrow 2NO_{(g)}$ $\Delta H = +180.5\ KJmol^{-1}$

Just for information.

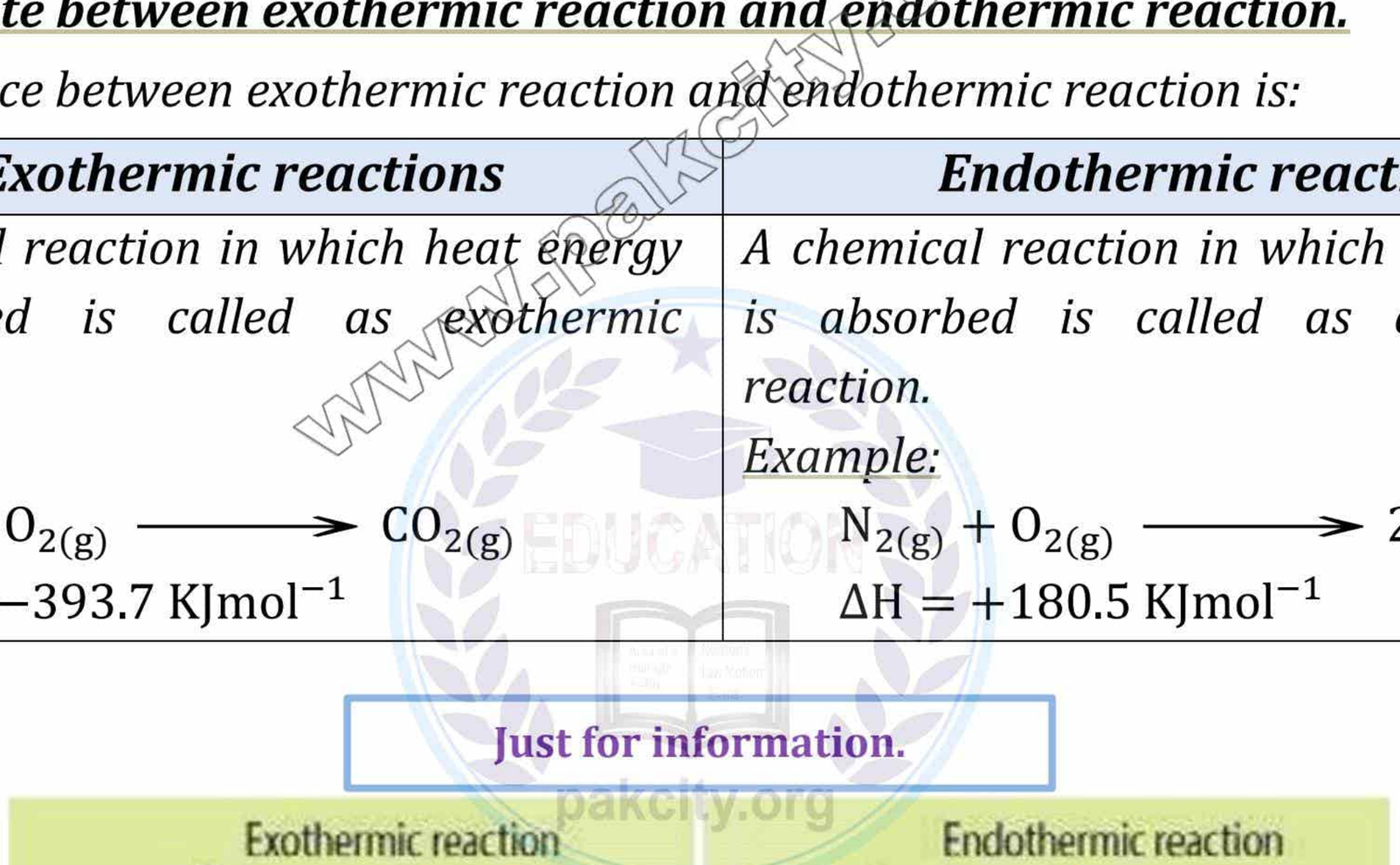

Fig Enthalpy changes in thermochemical reactions

Q38: ***Burning of Natural gas is spontaneous process.***

Ans: The process which proceeds on its own is called spontaneous.

But sometimes we need flame to start such process, but when it is started it proceeds on its own until completion of reaction e.g burning of natural gas.

Q39: ***Justify that heat of formation of a compound is the sum of all other enthalpies.***

Ans: Heat of formation of a compound ΔH_f° *is net overall heat change of enthalpies. The enthalpies which make up this* ΔH_f° *are heat of vaporization, bond dissociation energy ionization potential, electron affinity and lattice energy.*

$$\Delta H_f^\circ = \Delta H_s^\circ + \Delta Hd + \Delta H_{E.A} + \Delta Hi + \Delta He$$

Q40: ***What is difference between heat and temperature?***

Ans: It is a measure of total energy in a given amount of substance.

Its units are K. Jmol^{-1} *or* Kcal mol^{-1}

Temperature:

It is measure of average K.E of molecules of a system.

It is denoted by T.

It is expressed in $^\circ C$, $^\circ F$ *or Kelvin scales.*

Q41: ***Define heat and give its units.***

Ans: Heat is a form of energy of motion of molecules constituting the body. The unit of heat is the same as that of energy. The S.l unit of heat is Joule. Heat evolved or absorbed by the system is represented by a symbol q.

Q42: ***Define heat capacity of a body. Give mathematical expressions.***

Ans: The heat capacity of a body or a system is the quantity of heat required to change its temperature by one kelvin.

Mathematical expression:

$$q = c \times \Delta T$$

$$\Delta H_1 = -110.7\ \text{KJmol}^{-1}$$

Q43: ***What is the physical significance of equation*** $\Delta H = q_p$***?***

Ans: This shows that change in enthalpy is equal to the heat of reaction at constant pressure. The reactions are carried out at constant pressure more frequent than at constant volume. So, working with (ΔH) *is more convenient rather than* (ΔE).

Chapter : 07	Thermochemistry

Long Questions

Q1: Define enthalpy. Give its mathematical form and prove that $\Delta H = q_p$? OR

What is first law of thermodynamics? Prove that $\Delta H = q_p$? OR

What is the first law of thermodynamics? Give its mathematical form. (V.Imp)

Q2: What is Enthalpy of a reaction? How is ΔH of a reaction measured in laboratory by glass calorimeter?

Q3: Define the following with examples: (Imp)

- Non-spontaneous reactions.
- Enthalpy of atomization.
- System.
- Endothermic reactions.
- Enthalpy of solution
- Surroundings.

Q4: State law of thermodynamics and prove that $\Delta E = q_p$? (V.Imp)

Q5: Differentiate between:

- Spontaneous and Non-spontaneous.
- Exothermic and endothermic reactions.

Q6: Neutralization of $100cm^3$ of 0.5 M NaOH at 25°C with $100cm^3$ of 0.5 M HCl at 25°C raised the temperature of reaction mixture to 28°C. Find the enthalpy of neutralization. Specific heat of water $= 4.2JK^{-1}g^{-1}$.

Q7: Define enthalpy of reaction. How is it measure by glass calorimeter? OR

How ΔH can be determined by using bomb calorimeter? (V.Imp) OR

Discuss the measurement of enthalpy of a reaction with the help of Bomb calorimeter?

Q8: State and explain with an example, the Hess's law of constant heat summation. (V.Imp)

Q9: Define lattice energy. How Born Haber Cycle help us to calculate the lattice energy of NaCl?

Q10: Define the following enthalpies and give one example of each:

- Standard enthalpy of formation.
- Standard enthalpy of atomization.

Q11: Explain the following terms:

- Standard heat of Neutralization.
- Standard Enthalpy of solution.