

# Unit 05

## Energetics

### Descriptive Questions

**Q.1** (Ex. Q.4 (i)) Find out the enthalpy change of the following reaction using the given data.

09205001



**Data:**

Bond dissociation energy of  $\text{N}_2$  = 958.38 kJ/mol

Bond dissociation energy of  $\text{O}_2$  = 498 kJ/mol

Bond formation energy of NO = -626 kJ/mol

**Ans.** Total amount of energy absorbed = 958.38 + 498  
= 1456.38 kJ/mol

Total amount of energy released = 2 (-626)  
= -1252 kJ/mol  
Enthalpy change = 1456.38 - 1252  
= 204.38 kJ/mol

**Q.2** (Ex. Q.4 (ii)) Explain the difference between the terms heat and enthalpy. / How is enthalpy different from Heat?

09205002

**Ans.**

Heat	Enthalpy
<b>Definition</b> This form of energy is released when a bond is formed and absorbed when bond is broken.	<b>Definition</b> Enthalpy (H) or heat content, is defined as the total amount of thermal energy stored in a compound.
<b>System</b> It is not essential part of system	<b>System</b> It is essential part of system
<b>Process</b> Heat just enter and leave the object.	<b>Process</b> Enthalpy change is equal to heat evolved or absorbed, at constant pressure.
<b>Measurement</b> It is measurement of thermal energy transferred between two objects at different temperature.	<b>Measurement</b> It is measurement of energy in thermodynamic system.
<b>Representation</b> It is represented by 'q'	<b>Representation</b> It is represented by 'H'
<b>Unit</b> Its unit is Joule	<b>Unit</b> Its unit is kJ/mol.

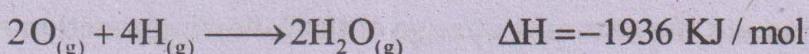
**Q.3 (Ex. Q.4 (iii)) Explain why formation of bond is always an exothermic process.**

09205003

**Ans.** Bond formation take place always with the evolution of Heat. If a reaction accompanied with the evolution of heat. It is called exothermic reaction.

**For Example:**

Total energy evolved in the formation of 4-OH bonds



This is the energy evolved when two moles of water are formed from 4 moles of hydrogen and 2 moles of oxygen atoms. Thus for the formation of one mole of water, the energy evolved will be  $968 \text{ kJ/mol}^{-1}$ .

**Q.4 (Ex. Q.4 (iv)) Explain the role of lipids in our body.**

09205004

**Ans. Role of Lipid in our Body**

i. **Organic Compound**

Lipids are group of organic compounds which include Fats, waxes, sterol etc.

ii. **Energy source**

Lipids serve as an energy reserve within our body. About half of the fuel our body needs comes from lipids.

iii. **Energy Bank in Animal body**

If you eat more food than you need in a day, excess food is stored as lipid in adipose tissue. In between meals and during exercise, our body relies on this resource to provide energy.

iv. **Water proofing**

Lipids such as waxes provide water proofing for skin, hair and feathers in humans and animals.

v. **Absorption of fat soluble vitamins**

Lipids are necessary for the absorption of fat -soluble vitamins (A,D,E and K) in the intestine.

**Q.5 (Ex. Q.4 (v)) Explain the following terms.**

09205005

**Ans. Activation Energy**

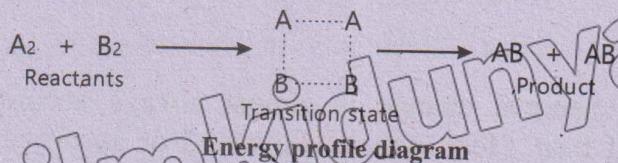
**Definition**

Energy absorbed by reactant or product molecule in order to be converted into transition state is called activation energy. It is represented by (E<sub>a</sub>.)

**Transition State**

**Definition**

When the two reactant molecules mixed together, all these molecules start colliding with each other. The collisions which result by colliding molecules having average or less than average kinetic energies may not be able to produce any result. But when the two excited molecules from both the reactants collide with each other they may be able to produce the transition state



After a very short period of time the transition state either returns to the reactants or to the products. The progress of the reaction can be shown in the form of the above energy profile diagram drawn between path of the reaction can be shown in the form of the following energy of the reactants and the products.

### Aerobic Respiration

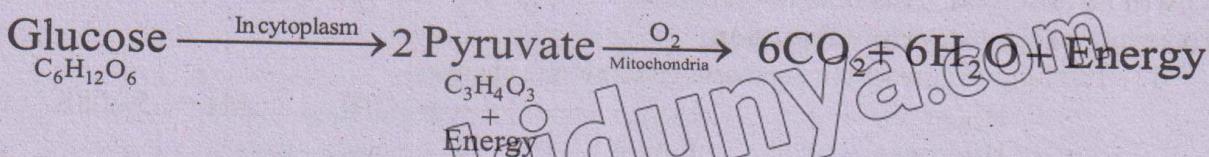
#### Definition

The process of respiration in human beings is a continuous process. During this process, we breathe in oxygen and breathe out carbon dioxide. Respiration also carries complex chemical reactions inside the human body. This process that occurs in the presence of oxygen is called **aerobic respiration**.

#### Process

Aerobic respiration is an exothermic process and involves the following reactions

#### Reactions



### Investigative Questions

**Q.1. (Ex. Q.5(ii)) Why is it essential to cook some of the food items while others we can eat without cooking?**

09205006

**Ans.** Some fruits and vegetables are usually safe to eat if they are not contaminated. However, many raw foods like meat and eggs may have harmful bacteria or Parasites. Cooking kills these micro-organism, make the food safe to eat. Cooking also makes food easier to digest and enhance the flavor and texture, making it more enjoyable to eat. **For example**, meat and poultry need to be cook thoroughly to avoid foodborne illnesses, while some fruits and nuts are soft to eat raw because they don't carry the same risks. So cooking is digestibility important for safety and taste.

**Q.2. (Ex. Q.5 (ii)) Why does fireworks look spectacular? What type of chemical compounds undergo chemical reactions during this activity?**

09205007

**Ans.** Fireworks look spectacular because people enjoy bright color enlightening sky. Fireworks are result of combustion reaction that yield heat, light and sound. Different metal powders along with oxidizing agents produce a variety of colors when burnt. For example copper (Cu) produces blue colour.

### SLO Based Additional Long Questions

**Q.1 Explain the Exothermic and Endothermic Reactions.**

09205008

**Ans. Definitions:**

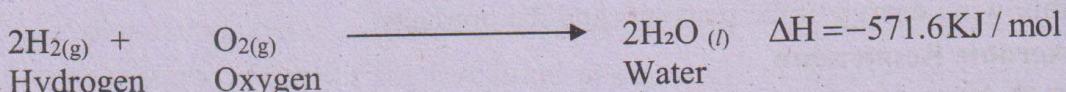
Chemical reactions in which heat energy is evolved are called **exothermic reactions**. Those reactions in which heat energy is absorbed are called **endothermic reactions**.

## **Explanation:**

A physical or a chemical change is almost always accompanied with either absorption or evolution of heat. Heat, which is evolved or absorbed during a chemical reaction, is called the heat of that reaction.

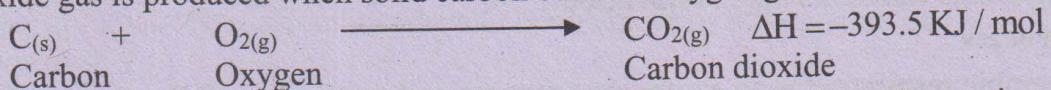
### **Example of exothermic reactions:**

1. Hydrogen gas and oxygen gas react to give liquid water is an exothermic reaction.



571.6 kJ heat energy is evolved during this reaction. If the energy evolved is shown separately it is expressed as  $\Delta H = -571.6 \text{ KJ/mol}$ . The same amount of energy will be absorbed when the reaction will move in the backward direction i.e. water will decompose to give hydrogen and oxygen back.

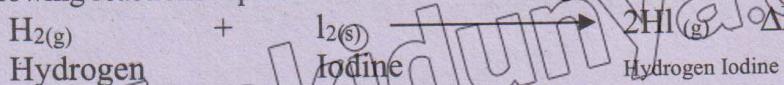
2. Carbon dioxide gas is produced when solid carbon burns in oxygen gas.



It is also an exothermic reaction and 393.5 KJ heat energy is evolved during this reaction. When this reaction moves in the backward direction, the same amount of energy i.e. 393.5 kJ will be absorbed. This reaction has  $\Delta H = -393.51 \text{ KJ/mol}$  of  $\text{CO}_2$ .

### **Example of Endothermic Reaction:**

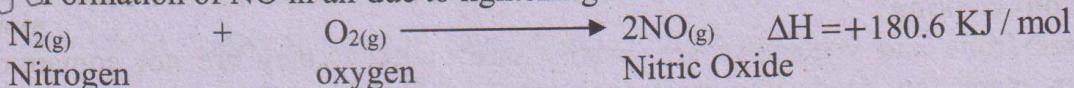
1. The following reactions represent endothermic changes.



The enthalpy change for the reaction is  $\Delta H = 53.08 \text{ KJ/mol}$

Hydrogen gas reacts with solid iodine only at high temperature and 53.08 kJ of heat energy is absorbed.

2. Formation of NO in air due to lightning in the clouds.



The enthalpy change for the reaction is  $\Delta H = 180.6 \text{ KJ/mol}$

**Q.2 Give the Importance of Exothermic and Endothermic reactions in daily life. 09205009**

**Ans.** Our present-day living conditions depend heavily on energy in its various forms. Exothermic chemical reactions are extensively used to fulfill this requirement. In such reactions, chemical energy is converted into heat energy. We burn fuels like gas, oil and coal to cook food and for other heating purposes in our homes and industry. During this burning process called combustion, compounds present in fuels react with oxygen of the air to produce a large amount of heat.

## **Metabolism:**

Foods such as fats and carbohydrates are important biological fuels. During metabolism, the chemical energy present in this food is converted to heat to keep us warm.

## **Power Station:**

A large portion of electricity is produced at power stations by burning fuels such as natural gas and coal. The heat which comes out from their combustion is used to produce steam at high pressure. This high pressure steam is then used to turn turbines, which in turn generate electricity.

### Combustion:

While driving a vehicle, it is the combustion of petrol or diesel that gives off energy and drives it forward.

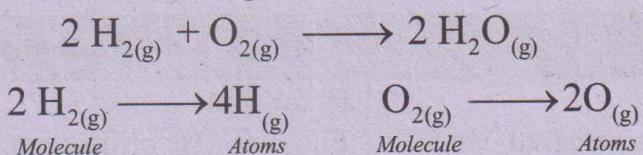
### Firework:

The one example of exothermic reactions people seem to enjoy the most is that of fireworks. Fireworks are the result of combustion reactions that yield heat, light and sound. Different metal powders along with oxidizing agents produce a variety of colours when burnt.

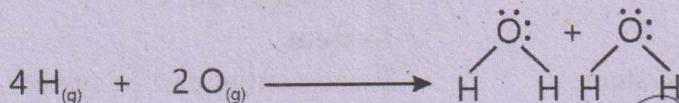
**Q.3 Why the Chemical reactions are either exothermic or endothermic? Explain with examples.**

09205010

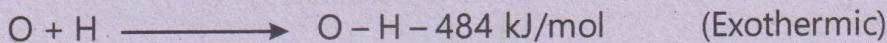
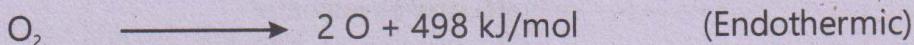
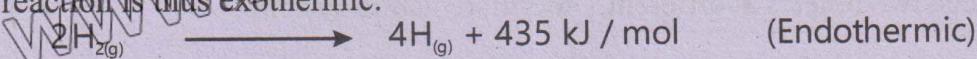
**Ans.** A chemical reaction mainly involves the processes which involve bond breaking and bond formation. In the following reaction, the chemical bonds between the atoms present in the molecules of H<sub>2</sub> and O<sub>2</sub> first break to give their atoms.



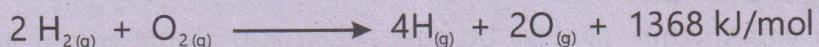
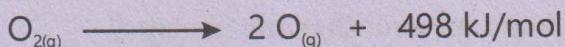
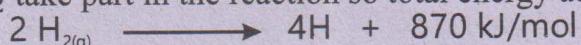
These atoms of hydrogen then form bonds with oxygen atoms to form two molecules of gaseous H<sub>2</sub>O.



Breaking of bonds of H<sub>2</sub> and O<sub>2</sub> absorb energy (endothermic process) while making of bonds between H and O evolve energy (exothermic process). In this reaction, weaker bonds are broken. Hence less energy is absorbed in the system. While the bonds which are formed in water molecule are stronger and thus greater energy is evolved. Hence, the energy which is evolved is more than the energy which is absorbed. The overall reaction is thus exothermic.

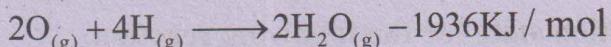


Since two moles of H<sub>2</sub> take part in the reaction so total energy absorbed in the reaction.



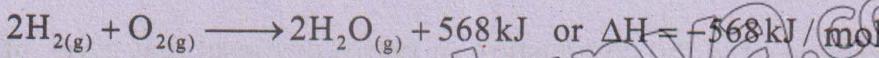
It means 1368 kJ energy is absorbed when 2 moles of H<sub>2</sub> and one mole of O<sub>2</sub> break their bonds to convert themselves into atoms.

Total energy evolved in the formation of 4 O – H bonds.



This is the energy evolved when two moles of water are formed from 4 moles of hydrogen atoms and 2 moles of oxygen atoms. Thus for the formation of one mole of water, the energy evolved will be 968 kJ.

Hence the overall energy evolved in this reaction is = -1936 + 1368 = -568 kJ for two moles of water.



The enthalpy change for the formation of two moles of gaseous water is thus  $-658 \text{ kJ}$ . So the enthalpy change for the formation of one mole of gaseous water will be

$$\frac{-568 \text{ kJ}}{2 \text{ mol}} = -284 \text{ kJ/mol}$$

The experimental value of formation of gaseous water is  $-284 \text{ kJ/mol}$  which is quite close to this calculated value.

### Exercise Short Question

**Q.1 What is the difference between enthalpy and enthalpy change?**

09205011

**Ans.**

Heat	Enthalpy
<b>Definition</b> This form of energy is released when a bond is formed and absorbed when it is broken.	<b>Definition</b> Enthalpy (H) or heat content, is defined as the total amount of thermal energy stored in a compound.
<b>System</b> It is not essential part of system	<b>System</b> It is essential part of system
<b>Process</b> Heat just enter and leave the object.	<b>Process</b> Enthalpy change is equal to heat evolved or absorbed, at constant pressure.
<b>Measurement</b> It is measurement of thermal energy transferred between two objects at different temperature.	<b>Measurement</b> It is measurement of energy in thermodynamic system.
<b>Representation</b> It is represented by 'q'	<b>Representation</b> It is represented by 'H'.
<b>Unit</b> Its unit is Joule (J)	<b>Unit</b> Its unit is kilo joules per mol (kJ/mol).

**Q.2 Why is breaking of a bond an endothermic process?**

09205012

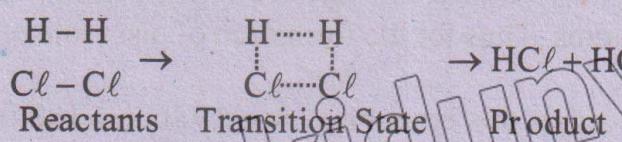
**Ans. Bond breaking is Endothermic.**

Bond breaking is an endothermic process because when two atoms combine, energy is stored in them and when we break bond, equal amount of energy is given to break that bond this energy is also known as dissociation energy. e.g dissociation energy for hydrogen is  $435 \text{ kJ/mol}$ .

**Q.3 Depict the transition state for the following reaction.**

09205013

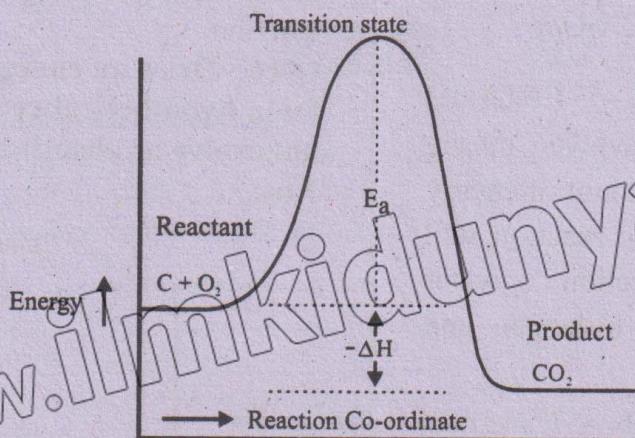
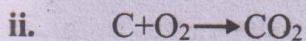
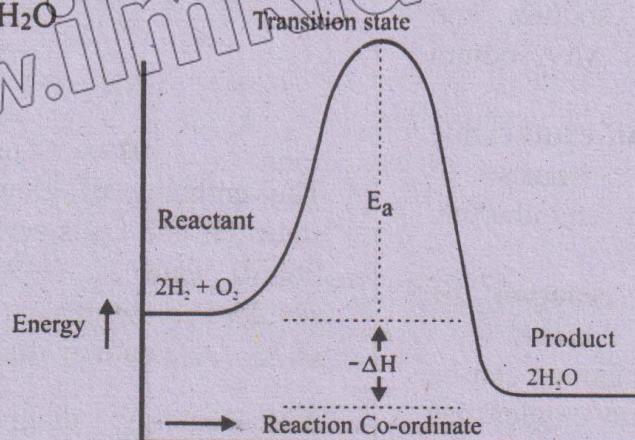
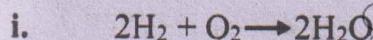
**Ans.**  $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$



**Q.4 Draw the reaction profiles for two exothermic reactions one of which moves faster than the other.**

09205014

**Ans.**



**Q.5 What is the role of glycogen in our body?**

09205015

**Ans.** Glycogen is primary storage form of glucose. It is stored in liver and muscle. It helps to regulate blood sugar level in our body.

### Practice Exercise Questions

**Q.6 Does boiling water in a beaker endothermic or exothermic change? Which form of energy is being transferred in this system?** 09205016

**Ans.** Boiling water in a beaker is endothermic reaction. Heat energy is transferred in this system.

**Q.7 Can energy be transferred in a form other than heat during a chemical reaction?** 09205017

**Ans.** Yes, energy can be transferred in other form than heat like light, sound etc.

**Q.8 Why it is not possible to calculate the enthalpy of a system?**

09205018

**Ans.** It is not possible to calculate the absolute enthalpy of a system because enthalpy (H) is a state function that depends on the internal energy (E), pressure (P) and volume (V) of a system, we cannot determine the absolute values of these quantities for a system in isolation, instead we calculate the change in enthalpy ( $\Delta H$ ).

**Q.9 Why the chemical reaction between sodium metal and water proceeds violently?** 09205019

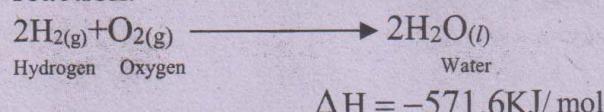
**Ans.** Reaction between sodium and water is exothermic that's why sodium react violently with water.

**Q.10 Is melting of ice an exothermic or endothermic change?** 09205020

**Ans.** Melting of ice is endothermic change.

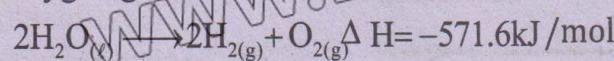
**Q.11 Can exothermic reaction be reversed?** 09205021

**Ans.** Yes, exothermic reactions can be reversed. Hydrogen gas and oxygen gas react to give liquid water in an exothermic reaction.



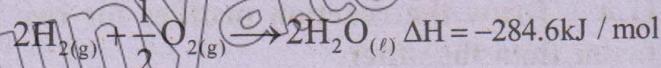
$$\Delta H = -571.6 \text{ kJ/mol}$$

571.6 kJ heat energy is evolved during this reaction. The same amount of energy will be absorbed when the reaction will move in the backward direction i.e. water will decompose to give hydrogen and oxygen gases back.



**Q.12 Calculate the enthalpy change for the formation of one mole of liquid water.** 09205022

**Ans.** Enthalpy change for the formation of one mole of liquid water is :



$$\Delta H = -571.6 \text{ kJ/mol}$$

$$\Delta H = \frac{-571.6}{2} \text{ kJ/mol}$$

$$\Delta H = -284.6 \text{ kJ/mol}$$

The enthalpy of elements in standard states H<sub>2</sub> and O<sub>2</sub> is zero. The enthalpy of liquid water is -284 kJ/mol under standard conditions

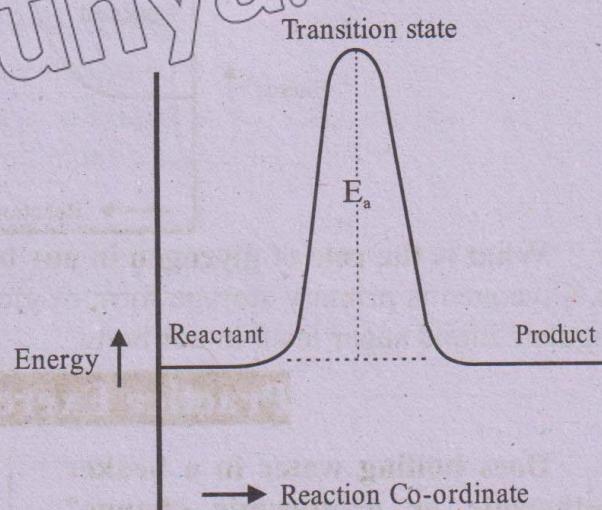
**Q.13 Are energy diagrams useful?**

09205023

**Ans.** Energy diagrams are useful because it gives us immediate answer about energy changes happening in a reaction.

**Q.14 Draw an energy profile diagram for a hypothetical reaction which does not evolve or absorb heat.** 09205024

**Ans:**



## SLO Based Additional Short Question

### Introduction

**Q.15 Define thermodynamics.** 09205025

**Ans.** Thermodynamics deals with how the energy changes during chemical reaction affect the properties of a chemical system.

**Q.16 Who use the word energy for the first time?**

09205026

**Ans.** Thomas Young was the first to use the word 'energy' to the field of physics in 1802.

**Q. 17 What is the difference between Chemical and Heat energy?** 09205027

**Ans.**

Chemical Energy	Heat Energy
This energy is stored in a molecule in which atoms are bonded to each other	This form of energy is released when a bond is formed and absorbed when it is broken.

### System and Surrounding

**Q. 18 Can we use Energy evolved during a chemical reaction?** 09205028

**Ans.** Energy evolved during a chemical reaction is used in everyday for cooking, heating, lightning, transportation, communication, entertainment and much more.

**Q.19 Differentiate between system and surrounding.** 09205029

System	Surrounding
1. Any physical or chemical change under study, may also be called system.	1. Everything else which does not fall in the system is called surrounding.
2. It includes reactants, products, catalyst, solvent, and anything else which is important to study a particular reaction.	2. It includes all other things such as beaker burner test tube etc.

### Enthalpy

**Q. 20 What is the importance of enthalpy?**

**Ans.** Enthalpy is important because it tells us how much heat is present in a system. Heat is important because we can extract useful work from it.

**Q.21 What is difference between  $\Delta E$  and  $\Delta H$ ?**

**Ans.**

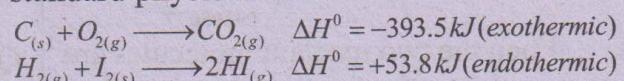
$\Delta E$	$\Delta H$
<ul style="list-style-type: none"> <li><math>\Delta E</math> is the change in internal energy.</li> <li>It is equal to heat absorbed by the system at constant volume.</li> </ul>	<ul style="list-style-type: none"> <li><math>\Delta H</math> is the enthalpy change.</li> </ul>
$\Delta E = q_v$	$\Delta H = q_p$
<ul style="list-style-type: none"> <li>It is equal to sum of heat and work.</li> </ul>	It is equal to sum of internal energy and product of pressure volume work.
$\bullet \Delta E = q + w$	$\Delta H = \Delta E + P\Delta V$

**Q.22 Define standard enthalpy of reaction.** 09205032

**Ans. Standard enthalpy of reaction ( $\Delta H^0$ )**

- "Amount of heat evolved or absorbed when one mole of reactants are converted into products under standard condition ( $25^\circ C$  and  $1\text{ atm}$ ) in a chemical reaction"
- It is represented by ( $\Delta H^0$ )
- Its sign is positive for endothermic reaction and negative for exothermic reaction.

Reactants and products should be taken in standard physical state.



**Q.23 Define enthalpy of a chemical reaction.** 09205033

**Ans. Enthalpy of Reaction:** The amount of heat or thermal energy evolved or absorbed in a chemical reaction is called enthalpy of reaction.

**Sign:**

Its sign is negative for exothermic and positive for endothermic reactions.

### Standard enthalpy change:

Enthalpy of reaction measured at 25°C (or 298K) and one atmospheric pressure is known as standard enthalpy change.

### Representation:

It is denoted by  $\Delta H^0$ .

- $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$   
 $\Delta H^0 = -393.5 \text{ kJ}$
- $H_{2(g)} + I_{2(g)} \rightarrow 2HI_{(g)}$   
 $\Delta H^0 = +53.8 \text{ kJ}$

### Exothermic or Endothermic reactions

**Q.24 How atmospheric N<sub>2</sub> and O<sub>2</sub> can react with each other?** 09205034

**Ans.** Nitrogen of the atmosphere reacts with oxygen to produce nitrogen oxide (NO) only in the presence of lightning. This is because reaction is highly endothermic, so only

**Q.26 Define exothermic and endothermic reactions.**

**Ans.:**

#### Exothermic Reactions

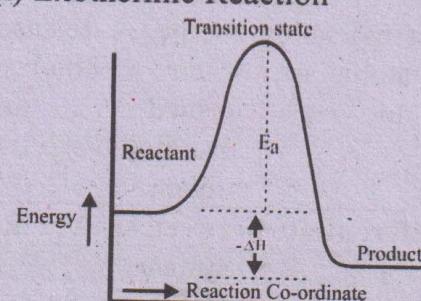
A chemical reaction that proceeds with the evolution of heat is called an exothermic reaction.

- $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$   
 $\Delta H^0 = -393.5 \text{ kJ}$
- $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$   
 $\Delta H^0 = -571.6 \text{ kJ}$

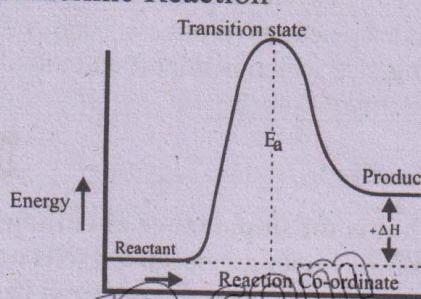
lightening can provide enough energy for this reaction to take place.

**Q.25 Give energy diagrams for endothermic and exothermic reactions.** 09205035

**Ans. (i) Exothermic Reaction**



**(ii) Endothermic Reaction**



09205036

#### Endothermic Reactions

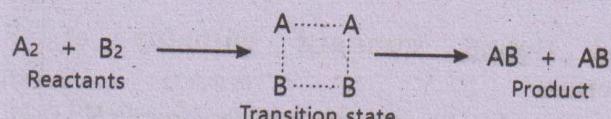
A chemical reaction that proceeds with the absorption of heat is called an endothermic reaction.

- $H_{2(g)} + I_{2(g)} \rightarrow 2HI_{(g)}$   
 $\Delta H^0 = +53.8 \text{ kJ}$
- $N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$   
 $\Delta H^0 = +180.6 \text{ kJ}$

### How does a Reaction take place?

**Q.27 Give collision theory of reactions.** 09205037

**Ans.** When the two reactant molecules are mixed together, all these molecules start colliding with each other. The collisions which result by colliding molecules having average or less than average kinetic energies may not be able to produce any result. But when the two excited molecules from both the reactants collide with each other they may be able to produce the transition state as shown in the following.



**Q.28 Why the energy of the transition state is higher than that of reactants or products?** 09205038

**Ans.** The energy of the transition state is higher than that of reactants or products because the bonds between the reactant or product molecules are being cleaved or stressed progressively.

**Q.29 How catalyst increase the rate of reaction?** 09205039

**Ans.** An addition of the catalyst in a reaction increases the rate of reaction because it changes the path adopted by the reactants whereby the activation energy value of the reaction is substantially decreased. As a result, more reactants are now able to be converted into product molecules and hence the rate of reaction will increase.

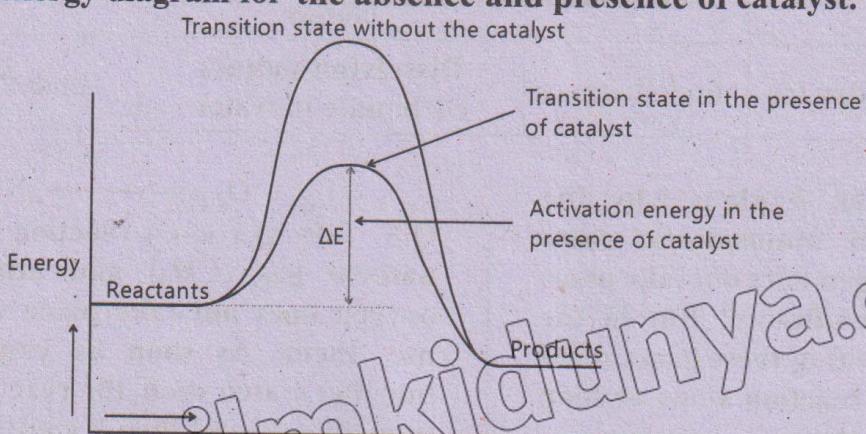
**Q.30 Define Catalyst with an example.** 09205040

**Ans.** A substance that increase the rate of a chemical reaction without itself undergoing any permanent chemical change.

Example:

- Nickel (Ni) acts as a catalyst in the hydrogenation of oil to give banaspati ghee.
- Platinum (Pt) acts as a catalyst in the production of  $H_2SO_4$ .
- Chlorine ( $Cl_2$ ) acts as a catalyst promoting the breakdown of ozone.

**Q.31 Draw energy diagram for the absence and presence of catalyst.** 09205041



### Aerobic and Anaerobic respiration

**Q.32 Differentiate between Aerobic and Anaerobic respiration.** 09205042

**Ans.**

Aerobic Respiration	Anaerobic Respiration
i. It occurs in the presence of oxygen.	i. It occurs in the absence of oxygen.
ii. It occurs in higher animals like human body.	ii. It occurs in bacteria and algae.
iii. The product of this reaction is $CO_2$ and $H_2O$ .	iii. The product of this reaction is alcohol.
Glucose $\xrightarrow[\text{C}_6H_{12}O_6}{\text{In cytoplasm}} 2 \text{ Pyruvate} \xrightarrow[\text{C}_3H_4O_3]{\text{Mitochondria}} 6CO_2 + 6H_2O + \text{Energy}$	Glucose $\xrightarrow[\text{C}_6H_{12}O_6}{\text{In cytoplasm}} 2 \text{ Pyruvate} \xrightarrow[\text{C}_3H_4O_3]{\text{Yeast}} C_2H_5OH + CO_2 + \text{Energy}$

**Q.33 Define Glycolysis.** 09205043

**Ans.** During glycolysis one molecule of glucose is split into two molecules of pyruvate. This process involves a series of reactions catalyzed by enzymes, with a net production of 2 ATP (Adenosine Triphosphate). When cells of our body require energy for performing the metabolic

activities, they use this ATP and break it down to get the required energy.

**Q.34 How energy is produced from food?** 09205044

**Ans.** The food we eat undergoes digestion in our body and the digested food molecules that are absorbed by the cells undergo oxidation to produce energy.

## Constructed Response Questions

**Q.1** (Ex. Q.3 (i)) Physical changes which usually occur around us are given in the table. Write down whether they are exothermic or endothermic. 09205045

Physical change	Exothermic or Endothermic	Physical change	Exothermic or Endothermic
Conversion of hydrated salt into anhydrous salt	Endothermic	Conduction of electricity by metals	Neither Endothermic Or Exothermic
Burning paper	Exothermic	Dissolving ammonium chloride in water	Endothermic
Vapourizing liquid nitrogen	Endothermic	Formation of rain from clouds	Exothermic
Evaporation of dry ice	Endothermic	Dissolving sodium carbonate in water	Endothermic

**Q.2** (Ex. Q.3 (ii)) Explain why the reaction between atmospheric gases oxygen and nitrogen does not take place under normal conditions? But in the presence of lightening these gases react to give NO. The reaction stops as soon as the lightening stops. 09205046

**Ans.** Nitrogen and oxygen does not react under normal conditions because it is highly endothermic reaction. Nitrogen molecule has triple covalent bond which require very high energy to break. That energy is supplied by lightening. So as long as lightening continue reaction will continue.



**Q.3** (Ex. Q.3 (iii)) A reaction between natural gas ( $\text{CH}_4$ ) and atmospheric oxygen does not take place when you mix them. As soon as you show a burning match stick, the reaction starts immediately and then it continues until one or both of the reactions is/are used up. Explain. 09205047

**Ans.** Activation energy of methane is very high which is supplied by burning match stick. Once reactant break and combine to form new products reaction goes on, until one or both reactant get consumed.

## Multiple Choice Questions (Exercise)

**Tick (✓) the correct answer.**

1. The following reaction is an exothermic reaction. 09205048



From where does the energy come to break the bond of  $\text{H}_2$  and  $\text{Cl}_2$ ?

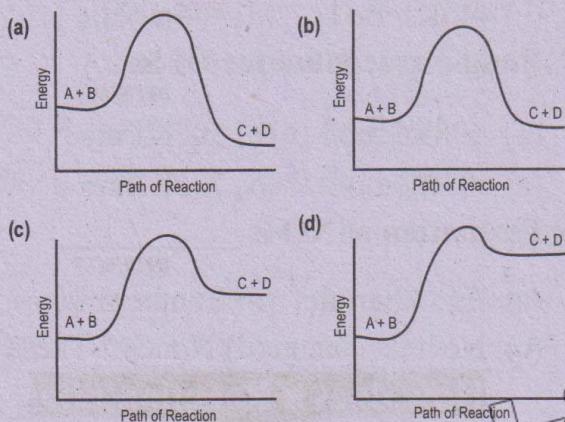
- (a) By collisions between the molecules
- (b) From sunlight
- (c) From the surrounding

- (d) By collisions of the molecules with the walls of the container

2. Which of the following reactions has the least value of activation energy 09205049

- (a)  $\text{H}_2(\text{g}) + 1/2\text{O}_2(\text{g}) \longrightarrow \text{H}_2\text{O}(\text{g})$
- (b)  $\text{C}(\text{s}) + \text{O}_2(\text{g}) \longrightarrow \text{CO}_2(\text{g})$
- (c)  $\text{NaCl}_{(\text{aq})} + \text{AgNO}_3_{(\text{aq})} \longrightarrow \text{AgCl}_{(\text{s})} + \text{NaNO}_3$
- (d)  $\text{H}_2(\text{g}) + \text{I}_2(\text{s}) \longrightarrow 2\text{HI}(\text{g})$

5. Which reaction do you expect to be a reversible reaction? 09205052



6. What does it show when a chemical reaction is exothermic? 09205053

  - (a) It shows the bonds which break are weaker than those are formed.
  - (b) It shows the bond which break are stronger than those are formed.
  - (c) Exothermic nature of the reaction is not concerned with bond formation or bond breakage.
  - (d) It shows that the reactants are more stable than the products.

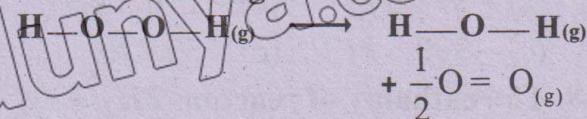
7. When NaOH and HCl are mixed the temperature increases. The reaction is: 09205054

- (a) endothermic with a positive enthalpy change.
  - (b) endothermic with a negative enthalpy change.
  - (c) exothermic with a positive enthalpy change.
  - (d) exothermic with a negative enthalpy change.

8. The average bond dissociation energy for the  $C - H$  bond is  $412 \text{ kJ mol}^{-1}$ . Which of the following process will have enthalpy change close to  $412 \text{ kJ mol}^{-1}$ .

- (a)  $\text{CH}_4(g) \rightarrow \text{C}(g) + 2\text{H}_2(g)$   
 (b)  $\text{CH}_4(g) \rightarrow \text{C}(g) + \text{H}_2(g)$   
 (c)  $\text{CH}_4(g) \rightarrow \text{C}(g) + 4\text{H}_2(g)$   
 (d)  $\text{CH}_4 \rightarrow \text{CH}_3(g) + \text{H}(g)$

9. The average bond energies for O-O and O = O are 146 and 496 kJ/mol respectively. Find the enthalpy in kJ for the following reaction? 09205056






10. Why does the following exothermic reaction not occur?  $C \rightarrow C$   $\Delta H = -3\text{ kJ/mol}$   
(Diamond) (Graphite)

- 0920505
- (a) Structure of diamond is more stable than that of graphite.
  - (b) Diamond has strong covalent bonds than does the graphite.
  - (c) The change form diamond to graphite has high activation energy.
  - (d) Density of graphite is less than that of diamond.

## **SLO Based Additional MCQ's**

## Introduction

11. When old bonds are broken, the energy is:

(a) Consume      (b) Release

- (c) Remain same (d) None of these

12. When new bonds are formed, the energy is: 09205059

(a) Consume (b) Release

(c) Remain same (d) None of these

**13. All chemical reactions involve:**

09205060

- (a) Catalysts
- (b) Enzymes
- (c) Energy changes
- (d) All of these

**14. Who use the word energy for the 1<sup>st</sup> time:**

09205061

- (a) Thomas Young
- (b) Bohr
- (c) Rutherford
- (d) None of these

**15. The word energy is used in physics for the first time:**

09205062

- (a) 1802
- (b) 1805
- (c) 1858
- (d) 1902

### **System and Surrounding**

**16. The part of the universe that we want to focus our attention called \_\_\_\_\_.**

09205063

- (a) system
- (b) Surrounding
- (c) Energy
- (d) Both a & b

### **Enthalpy**

**17. The enthalpy of reaction  $C + O_2 \rightarrow CO_2$**

09205064

- (a)  $-571.6\text{ kJ}$
- (b)  $-110.5\text{ kJ}$
- (c)  $-393.5\text{ kJ}$
- (d)  $+53.8\text{ kJ}$

**18. The enthalpy of reaction  $2H_2 + O_2 \rightarrow 2H_2O$**

09205065

- (a)  $-571.6\text{ kJ}$
- (b)  $-110.5\text{ kJ}$
- (c)  $-393.5\text{ kJ}$
- (d)  $+53.8\text{ kJ}$

**19. The enthalpy of reaction  $C + \frac{1}{2}O_2 \rightarrow CO$**

09205066

- (a)  $-571.6\text{ kJ}$
- (b)  $-110.5\text{ kJ}$
- (c)  $-393.5\text{ kJ}$
- (d)  $+53.8\text{ kJ}$

**20. The enthalpy of reaction  $H_2 + I_2 \rightarrow 2HI$**

09205067

- (a)  $-571.6\text{ kJ}$
- (b)  $11\text{ kJ}$
- (c)  $-393.5\text{ kJ}$
- (d)  $+53.8\text{ kJ}$

### **Exothermic and Endothermic Reaction**

**21. If the  $\Delta H$  value is negative then reaction will be:**

09205068

- (a) Exothermic
- (b) Endothermic
- (c) May or may not be Exothermic or Endothermic

(d) None of these

**22. If  $\Delta H^\circ$  is positive then reaction will be:**

09205069

- (a) Exothermic
- (b) Endothermic
- (c) Both a & b
- (d) None of these

**23. Bond formation energy of one O-H bond is \_\_\_\_\_ :**

09205070

- (a)  $484\text{ kJ/mol}$
- (b)  $486\text{ kJ/mol}$
- (c)  $488\text{ kJ/mol}$
- (d) None

**24. Bond dissociation for  $H_2$  is:**

09205071

- (a)  $430\text{ KJ/mol}$
- (b)  $435\text{ KJ/mol}$
- (c)  $440\text{KJ/mol}$
- (d)  $445\text{mol}$

**25. Bond dissociation for  $O_2$  is:**

09205072

- (a)  $498\text{KJ/mol}$
- (b)  $505\text{KJ/mol}$
- (c)  $605\text{KJ/mol}$
- (d)  $705\text{KJ/mol}$

**26. Formation of NO is \_\_\_\_\_ :**

09205073

- (a) Endothermic
- (b) Exothermic
- (c) No heat change
- (d) None of These

### **How does a Reaction take place?**

**27. Activation energy of a chemical reaction must be \_\_\_\_\_ the average kinetic energy of reacting molecules.**

09205074

- (a) Lower than
- (b) greater than
- (c) equal to
- (d) None of these

**28. No reaction occurs if the energy of reacting particles \_\_\_\_\_ activation energy.**

09205075

- (a) Greater than
- (b) Lower than
- (c) Equal to
- (d) Nearest to

**29. Washing clothes at  $140^\circ\text{F}$  uses almost the energy as at  $140^\circ\text{F}$  wash:**

09205076

- (a) Half
- (b) Twice
- (c) Thrice
- (d) None of the above

30. \_\_\_\_\_ of the energy used by traditional electric bulb is wasted in producing heat:

- (a) 60% (b) 70%  
(c) 80% (d) 90%

### Aerobic and Anaerobic Respiration

31. Which is not produced in an aerobic respiration?

09205078

- (a) Carbon dioxide  
(b) Water  
(c) Energy  
(d) Lactic acid

32. \_\_\_\_\_ acts as reserve energy sources.

09205079

- (a) Vitamins (b) Proteins  
(c) Lipids (d) Enzyme

33. Which is released in anaerobic respiration?

09205080

- (a) Amino acid (b) Stearic acid  
(c) Citric acid (d) Lactic acid

34. Aerobic respiration releases \_\_\_\_\_ energy than anaerobic respiration.

09205081

- (a) Equal (b) less  
(c) more (d) None of these

35. \_\_\_\_\_ acts a catalyst promoting the breakdown of ozone.

09205082

- (a)  $Cl_2$  (b)  $Br_2$   
(c)  $I_2$  (d) None

36. During the glycolysis net ATP produced are:

09205083

- (a) 2 (b) 4  
(c) 6 (d) 8

### Answer Key

1	b	2	c	3	d	4	d	5	b
6	b	7	d	8	d	9	a	10	c
11	a	12	b	13	c	14	a	15	a
16	a	17	c	18	a	19	b	20	d
21	a	22	b	23	a	24	b	25	a
26	a	27	b	28	b	29	b	30	d
31	d	32	c	33	d	34	c	35	a
36	a								