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

$$N_2 + O_2 \longrightarrow 2NO$$

Data:

Bond dissociation energy of N_2 = 958.38 kJ/mol

Bond dissociation energy of O_2 = 498kJ/mol

Bond formation energy of NO = -626 kJ/mol

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

Total amount of energy released = 2 (– 626)
= –1252kJ/mol

Enthalpy change = 1456.38-1252
= 204.38kJ/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
Definition This form of energy is released when a bond is formed and absorbed when bond is broken. **System** It is not essential part of system **Process** Heat just enter and leave the object. **Measurement** It is measurement of thermal energy transferred between two objects at different temperature. **Representation** It is represented by 'q' **Unit** Its unit is Joule	**Definition** Enthalpy (H) or heat content, is defined as the total amount of thermal energy stored in a compound. **System** It is essential part of system **Process** Enthalpy change is equal to heat evolved or absorbed, at constant pressure. **Measurement** It is measurement of energy in thermodynamic system. **Representation** It is represented by 'H'. **Unit** Its unit is kJ/mol.

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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

$$2O_{(g)} + 4H_{(g)} \longrightarrow 2H_2O_{(g)} \qquad \Delta H = -1936\ KJ/mol$$

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 $968kJ/mol^{-1}$.

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

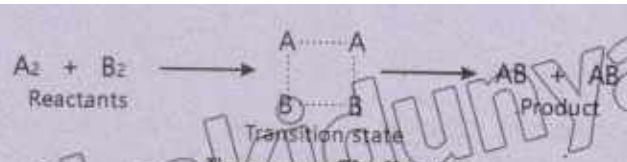
Energy absorbed by reactant or product molecule in order to be converted into transition state is called activation energy. It is represented by (Ea.)

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

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Energy profile diagram

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

$$\underset{C_6H_{12}O_6}{\text{Glucose}} \xrightarrow{\text{In cytoplasm}} 2\,\underset{C_3H_4O_3}{\text{Pyruvate}} + \text{Energy} \xrightarrow[\text{Mitochondria}]{O_2} 6CO_2 + 6H_2O + \text{Energy}$$

Investigative Questions

Q.1. (Ex. Q.5 (i)) 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.**

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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.

$$\underset{\text{Hydrogen}}{2H_{2(g)}} + \underset{\text{Oxygen}}{O_{2(g)}} \longrightarrow \underset{\text{Water}}{2H_2O_{(l)}} \quad \Delta H = -571.6\,KJ/mol$$

571.6 kJ heat energy is evolved during this reaction. If the energy evolved is shown separately it is expressed as $\Delta H = -571.6 KJ/mol$ 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 bums in oxygen gas.

$$\underset{\text{Carbon}}{C_{(s)}} + \underset{\text{Oxygen}}{O_{2(g)}} \longrightarrow \underset{\text{Carbon dioxide}}{CO_{2(g)}} \quad \Delta H = -393.5\,KJ/mol$$

It is also an exothermic reaction and 393.5KJ 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 $\Delta H = -393.51\,KJ/mol$ of CO_2.

Example of Endothermic Reaction:

1. The following reactions represent endothermic changes.

$$\underset{\text{Hydrogen}}{H_{2(g)}} + \underset{\text{Iodine}}{I_{2(s)}} \longrightarrow \underset{\text{Hydrogen Iodine}}{2HI_{(g)}} \quad \Delta H = +53.08\,KJ/mol$$

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

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

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

$$\underset{\text{Nitrogen}}{N_{2(g)}} + \underset{\text{oxygen}}{O_{2(g)}} \longrightarrow \underset{\text{Nitric Oxide}}{2NO_{(g)}} \quad \Delta H = +180.6\,KJ/mol$$

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

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.

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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_2 and O_2 first break to give their atoms.

$$2\,H_{2(g)} + O_{2(g)} \longrightarrow 2\,H_2O_{(g)}$$

$$\underset{\text{Molecule}}{2\,H_{2(g)}} \longrightarrow \underset{\text{Atoms}}{4H_{(g)}} \qquad \underset{\text{Molecule}}{O_{2(g)}} \longrightarrow \underset{\text{Atoms}}{2O_{(g)}}$$

These atoms of hydrogen then form bonds with oxygen atoms to form two molecules of gaseous H_2O.

$$4\,H_{(g)} + 2\,O_{(g)} \longrightarrow \text{H–Ö–H} \quad \text{H–Ö–H}$$

Breaking of bonds of H_2 and O_2 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.

$$2H_{2(g)} \longrightarrow 4H_{(g)} + 435\ kJ/mol \qquad \text{(Endothermic)}$$

$$O_2 \longrightarrow 2\,O + 498\ kJ/mol \qquad \text{(Endothermic)}$$

$$O + H \longrightarrow O - H - 484\ kJ/mol \qquad \text{(Exothermic)}$$

Since two moles of H_2 take part in the reaction so total energy absorbed in the reaction.

$$2\,H_{2(g)} \longrightarrow 4H + 870\ kJ/mol$$

$$O_{2(g)} \longrightarrow 2\,O_{(g)} + 498\ kJ/mol$$

$$2\,H_{2(g)} + O_{2(g)} \longrightarrow 4H_{(g)} + 2O_{(g)} + 1368\ kJ/mol$$

It means 1368 kJ energy is absorbed when 2 moles of H_2 and one mole of O_2 break their bonds to convert themselves into atoms.

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

$$2O_{(g)} + 4H_{(g)} \longrightarrow 2H_2O_{(g)} - 1936KJ/mol$$

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 $= -1936 + 1368 = -568kJ$ for two moles of water.

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$$2H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(g)} + 568\,kJ \quad \text{or} \quad \Delta H = -568\,kJ/mol$$

The enthalpy change for the formation of two moles of gaseous water is thus −658 kJ. So the enthalpy change for the formation of one mole of gaseous water will be

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

The experimental value of formation of gaseous water is −284 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
Definition This form of energy is released when a bond is formed and absorbed when it is broken.	**Definition** Enthalpy (H) or heat content, is defined as the total amount of thermal energy stored in a compound.
System It is not essential part of system	**System** It is essential part of system
Process Heat just enter and leave the object.	**Process** Enthalpy change is equal to heat evolved or absorbed, at constant pressure.
Measurement It is measurement of thermal energy transferred between two objects at different temperature.	**Measurement** It is measurement of energy in thermodynamic system.
Representation It is represented by 'q'	**Representation** It is represented by 'H'.
Unit Its unit is Joule (J)	**Unit** 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 kJ/mol.

Q.3 Depict the transition state for the following reaction. 09205013

Ans. $H_2 + Cl_2 \longrightarrow 2HCl$

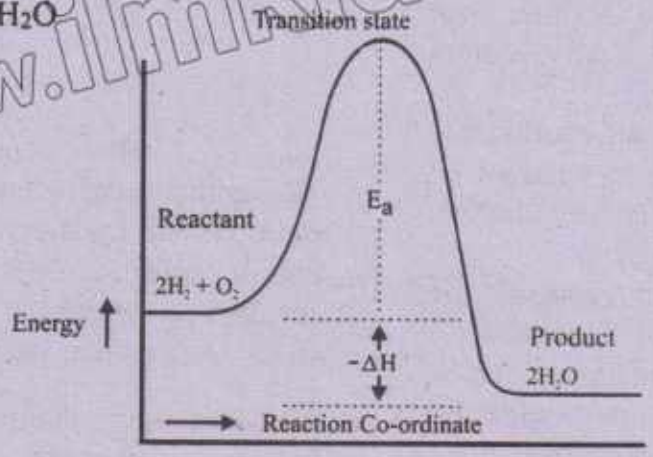
$$\begin{matrix} H-H \\ Cl-Cl \\ \text{Reactants} \end{matrix} \rightarrow \begin{matrix} H\cdots\cdots H \\ \vdots \quad\quad \vdots \\ Cl\cdots\cdots Cl \\ \text{Transition State} \end{matrix} \rightarrow \begin{matrix} HCl + HCl \\ \\ \text{Product} \end{matrix}$$

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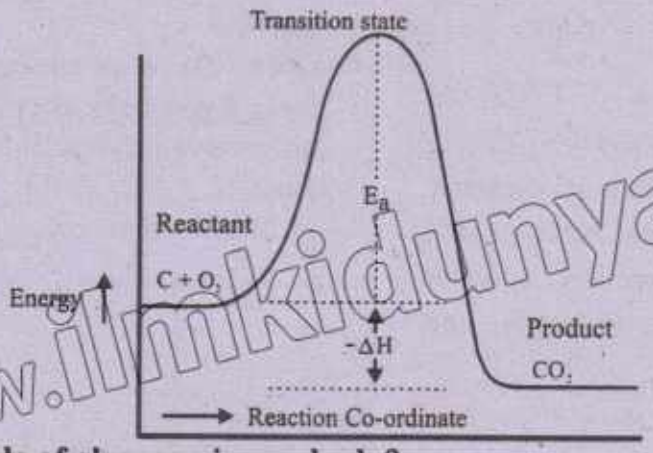
Q.4 Draw the reaction profiles for two exothermic reactions one of which moves faster than the other. 09205014

Ans.

i. $2H_2 + O_2 \longrightarrow 2H_2O$



ii. $C + O_2 \longrightarrow CO_2$



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 help 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 (ΔH).

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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.

$$\underset{\text{Hydrogen}}{2H_{2(g)}} + \underset{\text{Oxygen}}{O_{2(g)}} \longrightarrow \underset{\text{Water}}{2H_2O_{(l)}}$$

$$\Delta H = -571.6 KJ/mol$$

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.

$$2H_2O_{(l)} \longrightarrow 2H_{2(g)} + O_{2(g)} \quad \Delta H = -571.6 kJ/mol$$

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 :

$$2H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow 2H_2O_{(l)} \quad \Delta H = -284.6 kJ/mol$$

$$\Delta H = -571.6 kJ/mol$$

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

$$\Delta H = -284.6 kJ/mol$$

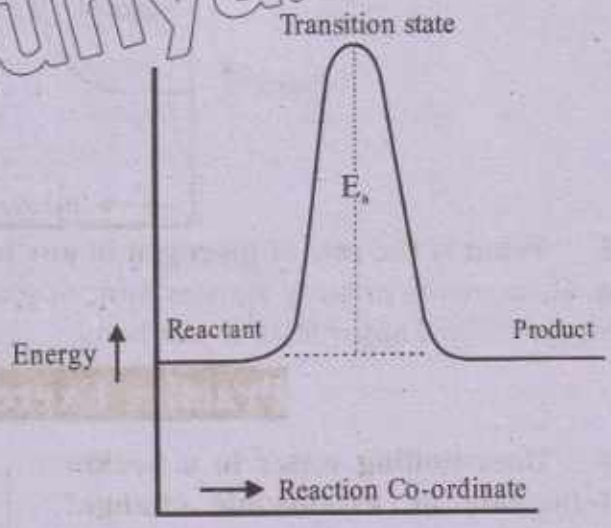
The enthalpy of elements in standard states H_2 and O_2 is zero. The enthalpy of liquid water is -284 kJ/mol under standard conditions

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.

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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? 09205030

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 ΔE and ΔH? 09205031

Ans.

ΔE	ΔH
• ΔE is the change in internal energy.	• ΔH is the enthalpy change.
• It is equal to heat absorbed by the system at constant volume.	It is equal to the heat of reaction at constant pressure.
$\Delta E = q_v$	$\Delta H = q_p$
• It is equal to sum of heat and work.	It is equal to sum of internal energy and product of pressure volume work.
• $\Delta E = q + w$	$\Delta H = \Delta E + P\Delta V$

Q.22 Define standard enthalpy of reaction. 09205032

Ans. Standard enthalpy of reaction (ΔH^0)

i. "Amount of heat evolved or absorbed when one mole of reactants are converted into products under standard condition (25^0C *and* $1\ atm$) in a chemical reaction"

ii. It is represented by (ΔH^0)

iii. It's sign is positive for endothermic reaction and negative for exothermic reaction.

Reactants and products should be taken in standard physical state.

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)} \quad \Delta H^0 = -393.5kJ(exothermic)$

$H_{2(g)} + I_{2(s)} \longrightarrow 2HI_{(g)} \quad \Delta H^0 = +53.8kJ(endothermic)$

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.

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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 ΔH^0.

i. $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$

$\Delta H^0 = -393.5\ kJ$

ii. $H_{2(g)} + I_{2(g)} \rightarrow 2HI_{(g)}$

$\Delta H^0 = +53.8\ kJ$

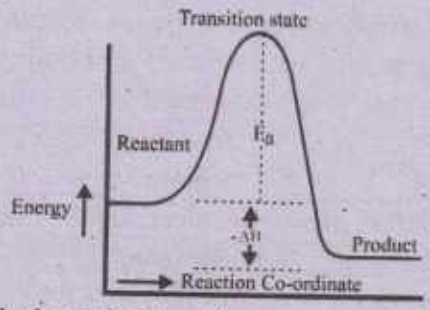
Exothermic or Endothermic reactions

Q.24 How atmospheric N_2 and O_2 can react with each other? 09205034

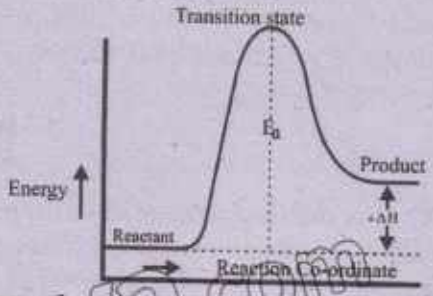
Ans. Nitrogen of the atmosphere reacts with oxygen to produce nitrogen oxide (NO) only in the presence of lightening. This is because reaction is highly endothermic, so only lightening can provide enough energy for this reaction to take place.

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

Ans. (i) Exothermic Reaction



(ii) Endothermic Reaction



Q.26 Define exothermic and endothermic reactions. 09205036

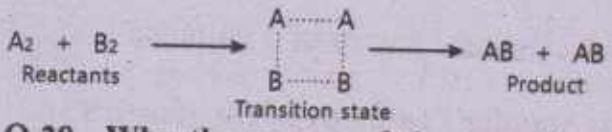
Ans.:

Exothermic Reactions	Endothermic Reactions
A chemical reaction that proceeds with the evolution of heat is called an exothermic reaction. i. $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta H^0 = -393.5kJ$ ii. $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$ $\Delta H^0 = -571.6kJ$	A chemical reaction that proceeds with the absorption of heat is called an endothermic reation. i. $H_{2(g)} + I_{2(g)} \rightarrow 2HI_{(g)}$ $\Delta H^0 = +53.8kJ$ ii. $N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$ $\Delta H^0 = +180.6kJ$

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 colloide 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.

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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.

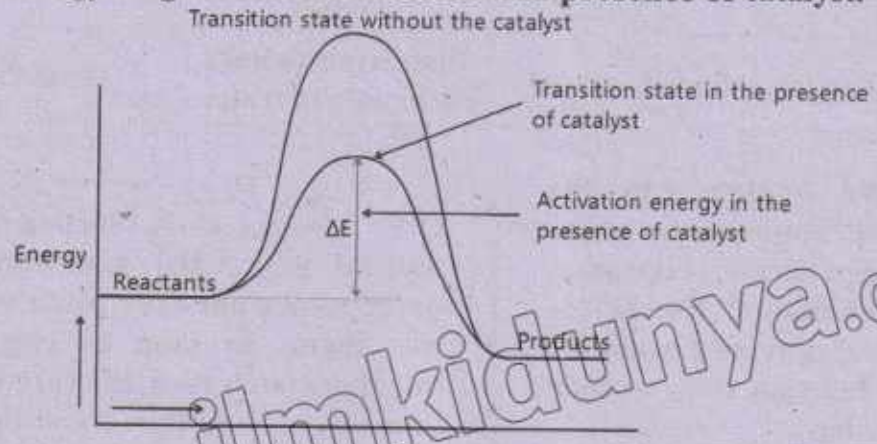
Q.30 Define Catalyst with an example. 09205040

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

Example:

i. Nickel (Ni) acts as a catalyst in the hydrogenation of oil to give banaspati ghee.
ii. Platinum (Pt) acts as a catalyst in the production of H_2SO_4.
iii. 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 $\xrightarrow{\text{Enzymes}}$ 2 Pyruvate $\xrightarrow{O_2}$ $6CO_2 + 6H_2O$ + Energy	Glucose $\xrightarrow{\text{Enzymes}}$ 2 Pyruvate $\xrightarrow{\text{Absence of oxygen}}$ $C_2H_5OH + CO_2$ + 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.

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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.

$$N_{2(g)} + O_{2(g)} \longrightarrow 2NO_{(g)}$$

Q.3 (Ex. Q.3 (iii)) A reaction between natural gas (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

$$H_2 + Cl_2 \xrightarrow{\text{Sunlight}} 2HCl$$

From where does the energy come to break the bond of H_2 and 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) $H_{2(g)} + 1/2\ O_{2(g)} \longrightarrow H_2O_{(g)}$

(b) $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$

(c) $NaCl_{(aq)} + AgNO_{3(aq)} \longrightarrow AgCl_{(s)} + NaNO_3$

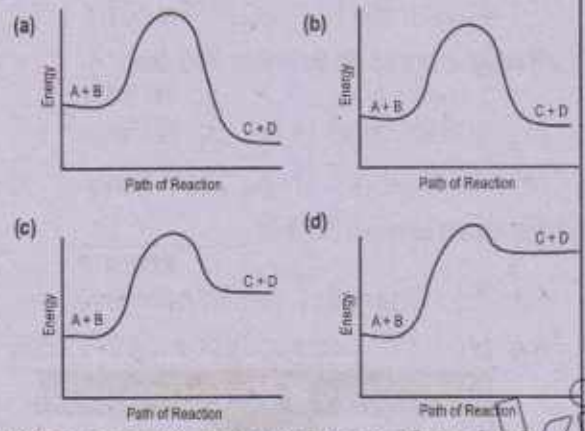
(d) $H_{2(g)} + I_{2(s)} \longrightarrow 2HI_{(g)}$

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3. **Formation of which hydrogen halide from the elements is an endothermic reaction?** 09205050
(a) HCl (b) HF
(c) HBr (d) HI

4. **What are the products of anaerobic respiration?** 09205051
(a) ATP + CO_2 + H_2O
(b) CO_2 + H_2O
(c) ATP + Ethanol + H_2O
(d) Ethanol + CO_2+ energy

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 $kJ\ mol^{-1}$. Which of the following process will have enthalpy change close to 412 $kJ\ mol^{-1}$.** 09205055
(a) $CH_{4(g)} \rightarrow C_{(g)} + 2H_{2(g)}$
(b) $CH_{4(g)} \rightarrow C_{(g)} + H_{2(g)}$
(c) $CH_{4(g)} \rightarrow C_{(g)} + 4H_{2(g)}$
(d) $CH_4 \rightarrow CH_{3(g)} + H_{(g)}$

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

$$H-O-O-H_{(g)} \longrightarrow H-O-H_{(g)} + \frac{1}{2}O=O_{(g)}$$

(a) - 102kJ (b) + 102kJ
(c) + 3505kJ (d) + 394kJ

10. **Why does the following exothermic reaction not occur?** $C_{(Diamond)} \longrightarrow C_{(Graphite)}$ ΔH=-3kJ/mol 09205057
(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:** 09205058
(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

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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 1st 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) $-571.6\ kJ$ (b) $-110.5\ kJ$
(c) $-393.5\ kJ$ (d) $+53.8\ kJ$

18. **The enthalpy of reaction $2H_2 + O_2 \rightarrow 2H_2O$** 09205065
(a) $-571.6\ kJ$ (b) $-110.5\ kJ$
(c) $-393.5\ kJ$ (d) $+53.8\ kJ$

19. **The enthalpy of reaction $C + \frac{1}{2}O_2 \rightarrow CO$** 09205066
(a) $-571.6\ kJ$ (b) $-110.5\ kJ$
(c) $-393.5\ kJ$ (d) $+53.8\ kJ$

20. **The enthalpy of reaction $H_2 + I_2 \rightarrow 2HI$** 09205067
(a) $-571.6\ kJ$ (b) $11\ kJ$
(c) $-393.5\ kJ$ (d) $+53.8\ kJ$

Exothermic and Endothermic Reaction

21. **If the ΔH 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 ΔH^0 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 kJ/mol (b) 486 kJ/mol
(c) 488 kJ/mol (d) None

24. **Bond dissociation for H_2 is:** 09205071
(a) 430 KJ/mol (b) 435 KJ/mol
(c) 440KJ/mol (d) 445mol l

25. **Bond dissociation for O_2 is:** 09205072
(a) 498KJ/mol (b) 505KJ/mol
(c) 605KJ/mol (d) 705KJ/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°F uses almost the energy as at 140°F wash:** 09205076
(a) Half
(b) Twice
(c) Thrice
(d) None of the above

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30. _____ of the energy used by traditional electric bulb is wasted in producing heat: 09205077
(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								

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