



Objective

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- When was ATP discovered?
 (A) 1929 A.D (B) 1939 A.D (C) 1915 A.D (D) 1902 A.D
- The Covalent bond connecting two phosphates is indicated by the symbol:
 (A) Proportion (B) Colon (C) Tilde (D) Ratio
- Fritz Lipmann was awarded noble prize in:
 (A) 1981 (B) 1941 (C) 1947 (D) 1927
- Nitrogenous base of ATP molecule is:
 (A) cytocine (B) adenine (C) thiamine (D) guanine
- Number of phosphate groups in ATP molecule:
 (A) 3 (B) 2 (C) 1 (D) 4
- The example of a nucleotide is:
 (A) DTP (B) AMP (C) ADP (D) ATP
- ATP is an example of:
 (A) Fatty acid (B) Nucleic acid (C) Nucleotide (D) Amino acid
- In Ribose sugar number of carbon atoms is:
 (A) 6 (B) 5 (C) 4 (D) 2
- From which bonds of ATP molecules energy is taken?
 (A) C–O bonds (B) P–P bonds (C) C–H bonds (D) C–N bonds
- One mole of ATP release energy:
 (A) 7.3 k cal (B) 6.3 k cal (C) 5.3 k cal (D) 4.3 k cal
- The loss of electron from atom is called:
 (A) Anabolism (B) Catabolism (C) Reduction (D) Oxidation
- The energy currency of all cells is:
 (A) ADP (B) glucose (C) ATP (D) protein
- Food contains energy in its bonds:
 (A) Solar (B) Heat (C) Kinetic (D) Potential
- Each ATP molecule has the number of sub-units:
 (A) 4 (B) 1 (C) 2 (D) 3
- ATP molecule was discovered by:
 (A) Calvin (B) Hamann (C) Karl Lohmann (D) Lipman
- Raw Material for Photosynthesis is:
 (A) Water, CO₂ (B) H₂O₂, O₂ (C) CO₂, O₂ (D) Glucose

17. Stomata cover the leaf surface:
 (A) 1 – 5% (B) 1 – 4% (C) 1 – 3% (D) 1 – 2%
18. Light of which colour is more effective in photosynthesis?
 (A) Blue and Green (B) Yellow and Blue (C) Blue and Red (D) Green and Red
19. Sun light is absorbed by:
 (A) Leaves (B) Chlorophyll (C) Stem (D) Flower
20. The main photosynthetic pigment is:
 (A) Chlorophyll–a (B) Chlorophyll–b (C) Chlorophyll–ab (D) Carotenoids
21. Temperature that causes closure of stomata:
 (A) 30 °C – 35 °C (B) 20 °C – 25 °C (C) 40 °C – 45 °C (D) 10 °C – 15 °C
22. Byproduct of photosynthesis is:
 (A) CO (B) O₂ (C) CO₂ (D) N₂ 
23. Chlorophyll absorbs type of light basically.
 (A) Blue and red (B) Red and green (C) Red and yellow (D) Green and blue
24. In which process oxygen is released as a byproduct?
 (A) reproduction (B) fermentation (C) respiration (D) photosynthesis
25. In which part of the leaf cells Chlorophyll is found:
 (A) Plasma Membrane (B) Stroma (C) Cytoplasm (D) Thylakoid
26. Calvin got nobel prize in:
 (A) 1991 (B) 1981 (C) 1961 (D) 1951
27. The whole series of Light Reactions is called:
 (A) L–Scheme (B) L–Scheme (C) Z–Scheme (D) All of these
28. Dark reactions take place in:
 (A) Mitochondria (B) Stroma (C) Thylakoid (D) Cytosole
29. Compounds produced during light reactions are:
 (A) NADPH, ATP (B) C₆H₁₂O₆ (C) C₁₂H₂₂O₁₂ (D) FADH
30. Dark Reactions are part of:
 (A) Necrosis (B) Metastasis (C) Respiration (D) Photosynthesis
31. Another name for the dark reaction of Photosynthesis is:
 (A) Water cycle (B) Nitrogen cycle (C) Carbon cycle (D) Calvin cycle
32. In which part of chloroplast, light reactions of photosynthesis take place?
 (A) Thylakoid membranes (B) Fatty acids and glycerol's
 (C) Inner membrane (D) Outer membrane
33. Dark Reactions were studied by:
 (A) Robert Brown (B) Malvin Calvin (C) Schleiden (D) Schwann

34. Which step of cellular respiration occurs in cytoplasm?
 (A) Glycolysis (B) Lactic acid fermentation
 (C) Electron transport chain (D) Krebs cycle
35. The greatest fuel of energy for cellular respiration is:
 (A) Protein (B) Glucose (C) Lipids (D) Amino acid
36. The sites of aerobic respiration in cell are:
 (A) Mitochondria (B) Golgi bodies (C) Ribosomes (D) Plastids
37. Chemical Formula of lactic acid is:
 (A) C_2H_5OH (B) C_2H_2OH (C) $C_6H_{12}O_6$ (D) $C_3H_6O_3$
38. Chemical Formula of ethyl Alcohol is:
 (A) $C_6H_{12}O_6$ (B) CH_3OH (C) D_2O (D) C_2H_5OH
39. The example of three carbon molecule is:
 (A) Starch (B) Ribose (C) Pyruvic acid (D) Glucose
40. Glycolysis takes place in:
 (A) Ribosomes (B) Cytoplasm (C) Mitochondria (D) Nucleus
41. Which of these can enter into Krebs cycle?
 (A) Citric Acid (B) Glucose (C) Acetyl-CoA (D) Pyruvic acid (3C)
42. In which stage of respiration carbon dioxide gas is produced?
 (A) Electron transport chain (B) Krebs cycle (C) Glycolysis (D) Both B & C
43. Nicotinamide adenine dinucleotide is a:
 (A) Co-Enzyme (B) Enzyme (C) Co-Factor (D) Factor
44. How many ATP molecules are formed during cellular respiration?
 (A) 24 (B) 28 (C) 32 (D) 36 
45. During anaerobic oxidation of glucose molecule, ATP molecules are gained as net profit:
 (A) 8 (B) 6 (C) 2 (D) 1
46. Each $FADH_2$ produces ATP:
 (A) 8 (B) 2 (C) 6 (D) 4
47. Through which process organisms get energy?
 (A) Transpiration (B) Evaporation (C) Respiration (D) Photosynthesis
48. In glycolysis, glucose (6C) molecule is broken into two molecules of:
 (A) Pyruvic acid (3C) (B) Acetyl-CoA (C) $FADH_2$ (D) NADH
49. How many molecules of CO_2 are produced when Krebs cycle operates once?
 (A) 6 (B) 5 (C) 3 (D) 2
50. Which is the final step of cellular respiration?
 (A) Electron transport chain (B) Glycolysis (C) fermentation (D) Krebs cycle

Subjective

Q1: **What is meant by bioenergetics?**

Ans: Bioenergetics:

Bioenergetics is the study of energy relationships and energy transformations (conversions) in living organisms.

Q2: **What is role of bioenergetics and ATP?**

Ans: Bioenergetics:

Bioenergetics is the study of energy relationships and energy transformations (conversions) in living organisms.

Role of ATP:

Organisms obtain energy by metabolizing the food they eat or prepare. Food contains energy in its bonds. When these bonds are broken down, a large amount of kinetic energy is release.

Some of this energy is stored in the form of potential energy in the bonds of ATP molecules while the rest escapes as heat. The potential energy stored in ATP is again transformed into kinetic energy to carry out the life activities

Q3: **How much forms of energy in living organisms exist?**

Ans: In living organisms energy exists in two forms: Kinetic energy is actively involved in doing work and Potential energy is stored for future use. The potential energy is stored in chemical bonds and is released as kinetic energy when these bonds break.

Q4: **Explain with an example that electrons can be a source of energy release.**

Ans: When electrons are present in oxygen, they make stable association with oxygen atom and are not good energy source. But if electrons are dragged away from oxygen and attached to some other atom e.g. carbon or hydrogen, they make unstable association.

They try to move back to oxygen and when this happens, energy is released. In this way, electrons act as energy source.

Q5: **What is difference between oxidation and reduction?**

Ans: The difference between oxidation and reduction is:

Oxidation	Reduction
➤ Addition of oxygen removal of hydrogen or the loss of electrons is called oxidation.	➤ Addition of hydrogen, removal of oxygen or the gain of electrons is called reduction.
➤ Oxidation is energy yielding process.	➤ Reduction is energy consuming process.

Q6: **Why oxidation reduction reactions are called redox reactions?**

Ans: In oxidation reduction reactions exchange of electrons occur simultaneously so these reactions are also called redox reaction.

Q7: **What is meant by redox reactions?**

Ans: Redox reactions:

Like always the oxidation reduction reactions run simultaneously and they are often called the Redox reactions.

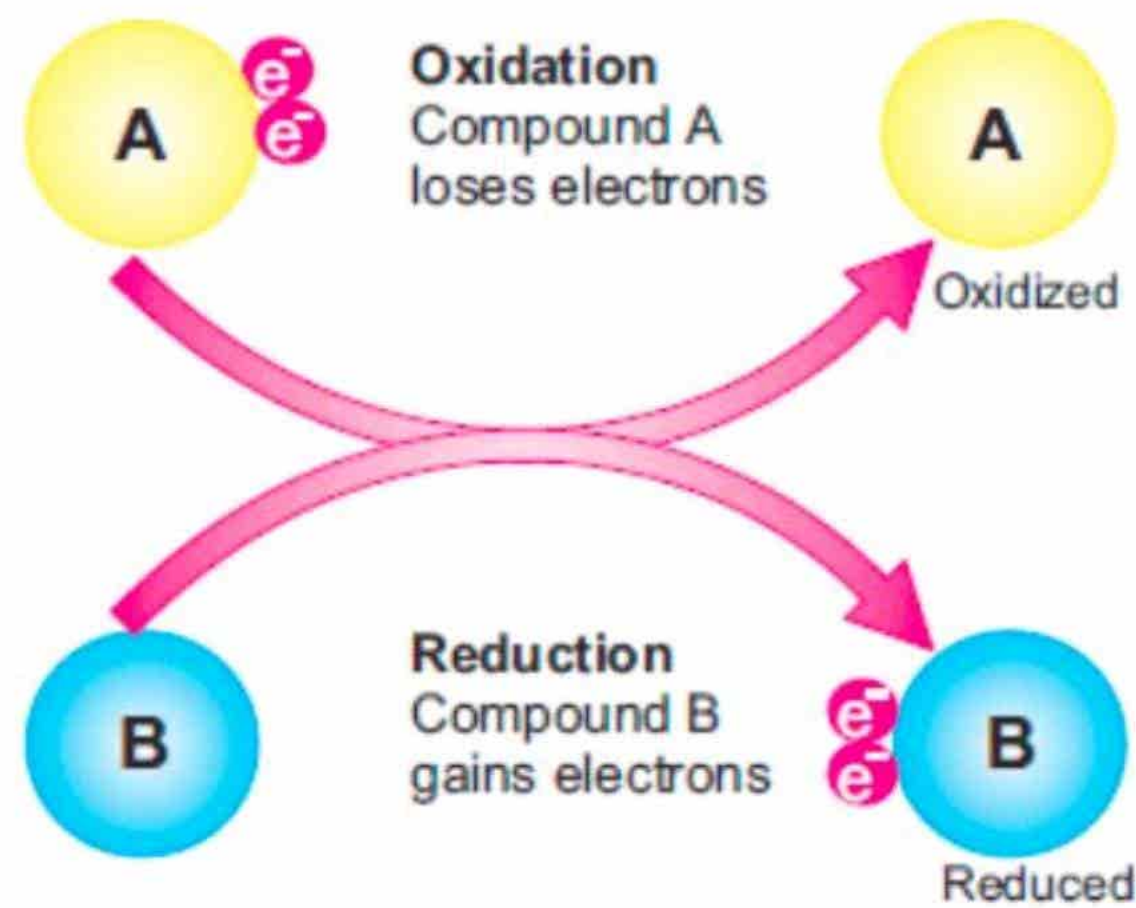


Figure : Redox reactions

Q8: **Define two types of energy in living organisms.**

Ans: Energy exists in two forms in living organisms:

- Kinetic energy
- Potential Energy

Kinetic energy:

It is actively involved in doing work.

Potential Energy:

The potential energy is stored in chemical bonds. It is used for future use. It is released as kinetic energy when these bonds break.

Q9: **Define ATP. Write its function in cell.**

Ans: The major energy currency of all cells is a nucleotide called ATP (Adenosine triphosphate).

ATP is the main energy source for majority of the cellular functions like:

- Movement
- Transmission of nerve impulses
- Active transport
- Exocytosis and Endocytosis
- Synthesis of macromolecules (DNA, RNA, proteins)

Q10: **Why ATP is called the cell's energy currency?**

Ans: When cells use energy to build ATP from ADP, or ADP from AMP, they are really storing energy as we store money in a bank. Because ATP plays a central role in all living organisms it must have appeared in the early history of life.

Q11: **What is NADP+?**

Ans: NADP+:

Nicotinamide Adenine Dinucleotide (NAD⁺) is a coenzyme that takes electrons and hydrogen ions and is thus reduced to NADH. One form of this enzyme also carries phosphate with it, so is called NADP⁺.

Q12: **Define Osmosis.**

Ans: Osmosis:

Osmosis is the movement of water from a dilute solution to a concentrated one through a membrane.

Q13: **How much area is covered by stomata?**

Ans: Stomata cover only 1-2% of the leaf surface but they allow much gas to diffuse through them.

Q14: **Who discovered ATP and when he was awarded Nobel Prize?**

Ans: ATP was discovered by Karl Lohmann in 1929. It was proposed to be the main energy transfer molecule in the cell by Nobel Prize winner, Fritz Lipmann in 1941.

Q15: **ATP stands for what? Write names of sub units of ATP.**

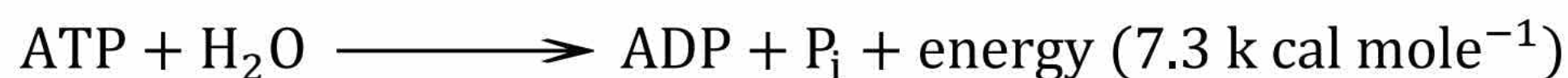
Ans: ATP stands for Adenosine Triphosphate.

Each ATP has three subunits:

- **Adenine** a double ringed nitrogenous base.
- **Ribose** a five-carbon sugar.
- **Three phosphate groups** in a linear chain.

Q16: **How much energy is released from one mole of ATP?**

Ans: The breaking of one phosphate bond releases about 7.3 k cal (7300 calories) per mole of ATP.



Q17: **Show the diagram and structure of ATP.**

Ans:

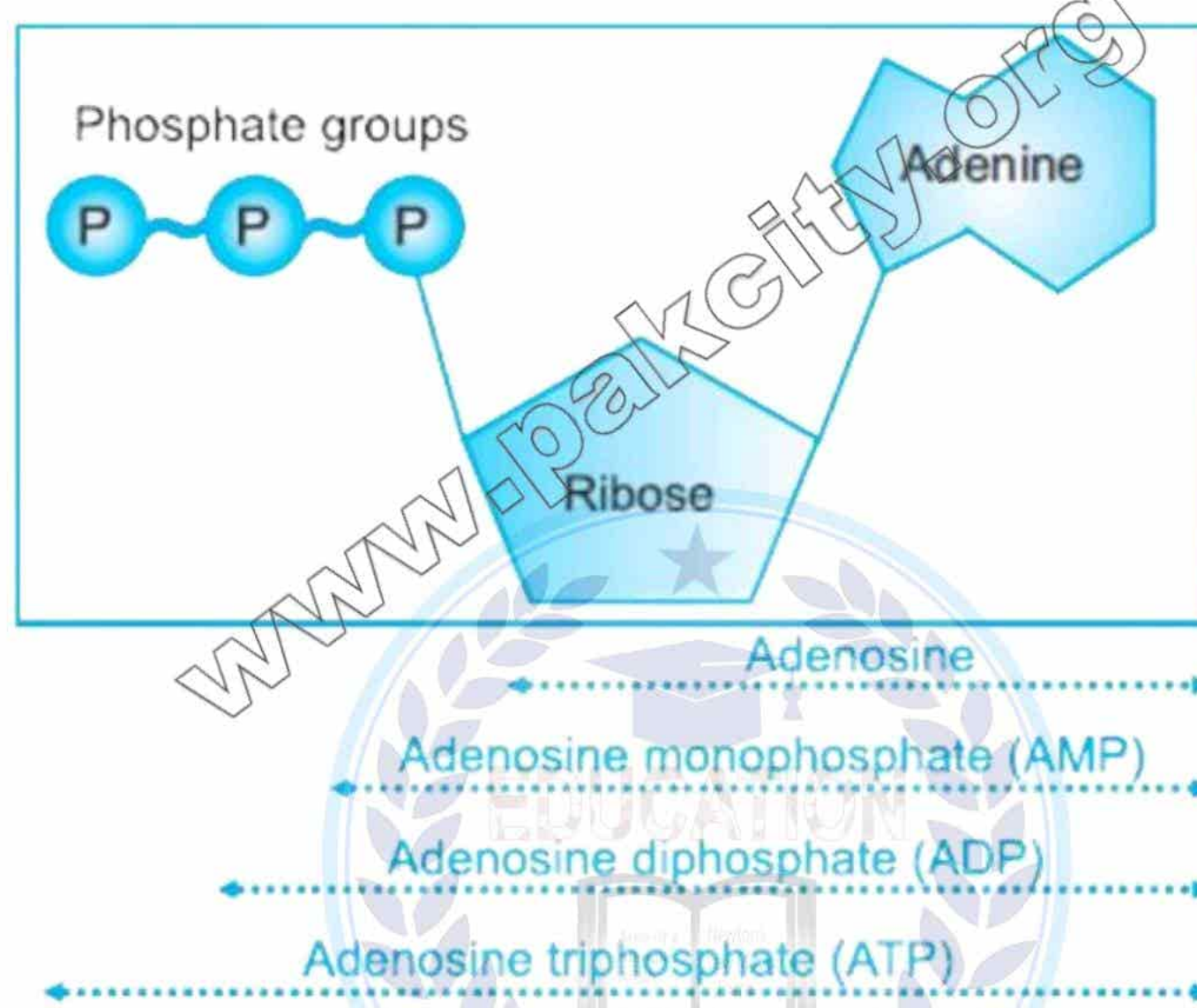


Figure : Molecular structure of ATP

Q18: **Give the names of any four cellular functions in which ATP is source of energy.**

Ans: Majority of the cellular functions are carried out due to ATP like the synthesis of macromolecules (DNA, RNA, Proteins), movement, transmission of nerve impulses, active transport, exocytosis and endocytosis etc.

Q19: **What is meant by photolysis?**

Ans: Light breaks water molecule and oxygen is released. This reaction is called photolysis. The hydrogen atoms of water give electrons to chlorophyll and become ions.

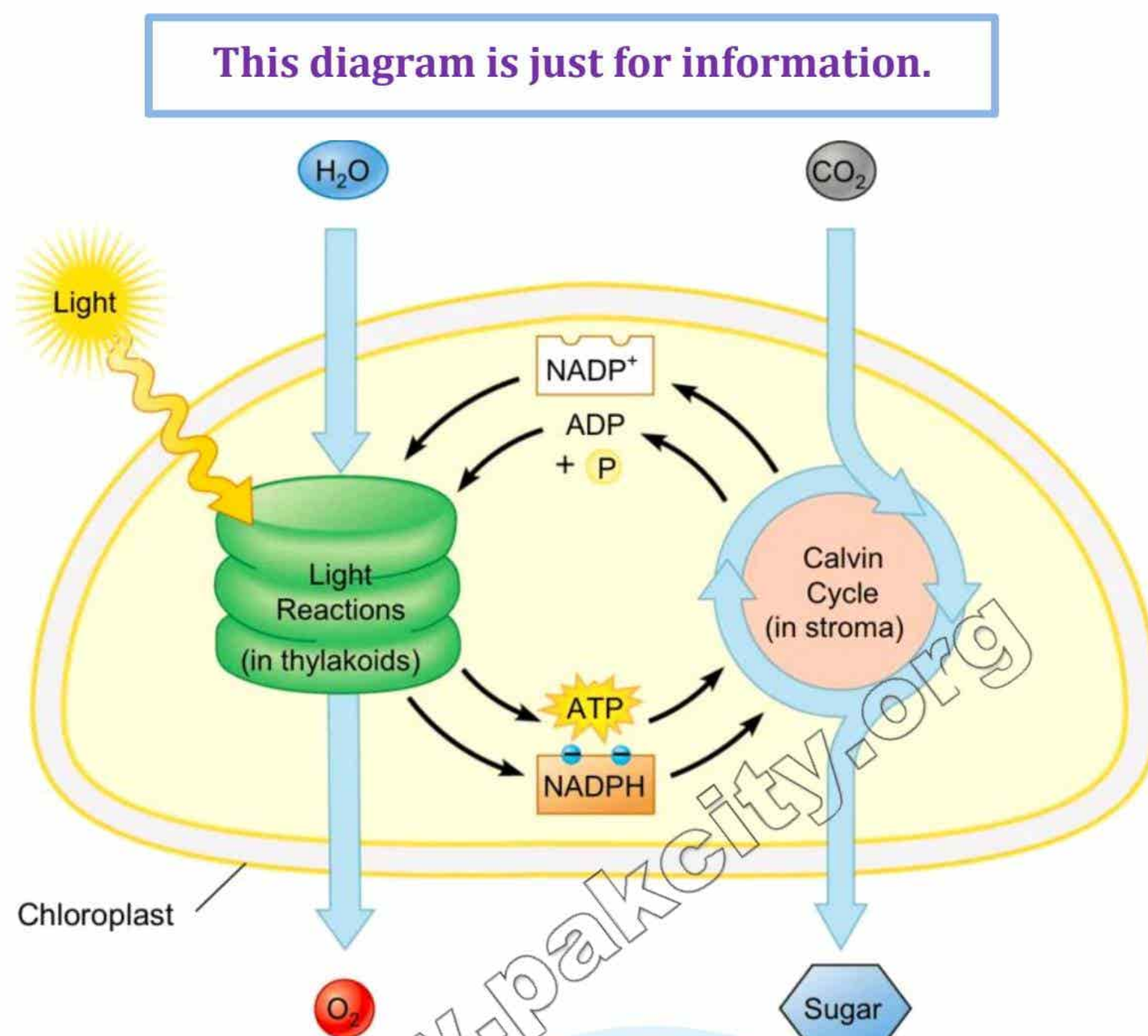
Q20: **Why and when Calvin was awarded Nobel Prize?**

Ans: The details of dark reactions were discovered by Melvin Calvin and his colleagues at the University of California. Calvin was awarded Nobel Prize, in 1961.

Q21: **What is difference between light reactions and dark reactions?**

Ans: The difference between light reactions and dark reactions is:

Light reactions	Dark reactions
<ul style="list-style-type: none"> ➤ In first phase of photosynthesis, light energy is captured and is used to make high energy molecules (ATP and NADPH). ➤ These take place on thylakoid membranes of chloroplast. ➤ Since these reactions require light energy so they are known as light reactions. 	<ul style="list-style-type: none"> ➤ In second phase of photosynthesis carbon dioxide is reduced to make glucose. In this phase energy from high energy molecules (ATP and NADPH) is utilized. ➤ It takes place in the stroma of chloroplasts. ➤ Since these reactions do not use light directly, they are known as dark reactions.

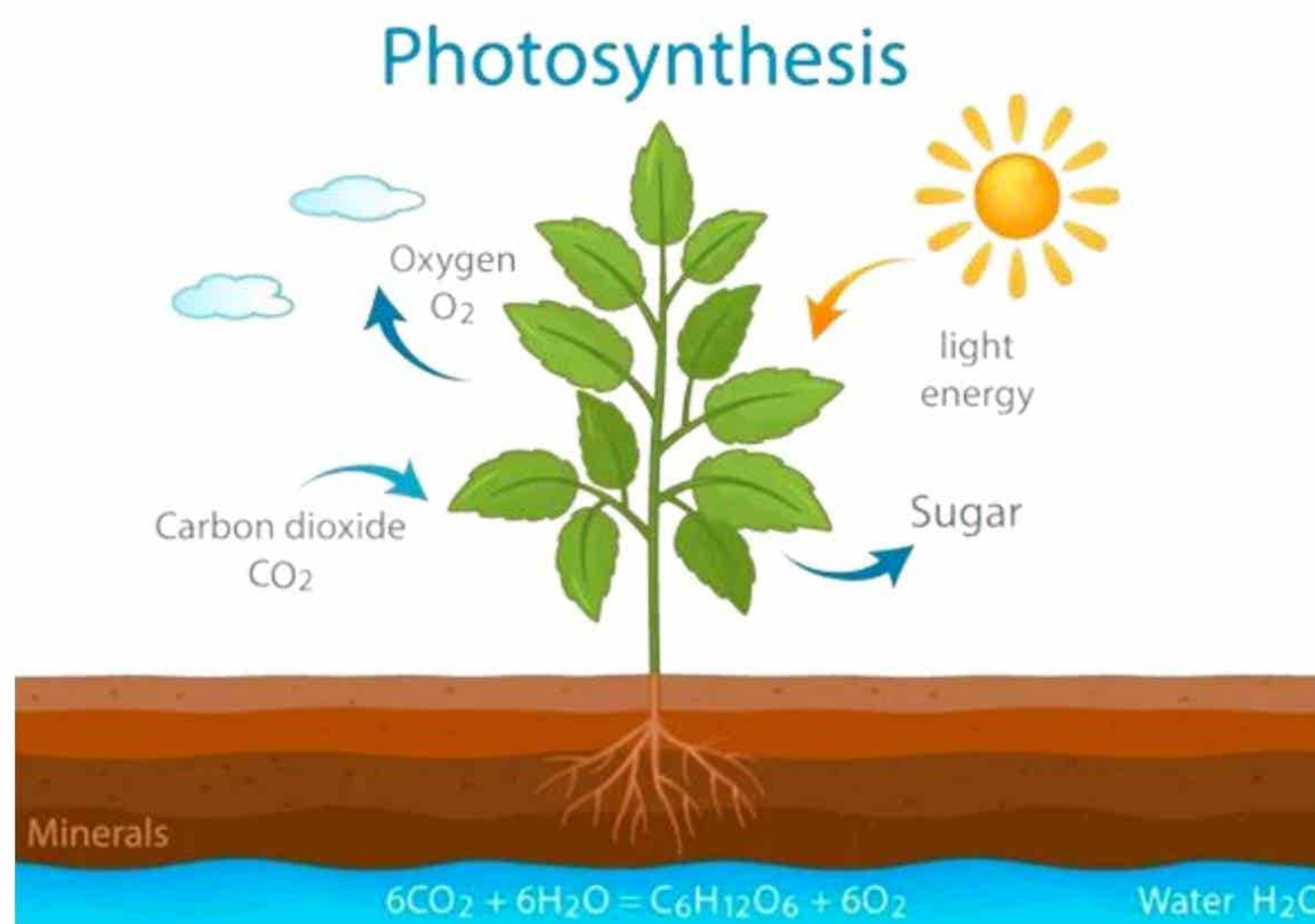


Q22: What is photosynthesis? Write its chemical equation.

Ans: The process by which plants and some other autotrophic organisms prepare their food (glucose) in the presence of sunlight and chlorophyll, with oxygen as a byproduct is called photosynthesis.

Chemical Equation:

The chemical equation of photosynthesis is as follows:



Q23: Write down two necessary conditions for photosynthesis.

Ans: For photosynthesis carbon dioxide, water, chlorophyll and sun light are necessary.

Q24: **What is the role of light in photosynthesis?**

Ans: Sunlight is absorbed by chlorophyll. It is then converted into chemical energy which drives the photosynthetic process. The blue and red lights carry out more photosynthesis which is absorbed by pigments.

Q25: **State the importance of chlorophyll and pigments in photosynthesis.**

Ans: Sunlight is absorbed by chlorophyll. It is then converted into chemical energy which drives the photosynthetic process. The light rays of different wavelengths are not only differently absorbed by photosynthetic pigments but are also differently effective in photosynthesis.

The blue and red lights carry out more photosynthesis which is absorbed by pigments. There are two types of photosynthetic pigments which are called main and accessory pigments.

Q26: **What are pigments and write down their colours in chlorophyll?**

Ans: Pigments are the coloured substances that absorb visible light. Different pigments absorb light of different wavelengths. Chlorophyll-a, chlorophyll-b and carotenes are pigments effective for photosynthesis.

Lights of different colours are absorbed by these pigments.



Q27: **What is meant by photo systems?**

Ans: The photosynthetic pigments are organized in the form of clusters, called photosystems, in thylakoid membranes of chloroplasts.

Q28: **Write about accessory pigments with examples.**

Ans: In thylakoid membranes of chloroplasts additional pigments like chlorophyll-b and carotenoids are also present. These are called accessory pigments. Some wavelengths not absorbed by chlorophyll-a are very effectively absorbed by accessory pigments and vice versa.

Q29: **Define Limiting Factor and name the limiting factors in Photosynthesis.**

Ans: Any environmental factor the absence or deficiency of which can decrease the rate of a metabolic reaction is called limiting factor.

Many factors like light intensity, temperature, concentration of CO₂ and availability of water act as limiting factors for photosynthesis.

Q30: **What is the effect of CO₂ concentration on Photosynthesis?**

Ans: Carbon dioxide concentration raises the rate of photosynthesis. It goes on increasing until limited by others factors. Increase in CO₂ concentration beyond a certain level causes the closure of stomata and it decreases the rate of photosynthesis.

Q31: **What is effect of light intensity and temperature on the rate of photosynthesis?**

Ans: Effect of light intensity:

The rate of photosynthesis varies with light intensity. It decreases with the decrease in light intensity. At much higher light intensity the rate of photosynthesis becomes constant.

Effect of Temperature:

The rate of photosynthesis decreases with decrease in temperature. It increases as the temperature is increased over a limited range. If light intensity is low increasing the temperature has little influence on the rate of photosynthesis.

Q32: What is the arrangement of stomata in terrestrial and aquatic plants?

Ans: Terrestrial plants have more stomata in lower epidermis of leaves while aquatic plants (which have exposed leaves) have more stomata in the upper epidermis.

Q33: How in non-vascular plants water and salts reach the mesophyll cells of leaves?

Ans: In non-vascular plants water and salts reach the mesophyll cells of leaves by the phenomena of osmosis, diffusion etc.

Q34: What is lactic acid fermentation?

Ans: Lactic acid fermentation occurs in skeletal muscles of humans and other animals during extreme physical activities. This also happens in the bacteria present in milk.

In this type of fermentation each pyruvic acid molecule is converted into lactic acid (C₃H₆O₃).

Q35: Explain alcoholic Fermentation with the help of equation.

Ans: It occurs in bacteria and yeast. In this type of anaerobic respiration, pyruvic acid is broken down into alcohol (C₂H₃OH) and CO₂.



Q36: How is soy sauce formed?

Ans: Soya sauce is made by the fermentation by a fungus Aspergillus.

Q37: What is significance of anaerobic respiration (fermentation)?



Ans: The significance of anaerobic respiration (fermentation) is:

Some existing bacteria and fungi live in oxygen free environment respire anaerobically and called anaerobes.

In some active tissues like skeletal muscles during exercise when oxygen supply cannot keep pace with energy demand so anaerobic respiration provides energy by break down of glucose into lactic acid.

Q38: Define Fermentation. Name its two types.

Ans: Some organisms oxidize their food incompletely without using any molecular oxygen called anaerobic respiration or fermentation.

Types of anaerobic respiration (fermentation)

Anaerobic respiration is further classified as:

- *Lactic acid fermentation*
- *Alcoholic fermentation*

Q39: Write the uses of Fermentation in Yeast.

Ans: Fermentation of yeast is used in brewing and baking industries.

Q40: Write the name of products of aerobic and anaerobic respiration.

Ans: Products of aerobic respiration are carbon dioxide and water while Products of anaerobic respiration are ethyl alcohol, carbon dioxide and lactic acid.

Q41: Define aerobic and anaerobic respiration. Write chemical equations also.

Ans: Aerobic respiration:

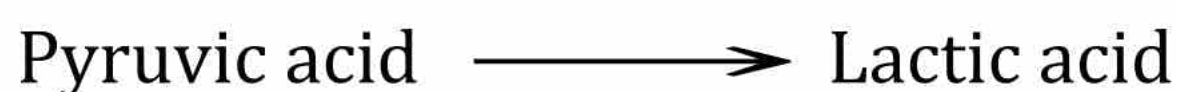
It is that type of respiration in which complete oxidation of glucose occurs with maximum release of energy in the presence of oxygen.





Anaerobic respiration:

Some organisms oxidize their food incompletely without using any molecular oxygen called anaerobic respiration. Glucose is incompletely oxidized with less amount of energy release.



Q42: What is glycolysis? Where does this reaction occur?

Ans: It is a process in which glucose molecule is broken down into two molecules of pyruvic acids (3C). Glycolysis occurs in cytoplasm and oxygen is not involved at this stage so it occurs both in aerobic and anaerobic respiration.

Q43: Write down names of two compounds produced during aerobic respiration.

Ans: Carbon dioxide and water are produced during aerobic respiration. Besides this energy are also released.

Q44: What are the uses of respiration energy in living organisms?

Ans: The energy obtained from respiration is used for various life processes like growth, movement and reproduction etc.

Q45: What is meant by Z-Scheme?

Ans: The whole series of light reactions is called Z-scheme due to its Z-shaped form.

Q46: Give the full name of F.A.D and N.A.D.

Ans: F.A.D:

Flavin Adenine Dinucleotide (FAD) is also a coenzyme like NAD^+ it gets two hydrogen and reduces to FADH_2 .

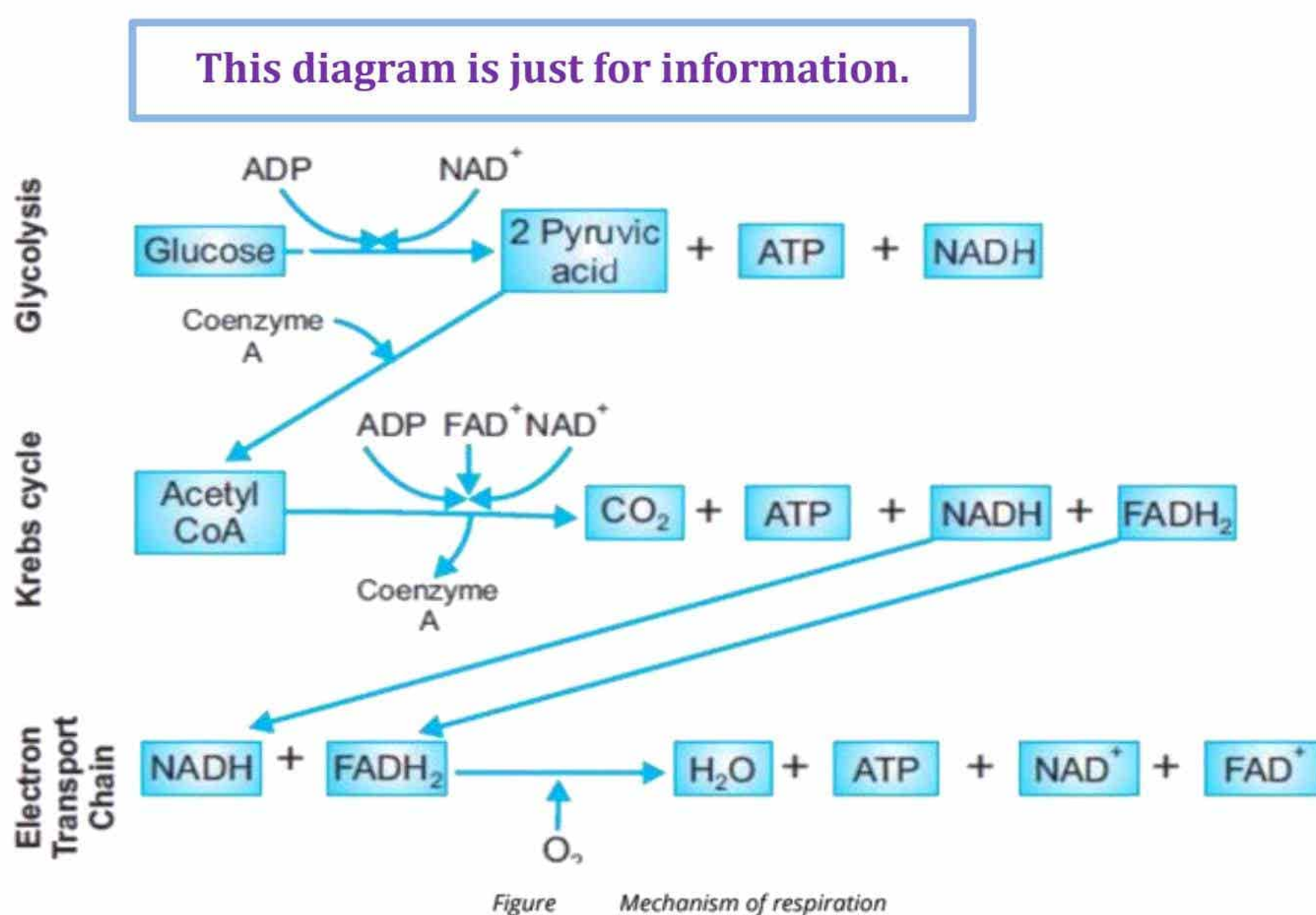
N.A.D:

NAD (Nicotinamide adenine dinucleotide) is co-enzyme that takes phosphate and hydrogen ions and is thus reduces to NADPH.

Q47: Define respiration and cellular respiration.

Ans: Respiration (Cellular respiration):

The cellular energy yielding process is called cellular respiration. During this process, oxidation reduction reaction breaks C – H bonds and so carbon dioxide and water are also produced.



Q48: Write names of main stages of aerobic respiration.

Ans: Aerobic respiration is a continuous process but we can divide it into three main stages:

- Glycolysis
- Krebs cycle
- Electron Transport chain

Q49: What is meant by electron transport chain and Krebs cycle?

Ans: Electron Transport chain:

It is the final step of cellular respiration. It is the transfer of electron in an electron transport chain.

Krebs cycle:

In Krebs cycle, pyruvic acid molecules are completely oxidized along with the formation of ATP, NADH and FADH₂. Before entering in Krebs cycle, pyruvic acid is changed into a 2-carbon compound called acetyl CoA.

Q50: Explain the mechanism of Electron transport Chain.

Ans: Electron transport Chain:

- The final step of cellular respiration is the transfer of electron on an electron transport chain. In this step the energy carried by electrons is used to synthesize ATP.
- In Electron transport Chain NAD and FADH₂ release electrons and hydrogen ions. These electrons are taken up by a series of electron carriers. When electrons move through series of electron carriers, they lose energy, which is used to synthesize ATP molecules.
- At the end of the chain electrons and hydrogen ions combine with molecular oxygen and form water.

Q51: Why it is incorrect to say that energy relationship step of respiration is electron transport chain?

Ans: Energy is released in glycolysis and Krebs cycle in the form of NADH and FADH₂. Electron transport chain transforms the energy present in these compounds to ATP. That is why it is incorrect to say that energy relationship step of respiration is electron transport chain.

Q52: How many ATP are produced during aerobic and anaerobic respiration?

Ans: During aerobic respiration 36 ATP are produced while in anaerobic respiration only 2 ATP are produced.

Q53: Where all the enzymes of glycolysis are found?

Ans: All the enzymes of glycolysis are found in cytoplasm.

Q54: Glycolysis produces ATP, but it cannot occur ATP. How is that?

Ans: The beginning of glycolysis requires two ATP, while 4 ATP are produced through last steps of glycolysis.

Q55: Why is it incorrect to say that the energy releasing step of respiration is electron transport chain?

Ans: Energy is released in glycolysis and Krebs cycle in the form of NADH and FADH₂. Electron transport chain transforms the energy present in these compounds to ATP.

Difference between photosynthesis and respiration

Characteristics	Photosynthesis	Respiration
Metabolism	Anabolism	Catabolism
Energy investment / production	Investment of light energy to store it in the form of bond energy	Bond energy transformed into chemical energy of ATP
Organisms capable of;	Some bacteria, all algae all plants	All organisms
Site of occurrence	Chloroplasts	In cytoplasm and mitochondria
Time of occurrence	In daytime only, in the presence of light	All the time

Difference between Aerobic and Anaerobic Respiration

Properties	Aerobic respiration	Anaerobic respiration
Presence of Oxygen	Yes	No
Number of ATP as net profit	36	2
Final products	CO ₂ , H ₂ O	Lactic acid or Ethanol + CO ₂
Site of occurrence	Glycolysis in cytoplasm and Krebs cycle and electron transport chain in mitochondria	In cytoplasm
Importance	Major source of energy for most organisms	<ul style="list-style-type: none"> • Source of energy for anaerobic organisms • Source of energy for aerobic organisms in short supply of O₂ • Source of many products (ethanol, cheese etc)



Long Questions

- Q1: What is the difference between photosynthesis and respiration? OR
Define photosynthesis. Write its equation and describe the mechanism of photosynthesis.
- Q2: Write a note on ATP. OR
Interpret that ATP is the chief energy currency of all cells. (V.Imp)
- Q3: Write down a comprehensive note on oxidation reduction reactions.
- Q4: Write down the summary of light reactions in plants. OR
Describe different events of light and dark reaction. OR
What are dark reactions? Describe events of dark reactions? (V.Imp)
- Q5: What is Photosystem? Explain the Calvin Cycle.
- Q6: Explain the effect of intensity of light, CO₂ concentration and temperature on photosynthesis. OR
Explain the role of chlorophyll and light in photosynthesis.
- Q7: Write note on limiting factors of photosynthesis.
- Q8: Describe the importance of anaerobic respiration or fermentation. OR
What is meant by fermentation? Explain its types. (V.Imp)
- Q9: What is meant by respiration? Explain its types.
- Q10: Define aerobic respiration and explain its mechanism. (V.Imp) OR
What is the difference between aerobic and anaerobic respiration?
- Q11: Illustrate respiratory energy budget by a chart.
- Q12: Electron transport chain is the final step of cellular respiration. Explain it.