Class: 9th

Subject: Biology

Chapter 8: BIOENERGETICS

Exercise MCQs:

1. When we get energy from ATP, which bonds are broken?

(a) P-P bonds ✅

(b) C-H bonds

(c) C-N bonds

(d) C-O bonds

2. Light reactions of photosynthesis occur in:

(a) Plasma membrane of cell

(b) Cytoplasm of cell

(c) Stroma of chloroplasts

(d) Thylakoids of chloroplasts ✅

3. Which type of chlorophyll is most common in plants?

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(a) Chlorophyll a ✅

(b) Chlorophyll b

(c) Chlorophyll c

(d) Chlorophyll d

4. Which wavelengths of light are absorbed to maximum by chlorophylls?

(a) Green and blue

(c) Red and blue ✅

(b) Green and red

(d) Only green

5. When yeast ferments glucose, the products are:

(a) Alcohol and CO_2 ✅

(b) Alcohol and water

(c) Lactic acid

(d) CO_2 and H_2O

6. Where do the dark reactions of photosynthesis occur?

(a) Stroma of chloroplasts ✅

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(b) Thylakoids of chloroplast

(c) Outer membrane

(d) Cytoplasm

7. Which molecule donates electrons in the light-dependent reactions of photosynthesis?

(a) NADPH

(b) Water ✅

(c) Oxygen

(d) Carbon dioxide

8. Which process in aerobic respiration produces the most ATP?

(a) Glycolysis

(b) Krebs cycle

(c) Electron transport chain ✅

(d) Fermentation

9. How many ATP molecules are the net profit from one glucose molecule during anaerobic respiration?

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(a) 2 ✅

(b) 4

(c) 12

(d) 36

10. What is a common byproduct of anaerobic respiration in animal cells?

(a) Oxygen

(b) Water

(c) Lactic acid ✅

(d) Carbon dioxide

Important MCQs:

1. ATP is composed of adenine, ribose, and:

(a) Glucose

(b) Two phosphate groups

(c) Three phosphate groups ✅

(d) One phosphate group

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2. Which bond in ATP is considered a high-energy bond?

(a) Adenine-ribose bond

(b) First phosphate bond

(c) Outer phosphate bond ✅

(d) Hydrogen bond

3. How much energy is released when one phosphate bond of ATP is broken?

(a) 2.3 kcal/mole

(b) 5.3 kcal/mole

(c) 7.3 kcal/mole ✅

(d) 9.3 kcal/mole

4. Which molecule is formed when ATP loses one phosphate group?

(a) AMP

(b) ADP ✅

(c) NADPH

(d) Glucose

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5. Cells get energy by breaking down:

(a) Water

(b) Glucose directly

(c) ATP ✅

(d) NADPH

6. ATP is synthesized during:

(a) Energy-consuming reactions

(b) Photosynthesis only

(c) Energy-releasing reactions ✅

(d) Respiration only

7. Photosynthesis is the process of making glucose from:

(a) Oxygen and glucose

(b) Carbon dioxide and oxygen

(c) Carbon dioxide and water ✅

(d) Water and ATP

8. The by-product of photosynthesis is:

(a) Carbon dioxide

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(b) Oxygen ✅

(c) Water

(d) Glucose

9. Light reactions occur in:

(a) Cytoplasm

(b) Mitochondria

(c) Thylakoid membranes ✅

(d) Stroma

10. Dark reactions of photosynthesis occur in:

(a) Thylakoid

(b) Stroma ✅

(c) Cytoplasm

(d) Mitochondria

11. Which molecule carries high-energy electrons in light reactions?

(a) NAD

(b) ATP

(c) NADPH ✅

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(d) FAD

12. Water molecule is broken during light reactions to release:

(a) Hydrogen ions and oxygen ✅

(b) Glucose

(c) ATP only

(d) CO_2

13. Which scientist discovered the details of dark reactions?

(a) Watson

(b) Darwin

(c) Melvin Calvin ✅

(d) Mendel

14. The main purpose of light reaction is to:

(a) Produce glucose

(b) Release CO_2

(c) Produce ATP and NADPH ✅

(d) Use up oxygen

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15. In dark reaction, 3-carbon carbohydrates are used to regenerate:

(a) ATP

(b) Glucose

(c) CO_2

(d) 5-carbon compounds ✅

16. The main pigment involved in photosynthesis is:

(a) Chlorophyll-b

(b) Carotenoids

(c) Chlorophyll-a ✅

(d) Xanthophyll

17. Accessory pigments include:

(a) Chlorophyll-a

(b) Chlorophyll-b and carotenoids ✅

(c) Chlorophyll-c

(d) Xanthophyll only

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18. Which colors of light are most effective for photosynthesis?

(a) Green and yellow

(b) Blue and red ✅

(c) Violet and orange

(d) White and green

19. Where does chlorophyll-a mainly absorb light?

(a) Green and blue

(b) Yellow and red

(c) Blue and red ✅

(d) Orange and violet

20. When chlorophyll absorbs light, what is released?

(a) Carbon dioxide

(b) Protons

(c) Electrons ✅

(d) Oxygen

21. Cellular respiration is the process of:

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(a) Formation of food

(b) Breaking food to release energy ✅

(c) Formation of glucose

(d) Formation of oxygen

22. In aerobic respiration, glucose is:

(a) Partially oxidized

(b) Not oxidized

(c) Completely oxidized ✅

(d) Changed to alcohol

23. Anaerobic respiration in yeast produces:

(a) Glucose

(b) Lactic acid

(c) Alcohol and carbon dioxide ✅

(d) Oxygen

24. Where does glycolysis occur in the cell?

(a) Mitochondria

(b) Cytoplasm ✅

(c) Nucleus

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(d) Ribosomes

25. Krebs cycle takes place in the:

(a) Thylakoid membrane

(b) Cytoplasm

(c) Matrix of mitochondria ✅

(d) Outer membrane of chloroplast

Exercise Short Questions:

1. Write the importance of oxidation-reduction reactions.

Oxidation-reduction (redox) reactions are essential for the release of energy from food molecules. In cellular respiration, oxidation of glucose releases energy, while reduction reactions help store this energy in molecules like ATP.

2. What do ATP and ADP mean? What are the roles of these molecules for the cellular metabolism?

- **ATP** stands for Adenosine Triphosphate and ADP stands for Adenosine Diphosphate.

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- **ATP** is the main energy currency of the cell. When it is broken down into ADP and a phosphate, energy is released, which is used for various cellular processes like muscle contraction, active transport, and synthesis of biomolecules.

3. Write down the word equation for photosynthesis.

Carbon dioxide + Water ⇒ Glucose + Oxygen

(in the presence of sunlight and chlorophyll)

4. Why is chlorophyll important for photosynthesis?

Chlorophyll is a green pigment found in chloroplasts that absorbs light energy (especially red and blue light) needed to drive the process of photosynthesis.

5. How is oxygen produced during photosynthesis?

Oxygen is produced during the light-dependent reactions of photosynthesis when water molecules are split (photolysis) by light energy absorbed by chlorophyll.

6. Which organisms carry out photosynthesis?

Which cell organelle is responsible for the absorption of light for photosynthesis?

- Green plants, algae, and some bacteria carry out photosynthesis.
- The chloroplast is the cell organelle responsible for absorbing light through its pigment chlorophyll.

7. State the main purpose of cellular respiration.

The main purpose of cellular respiration is to break down food molecules (mainly glucose) to release energy in the form of ATP, which is used for all cellular activities.

8. State the equation (in words or symbols) for aerobic respiration.

Glucose + Oxygen $\Rightarrow$ Carbon dioxide + Water + Energy (ATP)

Or in **symbols**:

$C_6H_{12}O_6 + 6O_2 \Rightarrow 6CO_2 + 6H_2O$ + Energy (ATP)

9. Write a brief note on the role of oxygen in aerobic respiration.

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Oxygen acts as the final electron acceptor in the electron transport chain during aerobic respiration. It combines with electrons and hydrogen ions to form water and allows maximum ATP production.

10. Define anaerobic and aerobic respiration.

- **Aerobic respiration**: Respiration that occurs in the presence of oxygen and results in complete oxidation of glucose, producing more energy.
- **Anaerobic respiration**: Respiration that occurs in the absence of oxygen and results in incomplete oxidation of glucose, producing less energy.

11. What are the end products of anaerobic respiration in animals and yeast?

- In animals: Lactic acid
- In yeast: Alcohol and Carbon dioxide (CO_2)

12. How do muscles respond to oxygen deficiency during intense exercise?

During oxygen deficiency, muscles perform anaerobic respiration, converting glucose into lactic

acid to produce energy temporarily. This causes muscle fatigue.

13. List ways in which respiratory energy is used in the body.

Respiratory energy (ATP) is used for:

- Muscle contraction and movement
- Active transport of substances
- Synthesis of proteins and biomolecules
- Cell division and DNA replication
- Transmission of nerve impulses
- Maintaining body temperature
- Detoxification and waste removal

Important long questions:

Q1: Explain ATP as a molecule that is the chief energy currency of all cells.

ATP stands for Adenosine Triphosphate. It is a molecule that stores and supplies energy for many

biochemical processes in the cell. ATP consists of adenine (a nitrogenous base), ribose (a sugar), and three phosphate groups.

- The energy in ATP is stored in the high-energy bonds between phosphate groups.
- When the terminal phosphate bond is broken, ATP is converted to ADP (Adenosine Diphosphate) and energy is released.
- This energy is used for muscle contraction, nerve impulse transmission, active transport, synthesis of biomolecules, cell division, and more.
- That is why ATP is called the "energy currency" of the cell—just like currency is used to buy goods, ATP is used to "pay" for cellular work.

Q2: Outline the processes involved in photosynthesis.

Photosynthesis is a process in which green plants convert sunlight energy into chemical energy stored

in glucose. It occurs in the chloroplasts of plant cells and includes two main stages:

1. Light-dependent reactions:

- These occur in the thylakoids of chloroplasts.
- Chlorophyll absorbs light energy and uses it to split water molecules into hydrogen and oxygen.
- Oxygen is released as a byproduct.
- The energy is used to form ATP and NADPH, which store energy for the next stage.

2. Light-independent reactions (Calvin Cycle):

- These occur in the stroma of chloroplasts.
- Carbon dioxide is fixed using ATP and NADPH to form glucose.
- Overall word equation: Carbon dioxide + Water ⇒ Glucose + Oxygen

(in the presence of sunlight and chlorophyll)

Q3: Write a note on the intake of carbon dioxide and water by plants.

1. Plants need carbon dioxide (CO_2) and water (H_2O) for photosynthesis.
2. Carbon dioxide enters the leaf through stomata, small pores mainly found on the underside of the leaf.
3. The process is controlled by guard cells, which open and close the stomata.
4. Water is absorbed from the soil by roots through the process of osmosis.
5. It is then transported upward to the leaves via xylem vessels.
6. These raw materials are used in the chloroplasts during photosynthesis to produce glucose and oxygen.

Q4: Explain the types and importance of anaerobic respiration.

Anaerobic respiration is the type of respiration that occurs in the absence of oxygen. It results in the incomplete breakdown of glucose, releasing less

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energy compared to aerobic respiration.

There are two main types:

a) Alcoholic Fermentation:

1. Occurs in ⇒ yeast and some bacteria.
2. Glucose Alcohol + CO_2 + Energy
3. Used in baking, brewing, and biofuel production.

b) Lactic Acid Fermentation:

- Occurs in human skeletal muscles during intense exercise.
- Glucose ⇒ Lactic acid + Energy
- Helps provide temporary energy when oxygen is insufficient.

Importance:

- Anaerobic respiration is essential in microorganisms that live in oxygen-free environments.
- It is used in industries for the production of bread, yogurt, alcohol, and cheese.
- In animals, it helps muscles work briefly when

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oxygen is not available.

Q5: Outline the mechanism of aerobic respiration.

Aerobic respiration occurs in the presence of oxygen and results in the complete breakdown of glucose, releasing a large amount of energy (ATP). It includes three major steps:

1. Glycolysis:

- Takes place in the cytoplasm.
- Glucose is broken down into two molecules of pyruvic acid, producing 2 ATPs and 2 NADH.
- Does not require oxygen.

2. Krebs Cycle:

- Occurs in the matrix of mitochondria.
- Pyruvic acid is converted into Acetyl-CoA, which enters the Krebs cycle.
- Produces CO_2, NADH, $FADH_2$, and 2 ATPs.

3. Electron Transport Chain (ETC):

- Happens on the inner mitochondrial membrane.
- NADH and $FADH_2$ release electrons that pass through a series of proteins.
- The energy from electrons is used to make ATP.
- At the end, electrons and protons combine with oxygen to form water.
- Total ATP produced per glucose molecule: approx. 36–38 ATPs

Q6: Compare the processes of respiration and photosynthesis.

1. Definition:

- Photosynthesis is the process in which green plants make glucose using sunlight, carbon dioxide, and water.
- Respiration is the process in which cells break down glucose to release energy.

2. Occurrence:

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- Photosynthesis occurs only in green plants, algae, and some bacteria.
- Respiration occurs in all living organisms, including plants and animals.

3. Site of Process:

- Photosynthesis takes place in the chloroplasts.
- Respiration occurs in the cytoplasm and mitochondria.

4. Reactants Used:

- Photosynthesis uses carbon dioxide and water.
- Respiration uses glucose and oxygen (in aerobic respiration).

5. Products Formed:

Photosynthesis produces glucose and oxygen.

Respiration produces carbon dioxide, water, and ATP (energy).

6. Energy Conversion:

- In photosynthesis, light energy is converted into chemical energy (glucose).

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- In respiration, chemical energy from glucose is converted into usable energy (ATP).

7. Type of Process:

- Photosynthesis is an anabolic process (building up).
- Respiration is a catabolic process (breaking down).

8. Requirement of Light:

- Photosynthesis requires light and only happens in daylight.
- Respiration does not require light and occurs all the time.

9. Gas Exchange:

- Photosynthesis uses CO_2 and releases O_2.
- Respiration uses O_2 and releases CO_2.

10. Purpose:

- Photosynthesis is for making food (glucose).
- Respiration is for releasing energy (ATP) for cellular activities.

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Note:

This chapter is designed to provide a solid foundation of knowledge, with the goal of deepening understanding and encouraging further exploration of the subject. The content has been carefully selected to support effective learning and inspire students to engage with the topic more deeply.

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Purpose: To contribute to education by offering insightful, valuable content that enhances learning and understanding.

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