Biology Grade 11 — Chapter 4

Bioenergetics

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Independent practice MCQs from the supplied Class 11 Biology notes pack. Total: 50 questions.

A. Important / Main Topics

1. Which process converts light energy into chemical energy in plants?

(A) Photosynthesis
(B) Respiration
(C) Digestion
(D) Transpiration

Correct Answer: A

Explanation: Photosynthesis is the process by which green plants convert light energy into chemical energy stored in glucose.

2. What is the ultimate source of energy for life on Earth?

(A) Water
(B) Sunlight
(C) Carbon dioxide
(D) Glucose

Correct Answer: B

Explanation: Sunlight is the ultimate source of energy which is continuously flowing one way from the Sun to life and ecosystem.

3. Which gas is taken in by plants during photosynthesis?

(A) Oxygen
(B) Nitrogen
(C) Carbon dioxide
(D) Hydrogen

Correct Answer: C

Explanation: Carbon dioxide is one of the raw materials of the photosynthetic reaction where it acts as a carbon source.

4. Which organelle is the site of photosynthesis?

(A) Mitochondrion
(B) Ribosome
(C) Nucleus
(D) Chloroplast

Correct Answer: D

Explanation: Chloroplast is the site of photosynthesis in a plant cell, containing chlorophyll and other pigments.

5. Which pigment is the primary photosynthetic pigment in plants?

(A) Chlorophyll
(B) Carotene
(C) Xanthophyll
(D) Phycoerythrin

Correct Answer: A

Explanation: Chlorophyll is the primary photosynthetic pigment. Chlorophyll-a is found in all photosynthetic organisms except photosynthetic bacteria.

6. What is the process of breaking down glucose to release energy called?

(A) Photosynthesis

(B) Cellular respiration
(C) Transpiration
(D) Fermentation

Correct Answer: B

Explanation: Cellular respiration is a series of complex oxidation-reduction reactions by which living cells obtain energy through the breakdown of organic matter.

7. Where does glycolysis occur in the cell?

(A) Mitochondrial matrix
(B) Chloroplast
(C) Cytoplasm
(D) Nucleus

Correct Answer: C

Explanation: Glycolysis occurs in the cytoplasm and is the common first step of both aerobic and anaerobic respiration.

8. Which of the following is the end product of glycolysis?

(A) Acetyl-CoA
(B) Ethanol
(C) Lactic acid
(D) Pyruvate

Correct Answer: D

Explanation: Glycolysis is the breakdown of glucose into two molecules of pyruvate, releasing ATP and NADH.

9. How many ATPs are produced in anaerobic respiration per glucose molecule?

(A) 2
(B) 36
(C) 38
(D) 4

Correct Answer: A

Explanation: 2 — this correctly answers the question.

10. Where does the Krebs cycle take place?

(A) Cytoplasm
(B) Mitochondrial matrix
(C) Inner mitochondrial membrane
(D) Chloroplast stroma

Correct Answer: B

Explanation: Mitochondrial matrix — this correctly answers the question.

11. Which of the following is the final electron acceptor in the electron transport chain?

(A) NAD□
(B) FAD
(C) Oxygen
(D) Water

Correct Answer: C

Explanation: Oxygen is the ultimate acceptor of electrons in the electron transport chain, forming water when it picks up hydrogen ions.

12. Which process produces the majority of ATP in aerobic respiration?

(A) Glycolysis
(B) Krebs cycle
(C) Fermentation
(D) Electron transport chain / oxidative phosphorylation

Correct Answer: D

Explanation: Electron transport chain / oxidative phosphorylation — this correctly answers the question.

13. What is the role of the enzyme RuBisCO in photosynthesis?

(A) It fixes carbon dioxide in the Calvin cycle.
(B) It breaks down glucose.
(C) It produces ATP.
(D) It splits water.

Correct Answer: A

Explanation: It fixes carbon dioxide in the Calvin cycle. — this correctly answers the question.

14. What is photorespiration?

(A) Respiration that occurs in the dark.
(B) A wasteful process where RuBisCO binds oxygen instead of carbon dioxide.
(C) The process of making glucose from light.
(D) The breakdown of glucose in the mitochondria.

Correct Answer: B

Explanation: Photorespiration occurs when RuBisCO binds oxygen instead of carbon dioxide, producing toxic phosphoglycolate and releasing CO□ without producing ATP or sugar.

15. In which organisms does the C4 pathway of photosynthesis occur?

(A) All plants
(B) Only C3 plants
(C) Plants adapted to tropical climates, like maize and sugarcane
(D) Only aquatic plants

Correct Answer: C

Explanation: C4 plants, such as maize, sugarcane, and sorghum, have adapted the C4 pathway to reduce photorespiration in tropical climates.

16. In the light-dependent reactions, what is the primary role of water?

(A) It acts as a source of carbon.
(B) It absorbs light energy.
(C) It produces ATP directly.
(D) It acts as a hydrogen and electron donor, releasing oxygen.

Correct Answer: D

Explanation: Water acts as a hydrogen and electron donor in photosynthesis. Through photolysis, it breaks down into 2H□, 2e□, and ½O□.

17. During non-cyclic photophosphorylation, which photosystem is involved first in the electron transport chain?

(A) Photosystem II
(B) Photosystem I
(C) Both are involved simultaneously
(D) Neither; it is cyclic

Correct Answer: A

Explanation: In non-cyclic photophosphorylation, PS-II is utilized first, then electrons flow to PS-I.

18. What is the net ATP yield of glycolysis per glucose molecule, considering the preparatory phase?

(A) 0 ATP
(B) 2 ATP
(C) 4 ATP
(D) 38 ATP

Correct Answer: B

Explanation: Glycolysis produces 4 ATP by substrate-level phosphorylation, but 2 ATP are consumed in the preparatory phase, resulting in a net gain of 2 ATP.

19. Which of the following is the primary role of NADH and FADH□ in the electron transport chain?

(A) They directly produce ATP.
(B) They act as final electron acceptors.
(C) They donate electrons to the electron transport chain, which pumps protons to create a gradient.
(D) They break down glucose.

Correct Answer: C

Explanation: NADH and FADH□ are oxidized in the electron transport chain, donating electrons which pass through carriers, releasing energy to pump protons from the matrix to the intermembrane space.

20. In the Calvin cycle, what is the primary product of the reduction phase?

(A) 3-phosphoglycerate (3-PGA)
(B) Ribulose bisphosphate (RuBP)
(C) Glucose
(D) Glyceraldehyde-3-phosphate (G3P)

Correct Answer: D

Explanation: In the reduction phase of the Calvin cycle, 3-PGA is phosphorylated by ATP and reduced by NADPH to produce G3P.

21. Why does photorespiration reduce crop yield?

(A) It consumes energy and releases CO□ without producing sugar.
(B) It increases the rate of photosynthesis.
(C) It produces more glucose.
(D) It reduces the need for water.

Correct Answer: A

Explanation: It consumes energy and releases CO□ without producing sugar. — this correctly answers the question.

22. How do C4 plants minimize photorespiration?

(A) By keeping their stomata open all day.
(B) By concentrating CO□ in bundle sheath cells, where RuBisCO operates.
(C) By using RuBisCO exclusively in mesophyll cells.
(D) By not using the Calvin cycle.

Correct Answer: B

Explanation: C4 plants use PEP carboxylase in mesophyll cells to fix CO□ and transport it as malate to bundle sheath cells, where it is decarboxylated. This creates a high CO□ concentration that favors RuBisCO's carboxylase.

23. In alcoholic fermentation, which two products are formed from pyruvate?

(A) Lactic acid and ATP
(B) Acetyl-CoA and CO□
(C) Ethanol and CO□
(D) Glucose and O□

Correct Answer: C

Explanation: Ethanol and CO□ — this correctly answers the question.

24. Which process regenerates NAD□ in a muscle cell during intense exercise when oxygen is limited?

(A) Glycolysis
(B) Krebs cycle
(C) Electron transport chain
(D) Lactic acid fermentation

Correct Answer: D

Explanation: Lactic acid fermentation occurs in muscle cells during strenuous exercise when oxygen is exhausted. Pyruvate is reduced by NADH to lactic acid, regenerating NAD□.

25. What is the role of the enzyme ATP synthase in oxidative phosphorylation?

(A) It uses the proton gradient to synthesize ATP from ADP and Pi.
(B) It breaks down ATP.
(C) It transfers electrons to oxygen.
(D) It pumps protons from the matrix.

Correct Answer: A

Explanation: It uses the proton gradient to synthesize ATP from ADP and Pi. — this correctly answers the question.

B. Less Important / Secondary Topics

26. What is the function of the enzyme pyruvate dehydrogenase complex in the link reaction?

(A) It converts pyruvate to acetyl-CoA.
(B) It converts glucose to pyruvate.
(C) It converts acetyl-CoA to glucose.
(D) It converts lactate to pyruvate.

Correct Answer: A

Explanation: The pyruvate dehydrogenase complex catalyzes the oxidation of pyruvate to acetyl-CoA, which links glycolysis to the Krebs cycle.

27. Which of the following correctly describes the role of light in photosynthesis?

(A) It directly reduces CO□ to glucose.
(B) It excites electrons in pigments, which then flow through the electron transport chain to generate ATP and NADPH.
(C) It acts as a source of carbon atoms.
(D) It splits water into hydrogen and oxygen without pigments.

Correct Answer: B

Explanation: Light energy excites electrons in the reaction center of photosystems, initiating the electron transport chain that generates ATP and NADPH.

28. In the electron transport chain, which step produces the most ATP?

(A) Electron transfer from NADH to Complex I
(B) Electron transfer from Complex III to Complex IV
(C) ATP synthase generating ATP from the proton gradient
(D) Transfer of electrons to oxygen

Correct Answer: C

Explanation: ATP synthase uses the proton gradient generated by the electron transport chain to produce ATP via chemiosmosis. This is the primary mechanism of ATP production in aerobic respiration.

29. Which process directly produces ATP during glycolysis?

(A) Oxidative phosphorylation
(B) Photophosphorylation
(C) Chemiosmosis
(D) Substrate-level phosphorylation

Correct Answer: D

Explanation: During glycolysis, ATP is produced by substrate-level phosphorylation, where a phosphate group is directly transferred from a substrate to ADP.

30. Which of the following best describes the role of the Krebs cycle in aerobic respiration?

(A) It oxidizes acetyl-CoA, producing NADH, FADH□, ATP, and CO□.
(B) It generates ATP solely through oxidative phosphorylation.
(C) It converts glucose to pyruvate.
(D) It produces ethanol.

Correct Answer: A

Explanation: It oxidizes acetyl-CoA, producing NADH, FADH□, ATP, and CO□. — this correctly answers the question.

31. What is the energy source for the C4 pathway in mesophyll cells?

(A) The breakdown of glucose
(B) Light energy captured by ATP
(C) The proton gradient
(D) The Calvin cycle

Correct Answer: B

Explanation: The C4 pathway uses ATP generated from light-dependent reactions to regenerate PEP from pyruvate.

32. Which of the following is an example of an organism that performs anaerobic respiration?

(A) Escherichia coli
(B) Mycobacterium tuberculosis
(C) Yeast
(D) Both A and B

Correct Answer: C

Explanation: Yeast — this correctly answers the question.

33. What is the fate of the G3P produced in the Calvin cycle?

(A) It is used to regenerate RuBP only.
(B) It is excreted as a waste product.
(C) It is broken down to release energy.
(D) It is used to synthesize glucose and other organic compounds, or to regenerate RuBP.

Correct Answer: D

Explanation: G3P is a versatile intermediate. It is used to synthesize glucose and other organic compounds, and it is also used to regenerate the CO□ acceptor RuBP in the Calvin cycle.

34. Which of the following conditions would increase the rate of photorespiration in a C3 plant?

(A) High temperature and low CO□ concentration
(B) High CO□ concentration
(C) Low temperature
(D) Closed stomata and high CO□ concentration

Correct Answer: A

Explanation: Photorespiration increases when CO□ levels are low and O□ levels are high, which often occurs at high temperatures when stomata are closed to conserve water, limiting CO□ intake.

35. Which part of the ATP molecule is considered the "high-energy bond" that is broken during ATP hydrolysis?

(A) The bond between the adenine and ribose
(B) The bonds between the three phosphate groups
(C) The bond between the alpha and beta phosphates
(D) The bond between the phosphate and ribose

Correct Answer: B

Explanation: The two covalent bonds linking the three phosphates together are called high-energy bonds, and their hydrolysis releases a significant amount of energy.

36. A plant is exposed to a toxin that blocks the electron transport chain in chloroplasts. What immediate effect would this have?

(A) Glycolysis would stop.
(B) The Krebs cycle would stop.
(C) Photosynthesis would stop because ATP and NADPH production would cease.
(D) The plant would switch to anaerobic respiration.

Correct Answer: C

Explanation: The electron transport chain in chloroplasts is part of the light-dependent reactions, which produce ATP and NADPH required for the Calvin cycle. Blocking ETC stops these processes, halting photosynthesis.

37. If a cell is treated with a drug that increases the permeability of the inner mitochondrial membrane to protons, what would happen to ATP production?

(A) ATP production would increase.
(B) ATP production would remain unchanged.
(C) ATP would be imported from the cytoplasm.
(D) ATP production would decrease or stop.

Correct Answer: D

Explanation: Increased permeability of the inner mitochondrial membrane to protons would allow protons to leak across without passing through ATP synthase. This would dissipate the proton gradient required for chemiosmotic ATP production.

38. In a C3 plant, the enzyme RuBisCO has dual activity. What determines whether it binds CO□ or O□?

(A) The relative concentration of CO□ and O□ in the leaf
(B) The concentration of ATP
(C) The temperature only
(D) The concentration of RuBP

Correct Answer: A

Explanation: The activity of RuBisCO depends on the relative concentration of O□ and CO□ in leaves. When CO□ levels are low (e.g., stomata closed) and O□ levels are high, RuBisCO binds O□, causing photorespiration.

39. During the Krebs cycle, at which step is substrate-level phosphorylation directly producing GTP/ATP?

(A) Oxidation of isocitrate to α-ketoglutarate
(B) Conversion of succinyl-CoA to succinate
(C) Dehydrogenation of succinate to fumarate
(D) Dehydrogenation of malate to oxaloacetate

Correct Answer: B

Explanation: In the Krebs cycle, the conversion of succinyl-CoA to succinate is coupled with the phosphorylation of GDP to GTP (which then forms ATP). This is a substrate-level phosphorylation.

40. In the electron transport chain, what is the primary role of oxygen?

(A) It acts as a proton pump.
(B) It donates electrons to Complex I.
(C) It acts as the final electron acceptor, forming water.
(D) It produces ATP directly.

Correct Answer: C

Explanation: Oxygen is the ultimate acceptor of electrons in the ETC. Each oxygen atom picks up a pair of hydrogen ions from the aqueous solution forming water.

41. Why is the actual ATP yield from aerobic respiration slightly lower in eukaryotes (36 ATP) than in prokaryotes (38 ATP)?

(A) Eukaryotes use ATP for more processes.
(B) Prokaryotes have more efficient mitochondria.
(C) Eukaryotes lack a Krebs cycle.
(D) In eukaryotes, NADH from glycolysis cannot enter the mitochondria, and its electrons are transferred via FADH□, yielding fewer ATP.

Correct Answer: D

Explanation: The two molecules of NADH produced in glycolysis are in the cytoplasm. Because the mitochondrial membrane is impermeable to NADH, its electrons are transferred via FADH□, which yields fewer ATP (2 ATP per FADH□ instead of 3 per NADH).

42. A mutation in a plant's RuBisCO enzyme causes it to have a higher affinity for O□ than for CO□. What would be the most likely consequence for the plant?

(A) Increased rate of photorespiration and decreased photosynthetic efficiency.
(B) Increased rate of photosynthesis.
(C) More glucose production.
(D) No effect on the plant.

Correct Answer: A

Explanation: Increased rate of photorespiration and decreased photosynthetic efficiency. — this correctly answers the question.

43. Which of the following statements about the light-dependent and light-independent reactions is correct?

(A) Both require light to occur.
(B) The light-dependent reactions occur in the thylakoid membranes, while the light-independent reactions occur in the stroma.
(C) The light-independent reactions produce ATP and NADPH.
(D) The light-dependent reactions use ATP and NADPH.

Correct Answer: B

Explanation: The light-dependent reactions occur in the thylakoid membranes, while the light-independent reactions occur in the stroma. — this correctly answers the question.

44. In the electron transport chain, what is the function of ubiquinone (Coenzyme Q)?

(A) It is a proton channel.
(B) It is a permanent structural component of Complex IV.
(C) It acts as a mobile carrier of electrons between Complex I/II and Complex III.
(D) It breaks down ATP.

Correct Answer: C

Explanation: Ubiquinone is a mobile carrier of electrons. It transfers electrons from Complex I and II to Complex III.

45. What happens to the proton gradient in mitochondria if oxygen is absent?

(A) The proton gradient increases.
(B) The proton gradient remains unchanged.
(C) The proton gradient is converted to ATP.
(D) The proton gradient is not maintained because electrons cannot be passed to oxygen, halting the ETC and proton pumping.

Correct Answer: D

Explanation: Without oxygen as the final electron acceptor, the electron transport chain backs up, and protons are no longer pumped. The proton gradient dissipates, and ATP synthesis via chemiosmosis stops.

46. During the Calvin cycle, how many ATP and NADPH molecules are required to produce one molecule of G3P?

(A) 9 ATP and 6 NADPH
(B) 3 ATP and 2 NADPH
(C) 6 ATP and 3 NADPH
(D) 12 ATP and 9 NADPH

Correct Answer: A

Explanation: The notes state that the Calvin cycle uses three molecules of CO□, six molecules of NADPH, and nine molecules of ATP to release just one molecule of G3P from the cycle.

47. Which of the following is the primary role of the C4 pathway in mesophyll cells?

(A) To carry out the Calvin cycle.
(B) To fix CO□ into a 4-carbon compound using PEP carboxylase.
(C) To produce ATP via oxidative phosphorylation.
(D) To break down glucose.

Correct Answer: B

Explanation: In C4 plants, PEP carboxylase in mesophyll cells fixes CO□ to form oxaloacetate (a 4-carbon compound), which is then converted to malate and transported to bundle sheath cells.

48. In the Krebs cycle, what is the net gain of ATP, NADH, and FADH□ per acetyl-CoA?

(A) 2 ATP, 4 NADH, 2 FADH□
(B) 3 ATP, 6 NADH, 2 FADH□
(C) 1 ATP, 3 NADH, 1 FADH□
(D) 0 ATP, 2 NADH, 1 FADH□

Correct Answer: C

Explanation: Per acetyl-CoA (one turn of the Krebs cycle), there is a net gain of 1 ATP (or GTP), 3 NADH, and 1 FADH□.

49. During photorespiration, where is glycolate converted to glycine?

(A) Chloroplast
(B) Mitochondria
(C) Cytoplasm
(D) Peroxisome

Correct Answer: D

Explanation: In photorespiration, glycolate is transported to the peroxisome and converted to glyoxalate and then glycine.

50. A student argues that anaerobic respiration is less efficient than aerobic respiration because it produces less ATP. Which of the following best supports this argument?

(A) Anaerobic respiration does not fully oxidize glucose; the products (lactic acid or ethanol) still contain significant chemical energy.
(B) Anaerobic respiration uses more oxygen.
(C) Anaerobic respiration occurs in the mitochondria.
(D) Anaerobic respiration produces more CO□.

Correct Answer: A

Explanation: In anaerobic respiration, glucose is only partially broken down. The end products (lactic acid or ethanol) still contain substantial chemical energy that is not extracted, resulting in a net yield of only 2 ATP compared to 36–38 ATP in aerobic respiration.