AP Biology REVIEW--Chapters 06-08

MULTIPLE CHOICE QUESTIONS

1. ATP is necessary for the conversion of glucose to glucose 6-phosphate. Splitting ATP into ADP and P_i releases energy into what form?
   A) Potential
   B) Kinetic
   C) Entropic
   D) Enthalpic

2. Before ATP is split into ADP and P_i, it holds what type of energy?
   A) Potential
   B) Kinetic
   C) Entropic
   D) Enthalpic

3. Which of the following statements concerning energy transformations is true?
   A) Increases in entropy reduce usable energy.
   B) Energy may be created during transformation.
   C) Potential energy increases with each transformation.
   D) Increases in temperature decreases total amount of energy available.

4. A reaction has a ΔG of –20 kcal/mol. This reaction is
   A) endergonic, and equilibrium is far toward completion.
   B) exergonic, and equilibrium is far toward completion.
   C) endergonic, and the forward reaction occurs at the same rate as the reverse reaction.
   D) exergonic, and the forward reaction occurs at the same rate as the reverse reaction.

5. ATP hydrolysis releases energy to fuel cellular func tions. ATP hydrolysis is
   A) endergonic.
   B) exergonic.
   C) chemoautotrophic.
   D) None of the above

6. Enzymes are biological catalysts and function by
   A) increasing free energy in a system.
   B) lowering activation energy of a reaction.
   C) lowering entropy in a system.
   D) increasing temperature near a reaction.

7. Which of the following contribute to the specificity of enzymes?
   A) Each enzyme has a narrow range of temperature and pH optima.
   B) Each enzyme has a specific active site that interacts with a particular substrate.
   C) Substrates themselves may alter the active site slightly for optimum catalysis.
   D) All of the above

8. Coenzymes and cofactors, as well as prosthetic groups, assist enzyme function by
   A) stabilizing three-dimensional shape and maintaining active sites.
   B) assisting with the binding of enzyme and substrate.
   C) Both a and b
   D) None of the above

9. Which of the following are characteristics of enzymes?
   A) They are consumed by the enzyme-mediated reaction.
   B) They are not altered by the enzyme-mediated reaction.
   C) They raise activation energy.
   D) All of the above

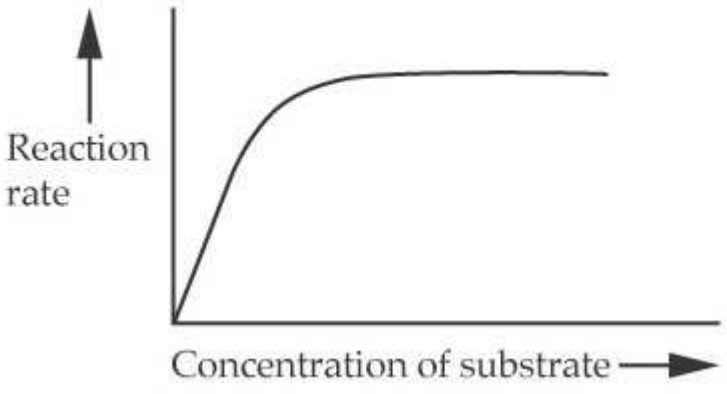
10. Ascorbic acid, found in citrus fruits, acts as an inhibitor to catecholase, the enzyme responsible for the browning reaction in fruits such as apples, peaches, and pears. One possibility for its function could be that ascorbic acid is very similar in size and shape to catechol, the substrate of the browning reaction. If this is true, then this inhibition is most likely an example of _____ inhibition.
   A) competitive
   B) indirect
   C) noncompetitive
   D) None of the above

11. Refer to question 10. Suppose further studies indicate that ascorbic acid is not similar to catechol in size and shape but that the pH of the ascorbic acid solution is altering the protein folding of catecholase. If this is true, then this inhibition is most likely an example of _____ inhibition.
   A) competitive
   B) irreversible
   C) noncompetitive
   D) None of the above

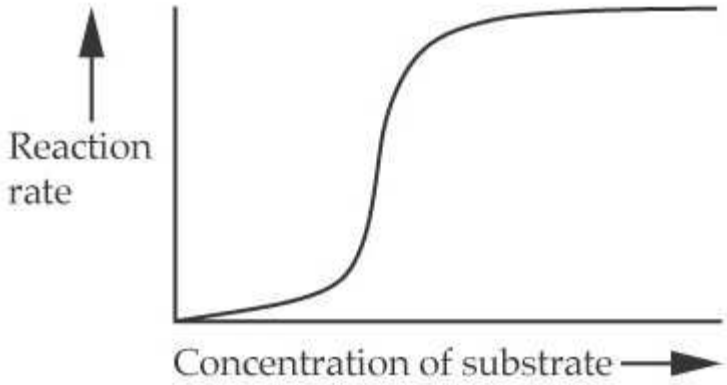
12. Metabolism is organized into pathways. The pathway is linked in which of the following manners?
   A) All cellular functions feed into a central pathway.
   B) All steps in the pathway are catalyzed by the same enzyme.
   C) The product of one step in the pathway functions as the substrate in the next step.
   D) Products of the pathway accumulate and are secreted from the cell.

13. Which of the following represents an enzyme-catalyzed reaction?
   A) $E + P \rightarrow E + S$
   B) $E + S \rightarrow E + P$
   C) $E + S \rightarrow P$
   D) $E + S \rightarrow E$

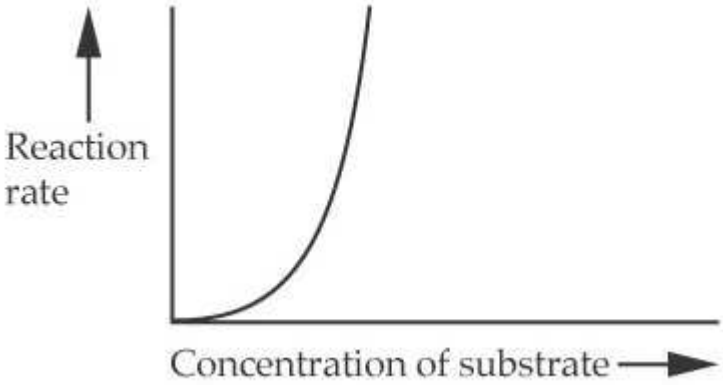
14. Which of the following graphs of enzyme-mediated reactions represents an allosteric enzyme?
A)



B)



C)



15. You are studying a new species never before studied. It lives in acidic pools in volcanic craters where temperatures reach 100°C. You determine that it has a surface enzyme that catalyzes a reaction leading to its protective coating. You decide to study this enzyme in the laboratory. Under what conditions would you most likely find optimum activity of this enzyme?
A) 0 °C
B) 37 °C
C) 55 °C
D) 95 °C

16. Which of the following cellular metabolic processes can occur in the presence *or* the absence of oxygen?
    A) The citric acid cycle
    B) Electron transport
    C) Glycolysis
    D) Fermentation

17. Which of the following statements regarding glycolysis is true?
    A) A 6-C sugar is broken down to two 3-C molecules.
    B) Two ATP molecules are consumed.
    C) A net sum of two ATP molecules is generated.
    D) All of the above

18. During which process is most ATP generated in the cell?
    A) Glycolysis
    B) The citric acid cycle
    C) Electron transport coupled with chemiosmosis
    D) Fermentation

19. One purpose of the electron transport chain is to
    A) cycle NADH + H^+ back to NAD^+.
    B) use the intermediates from the citric acid cycle.
    C) break down pyruvate.
    D) All of the above

20. Cellular respiration is allosterically controlled. Which of the following act as inhibitors at the various control points?
    A) ATP
    B) NADH + H^+
    C) Both a and b
    D) None of the above

21. Which of the following describes the role of the mitochondrial membrane?
    A) The membrane acts as an anchor for the membrane-associated enzymes of cellular respiration.
    B) The membrane allows for the establishment of a proton-motive force.
    C) Both a and b
    D) None of the above

22. In a redox reaction between G3P and NAD^+ yielding BPG and NADH + H^+, _____ is oxidized and _____ is reduced.
    A) G3P; NAD^+
    B) BPG; NADH + H^+
    C) G3P; NADH + H^+
    D) NAD^+; NADH + H^+

23. Which of the following is true regarding redox reactions?
    A) Oxidizing agents accept electrons.
    B) A molecule that accepts electrons is said to be reduced.
    C) Redox reactions involve electron transfers.
    D) All of the above

24. Cyanide poisoning inhibits aerobic respiration at cytochrome c oxidase. Which of the following is not a result of cyanide poisoning at the cellular level?
    A) Oxygen is reduced to water.
    B) ATP cannot be synthesized in the mitochondria because electron transport is never completed.
    C) Cells (with the exception of brain cells) must switch to anaerobic respiration.
    D) All of the above

25. Which of the following is correctly matched with its catabolic product?
    A) polysaccharides $\rightarrow$ amino acids
    B) lipids $\rightarrow$ glycerol and fatty acids
    C) proteins $\rightarrow$ glucose
    D) polysaccharides $\rightarrow$ glycerol and fatty acids

26. The main purpose of cellular respiration is to
    A) convert energy stored in the chemical bonds of glucose to an energy form that the cell can use.
    B) destroy energy in the cell.
    C) convert kinetic to potential energy.
    D) create energy in the cell.

27. Which of the following statements concerning the synthesis of ATP in the mitochondria is true?
    A) ATP synthesis cannot occur without the presence of ATP synthase.
    B) The proton-motive force is the establishment of a charge and concentration gradient across the mitochondrial membrane.
    C) The proton-motive force is not necessary to drive protons back across the membrane through channels established by the ATP synthase channel protein.
    D) The ATP synthase protein is composed of two units.

28. Which of the following does not occur in the mitochondria of eukaryotic cells?
    A) Fermentation
    B) Oxidative phosphorylation
    C) Citric acid cycle
    D) Electron transport chain

29. The largest change in free energy during glycolysis occurs at what reaction?
    A) Reaction 2: G6P $\rightarrow$ F6P
    B) Reaction 5: DAP $\rightarrow$ G3P
    C) Reaction 6: G3P $\rightarrow$ BPG + NADH
    D) Reaction 7: BPG $\rightarrow$ 3PG + ATP

30. Which of the following is recycled and reused in cellular metabolism?
    A) ADP
    B) NAD
    C) FAD
    D) All of the above

31. The main purpose of photosynthesis is to
    A) consume CO_2.
    B) produce ATP.
    C) convert light energy to chemical energy.
    D) produce starch.

32. Which of the following best represent the components that are necessary for photosynthesis to take place?
    A) Mitochondria, accessory pigments, visible light, water, and CO_2
    B) Chloroplasts, accessory pigments, visible light, water, and CO_2
    C) Mitochondria, chlorophyll, visible light, water, and O_2
    D) Chloroplasts, chlorophyll, visible light, water, and CO_2

33. Chlorophyll is suited for the capture of light energy because
    A) certain wavelengths of light raise it to an excited state.
    B) in its excited state chlorophyll gives off electrons.
    C) chlorophyll's structure allows it to attach to thylakoid membranes.
    D) All of the above

34. Plants give off O_2 because
    A) O_2 results from the incorporation of CO_2 into sugars.
    B) They do not respire; they photosynthesize.
    C) water is the initial proton donor, leaving O_2 as a photosynthetic by-product.
    D) All of the above

35. Cyclic and noncyclic electron flow are used in plants to
    A) meet the ATP demands of the Calvin cycle.
    B) produce excess NADPH + H^+.
    C) unbalance ATP and NADPH + H^+ ratios in the chloroplast.
    D) All of the above

36. Which of the following statements concerning the light reactions of photosynthesis is true?
    A) Photosystem I cannot operate independently of photosystem II.
    B) Photosystems I and II are activated by different wavelengths of light.
    C) Photosystems I and II transfer electrons and create proton equilibrium across the thylakoid membrane.
    D) All of the above

37. ATP is produced during the light reactions via
    A) CO_2 fixation.
    B) chemiosmosis.
    C) reduction of water.
    D) All of the above

38. Because of the properties of chlorophyll, plants need adequate _____ light to grow properly.
    A) green
    B) blue and red
    C) infrared
    D) ultraviolet

39. Which of the following statements concerning the Calvin cycle is not true?
    A) Light energy is not required for the cycle to proceed.
    B) CO_2 is assimilated into sugars.
    C) RuBP is regenerated.
    D) It uses energy stored in ATP and NADPH + H^+.

40. Which of the following statements concerning rubisco is true?
    A) Rubisco is an enzyme.
    B) Rubisco catalyzes both the beginning steps of photorespiration and the Calvin cycle.
    C) Rubisco is the most abundant protein on Earth.
    D) All of the above

41. Which of the following begins the Calvin cycle that results in the entire pathway being carried out?
    A) 3PG is reduced to G3P using ATP and NADPH + H^+.
    B) RuBP is regenerated.
    C) CO_2 and RuBP join forming 3PG.
    D) As a cycle, it can start at any point.

42. The Calvin cycle results in the production of _____.
    A) glucose
    B) starch
    C) rubisco
    D) G3P

43. Which of the following statements regarding photorespiration is true?
    A) Photorespiration is a metabolically expensive pathway.
    B) Photorespiration is avoided when CO_2 levels are low.
    C) Photorespiration increases the overall CO_2 that is converted to carbohydrates.
    D) All of the above

44. Which of the following statements is true regarding the relationship between photosynthesis and cellular respiration in plants?
    A) Photosynthesis occurs in specialized photosynthetic cells.
    B) Cellular respiration occurs in specialized respiratory cells.
    C) Cellular respiration and photosynthesis can occur in the same cell.
    D) Both a and c

45. Tension is a result of which of the following?
    A) Transpiration at the leaf surface
    B) The cohesive nature of water
    C) The narrowness of the xylem tube
    D) All of the above

46. Which of the following is true of both xylem transport and phloem transport?
    A) Both are passive processes that do not require energy from the plant.
    B) Both involve only living cells.
    C) Both rely on a water potential gradient.
    D) The direction of flow can reverse in both.

47. Which of the following regulates stomatal opening and closing?
    A) Abscisic acid levels
    B) Light levels
    C) Carbon dioxide concentrations
    D) All of the above

48. The opening and closing of the stomata are accomplished by the
    A) sieve tube.
    B) guard cells
    C) translocation.
    D) aquaporins.

49. Which of the following regarding water transport is true?
    A) Root pressure is sufficient to drive xylem sap movement.
    B) Bulk flow is not a mechanism by which water and minerals are transported.
    C) The cohesive nature of water is central to water movement in a plant.
    D) None of the above

SHORT ANSWER/ESSAY QUESTIONS

50. Amylase is a digestive enzyme that breaks down starch and is secreted in the mouth of humans. Amylase functions well in the mouth but ceases to function once it hits the acidic stomach environment. Explain why amylase does not function in the stomach.

51. The ultimate goal of metabolism is to drive ATP synthesis. ATP is considered the energy currency of the cell. Discuss how ATP couples endergonic and exergonic reactions and why it is so important in cellular functions.

52. Explain how substrate concentration affects the rate of an enzyme-mediated reaction.

53. Why is oxygen necessary for aerobic respiration?

54. Compare and contrast energy yields from aerobic respiration and fermentation.

55. Identify the controlling steps of glycolysis, the citric acid cycle, and electron transport. What regulators affect each of these steps?

56. Why are plants green?

57. Rubisco has both carboxylase and oxygenase activities. These processes compete with one another. What determines which function the enzyme has? What conditions favor photorespiration? What conditions favor photosynthesis?

58. The Calvin cycle was once referred to as the "dark" reactions of photosynthesis. Why is this a misnomer?

59. Explain the differences between cyclic and noncyclic electron flow. Why are both processes necessary?

60. Explain how transpiration, cohesion, and tension work together to move water in a large plant.

Answer Key

1. B
2. A
3. A
4. B
5. B
6. B
7. D
8. C
9. B
10. A
11. B
12. C
13. B
14. B
15. D
16. C
17. D
18. C
19. A
20. C
21. C
22. A
23. D
24. A
25. B
26. A
27. C
28. A
29. C
30. D
31. C
32. D
33. D
34. C
35. A
36. B
37. B
38. B
39. A
40. D
41. C
42. D
43. A
44. D
45. A
46. C
47. D
48. B

49. C
50. The pH optimum of amylase is approximately 7. At that pH, the protein has the three-dimensional shape to allow starch to bind to its active site and catalyze its hydrolysis. When it is at the stomach pH (approxi mately 2), the protein is denatured, and its three-dimensional shape and active site are lost; therefore, it can no longer catalyze the reaction.
51. The conversion of ATP to ADP and P_i releases approxi mately 7.3 kcal/mol of energy. This energy release fuels (endergonic) reactions in the cell. Equilibrium of the reaction is far to the right and favors the formation of ADP. In the converse, the formation of ATP from ADP and P_i is energy intensive and can be coupled to highly exergonic reactions within the cell. Thus ATP functions as an energy shuttle between endergonic and exergonic reactions. The small size of the molecule and its ubiquitousness allow it to be available and move freely within the cell.
52. Increasing substrate concentration will result in an increased rate of reaction until all available active sites are occupied. At that point, no amount of substrate increase will increase the rate of reaction (see Figure 6.14).
53. Oxygen acts as the terminal electron acceptor in the electron transport pathway. Without it, NADH + H^+ cannot be cycled back to NAD^+. The accumulated NADH + H^+ acts as an inhibitor to the citric acid cycle and effectively shuts it down. Therefore, in the absence of oxygen, a cell can only undergo glycolysis.
54. Fermentation yields only 2ATP. Cellular respiration yields ~36-38 ATP. Though this difference is great, organisms can survive quite well relying on fermentation because the rate at which glycolysis occurs is increased nearly tenfold.
55. This control point for glycolysis is phosphofructo kinase, which is inhibited by ATP. This allows glycolysis to speed up during fermentation and slow down during cellular respiration. The control point for the citric acid cycle is isocitrate dehydrogenase. NADH + H^+ and ATP inhibit the enzyme, and NAD^+ and ADP are activators. Electron transport is controlled by the amount of NADH + H^+ fed in and by NADH-Q reductase.
56. The primary pigments in plants are chlorophylls. Chlorophylls absorb blue and orange-red wavelengths of light and reflect green light, thus making plants appear green. See the absorption spectra and action spectra of chlorophyll in Figure 8.6.
57. Whether rubisco acts as a carboxylase or an oxygenase depends on the relative ratio of O_2 to CO_2. At higher CO_2 levels it acts as a carboxylase. At low CO_2 levels it acts as an oxygenase. Photorespiration is favored during hot, dry weather, which forces the closing of stomata and leads to increases in O_2 levels within the leaf. Photosynthesis is favored when stomata can remain open and light intensity is optimal.
58. Light is required for both the light reactions of photosynthesis and the Calvin cycle. The Calvin cycle depends on the ATP generated during the light-dependent reactions.
59. See Figures 8.9 and 8.10. See also the answer to Question 5 under "Knowledge and Synthesis Questions."
60. The transpiration–cohesion–tension mechanism pulls water from the roots up through the plant. Water evaporates from mesophyll cells during transpiration. This puts tension on the film of water associated with the mesophyll cell wall. The tension at the mesophyll cell draws water from the xylem of the nearest vein. This creates tension in the entire xylem column, and the column is drawn upward from the roots.