

Correct answers are highlighted in red. Explanations for each right answer are given in red as well. Remember your version will have a different question order from this

1. Our bodies convert food to energy at less than 100 percent efficiency.
This is an illustration of
- A. a series of endergonic reactions.
B. decreased entropy.
C. the second law of thermodynamics.
D. changing kinetic energy into potential energy.
E. the inefficiency of uncatalyzed reactions.
Refer to text book Chapter 4 pg. 73

2. Which of the following is **true** regarding catabolic pathways?
- A. They do not depend on enzymes.
B. They consume energy to build up polymers from monomers.
C. They release energy as they degrade polymers to monomers.
D. They lead to the synthesis of catabolic compounds.
E. Both A and D are correct.
Refer to text book Chapter 4 pg. 78

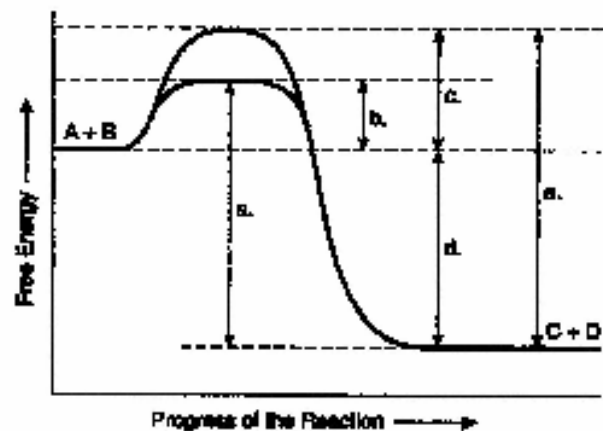
3. ATP generally energizes a cellular process by
- A. releasing heat upon hydrolysis.
B. acting as a catalyst.
C. direct chemical transfer of a phosphate group.
D. emitting light flashes.
E. lowering the activation energy of a reactant.
Refer to text book Chapter 4 pg. 79

4. Of the following, the structure of ATP is most closely related to
- A. cholesterol.
B. a double helix.
C. a phospholipid.
D. an amino acid with three phosphate groups attached.
E. RNA nucleotides.
Refer to text book (purple pages) F-29

5. All of the following molecules are part of an animal cell membrane **except**
- A. lipid.
B. DNA.
C. protein.
D. cholesterol.
E. phospholipids.

Refer to text book Chapter 5 Fig. 5.1 Nucleic acids are not components of cell membranes.

Questions 6, 7 and 8 are based on the reaction $A + B \rightarrow C + D$ and figure shown below.



6. Which of the following terms best describes this reaction?
- A. endergonic
B. anabolic
C. exergonic
D. allosteric
E. nonspontaneous
Refer to text book Chapter 4 Fig. 4.17

7. Which of the following represents the ΔG of this reaction?

- A. a
- B. b
- C. c
- D. **d**
- E. e

Refer to text book Chapter 4 Fig. 4.17

8. Which of the following represents the activation energy required for this enzyme-catalyzed reaction?

- A. a
- B. **b**
- C. c
- D. d
- E. e

Refer to text book Chapter 4 Fig. 4.17

9. According to the fluid mosaic model of cell membranes, which of the following is a **true** statement about membrane phospholipids?

- A. **They can move laterally along the plane of the membrane.**
- B. They frequently flip-flop from one side of the membrane to the other.
- C. They occur in an uninterrupted bilayer with membrane proteins restricted to the surface of the membrane.
- D. They are free to depart from the membrane and dissolve in the surrounding solution.
- E. They have hydrophilic tails in the interior of the membrane.

Refer to text book Chapter 5 Pg. 95

10. Which of the following factors would tend to **increase** membrane fluidity?

- A. **A greater proportion of unsaturated phospholipids.**
- B. A lower temperature.
- C. A relatively high protein content in the membrane.
- D. A greater proportion of saturated phospholipids.
- E. A relatively low protein content in the membrane.

Refer to text book Chapter 4 Fig. Fig. 5.5

Student Number _____

11. Our white blood cells engulf bacteria from our bloodstream by

- A. facilitated diffusion.
- B. exocytosis.
- C. **phagocytosis.**
- D. pinocytosis.
- E. receptor-mediated endocytosis.

Refer to text book Chapter 5 Fig. 5.20

12. Which statement is **not** true of membrane transport proteins?

- A. **They produce a chemical change in the molecules they are transporting.**
- B. They are responsible in some cases for facilitated diffusion.
- C. They are responsible in some cases for active transport.
- D. Their specificity depends on their three dimensional structure.
- E. They belong to the family of integral proteins.

Refer to text book Chapter 5 Pgs. 102 -104

13. How does an enzyme catalyze a reaction?

- A. By lowering the ΔG of a reaction
- B. By feedback inhibition
- C. By reducing entropy
- D. **By lowering the energy of activation of a reaction**
- E. By increasing the amount of free energy of a reaction

Refer to text book Chapter 4 Fig. 4.17

14. Which of the following statements regarding enzymes is **false**?

- A. Enzymes are proteins that function as catalysts.
- B. **Enzymes provide the activation energy for the reactions they catalyze.**
- C. Enzymes display specificity for certain molecules of which they attach.
- D. The activity of enzymes can be regulated by specific inhibitor molecules.
- E. Enzymes may be used many times over for a specific reaction.

Refer to text book Chapter 4 Pg. 83

Questions 15 and 16 are based on the following information. A series of enzymes catalyze the reaction $X \rightarrow Y \rightarrow Z \rightarrow A$. Product **A** binds to the enzyme that converts **X** to **Y** at a position remote from its active site. This binding decreases the activity of the enzyme.

15. Substance **X** is

- A. a coenzyme.
- B. an allosteric inhibitor.
- C. **a substrate.**
- D. an intermediate.
- E. the product.

Substance X is a substrate that an enzyme can help transform into substance Y.

16. Substance **A** functions as

- A. a coenzyme.
- B. **an allosteric inhibitor.**
- C. the substrate.
- D. an intermediate.
- E. a competitive inhibitor.

Substance A the final product in this pathway can inhibit the first enzyme, at a site other than the active site. Allosteric inhibition and negative feedback inhibition.

17. In the thylakoid membranes, what is the main role of the antenna pigment molecules?

- A. To split water and release oxygen to the reaction-centre chlorophyll.
- B. **To harvest photons and transfer light energy to the reaction-centre chlorophyll.**
- C. To synthesize ATP from ADP and inorganic phosphorus.
- D. To pass electrons along the ETC to NADPH.
- E. To pump protons into the thylakoid lumen.

Refer to text book Chapter 7 pg. 145

18. Protons (H^+) accumulate in the thylakoid space during electron transport between photosystem II and I. The excess protons in the thylakoid space

- A. raise the pH of the space until the processes stop.
- B. **move from the thylakoid space to the stroma through an ATP synthase complex channel that generates ATP.**
- C. convert $NADP^+$ to NADPH and generates ATP in the process.
- D. are small enough to diffuse back out through the lipid bilayer.
- E. enter the photorespiration pathway.

Refer to text book Chapter 7 Fig. 7/10

19. The reason the light reactions have both cyclic and noncyclic pathways is

- A. to ensure that ATP and NADPH are generated in a 1:1 ratio.
- B. because only the combination of pathways can generate sufficient NADPH for the light-independent reactions.
- C. to provide more electrons from water than would be released by the noncyclic pathway.
- D. **because the light-independent reactions require ATP and NADPH in different amounts than are generated by noncyclic electron flow.**
- E. because a single photon of light cannot energize a ground state electron in photosystem I's primary electron acceptor.

Refer to text book Chapter 7 Pg. 149-150

20. The exit product of the Calvin Cycle is

- A. carbon dioxide.
- B. PEP carboxylase.
- C. ribulose biphosphate (RuBP).
- D. **glyceraldehyde 3 phosphate (G3P).**
- E. ATP.

Refer to text book Chapter7 Fig. 7.14

21. Which colour of light is **least** effective in driving photosynthesis?

- A. blue
- B. red
- C. yellow
- D. **green**
- E. orange

The green wavelengths of light are not used in photosynthesis. Green light is not absorbed by the pigments but reflected away, that is why we see the leaves as green.

22. The three substrates (normal reactants) for the enzyme rubisco are

- A. RuBP, CO₂, and ATP.
- B. G3P, glucose, and CO₂.
- C. **CO₂, O₂, and RuBP.**
- D. RuBP, ATP, and NADPH.
- E. CO₂, glucose, and RuBP.

Rubnisco uses as substrates RuBP and CO₂ normally, but can also use O₂ if CO₂ levels are low. Remember its name is Ribulose-bisphosphate carboxylase oxygenase. ATP is not used refer to Fig. 7.14.

23. The light compensation point is the

- A. **irradiance (light level) at which the photosynthetic and respiratory processes are in equilibrium.**
- B. CO₂ concentration at which photosynthesis and respiration are in equilibrium.
- C. same as the CO₂ compensation point.
- D. time of the brightest light during the light period.
- E. carboxylation efficiency.

Refer to notes.

24. In which of the following processes are C4 plants more efficient than C3 plants?

- A. chemiosmosis
- B. **fixation of CO₂**
- C. transport of sugars
- D. light absorption
- E. photorespiration

C4 plants have the enzyme PEP carboxylase that is far more efficient at capturing CO₂ at lower concentrations than Rubiisco is.

25. How many molecules of ATP and NADPH are required to synthesize one molecule of glucose via photosynthetic CO₂ fixation in plants?

- A. 3 ATP and 1 NADPH
- B. 6 ATP and 2 NADPH
- C. 2 ATP and 1 NADPH
- D. **18 ATP and 12 NADPH**
- E. 9 ATP and 6 NADPH

So from our lectures we learned that we need 9 ATP and 6 NADPH molecules to get 1 G3P. Since it takes 2 G3P to make one glucose (6C) – well you do the math.

26. The enzymes of the Krebs Cycle are found in the

- A. lumen.
- B. stroma.
- C. cytoplasm.
- D. **matrix.**
- E. cytosol.

Refer to your notes.

27. Inside an active mitochondrion, most electrons follow which pathway?

- A. Krebs cycle → oxygen → electron transport chain → ATP
- B. electron transport chain → Krebs cycle... → ATP
- C. glycolysis → NADH → oxidative phosphorylation → ATP → oxygen
- D. **Krebs cycle → NADH → electron transport chain → oxygen**
- E. pyruvate → Krebs cycle → ATP → NADH... → oxygen

Refer to the lecture notes and Chapter 7.

28. All of the following are functions of the Krebs cycle **except**

- A. production of ATP.
- B. production of NADH.
- C. production of FADH₂.
- D. release of CO₂.

E. **transferring electrons and protons to oxygen to form water.**

This is part of the electron transport chain not the Krebs cycle. Chapter 6 Fig. 6.16

29. If a 12 carbon fatty acid enters the respiratory pathway as **Acetyl CoA**, what is the theoretical total number of ATP molecules that can be produced by the Krebs Cycle followed by oxidative respiration?

- A. 12
- B. 38
- C. 72
- D. **144**
- E. 288

Fatty acids do not go through Glycolysis.

They are able to enter oxidative respiration as Acetyl -CoA. So a 12 carbon fatty acid would give 6 acetyl CoA molecules. One Acetyl CoA gives approx. 24 ATPs. so 6 would give approx. 144.

30. How many ATP molecules are gained by substrate-level phosphorylation from the complete breakdown of a single molecule of glucose in the presence of oxygen?

- A. 2
- B. **4**
- C. 6
- D. 34
- E. 38

We net 2 from Glycolysis and get 2 from the Krebs cycle per glucose molecule.

31. What kind of metabolic poison would most directly interfere with glycolysis?

- A. An agent that binds to pyruvate and inactivates it
- B. **An agent that closely mimics the structure of glucose but is not metabolized**
- C. An agent that reacts with oxygen and depletes its concentration in the cell
- D. An agent that inhibits the formation of acetyl coenzyme A
- E. An agent that reacts with NADH and oxidizes it to NAD⁺

Of the choices above only B would directly interfere with Glycolysis.

32. Hydrogen ions flowing through a cylinder rotate the cylinder and attached rod much like flowing water rotates a turbine. This analogy best describes

- A. the Krebs cycle.
- B. formation of NADH in glycolysis.
- C. oxidative phosphorylation.
- D. **ATP synthase activity.**
- E. the electron transport system.

Text book Chapter 6 Fig. 6.17

33. Each ATP molecule contains about 1% of the amount of chemical energy in a single glucose molecule. Cell respiration produces about 38 ATP from one glucose molecule. What happens to the rest of the energy in the glucose?

- A. It is stored as fat.
- B. It is stored as starch.
- C. **It is converted to heat.**
- D. It is used directly for energy.
- E. It is used to make water from hydrogen ions and oxygen atoms.

The rest of the energy is waste heat.

34. There are eight total steps in the Krebs cycle. Pyruvate is completely oxidized during Step 3 and Step 4.

What is the purpose of Steps 5, 6, 7 and 8?

- A. To replenish the supplies of NAD⁺ and FAD
- B. To break down glucose into a three-carbon molecule
- C. **To regenerate oxaloacetate**
- D. To produce ATP by substrate-level phosphorylation
- E. To produce ATP by oxidative phosphorylation

Text book Chapter 6 Fig. 6.14

35. Oxygen acts as a final electron acceptor in respiration and is ultimately converted into which molecule?

- A. **H₂O**
- B. ATP
- C. CO₂
- D. glucose
- E. oxaloacetate

Text book Chapter 6 Fig. 6.15

36. Which is **not** a major enzyme of DNA replication?

- A. RNA primase
 - B. DNA polymerase
 - C. **DNA primase (Lecture 13 Figure 13.12)**
 - D. Topoisomerase
-

37. What is **true** of pyrimidines?

- A. **single ring structure (Lecture 13 Figure 13.4)**
 - B. double ring structure
 - C. attach to the deoxyribose carbon 3
 - D. two pyrimidines are held together by three hydrogen bonds
-

38. New nucleotides bind to a polypeptide chain by what type of bonding?

- A. 5'3' diester
 - B. 5'3' phosphodiester
 - C. **3'5' phosphodiester (Lecture 13 Figure 13.10)**
 - D. hydrogen
-

39. In the Meselson and Stahl experiment, the DNA in the parental generation was all ¹⁵N¹⁵N, and after one round of replication the DNA was all ¹⁵N¹⁴N. After three rounds of replication, what ratios of DNAs were seen?

- A. one ¹⁵N¹⁴N : one ¹⁴N¹⁴N
 - B. one ¹⁵N¹⁴N : two ¹⁴N¹⁴N
 - C. **one ¹⁵N¹⁴N : three ¹⁴N¹⁴N (Lecture 14 Figure 13.6)**
 - D. one ¹⁵N¹⁴N : four ¹⁴N¹⁴N
-

40. What describes a DNA solenoid?

- A. **6 nucleosomes per turn (Lecture 13 Figure 13.18)**
 - B. 10nm chromatin fibre
 - C. beads on a string
 - D. active DNA
-

41. Which of the following is a post-transcriptional modification?

- A. 5' polyadenylation
 - B. 3' guanine capping
 - C. **splicing (Lecture 15 Figure 14.8)**
 - D. exon shuffling
-

42. How does transcription in a prokaryotic cell differ from transcription in a eukaryotic cell?

- A. existence of exons and introns in pre-mRNA
 - B. existence of 5'UTR and 3'UTR mRNA
 - C. **location of transcription in cell (Lecture 15 Figure 14.3)**
 - D. existence of pre-mRNA processing
-

43. If a DNA template strand with a sequence of 3' CAAATTGG 5' is being transcribed, what is the sequence generated?

- A. 5' GTTTAACC 3'
 - B. 5' CCAATTTG 3'
 - C. **5' GUUUAACC 3' (Lecture 15 Figure 14.4)**
 - D. 5' CCAUUUUC 3'
-

44. During translation, a methionine bound to a tRNA is in the P site, and a phenylalanine bound to a tRNA is in the A site.

What is the order of the next four steps?

Step 1 the ribosome translocates

Step 2 a new aminoacyl-tRNA enters the A site

Step 3 peptidyl transferase catalyzes a peptide bond between the two amino acids

Step 4 empty tRNA is released from the ribosome

- A. Step 1,2,3,4
B. Step 3,1,4,2 (Lecture 16 Figure 14.15)
 C. Step 3,4,2,1
 D. Step 1,2,4,3

45. How does translation terminate in eukaryotic cells?

- A. terminator codon binds to the A site
 B. terminator codon binds to the P site
C. release factor binds to the terminator codon (Lecture 16 Figure 14.16)
 D. terminator tRNA binds to the terminator codon

46. A part of an mRNA molecule with the sequence 5' UGCGCA 3' is being translated by a ribosome. The following activated tRNA molecules are available. What two amino acids form a dipeptide bond?

tRNA Anticodon	Amino Acid
3'GGC5'	Proline
3'CGU5'	Alanine
3'UGC5'	Threonine
3'CCG5'	Glycine
3'ACG5'	Cysteine

- A. cysteine-alanine (Lecture 16 Figure 14.11)**
 B. proline-cysteine
 C. glycine-cysteine
 D. threonine-glycine

47. How does "chromatin remodeling" activate gene expression?

- A. proteins initiating transcription disengage from the promoter
 B. wind DNA helix tightly around nucleosomes
 C. deacetylates histones
D. recruits a protein complex that displaces nucleosomes from the promoter (Lecture 17 Figure 15.7)

48. What is a difference between miRNA and siRNA gene regulation?

- A. how dicer cuts the stem loop
 B. only one inhibits translation
 C. only one degrades mRNA
D. location of synthesis (Lecture 17 Figure 15.13)

49. Where in the cell do DNA replication, transcription and translation occur respectively?

- A. nucleus, nucleus, nucleus
B. nucleus, nucleus, cytoplasm (Lecture 15 Figure 14.3)
 C. nucleus, cytoplasm, cytoplasm
 D. cytoplasm, cytoplasm, cytoplasm

50. Which of the following is **not** a "non-protein coding gene"?

- A. rRNA
 B. tRNA
C. RNA polymerase (Lecture 17 overhead)
 D. snRNA

Bonus Question

51. The skunk cabbage plant uncouples proteins from the ETC resulting in
- A. increased amounts of ATP production.
 B. decreased sugar metabolism.
C. increased internal tissue temperature.
 D. decreased mitochondrial catabolism.
 E. increased cytosolic pH.

ATP production is halted and the energy directed to produce heat which the plant uses to flower very early in the season.