

This exam consists of 40 questions spreading like the plague over six pages. There is a codon chart provided for your viewing pleasure on the last page. If you don't know what this is used for, you're in big trouble. Good luck!

The dreaded "what makes what" section. Use the key below to answer questions 1 through 6.

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|-------------------------------|--------------------------------------|
| I. Glycolysis | V. Alcohol Fermentation |
| II. Oxidation of Pyruvate | VI. Lactic Acid Fermentation |
| III. Krebs Cycle | VII. Non-cyclic Photophosphorylation |
| IV. Oxidative Phosphorylation | VIII. Cyclic Photophosphorylation |
| | IX. Calvin-Benson Cycle |

- How many of the above processes have a net production of ATP?
A. Three B. Four **C. Five** D. Six E. Seven
- How many of the above processes have a net production of either NADH or NADPH?
A. Three **B. Four** C. Five D. Six E. Seven
- Which of the above processes have a net production of CO₂?
A. II, III B. II, III, IV C. II, III, VI D. II, III, V, VI **E. None of the above**
- Which of the above processes utilize an H⁺ gradient?
A. VII, VIII B. II, IV **C. IV, VII, VIII** D. II, IV, VII, VIII
- Which of the above processes produce O₂?
A. IV only **B. VII only** C. VIII only D. VII, VIII E. IV, VII, VIII
- Which of the above systems convert NADH to NAD⁺?
A. IV only B. III, IV C. IV, V **D. IV, V, VI** E. III, IV, V, VI
- A small acorn over time can grow into a huge oak tree. The wood in such a tree can weigh many tons, even after it has been cut into logs and dried. Where does most of this biomass (dry mass) come from as the tree grows?
A. Minerals in the soil B. Organic matter in the soil
C. The air D. Sunlight
E. None of the above
- Guthion is a chemical that binds to Complex IV of the mitochondrial electron transport system. This prevents Complex IV from donating its electron to oxygen. What would happen if a fly were exposed to a large amount of guthion?
A. It would live with little to no effects
B. It would live, but with difficulty
C. It would die shortly after exposure
D. Most would die, but some would survive if they were transformed
E. Who cares, it is only a fly

9. Which of the following statements (A-D) about ATP production in plants is FALSE? If statements A-D are TRUE, then choose E.
- A. Plant cells can generate ATP in their cytoplasm, the chloroplast, and the mitochondria
 - B. On a warm, humid summer day, most of the ATP production of a cell would occur in the chloroplast
 - C. Later on at midnight, most of the ATP production in the same cell would occur in the mitochondria
 - D. ATP synthesis in both the mitochondria and the chloroplast utilizes a membrane-bound proton pump to generate potential energy
 - E. All of the above statements about ATP production in plants are TRUE.**

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11. Complex II is an enzyme that oxidizes FADH_2 in the mitochondria. What would happen if Complex II were destroyed in the electron transport system of a yeast cell and a human cell?
- A. Nothing, both cells could utilize NADH to supply the system with electrons, H^+ would be pumped, and ATP could be synthesized
 - B. The cell could still produce most of its ATP from NADH, but there would be some loss due to the loss of electrons from FADH_2
 - C. Eventually the Krebs cycle would shut down and the human cell would die. The yeast cell could survive by generating ATP from glycolysis**
 - D. Eventually the Krebs cycle would shut down in the yeast cell and the cell could only generate ATP from NADH produced in glycolysis. There would be little effect on the human cell
 - E. Both cells would die
12. Which of the following statements is FALSE about a chloroplast in which all of the PSII (p680) were destroyed but the PSI (p700) and the rest of the electron transport systems were still fully functional?
- A. The chloroplast could still produce ATP
 - B. The chloroplast could still produce NADPH**
 - C. The chloroplast could still perform cyclic photophosphorylation but not non-cyclic photophosphorylation
 - D. The chloroplast would still be able to generate an H^+ gradient
 - E. Oxygen would not be generated when light was present
13. Which molecule is responsible for pumping the H^+ across the thylakoid membranes in the light-dependent reactions of photosynthesis?
- A. PSII (p680)
 - B. Phaeophytin
 - C. Plastoquinone**
 - D. Cytochrome complex
 - E. Plastocyanin

14. Which of the following statements (A-D) about photorespiration is FALSE? If statements A-D are true, then choose E.
- A. Photorespiration is bad for the plant (I will be very upset if you choose this one...)
 - B. Photorespiration is more commonly seen in C3 plants than C4 plants
 - C. The phosphoglycolate produced by photorespiration has many uses in the plant**
 - D. Repairing the damage caused by photorespiration can cost the plant up to 40% of its total net photosynthetic gain
 - E. All of the above statements are TRUE
15. Why would a muscle cell sometimes perform lactic acid fermentation if it produces so much less ATP and produces a poison (lactic acid)?
- A. Muscle cells can recycle the lactic acid and produce pyruvate
 - B. Lactic acid fermentation regenerates NAD⁺**
 - C. Muscle cells must perform lactic acid fermentation to bulk up and improve efficiency
 - D. Lactic acid fermentation produces ATP which oxygen-starved muscles need
 - E. Muscle cells are just weird and like to poison themselves
16. During which of the below activities would there be a substantial amount of lactic acid fermentation in your muscles?
- A. Sleeping
 - B. Sitting in class, listening intently to my lectures
 - C. Walking to class
 - D. Intense exercise**
 - E. All of the above
17. During beta oxidation, how do molecules enter the Krebs cycle?
- A. As pyruvate
 - B. As Acetyl CoA**
 - C. As Beta CoA
 - D. As CO₂
 - E. Molecules don't enter the Krebs cycle during beta oxidation
18. Which of the following comparisons between aerobic respiration and photosynthesis is FALSE?
- A. Both processes synthesize ATP through the generation of H⁺ gradients via electron transport systems
 - B. Photosynthesis breaks a water molecule to produce oxygen gas and ultimately give that electron to an electron carrier molecule (NADP) while respiration takes electrons from electron carrier molecules (NADH and FADH₂) and ultimately donates them to oxygen gas to produce water
 - C. Both photosynthesis and aerobic respiration are exergonic**
 - D. Both photosynthesis and aerobic respiration have a net production of ATP
 - E. Oxidation and reduction of molecules are important in both process
19. NADPH is an electron carrier molecule which carries high-energy electrons from the thylakoid membranes to be utilized in the Calvin Cycle. How are the high-energy electrons initially energized?
- A. They are energized by the pigment molecules in the antenna complex
 - B. They are energized by the lysis of a water molecule
 - C. They are energized by ATP hydrolysis
 - D. They are energized by absorption of photons**
 - E. None of the above

20. Which process produces the most ATP?
 A. Oxidation of pyruvate
C. Oxidative phosphorylation
 E. Lactic Acid Fermentation
- B. Krebs Cycle
 D. Glycolysis
21. Which of the following results of the Meselson & Stahl experiment would you expect for the second round of DNA synthesis if DNA synthesis were dispersive?

15/15

15/14

14/14

A B C D E

Matching - match the scientist on the left to their contribution to science on the right

- | | | |
|------------------------|----------|---|
| 22. Watson & Crick | A | A. Proposed the double helix model of DNA |
| 23. Frederick Griffith | D | B. Demonstrated that DNA was the molecule of heredity |
| 24. Hershey & Chase | B | C. X-ray crystallographer who had her work stolen by other scientists |
| | | D. First demonstrated bacterial transformation |
| | | E. Provided evidence that DNA replication was semi-conservative |

Matching - match the enzyme on the left to its function on the right

- | | | |
|------------------------|----------|--|
| 25. Topoisomerase | E | A. RNA polymerase that creates a primer during DNA replication |
| 26. RNA polymerase II | B | B. Produces mRNA |
| 27. DNA polymerase III | C | C. Performs the majority of DNA synthesis |
| | | D. Removes RNA primers |
| | | E. Removes supercoils |

28. Which of the following statements (A-D) about protein synthesis is FALSE? If statements A-D are true, then choose E.
- A. Uncharged tRNA's are destroyed as they no longer have amino acids attached**
 B. The anti-codon of a tRNA is complementary to a codon of the mRNA
 C. There are three stop codons
 D. Translation will occur until a stop codon is reached
 E. All of the above statements about protein synthesis are TRUE

Use the following non-template strand of DNA to answer questions 29-31

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5' C A A A A G G A T G G C C A T G C A G T T G T A A C C G G C 3'

29. How many amino acids are initially in the protein encoded by this gene?
A. Four **B. Five** C. Six D. Seven E. Eight
30. What is the third amino acid in the protein encoded by this gene
A. Aspartic Acid **B. Methionine** C. Threonine D. Argenine
E. Proline
31. What type of mutation would occur if the A were changed to a T?
A. Silent **B. Missense** C. Nonsense D. Frame shift
32. What amino acid is attached to the tRNA with the following anticodon: 5' CUG 3'
A. Leucine B. Valine **C. Glutamine** D. Aspartic Acid
33. Three consecutive nucleotide bases are removed from a gene in an area that codes for protein (i.e. not in the start or stop codon). Will this cause a frameshift mutation?
A. Yes **B. No**
C. Possibly, depending on which three bases are removed
34. During the elongation phase of protein synthesis, the _____ is the open site with an exposed codon where the tRNA can try to match their anticodons
A. **A Site** B. P Site C. E Site D. X Site
35. Which protein is incorrectly matched with its function?
A. Single-strand DNA-binding proteins – keep single stranded DNA from binding with itself
B. Helicase – Unwinds DNA
C. Primase – creates a primer for RNA polymerase II
D. RNA Polymerase II – transcribes mRNA
E. Ligase – joins DNA nicked by topoisomerase
36. Which of the followings statements (A-D) about DNA replication is FALSE? If statements A-D are true, then choose E.
A. In eukaryotes, there is only one origin of replication found on each chromosome
B. The leading strand is the strand of DNA in a replication fork in which DNA polymerase III synthesizes DNA in the same direction as helicase is opening DNA
C. Ligase activity is much greater on the lagging strand than the leading strand
D. Topoisomerase removes supercoils created by helicase by nicking DNA, allowing the DNA to spin and release the stored potential energy. Ligase then reseals the DNA
E. All of the above statements about DNA replication are TRUE

37. Pretend for a moment that protein was the molecule of heredity, not DNA. What would have been the results of the Hershey-Chase experiment if this were true?
- A. The radioactivity in the ^{35}S samples and the ^{32}P samples would both be in the pellet.
 - B. The radioactivity in the ^{35}S samples and the ^{32}P samples would both be in the liquid.
 - C. The radioactivity in the ^{35}S samples would be in the liquid. The radioactivity in the ^{32}P samples would be in the pellet.
 - D. The radioactivity in the ^{35}S samples would be in the pellet. The radioactivity in the ^{32}P samples would be in the liquid.**
 - E. None of the above
38. DNA replication is:
- A. Conservative
 - B. Semi-Conservative**
 - C. Dispersive
 - D. Liberal
 - E. Apolitical
39. Which of the following molecules can fit into the active site of Rubisco?
- A. O_2
 - B. CO_2
 - C. ATP
 - D. A & B**
 - E. A, B, & C
40. What is the chemical relationship between one of the substrates and the allosteric inhibitor of phosphofructokinase?
- A. They are the same molecule**
 - B. The allosteric inhibitor can bind to the substrate**
 - C. The allosteric inhibitor is a break-down product of the substrate
 - D. The allosteric inhibitor is a polymer of the substrate
 - E. There is no chemical relationship between these two molecules

I accepted both answers for this question. Answer A was supposed to be the right answer, but I later realized that Answer B was also correct. Whoops!

Question 3 was a typo - the correct answer should have been II, III, V, but I mistyped one of the answers. Therefore, answer E was the correct answer, however, II and III do produce CO_2 and the question doesn't state that I was looking for ALL of the processes, so I accepted both.