

There are 29 multiple choice questions, each worth 3 points (87 points total). The remaining questions are worth the values indicated. Total points on this exam is 100 points. There is a 75 minutes time limit for this exam. Good luck! Be sure to (i) circle the correct response among the list of responses and (ii) Show the letter of the correct response to the right of the answer in the space shown.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Digestion of carbohydrates begins in the

- A) small intestine.
- B) stomach.
- C) pancreas.
- D) large intestine.
- E) mouth.

1) E

2) The synthesis of glycogen from glucose is called

- A) glycogenesis.
- B) gluconeogenesis.
- C) glucogenesis.
- D) glyceration.
- E) glycolysis.

2) A

3) In the process of glycolysis, glucose is converted to

- A) pyruvate.
- B) sucrose.
- C) oxaloacetate.
- D) citrate.
- E) ribose.

3) A

4) The process by which complex molecules are broken down into simpler ones for the body's use is called

- A) gluconeogenesis.
- B) anabolism.
- C) metabolism.
- D) catabolism.
- E) glucogenesis.

4) D

5) When glycogen is broken down into glucose, the process is called

5) D

- A) glycogenesis.
- B) gluconeogenesis.
- C) glucagon production.
- D) glycogenolysis.
- E) lactate production.

6) The process of glycolysis is regulated by

6) E

- A) cell requirements for pyruvate.
- B) feedback inhibition.
- C) ATP needs.
- D) allosteric control.
- E) All of the above.

7) FAD stands for

A or E

- A) flavin adenosine dinucleotide.
- B) folate adenosine diphosphate.
- C) fumarate alcohol dehydrogenase.
- D) folic acid diphosphate.
- E) flavin adenine dinucleotide.

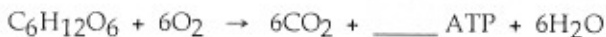
8) In biochemical systems, the term *reduction* often refers to

8) A

- A) a gain of hydrogen or electrons by a compound.
- B) an energy-releasing reaction.
- C) a loss of hydrogen or electrons by a compound.
- D) a gain in oxygen.
- E) a loss of electrons.

9) What is the correct coefficient for net ATP yield in the complete combustion of glucose (meaning going from glucose to pyruvate to acetyl coenzyme A to Citric Acid cycle to electron transport pathway) would be what? This is NET production of ATP.

9) B



A) 6

B) 36

C) 18

D) 12

E) 24

10) Cyanide ion and carbon monoxide (because of their similar structure to oxygen) inhibit the enzyme that oxidizes cytochrome c in the electron transport pathway, so the correct answer below would be:

10) C

- A) ATP production.
- B) antibiotic activity.
- C) cytochrome c oxidase.
- D) CoA formation.
- E) CoQ formation.

11) In the hydrolysis of succinyl CoA in step 5 of the citric acid cycle, CoA is released as

11) D

- A) CoA-COO^- .
- B) CoA-OH .
- C) CoA-O^- .
- D) CoA-SH .
- E) CoA-S^- .

12) The citric acid cycle is used in the oxidation of

12) A

- A) glucose, fatty acids, and many of the amino acids.
- B) glucose only.
- C) fatty acids only.
- D) glucose and fatty acids only.
- E) amino acids only.

13) The process which requires oxygen to produce carbon dioxide and water is called

13) A

- A) respiration.
- B) fermentation.
- C) decomposition.
- D) reduction.
- E) oxidation.

14) Another name for the citric acid cycle is

14) E

- A) gluconeogenesis.
- B) glucose hydrolysis.
- C) oxidative phosphorylation.
- D) the chemiosmotic pump.
- E) the Krebs cycle.

15) When combined with the electron transport chain, one turn of the citric acid cycle is ultimately responsible for _____ ATP molecules.

- A) 24 B) 2 C) 12 D) 14 E) 11

15) C

16) Most of the energy released in the citric acid cycle is used to produce

- A) acetyl CoA.
B) citric acid.
C) carbon dioxide and water.
D) glucose.
E) NADH and FADH₂ (which can then transfer electrons to electron transport chain.)

16) E

17) The compounds in the respiratory chain that remove hydrogen ions and electrons from NADH are classified as

- A) phosphorylators.
B) oxidative transporters.
C) osmotic carriers.
D) electron carriers.
E) citrates.

17) D

18) When oxygen (aerobic conditions) is in plentiful supply in the cell, pyruvate is converted to

- A) glucose.
B) CoA.
C) acetyl CoA.
D) fructose.
E) lactate.

18) C

19) Which step is found in the breakdown of a fat?

- A) an oxidation with a cytochrome.
B) an activation (when you attach Coenzyme A) that requires 2 ATP.
C) direct substrate phosphorylation.
D) an oxidation with CoQ.
E) production of pyruvate.

19) B

20) When excess acetyl CoA accumulates in the liver, a pathway in which you produce compounds with ketone groups in the compound, is called _____ would be initiated. 20) E

- A) transamination
- B) emulsification
- C) glycolysis
- D) gluconeogenesis
- E) ketogenesis

21) Which of the following does NOT require NAD⁺ ?

- A) transamination
- B) β -oxidation
- C) glycolysis
- D) oxidative deamination
- E) citric acid cycle

Credit
21) A

22) Fatty acids and glycerol are produced from the metabolism of

- A) carbohydrates.
- B) amino acids.
- C) proteins.
- D) lipids.
- E) glucose.

22) D

23) The 2-carbon units obtained by degradation of a fatty acid, which occurs in the mitochondria, are further metabolized in

- A) glycolysis.
- B) gluconeogenesis.
- C) transamination.
- D) the citric acid cycle.
- E) β -oxidation.

23) D

24) The action of pancreatic lipase on triacylglycerols produces

- A) micelles.
- B) low-density lipoproteins.
- C) high-density lipoproteins.
- D) monoacylglycerols and free fatty acids.
- E) emulsions.

Credit
24) D

25) Beta-oxidation takes place in the

- A) cytosol.
- B) cytoplasm.
- C) nucleus.
- D) mitochondrial matrix.
- E) Golgi body.

25) D

26) The digestion of protein begins in the

- A) pancreas.
- B) stomach.
- C) small intestine.
- D) large intestine.
- E) mouth.

26) B

27) The primary fuel for the synthesis of ATP is

- A) glucose.
- B) ammonia.
- C) GTP.
- D) lactate.
- E) protein.

27) A

28) The series of reactions that produces energy by hydrolyzing fats to units of acetyl CoA is called

- A) hydration.
- B) β -reduction.
- C) β -oxidation.
- D) transamination.
- E) hydrolysis.

28) C

29) In the activation of a fatty acid, energy from the hydrolysis of ATP is used to

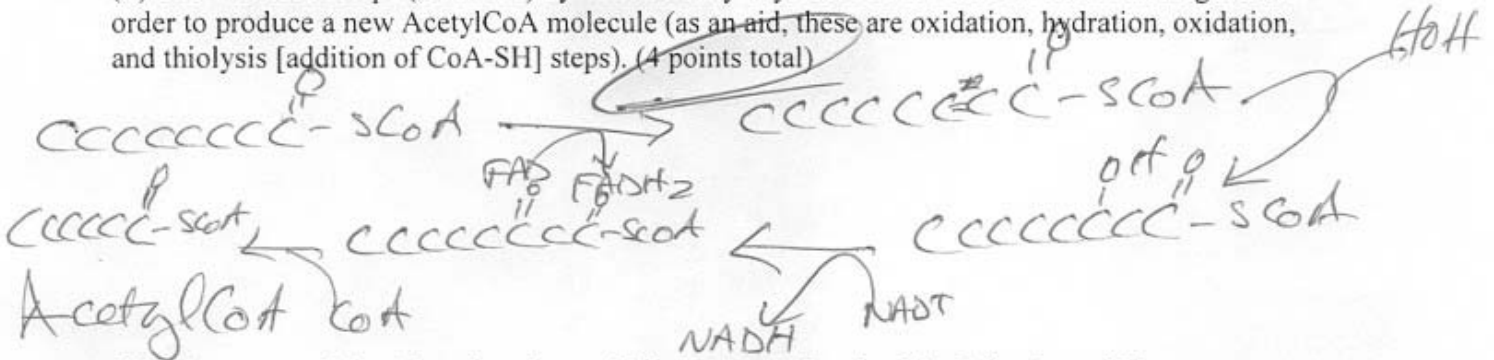
- A) oxidize the hydroxyl group on the β -carbon.
- B) cause a unit of acetyl CoA to separate from the fatty acid chain.
- C) form a double bond in an oxidation reaction.
- D) join the fatty acid to CoA.
- E) add a molecule of water across a double bond to give a hydroxyl group on the β -carbon.

29) D

31 (9) This question relates to some of the steps used in β -oxidation of fatty acids in the cell. (i) In order to metabolize fatty acids, you must first activate the fatty acid to produce the fatty acyl CoA. This step takes energy (uses ATP). How many ATP is required for this step (1 point)?

2 ATP required

(ii) Show the four steps (reactions) by which a fatty acyl CoA in the mitochondria undergoes in order to produce a new AcetylCoA molecule (as an aid, these are oxidation, hydration, oxidation, and thiolysis [addition of CoA-SH] steps). (4 points total)



(iii) If you start with a 16-carbon fatty acid, how many of each of the following will be produced? Also what is the total ATP that would be ultimately produced? (4 points total)

<u>8</u>	Acetyl CoA molecules	$\times 12 =$	<u>84</u>
<u>7</u>	FADH ₂	$\times 2 =$	<u>12</u>
<u>7</u>	NAHH + H ⁺	$\times 3 =$	<u>18</u>
<u>131</u>	Total ATP ultimately produced		<u>114</u>

$129 - 2 = 127$

32 (4) For glycolysis, explain how you get the total number of ATP molecules that you do during aerobic metabolism.

