

Exam 1-Version A

DO NOT BEGIN THIS EXAM UNTIL INSTRUCTED TO DO SO!

!! IMPORTANT - DO THIS FIRST!!

***Fill in Test Version A and
your Student ID on your Scantron Form***

- There are **27** multiple-choice questions on this exam
- All questions have ONE and only ONE correct answer (hopefully)
- No points are awarded for a question if more than ONE answer is given
- No points are subtracted for incorrect answers (you should guess).
- ***Absolutely NO use of any electronics or notes is permitted during the exam.***

**The exam ends at 11:15.
No exams will be accepted before 11:15
(to minimize disruptions caused by students leaving early)**

You may leave ONLY after ALL scantron forms have been collected.

1. Which one of the following is used to carry around individual fatty acids in the cytosol?
 - A. Serum albumin
 - B. Apolipoproteins
 - C. Cholate
 - D. Caveolae
 - E. Fatty acid-binding proteins
2. Which of the following lipases hydrolyze fat outside the cell?
 - I. Lipoprotein Lipase
 - II. Hormone Sensitive Lipase
 - III. Human Pancreatic Lipase
 - IV. Adipose Triglyceride Lipase
 - A. I and II
 - B. I and III
 - C. II and III
 - D. II and IV
 - E. III and IV
3. Which ONE of the following fatty acids **CANNOT** be made from Oleate – 18:1($\Delta 9$) – **in HUMANS**? Humans have desaturases that can create cis-double bonds at $\Delta 4$, $\Delta 5$, $\Delta 6$, and $\Delta 9$. If ALL of them CAN be made using Oleate in humans, choose E.
 - A. 18:3 ($\Delta 4, 5, 9$)
 - B. 20:3 ($\Delta 6, 10, 11$)
 - C. 22:3 ($\Delta 6, 10, 13$)
 - D. 24:3 ($\Delta 4, 9, 15$)
 - E. All of the above fatty acids CAN be made from Oleate in humans.
4. Which ONE of the following statements about steroid hormones is **TRUE** based on what you learned in BIOC406?
 - A. Steroid receptors reside in the plasma membrane.
 - B. Steroid receptors bind to the Sterol Regulatory Elements.
 - C. Glucocorticoids suppress inflammation by inhibiting Phospholipase A2.
 - D. Steroid hormones cannot diffuse through the plasma membrane.
 - E. Arachidonates are the precursors of steroid hormones.

5. Which ONE of the lipoproteins transports excess cholesterol from extra-hepatic tissues to the liver?

- A. Chylomicron
- B. Very Low-Density Lipoprotein (VLDL)
- C. Intermediate-Density Lipoprotein (IDL)
- D. Low-density Lipoprotein (LDL)
- E. High-density Lipoprotein (HDL)

6. Which of the following is a result of treatment with Statins?

- A. LDL receptor expression is increased.
- B. HMG-CoA reductase (HMGR) is activated.
- C. The SREBP/SCAP/INSIG complex stays in the endoplasmic reticulum (ER).
- D. HMG-CoA reductase (HMGR) expression is decreased.
- E. LDL uptake from the circulation is decreased.

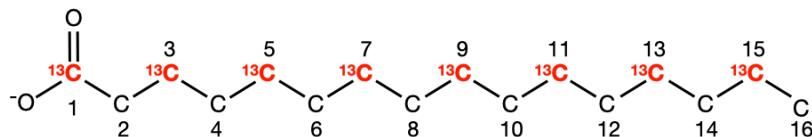
7. Which of the following statements about the difference between fatty acid synthesis and β -oxidation is **TRUE**?

- A. Fatty acid synthesis requires a dehydration reaction, and β -oxidation requires a hydration reaction.
- B. Glucagon signaling supports or enhances fatty acid synthesis.
- C. Fatty acid synthesis takes place in the mitochondrial matrix, and β -oxidation takes place in the cytosol.
- D. Fatty acid synthesis produces NADPH molecules, and β -oxidation consumes NADH and FADH₂ molecules.
- E. **None of the above** statements are true.

8. Which ONE of the following statements regarding the 26S proteasomal system is **TRUE**?

- A. Partially degraded proteins are often released from the 26S proteasomes because their processibility is low.
- B. ATP hydrolysis makes the cleavage of peptide bonds by the 20S Core Particle (CP) energetically favorable.
- C. The 19S Regulatory Particle (RP) contains a DUB (De-Ubiquitinase) that degrades polyubiquitin chains into small peptides for recycling.
- D. The conformation of the α -subunits in the 20S Core Particle (CP) is important for controlling the accessibility of substrate to the proteolytic sites in the β -subunits.
- E. All ubiquitylated proteins are destined to be degraded via the proteasome.

9. After learning about fatty acid synthesis in BIOC406, you found yourself fascinated by fatty acid synthesis. So, you decided to synthesize palmitate (16:0) in a test tube with the isotopic labeling (^{13}C) pattern shown in the image below. Which ^{13}C -labeled acetyl-CoA and malonyl-CoA do you need to add to the test tube, in addition to NADPH and human Fatty Acid Synthase (FAS), to generate this product? The carbons of the product fatty acid are numbered to help with your answer.



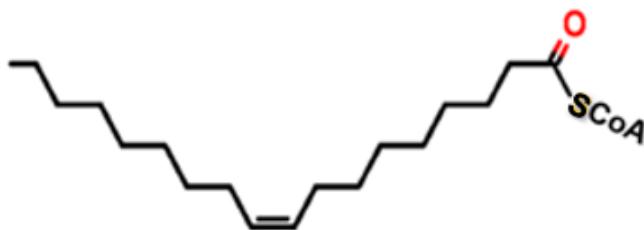
Acetyl-CoA choices	Malonyl-CoA choices
I. $\text{CoA}-\text{S}-\overset{\text{O}}{\parallel}\text{C}-\overset{\text{13C}}{\text{C}}-\overset{\text{13C}}{\text{C}}$	I. $\text{CoA}-\text{S}-\overset{\text{O}}{\parallel}\text{C}-\overset{\text{13C}}{\text{C}}-\overset{\text{13C}}{\text{C}}-\overset{\text{O}^-}{\text{O}}$
II. $\text{CoA}-\text{S}-\overset{\text{O}}{\parallel}\text{C}-\overset{\text{13C}}{\text{C}}$	II. $\text{CoA}-\text{S}-\overset{\text{O}}{\parallel}\text{C}-\overset{\text{13C}}{\text{C}}-\overset{\text{O}}{\parallel}\text{C}-\overset{\text{13C}}{\text{C}}-\overset{\text{O}^-}{\text{O}}$
III. $\text{CoA}-\text{S}-\overset{\text{O}}{\parallel}\text{C}-\overset{\text{13C}}{\text{C}}-\overset{\text{13C}}{\text{C}}$	III. $\text{CoA}-\text{S}-\overset{\text{O}}{\parallel}\text{C}-\overset{\text{13C}}{\text{C}}-\overset{\text{13C}}{\text{C}}-\overset{\text{O}^-}{\text{O}}$

- A. Acetyl-CoA: (I) and Malonyl-CoA: (I)
- B. Acetyl-CoA: (II) and Malonyl-CoA: (II)**
- C. Acetyl-CoA: (III) and Malonyl-CoA: (III)
- D. Acetyl-CoA: (III) and Malonyl-CoA: (II)
- E. Acetyl-CoA: (II) and Malonyl-CoA: (III)

10. On Saturday, I ate a double cheeseburger with large fries and Sprite for lunch. Then, I came back to my office and wrote these exam questions. After sitting in front of my computer for an hour, I was drowsy, but I couldn't stop thinking about what molecular events might be happening inside my body based on what I had taught in the BIOC406 lectures. Which of the following events would have happened?

- I. Dephosphorylation of ACC (Acetyl-CoA Carboxylase)
 - II. Activation of CAT-1 (Carnitine Acyl-transferase-1)
 - III. Decrease in citrate transport from mitochondria to the cytosol
 - IV. Polymerization of ACC (Acetyl-CoA Carboxylase)
- A. I and II
 - B. I and III
 - C. I and IV**
 - D. II and III
 - E. II and IV

11. How many FADH₂ and acetyl-CoA are produced by completely oxidizing Oleoyl-CoA 18:1 ($\Delta 9$) via β -oxidation? The Oleoyl-CoA structure is shown in the image. To completely oxidize Oleoyl-CoA into Acetyl-CoA, Enoyl-CoA isomerase and/or 2,4 Dienoyl-CoA reductase may be needed.



- A. 6 FADH₂ and 9 acetyl-CoA
- B. 7 FADH₂ and 8 acetyl-CoA
- C. 7 FADH₂ and 9 acetyl-CoA
- D. 8 FADH₂ and 8 acetyl-CoA
- E. 8 FADH₂ and 9 acetyl-CoA

12. Which of the following statements regarding protein degradation is **FALSE**?

- A. Autophagosomal cargos are surrounded by two separate membrane bilayers.
- B. V-type ATPases located in the lysosomal membrane use ATP to transport protons (H⁺) across the lysosomal membrane.
- C. Lysine residues on Ubiquitin are not subjected to ubiquitylation.
- D. Modification of a protein with Ubiquitin can be reversed by the action of De-Ubiquitinases (DUBs).
- E. Proteolytic cleavage is a common way to activate the serine proteases that we use to digest dietary proteins in the small intestinal lumen.

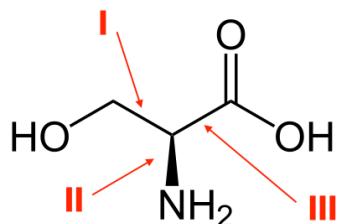
13. Which ONE of the following statements regarding cholesterol synthesis and regulation is **FALSE**?

- A. The reaction catalyzed by HMG-CoA reductase (HMGR) is the committed step in cholesterol biosynthesis.
- B. Dephosphorylation of HMGR by Protein Phosphatase 2A (PP2A) decreases its activity.
- C. Farnesyl Pyrophosphate is formed by head-to-tail condensation of three isoprenoid units.
- D. The activated 5-carbon intermediate Isopentyl Pyrophosphate is also used to synthesize heme A.
- E. Complex formation between INSIG and HMGR in the ER membrane induces degradation of HMGR via the Ubiquitin-proteasome system.

14. Which of the following drugs are **CORRECTLY** paired with their targets?

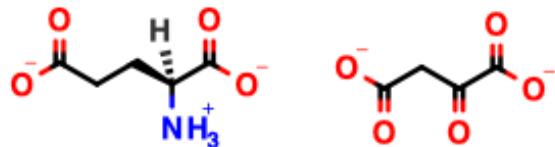
- I. Velcade – V-type ATPase
 - II. Statins – HMG CoA Reductase (HMGR)
 - III. Orlistat – Lipoprotein Lipase
 - IV. Aspirin – PGH₂ Synthase (a Cyclooxygenase)
- A. I only
- B. I and III only
- C. II and IV only**
- D. I, II, and IV
- E. II, III, and IV

15. Which of the following bonds **CAN** be cleaved by an enzymatic reaction involving Pyridoxal Phosphate (PLP)?



- A. I only
- B. II only
- C. I and II only
- D. II and III only
- E. I, II, and III**

16. What are the products of the transamination reaction using the substrates shown in the image?



- A. Pyruvate and Glutamate
- B. Oxaloacetate and Alanine
- C. Glutamine and Pyruvate
- D. α -ketoglutarate and Aspartate**
- E. N-acetyl-glutamate

17. Which ONE of the following statements regarding fat absorption and storage is **FALSE**?

- A. Oxidization of fat yields more energy than oxidation of glucose.
- B. Water is excluded from the hydrophobic core of lipid droplet.
- C. Dietary fat is directly transported across the plasma membrane of intestinal cells.
- D. Bile salts help dietary fat absorption by emulsifying fat globules in the intestinal lumen.
- E. Human Pancreatic Lipase (HPL) requires both colipase and contact with mixed micelle to stabilize its active conformation.

18. Which ONE of the following conditions would **NOT** decrease β -oxidation in the liver based on what you learned in BIOC406?

- A. An increase in Malonyl-CoA levels in the cytosol.
- B. A decrease in carnitine levels in the mitochondrial intermembrane space.
- C. A decrease in Palmitoyl-CoA generation in the mitochondrial matrix.
- D. An increase in ketone body export.
- E. A decrease in CoA levels in the mitochondrial matrix.

19. Which ONE of the following statements about fatty acid synthesis in humans is **FALSE**?

- A. The Biotin cofactor attached to the Biotin Carboxyl Carrier Protein (BCCP) domain of Acetyl-CoA Carboxylase (ACC) is required to remove a carboxyl group from Malonyl-CoA.
- B. Once a growing fatty acyl chain is added to the thiol group of the KS domain, ACP needs to pick up a Malonyl group to continue another cycle.
- C. Synthesis of Malonyl-CoA by ACC requires ATP hydrolysis to make the reaction exergonic.
- D. The reaction catalyzed by MAT (Malonyl/Acetyl-CoA-ACP Transacylase) is reversible.
- E. CO₂ release during condensation of the Malonyl group attached to ACP with a growing fatty acyl chain attached to KS (β -ketoacyl-ACP Synthase) makes the reaction irreversible.

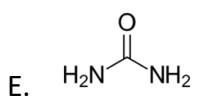
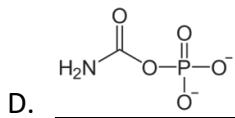
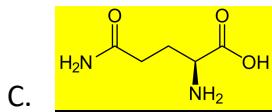
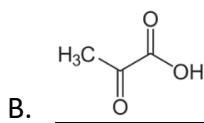
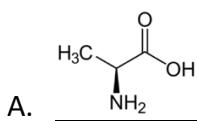
20. Which ONE of the following statements regarding Urea and its synthesis is **FALSE**?

- A. One nitrogen atom in urea is derived from carbamoyl-phosphate.
- B. Synthesis of Carbamoyl Phosphate by Carbamoyl Phosphate Synthase-I (CPS-I) takes place in the mitochondrial matrix.
- C. Glutamate Dehydrogenase generates free ammonia by converting Glutamine to Glutamate.
- D. NADH generated during the conversion of Malate to Oxaloacetate can be used to offset the energetic cost of the Urea Cycle.
- E. Ornithine is transported back to the mitochondrial matrix during the Urea cycle.

21. Which of the following conditions would SUPPORT or ENHANCE the synthesis of Ketone bodies?

- A. When glycogen levels are increased in the liver.
- B. When oxaloacetate (OAA) is used for gluconeogenesis in the liver.
- C. When β -oxidation is decreased in the liver.
- D. When blood sugar levels increase after having meatball spaghetti.
- E. When the TCA cycle is actively running in the liver.

22. Which ONE of the following molecules is used to transport nitrogen/ammonia produced **in adipose tissues to the liver in the circulation?**



23. Which ONE of the following takes place in the mitochondrial matrix?

- A. Generation of HMG-CoA for Ketone body synthesis
- B. Generation of Malonyl-CoA for fatty acid synthesis
- C. Generation of fatty acids by Lipoprotein lipase (LPL)
- D. Generation of cAMP by Adenylate Cyclase during Glucagon signaling
- E. Generation of Squalene for cholesterol synthesis

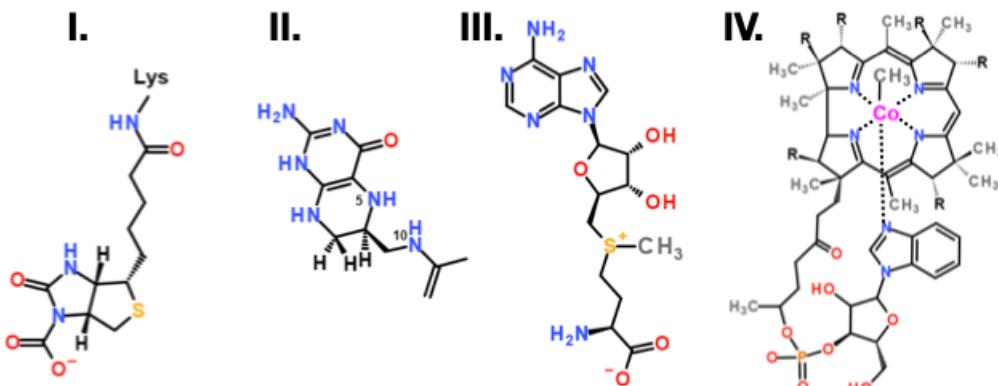
24. Which ONE of the following digestive proteases initiates the cascade of proteolytic cleavages to activate zymogens in the small intestine?

- A. Enteropeptidase
- B. Trypsin
- C. Chymotrypsin
- D. Carboxypeptidase
- E. Pepsin

25. Which of the following are used for the excretion of extra nitrogen/NH₃ in the muscle?

- I. Pyruvate
 - II. Bicarbonate (HCO₃⁻)
 - III. Pyridoxal Phosphate (PLP)
 - IV. NAD+
- A. I and III only
- B. II and IV only
- C. I, II, and III only
- D. I, III, and IV only
- E. I, II, III, and IV

26. Which of the following cofactors are used in the transfer of one carbon units in the reactions for converting Propionyl-CoA to Succinyl-CoA during the degradation of Isoleucine or Valine?



- A. I and II
- B. I and III
- C. I and IV
- D. II and III
- E. III and IV

27. Which of the following fatty acids can contribute to the formation of Methylmalonate in Methylmalonic acidemia (MMA) patients?

I. 19:2 cis-Δ9, Δ12

II. 23:1 cis-Δ12

III. 19:1 cis-Δ9

A. I only

B. II only

C. II and III only

D. I and II only

E. I, II, and III