Exam III Name:_____

Image that you have just washed up on an uninhabited tropical island. There are lots of unfamiliar plants that may or may not be poisonous. Fortunately, you find that a previous castaway planted beets on the island; some of which remain! Beets contain high amounts of carbohydrates but low amounts of arginine. You know this is not going to be a problem for you. You gorge yourself on beets and begin to daydream about what is happening within your body…

1. Approximately 30 minutes after gorging on beets, which of the following hormones has increased in concentrations in your blood stream?

Insulin Glucagon Epinephrine

2. This hormone was released by:

Cardiac myocytes Pancreatic α-cells Pancreatic β-cells Hepatocytes

Lipocytes Neurons Skeletal myocytes LDL

3. This hormone signal leads to the activation of:

Protein Kinase A (PKA) Phosphoprotein Phosphatase 1 (PP1)

Adenylate Cyclase (AC) Yummy Beet 2 (YB-2)

4. In general, the level of phosphorylation of the enzymes of carbohydrate and lipid metabolism is:

Increasing Decreasing Remaining Unchanged

5. The overall rate of glycolysis within hepatocytes is:

Increasing Decreasing Remaining Unchanged

i. The activity of phosphofructokinase 2 within hepatocytes is:

Increasing Decreasing Remaining Unchanged

ii. The activity of aldolase within hepatocytes is:

Increasing Decreasing Remaining Unchanged

iii. The activity of fructose-2,6-bisphosphatase within hepatocytes is:

Increasing Decreasing Remaining Unchanged

iv. The concentration of fructose-2,6-bisphosphate within hepatocytes is:

Increasing Decreasing Remaining Unchanged

6. The overall rate of gluconeogenesis within hepatocytes is:

Increasing Decreasing Remaining Unchanged

7. The overall rate of glycogenesis within hepatocytes is:

Increasing Decreasing Remaining Unchanged

i. The activity of glycogen phosphorylase within hepatocytes is:

Increasing Decreasing Remaining Unchanged

ii. The activity of glycogen branching enzyme within hepatocytes is:

Increasing Decreasing Remaining Unchanged

iii. The activity of glycogen synthase within hepatocytes is:

Increasing Decreasing Remaining Unchanged

8. The activity of citrate synthase in the mitochondrial matrix within hepatocytes is:

Increasing Decreasing Remaining Unchanged

9. The concentration of NAD^+ in the mitochondrial matrix within hepatocytes is:

Increasing Decreasing Remaining Unchanged

10. The number of protons in the mitochondrial matrix within hepatocytes is:

Increasing Decreasing Remaining Unchanged

11. The activity of acetyl-CoA carboxylase within hepatocytes is:

Increasing Decreasing Remaining Unchanged

12. The concentration of acyl-CoA molecules in the mitochondrial matrix within hepatocytes is:

Increasing Decreasing Remaining Unchanged

13. The rate of β-oxidation within hepatocytes is:

Increasing Decreasing Remaining Unchanged

14. Arginine is synthesized from α-ketoglutarate within your hepatocytes.

i. Diagram the pathway for the conversion of glucose (from the beets) into α-ketoglutarate. Include either the names of the molecules or the enzymes along your pathway.

ii. Indicate the location within the cell in which the steps occur.

iii. α-ketoglutarate is converted to glutamate.

a) Draw glutamate.

b) Propose a name for the enzyme that catalyzes this reaction

c) Indicate any cofactors or co-substrates that are required for this reaction.

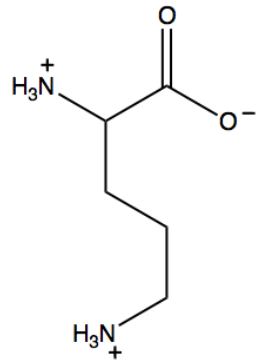
iv. The carboxylic acid group on the side chain of glutamate is reduced to an aldehyde to form glutamate-5-semialdehyde.

a) Draw glutamate-5-semialdehyde.

b) Propose a name for the enzyme that catalyzes this reaction

c) Indicate any cofactors or co-substrates that are required for this reaction.

v. The carbonyl oxygen of the sidechain aldehyde of glutamate-5-semialdehyde is converted to a terminal, primary amine yielding ornithine.



a) Ornithine is a naturally occurring amino acid that is <u>not</u> typically incorporated into proteins. What other common amino acid does it resemble?

b) Draw this "other" common amino acid from (a).

c) Chemically classify ornithine (i.e. polar/nonpolar; acidic/basic/neutral).

d) Propose a name for the enzyme that catalyzes the conversion of glutamate-5-semialdehyde to ornithine.

e) Indicate any cofactors or co-substrates that are required for this reaction.

f) Propose an electron pushing mechanism for this conversion reaction.

g) Arginase catalyzes the addition of urea to ornithine to yield arginine. Your body will make the arginine from the beet carbohydrates! Draw arginine.