1. Branched Chain Ketoacid Dehydrogenase comprises of four subunits which need to fold correctly. The structure of these subunits, folding to form one functional protein is known as its:
   1. Primary Structure
   2. Secondary Structure
   3. Tertiary Structure
   4. **Quaternary Structure**
2. Branched chain acetyltransferase can perform transamination reactions on which amino acid?
   1. Alanine
   2. **Valine**
   3. Aspartate
   4. Phenylalanine
3. Which of the following are essential amino acids?
   1. Tyrosine
   2. **Valine**
   3. Asparagine
   4. All of the above
4. How are amino acids sensed intracellularly by mTORC1
   1. All amino acids are sensed
   2. All essential amino acids are sensed
   3. All non-essential amino acids are sensed
   4. **A select group of amino acids are sensed**
5. Phenylketonuria causes which of the following effects?
   1. Conditional essentiality of phenylalanine
   2. A buildup of tyrosine
   3. **Conditional essentiality of tyrosine**
   4. A buildup of tryptophan
6. Compare the degradation pathway of Glutamine to Leucine
   1. Leucine degradation will be slowed by increased ketoisocaproate levels, glutamine degradation will be slowed by increased ADP
   2. Leucine degradation will be slowed by increased ketoisocaproate levels, glutamine degradation will be slowed by increased ATP
   3. Leucine degradation will be accelerated by increased ketoisocaproate levels, glutamine degradation will be slowed by increased ADP
   4. **Leucine degradation will be accelerated by increased ketoisocaproate** **levels, glutamine degradation will be slowed by increased ATP**
7. A rare phytochemical inactivates Branched Chain Ketoacid Dehydrogenase kinase (BCKDHK). What would be the effect of this chemical?
   1. **Elevated catabolism of branched chain amino acids due to higher activity of branched chain ketoacid dehydrogenase (BCKDH)**
   2. Elevated catabolism of branched chain amino acids due to lower activity of branched chain ketoacid dehydrogenase (BCKDH)
   3. Impaired catabolism of branched chain amino acids due to higher activity of branched chain ketoacid dehydrogenase (BCKDH)
   4. Impaired catabolism of branched chain amino acids due to lower activity of branched chain ketoacid dehydrogenase (BCKDH)
8. Why are Branched Chain Amino Acids important for proper nutrition?
   1. They are very rate in most proteins
   2. They are only synthesized from other amino acids not from glycolytic precursors
   3. **They are under-represented in the free amino acid pool**
   4. They are the only amino acids that are not transaminated
9. What is the relevance of the glutamine pool in amino acid biosynthesis?
   1. Glutamine levels are very low relative to other amino acids
   2. Glutamine is easily converted to branched chain amino acids
   3. Glutamine is able to be converted to alpha ketoglutarate in the presence of high energy
   4. **Glutamine is able to store excess nitrogen in the amino acid pool**
10. Serine biosynthesis is controlled by
    1. **Negative feedback at the first committed step**
    2. Balance with Leucine, Glutamate and Asparate via transaminases
    3. Activation by glucagon in the liver
    4. Ketoisocaproic acid
11. Compare flux between the urea cycle and the TCA cycle
    1. **Urea cycle entry is positively regulated by N-Acetyl glutamate but not the TCA cycle**
    2. TCA cycle entry is inhibited by N-Acetyl glutamate but not the urea cycle
    3. Both the TCA and urea cycle entry are activated by N-Acetyl glutamate
    4. Both the TCA and the urea cycle are inhibited by N-Acetyl glutamate
12. Compare and contrast the catabolism of lysine and phenylalanine
    1. **Phenylalanine’s carbon skeleton can be converted to both glucose or acetyl-CoA making it glucogenic**
    2. Lysine’s carbon skeleton can be converted to both glucose or acetyl-CoA making it glucogenic
    3. Phenylalanine’s carbon skeleton can be converted to both glucose or acetyl-CoA making it ketogenic
    4. Lysine’s carbon skeleton can be converted to both glucose or acetyl-CoA making it ketogenic
13. What mechanism promotes protein degradation in muscle cells
    1. Insulin
    2. **Glucocorticoids**
    3. Glucagon
    4. Growth Hormone/IGF1
14. Which of the following is **false** regarding protein breakdown?
    1. mTORC1 is active when energy is high and inhibits protein breakdown
    2. Insulin inhibits protein degradation and instead promoted protein synthesis
    3. Testosterone impairs protein degradation and instead promotes protein synthesis
    4. **Glucocorticoids block protein degradation**
15. What statement best describes the amino acid pool?
    1. A depot in the liver where essential amino acids are stored
    2. The reserve of amino acids in the body available for use
    3. The entire complement of proteins in the body that are available
    4. The levels of amino acids in a particular digested protein source
16. Lysine is one of the regulators of mTORC1 activity. Describe a property of lysine which may make it appropriate for this role (1 point). Describe what would happen to mTORC1 activity (1 point) and protein homeostasis (1 point) if a protein’s diet did not contain lysine (3 points total).
17. Pick an example how an amino acid can become conditionally essential on another amino acid (1 point). Describe some potential effects of this conditionality (1 point) and

how they could be treated (1 point; 3 points total).

1. Describe how Asparagine biosynthesis occurs from glucose breakdown (1 point). Be sure to note how specific amino acids, acetyl-coA levels, NADH and ATP can regulate activate or slow this process and at which step(s) (2 points). Summarize these effects describing the role that nutrient and energy levels play in governing Asparagine biosynthesis (1 point; 4 points)