***NOTE**: These sample questions are intended to give you an idea of what some of the questions on the final exam will be like. There will also be many other questions with formats not shown in these samples.*

1. Multiple choice (15 points).

1. The conversion of glutamate to an α-ketoacid and NH_4^+:

   A) does not require any cofactors.
   B) is a reductive deamination.
   C) is accompanied by ATP hydrolysis catalyzed by the same enzyme.
   D) is catalyzed by glutamate dehydrogenase.
   E) requires ATP.

2. Which of the following amino acids are essential for humans?

   A) Alanine
   B) Aspartic acid
   C) Asparagine
   D) Serine
   E) Threonine

3. The half-life of a cytosolic protein is primarily determined by the
   A) Length of the protein chain
   B) Amino terminal residue
   C) Sequence at carboxyl terminus
   D) Amount of protein produced
   E) None of the above

4. Ketogenic amino acids are degraded to which of the following metabolites
   A) Pyruvate
   B) Acetyl-CoA
   C) Acetoacetate
   D) All of the above
   E) B and C

5. The nitrogen atom in the indole ring of tryptophan is derived from which amino acid?

   A) Aspartic acid
   B) Glutamic acid
   C) Glutamine
   D) Asparagine
   E) Arginine

6. Erythrose 4-phosphate is a precursor of:

   A) aspartate.
   B) cysteine.
   C) phenylalanine.
   D) serine.
   E) threonine.

7. Which of the following amino acids derives its nitrogen from a purine ring?

   A) Histidine
   B) Lysine
   C) Arginine
   D) Glutamine
   E) Tryptophan

8. Glutathione is a(n):

   A) enzyme essential in the synthesis of glutamate.
   B) isomer of oxidized glutamic acid.
   C) methyl-group donor in many biosynthetic pathways.
   D) product of glutamate and methionine.
   E) tripeptide of glycine, glutamate, and cysteine.

9. In the de novo synthesis of DNA and RNA
   A) ribonucleotides are made from deoxynucleotides.
   B) deoxyribonucleotides are made from ribonucleotides.
   C) dideoxyribonucleotides are the precursors for both.
   D) all of the above
   E) none of the above

10. Assuming that the average amino acid residue contributes 110 to the peptide molecular weight, what will be the minimum length of the mRNA encoding a protein of molecular weight 50,000?

    A) 133 nucleotides
    B) 460 nucleotides
    C) 1,400 nucleotides
    D) 5,000 nucleotides
    E) A minimum length cannot be determined from the data given.

11. During starvation, more urea production occurs. Explain this observation.

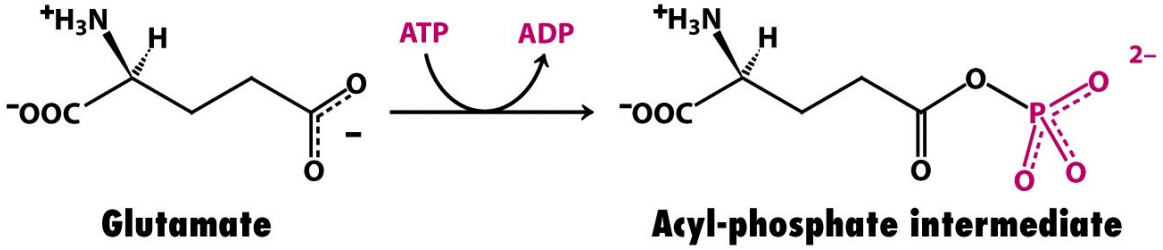
12. If you received a laboratory report showing the presence of a high concentration of phenylalanine and its metabolites in the urine of a patient, what disease would you suspect? What defect(s) in metabolism account(s) for the accumulation of phenylalanine in such patients?

13. Briefly explain the role of the ubiquitin/26S proteasome in degrading cellular proteins to amino acids?

14. Which would you expect to have a greater effect on the rate of urea biosynthesis, a defect in fumerase activity or a defect in alanine aminotransferase?

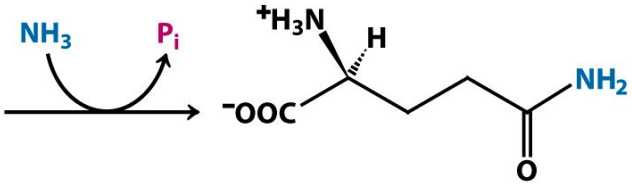
15. Why is folate metabolism important? List the all folate end products.

16. Propose a mechanism for this reaction. Please note that you need to show electron pushing with arrows (ie you must also include the reactive part of the cofactors).



Glutamate **Acyl-phosphate intermediate**

Glutamine synthase



Glutamine

17 . In **one or two sentences**, what is the pharmacological rationale for targeting thymidylate synthase for cancer therapies? In **one sentence**, when targeting rapidly dividing cancer cells and trying to minimize the effects to normal cells, why is thymidylate synthase a better target than dihydrofolate reductase, if they both inhibit thymidlate synthesis?

18. Draw a transamination reaction between α-ketoglutarate and alanine.

19. What is the importance of folic acid metabolism related to chemotherapy. Illustrate the example of one drug.

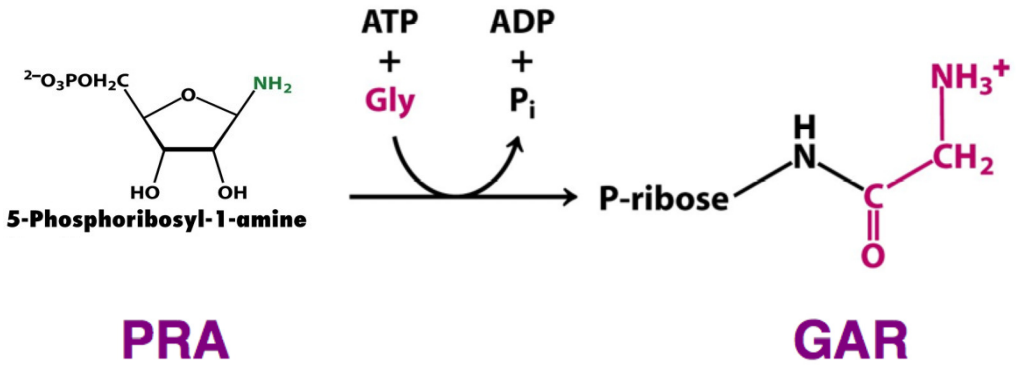
20. Describe two types of regulation of the enzyme glutamine synthetase and explain why the regulation of this enzyme is so complex.

In the laboratory, some researchers chemically altered Met-tRNA^{Met} such that it was converted into fMet-tRNA^{Met}, with no changes being made to the tRNA itself. This fMet-tRNA^{Met} was then used in an *in vitro* bacterial protein synthesis experiment.

(a) Would the fMet of this charged tRNA be incorporated at the initial position in the polypeptide? Explain why or why not.

(b) Would the fMet-tRNA^{Met} be able to participate in the elongation phase of protein synthesis? Why or why not?

21. Propose a mechanism for the following reaction. Show all relevant electron movements by arrows. (ie you must also include the reactive part of the cofactors)



PRA GAR

22. Why do purine salvage pathways save the cell energy?

23. What is significant about the fact that *E. coli* ribonucleotide reductase contains two allosteric sites?

24.

Drug candidate	IC_{50}(nmol)	Log (P)	Cmax (μM) Bioavailability
A	0.4	4.67	<0.1
B	0.01	3.70	<0.1
C	0.3	3.69	0.7
D	0.6	2.92	11

Consider the information concerning a related class of potential drugs in the table given above. Which one is least soluble in water and most hydrophobic?

A) A
B) B
C) C
D) D
E) They are all equally soluble in water.

Sketch the binding curve for the titration of a receptor R with a ligand L and label the point on the plot that corresponds to the Kd for the RL complex.