

**Bio 366: Biological Chemistry II**  
**Test #2, 100 points total**

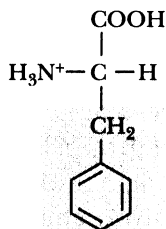
Please neatly PRINT YOUR NAME on EACH PAGE. PRINT the last four digits of your SOCIAL SECURITY NUMBER on the BACK SIDE OF PAGE 11 of this test. There should be 12 pages to this test, including the ENZYME KEY (you do not have to hand in this key). Remember to SIGN OUT by your TEST NUMBER as you leave. The answers will be posted outside Dr. Stewart's office (Bio 229) by later this week.

**A. True or False. Circle the correct answer. 1 point each (20 points total).**

- A1.     T     F      $\alpha$ -Ketoglutarate serves as a progenitor in the biosynthesis of glutamate, glutamine, proline, and arginine.
- A2.     T     F     Birds excrete nitrogen waste, both from amino acid and nucleotide degradation, as a mostly insoluble mixture of uric acid and urate.
- A3.     T     F     Three of the essential amino acids in mammals are lysine, valine, and leucine.
- A4.     T     F     One of the biological roles of nucleotides is as components of coenzymes.
- A5.     T     F     It is very important that we get sufficient amounts of nucleotides in our diets.
- A6.     T     F     Most of the nitrogen in the biosphere is in the form of dinitrogen gas (in the atmosphere) and nitrate ions (in the soils and oceans).
- A7.     T     F     Lysine and leucine are the only purely ketogenic amino acids.
- A8.     T     F     All organisms are capable of nitrate assimilation.
- A9.     T     F     Glutamate is the primary amino donor for the biosynthesis of amino acids.
- A10.    T     F     Most mammals can synthesize about 14 of the 20 common amino acids found in proteins.
- A11.    T     F     You have printed your name at the top of each page. (The correct answer should be True, but if you mark it falsely, you will lose the point!)
- A12.    T     F     Excess amino acids are converted to glucose via the TCA cycle.
- A13.    T     F     AMP and GMP are both synthesized from IMP via the same pathway.
- A14.    T     F     Ribose-5-phosphate is the first precursor in the IMP synthesis pathway.
- A15.    T     F     Most chemical mutagens modify the backbone of DNA.
- A16.    T     F     Nitric acid is a mutagen that intercalates between the bases of DNA.
- A17.    T     F     Microsatellites are short (2 to 5 base-pairs) tandem nucleotide repeats that are found scattered throughout the genomes of eukaryotes.
- A18.    T     F     5-Bromouracil is a thymine analog whose enol form pairs with C
- A19.    T     F     Alkylating agents add methyl or ethyl groups to the sugars of nucleotides, and usually cause transitions rather than transversions.
- A20.    T     F     At any one time, about 1% of the bases of DNA are in their rarer tautomeric forms, which have different H-bonding abilities from their more common tautomers.

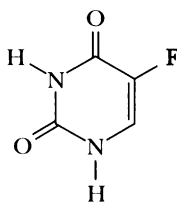
B. Name the compounds drawn below, or draw the compounds named below, as appropriate. For full credit, you must give the properly-spelled, full common biochemical name for each. For the amino acids, you must give its full common name, its three-letter abbreviation, and its single-letter abbreviation. Question B.1. is given for free as an example. (1 point each, 30 points total)

B.1.



Phenylalanine, Phe, F

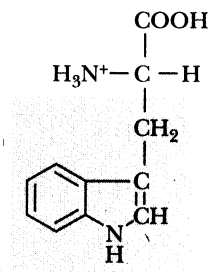
B.2.



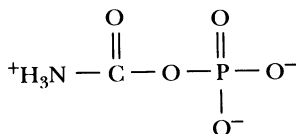
B.3.

 $\alpha$ -Ketoglutarate

B.4.



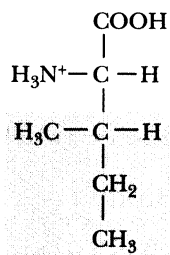
B.5.



B.6.

Glutamate, Glu, E

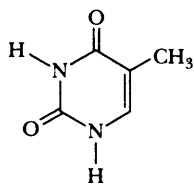
B.7.



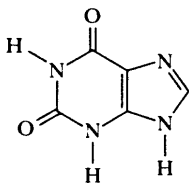
B.8.

Uric Acid

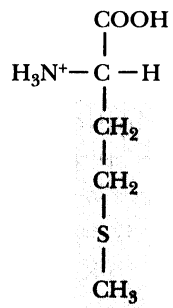
B.9.



B.10.



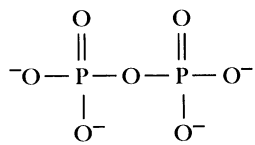
B.11.



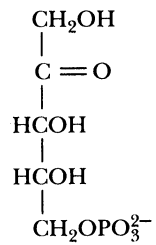
B.12.

Proline (Pro, P)

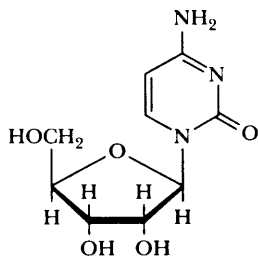
B.13.



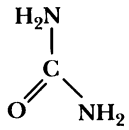
B.14.



B.15.



B.16.



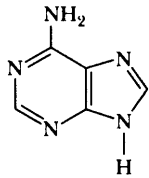
B.17.

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Valine, Val, V

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B.18.



B.19.

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Guanine

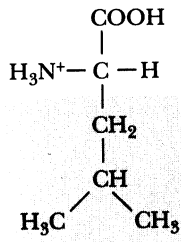
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B.20

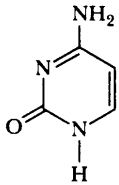
β-D Ribofuranose (or Ribose)

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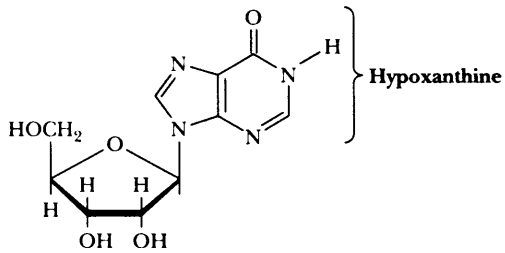
B.21.



B.22.



B.23.



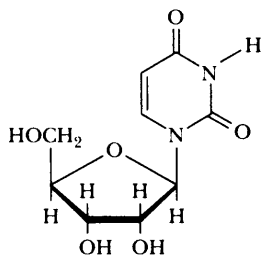
B.24.

Uracil

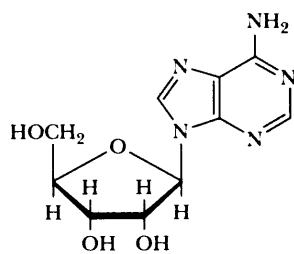
B.25.

Adenosine triphosphate (ATP)

B.26.



B.27.



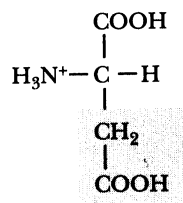
B.28.

Guanosine

B.29.

Alanine, Ala, A

B.30.



**C. Matching (1 point each; 25 points total):** Write the letter(s) of the correct answer(s) in the blank next to the statement. Some questions have more than one correct answer; all correct answers must be given for full credit. The same letter may be used more than once or not at all.

- C1. \_\_\_\_\_ Converts glutamate to ammonia and  $\alpha$ -ketoglutarate.
- C2. \_\_\_\_\_ Citrulline is a product of its reaction.
- C3. \_\_\_\_\_ Reduces the disulfide bond in the active site of ribonucleotide reductase.
- C4. \_\_\_\_\_ Methotrexate and aminopterin inhibit this enzyme.
- C5. \_\_\_\_\_ Breaks down dUTP so it is not used in DNA synthesis.
- C6. \_\_\_\_\_ Its reaction results in net deamination of amino acids..
- C7. \_\_\_\_\_ In inhibition of this enzyme prevents dTMP synthesis.
- C8. \_\_\_\_\_ The mitochondrial enzyme that converts carbamoyl-P to ornithine.
- C9. \_\_\_\_\_ Aminates UTP at position six.
- C10. \_\_\_\_\_ The major enzymes used in purine salvage in mammals .
- C11. \_\_\_\_\_ Disproportionates  $H_2O_2$  to water and oxygen.
- C12. \_\_\_\_\_ Two base-specific nucleoside monophosphate kinases.
- C13. \_\_\_\_\_ FdUMP is a mechanism-based inhibitor of this enzyme.
- C14. \_\_\_\_\_ Catalyzes:  $NO_2^- + 8H^+ + 6e^- \rightarrow NH_4^+ + 2H_2O$
- C15. \_\_\_\_\_ Converts uric acid to allantoin.
- C16. \_\_\_\_\_ Genetic-based lack of this enzyme causes phenylketonuria (PKU).
- C17. \_\_\_\_\_ Converts hypoxanthine to Xanthine.
- C18. \_\_\_\_\_ Overexpression of these two detoxification enzymes in *Drosophila* was reported to cause the flies to live longer and to be more "physically fit"!
- C19. \_\_\_\_\_ Converts xanthine to uric acid.
- C20. \_\_\_\_\_ Catalyzes this reaction:  $dNDP + ATP \leftrightarrow dNTP + ADP$
- C21. \_\_\_\_\_ The active site of this enzyme is on a thumb-like projection, unlike most other enzymes, whose active sites are usually in clefts.
- C22. \_\_\_\_\_ Ubiquitous enzymes that catalyze the three major reactions by which ammonium enters organic linkages.
- C23. \_\_\_\_\_ Is the committed step in pyrimidine synthesis in *E. coli*.
- C24. \_\_\_\_\_ Is the committed step in pyrimidine synthesis in mammals.
- C25. \_\_\_\_\_ Catalyzes the following reaction:  $AMP + ATP \leftrightarrow 2 ADP$

**D. Briefly explain the three general ways that nitrogen waste is excreted from animals, both from amino acid and nucleotide degradation. Include structures of the three major waste products, and a short discussion of which animals excrete which products. (9 points)**

E. Explain how the following peptide might be digested in the small intestines of mammals such as ourselves. Skip the digestion that occurs in the stomach, and consider only the pancreatic enzymes. (4 points)

N—Ala—Tyr—Arg—Lys—Glu—Leu—Cys—Arg—Glu—Phe—Gln—Lys—C

F. Explain what is meant by the terms "transition" and "transversion" in reference to DNA mutations. Use diagrams, as appropriate. (4 points)

G. Explain the reaction catalyzed by RIBONUCLEOTIDE REDUCTASE. In your answer, give the overall reaction catalyzed by this enzyme, including generalized structures of the substrate and product. Draw a cartoon of this enzyme, briefly explaining its regulation. (Do not include discussion of the cascade following regeneration of the active site residues.) Be succinct; do not write on the back of this page. (8 points)

KEY FOR THE ENZYME MATCHING SECTION (YOU MAY REMOVE THIS PAGE IF IT WILL BE HELPFUL):

1. adenylate kinase
2. adenine phosphoribosyltransferase
3. aminotransferase
4. arginase
5. aspartate transcarbamoylase (ATCase)
6. carbamoyl-phosphate synthetase I (CPS-I)
7. carbamoyl-phosphate synthetase II (CPS-II)
8. carboxypeptidase A
9. carboxypeptidase B
10. catalase
11. CTP synthase
12. dihydrofolate reductase (DHFR)
13. dihydroorotase
14. guanylate kinase
15. glutamate decarboxylase (GAD)
16. glutamate dehydrogenase
17. glutamate-aspartate aminotransferase
18. glutamine synthetase
19. glutaredoxin
20. GMP synthetase
21. hypoxanthine-guanine phosphoribosyltransferase (HGPRT )
22. IMP dehydrogenase
23. inorganic pyrophosphatase
24. nitrate reductase
25. nitrite reductase
26. nitrogenase
27. nucleoside monophosphate kinase
28. nucleoside diphosphate kinase
29. orotate phosphoribosyltransferase
30. ornithine decarboxylase (ODC)
31. ornithine transcarbamoylase (OTCase)
32. orotate phosphoribosyltransferase
33. phenylalanine hydroxylase
34. PRPP-dependent phosphoribosyltransferase
35. ribonucleotide reductase
36. superoxide dismutase
37. thioredoxin
38. thioredoxin reductase
39. thymidylate synthase (TS)
40. trypsin
41. UMP synthase
42. urate oxidase
43. urease
44. xanthine oxidase
45. NONE OF THE ABOVE