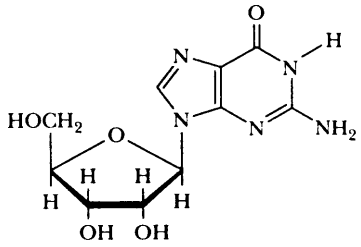
1 April 1997 **Name:** _____

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

Please neatly PRINT YOUR NAME on EACH PAGE. PRINT your SOCIAL SECURITY NUMBER on the BACK SIDE OF PAGE 10 of this test. There should be 10 pages to this test, including the ENZYME KEY (you do not have to hand in this key). Remember to SIGN OUT as you leave. The answers will be posted outside Dr. Stewart's office (Bio 229) by later this week.

A. Name the compounds below. For full credit, you must give the properly-spelled, full common biochemical name for each. (1 point each, 20 points total)

A1. 

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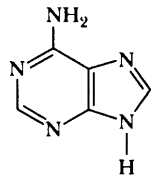
A2. 

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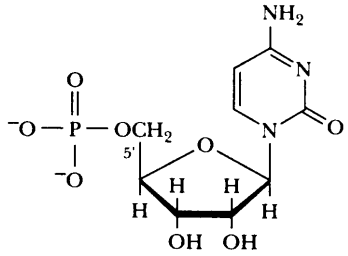
A3. 

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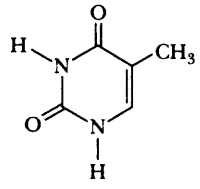
A4. 

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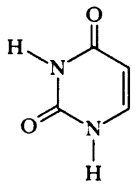
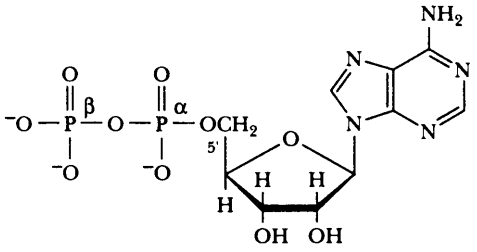
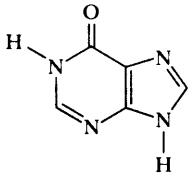
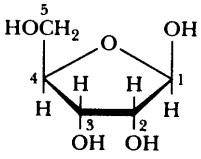
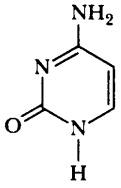
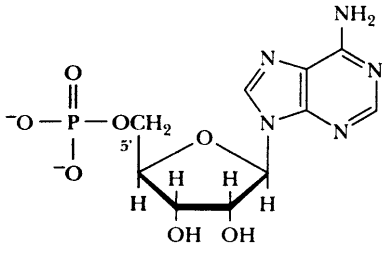
A5. 

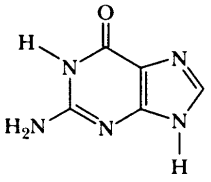
A6. 

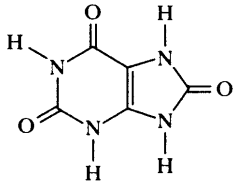
A7. 

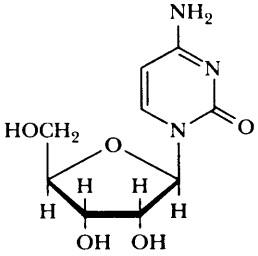
A8. 

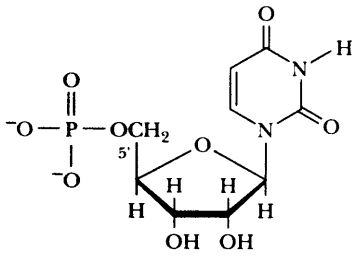
A9. 

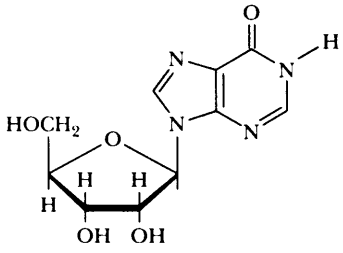
A10. 

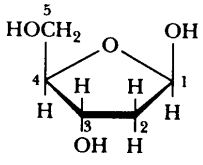
A11. 

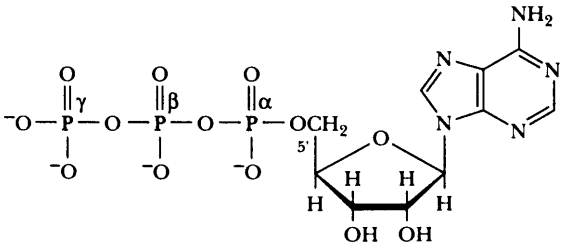
A12. 

A13. 

A14. 

A15. 

A16. 

A17. 

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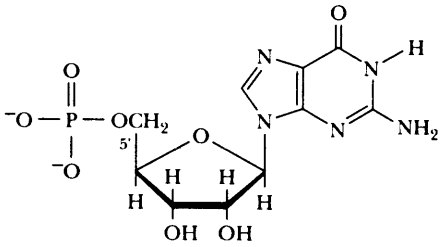
A18. 

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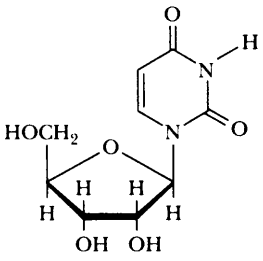
A19. 

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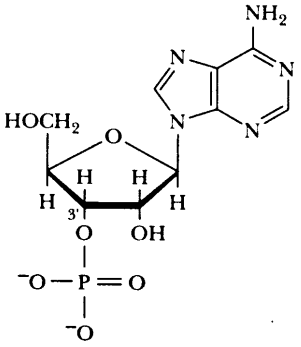
A20. 

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

1.	T	F	You have printed your name at the top of each page and your social security number on the back of the last page. (The correct answer should be True, but if you mark it falsely, you will lose the point!)
2.	T	F	Ornithine and citrulline are amino acids.
3.	T	F	In most organisms, deoxyribonucleotides are synthesized *de novo* from deoxyribose-containing precursor molecules.
4.	T	F	dUDP and dCDP are both precursors of dTTP.
5.	T	F	Glutamate and carbamoyl-phosphate supply the six atoms of the pyrimidine ring.
6.	T	F	Uricotelic animals excrete nitrogen waste primarily as urea.
7.	T	F	Lysine and leucine are the only purely ketogenic amino acids.
8.	T	F	The major pathways for nitrogen acquisiton in the biosphere lead to the formation of ammonium, which is subsequently incorporated into organic compounds.
9.	T	F	Mammals can synthesize the α-keto acid analogs of the "nonessential" amino acids, and then form the corresponding amino acids by transamination.
10.	T	F	Even though arginine is synthesized in the urea cycle, it is considered to be an essential amino acid for growing children.
11.	T	F	All steps of the urea cycle takes place in the cytosol of eukaryotic cells.
12.	T	F	Ammonium enters organic linkage by means of three major reactions that are found in all known cells.
13.	T	F	Nucleic acids are very nutritionally important in the human diet.
14.	T	F	Excess amino acids are stored in cells for future use.
15.	T	F	Inosine is often found at the "wobble" position of tRNA anticodons.
16.	T	F	The base on inosine is named hypoxanthine.
17.	T	F	The number of "calories" (Kcal) listed under the "nutritional facts" on commercial food packages accurately reflects the amount of energy that the human gut is likely to retrieve from the product, regardless of content.
18.	T	F	Transamination does not result in *net* deamination of amino acids.
19.	T	F	Aquatic animals simply release ammonia into the surrounding water.
20.	T	F	The pathways of amino acid biosynthesis are nearly identical in all known species.

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.

1. _____ A cytosolic enzyme in mammals that is involved in carbamoyl phosphate synthesis.

2. _____ Transfers an amino group from an amino acid to an α-keto acid.

3. _____ Functions similarly to thioredoxin to reduce ribonucleotide reductase.

4. _____ dCTP activates this enzyme, not ribonucleotide reductase.

5. _____ Prevents dUTP from being used as a substrate in DNA synthesis.

6. _____ Enzymes involved in the synthesis of GMP from IMP.

7. _____ Orotate phosphoribosyl transferase and OMP decarboxylase form this bifunctional enzyme in mammals.

8. _____ Lack of this enzymatic activity leads to elevated PRPP levels and, ultimately, to increased production of uric acid in humans.

9. _____ Catalyzes two different steps in the catabolism of IMP to uric acid.

10. _____ Two examples of nucleoside monophosphate kinases.

11. _____ Detoxifies hydrogen peroxide by disproportionating it to water and oxygen.

12. _____ Non-specific as to the bases on either of the substrates, and to whether the sugar is ribose or deoxyribose.

13. _____ The major enzyme(s) involved in nitrogen fixation.

14. _____ The first three steps of pyrimidine biosynthesis in mammals are catalyzed by a multifunctional enzyme having these these activities.

15. _____ Deficiency of this enzyme results in Lesch-Nyhan syndrome.

16. _____ Primates have lost this enzyme, which converts uric acid to allantoin.

17. _____ Digests dietary (bacterial) RNAs in foregut-fermenting animals.

18. _____ The major enzyme(s) involved in nitrate assimilation.

19. _____ Converts xanthine to uric acid.

20. _____ Catalyzes this reaction: $dNDP + ATP \leftrightarrow dNTP + ADP$

21. _____ Catalyzes this reaction: $AMP + ATP \leftrightarrow 2\ ADP$

22. _____ The two major enzymes involved in purine salvage in mammals.

23. _____ Transfers an amino group from glutamate to oxaloacetate.

24. _____ The human genetic disease resulting from deficiency of this enzyme was discovered and explained by Archibald Garrod.

25. _____ Phenylketonuria results from a lack of this enzyme.

ENZYME KEY (you can remove this sheet, if it is more convenient):

1. adenylate kinase
2. adenosine deaminase
3. aminotransferase
4. amidophosphoribosyltransferase
5. adenine phosphoribosyltransferase (APRT)
6. arginase
7. aspartate transcarbamoylase (ATCase)
8. carbamoyl-phosphate synthetase I (CPS-I)
9. carbamoyl-phosphate synthetase II (CPS-II)
10. catalase
11. CTP synthetase
12. dCMP deaminase
13. chymotrypsin
14. dihydrofolate reductase (DHFR)
15. dihydroorotase
16. DHO dehydrogenase
17. glutamate dehydrogenase
18. glutamate-aspartate aminotransferase
19. glutamine synthetase
20. glutamate-aspartate aminotransferase
21. glutaredoxin
22. GMP synthetase
23. guanylate kinase
24. hypoxanthine-guanine phosphoribosyltransferase (HGPRT)
25. homogentisate dioxygenase
26. IMP dehydrogenase
27. inorganic pyrophosphatase
28. NAD(P)H:flavin oxidoreductase
29. nitrate reductase
30. nitrite reductase
31. nitrogenase
32. nucleoside diphosphate kinase
33. OMP decarboxylase
34. ornithine decarboxylase (ODC)
35. ornithine transcarbamoylase (OTCase)
36. orotate phosphoribosyltransferase
37. phenylalanine dehydroxylase
38. PRPP-dependent phosphoribosyltransferase
39. ribonuclease (pancreatic type)
40. ribonucleotide reductase
41. serine hydroxymethyl-transferase
42. superoxide dismutase
43. thioredoxin reductase
44. thioredoxin
45. thymidylate synthase
46. transaminase
47. urate oxidase
48. urease
49 dUTPase
50. UMP synthase
51. xanthine oxidase
52. none of the above

D. The first common stage of amino acid degradation involves deamination; describe the three typical steps of this deamination process, including the general reactions and names of the enzymes involved. (12 points)

1 April 1997 **Name: _____**

E. This is a "thought" question (don't panic!): For many years it was believed that the cells in the brains of animals were terminally differentiated, thus did not undergo cell division. A few years ago, it was discovered that a certain region of the brain in some species of male songbirds grows (*i.e.*, undergoes cell division) during spring, their mating season. The way this experiment was performed was by giving the birds radioactively-labeled thymidine, thin-sectioning their brains, and placing the sections next to X-ray film (which is exposed by the radioactivity, if present in the brain cells).

1. EXPLAIN WHY THIS EXPERIMENT WORKS, AT THE BIOCHEMICAL LEVEL. That is, why do dividing cells take up large enough amounts of this radioactively-labeled compound to expose X-ray film, whereas terminally-differentiated cells do not? (5 pts)

2. What do you think would happen if the birds were also given 5-fluorouracil? <u>Why</u>? (5 pts)

F. (13 points total) 1. Explain the structure, function, and regulation of *E. coli* ribonucleotide reductase, illustrating with a cartoon drawing of the enzyme (7 points). 2. Explain how the catalytic cycle of ribonucleotide reductase is completed by the action of thioredoxin and associated enzymes, including an explanation of the detoxification pathways associated with these oxidation-reduction reactions (6 points). Be succint; do not write on the back of this page.