This exam consists of two parts. Part I is multiple choice. Each of these 25 questions is worth two points. Answer the Part I questions on this sheet, below. Answer the Part II questions on the question pages.

Please use BLOCK CAPITAL letters like this --- A, B, C, D, E. Not lowercase!

1. ______ 10. ______ 18. ______  
2. ______ 11. ______ 19. ______  
3. ______ 12. ______ 20. ______  
4. ______ 13. ______ 21. ______  
5. ______ 14. ______ 22. ______  
6. ______ 15. ______ 23. ______  
7. ______ 16. ______ 24. ______  
8. ______ 17. ______ 25. ______ NCBI search score  
9. ______  

GRADE:  
Part I Total ______  
Part II:  
  II-1 ______  
  II-2 ______  
  II-3 ______  
  II-4 ______  
  II-5 ______  
Part II Total ______  
Total, I & II ______
1. On the scale of the CPK models used in class, i.e. magnification of $10^8$, an average amino acid (say, Alanine) would be about the size of a
   A. a house  D. an apple
   B. a truck  E. a marble
   C. a pillow

2. You go to the Old Faithful Geyser in Yellowstone Park and collect a yellow scum from the edge of a pond of nearly boiling water. Chances are the organisms are
   A. Bacteria  D. Dead
   B. Mold  E. Archaea
   C. Eukaryotes

3. The most important force stabilizing protein primary structure is
   A. ionic attraction  D. hydrogen bonds
   B. hydrophobic  E. covalent peptide bonds
   C. van der Waals forces

4. Banded Iron formations are evidence that what happened?
   A. Great Flood  D. Magnetic field switched
   B. Dinosaurs lived  E. Moon came from collision
   C. Oxygen increased

5. Evolution will occur when you find three things. Which choice isn't one of those?
   A. Reproduction  C. Variation
   B. Adaptation  D. Selective pressure

6. Examine the amino acids at right:
   A. #1 is L, #2 is L
   B. #1 is L, #2 is D
   C. #1 is D, #2 is L
   D. #1 is D, #2 is D

7. On the Ramachandran plot at right, the dot represents
   A. the right handed alpha helix
   B. the left handed alpha helix
   C. the beta pleated sheet
   D. the collagen triple helix

8. The protein structure shown at right is
   A. a sandwich
   B. a barrel
   C. a saddle
   D. a helix bundle

9. The commonly used pregnancy test looks for hCG using what method?
   A. rate sedimentation  D. Southern Blot
   B. amino acid analysis  E. SDS PAGE
   C. ELISA
10. Chaperones for protein folding like HSP-70 and Gro-EL are usually unnecessary if the protein is:
   A. small       D. large
   B. globular    E. an enzyme
   C. hydrophobic

11. If one strand of a short stretch of DNA reads GAACCT, the other strand will read
    A. AGGTTC     D. TCCAAG
    B. TCCAAG     E. AGCTGC
    C. GAACCT

12. Who showed that DNA replication is semi-conservative?
    A. Fred Griffith   D. Oswald Avery
    B. Fred Sanger    E. Hershey and Barr
    C. Fred Flintstone F. Meselson and Stahl

13. A "start signal" for translation in prokaryotes (bacteria) would be
    A. –35, –10, etc.   D. promoter sequence
    B. hairpin poly-U   E. UAA stop codon
    C. AUG start codon and AGGAG

14. Eukaryotic DNA genes contain (what) which must be removed during transcription.
    A. Exons       C. Prions
    B. Introns     D. Photons

15. Sometimes genes are duplicated and produce two related proteins that are used for different purposes in the cell. These are called
    A. monologues   D. orthologs
    B. dialogues    E. metalogs
    C. paralogs

16. BLAST is used to search for nucleotide sequences. For proteins you need to use
    A. PLAST       C. PROBLAST
    B. BLASTP      D. KAPOW

17. Which sort of DNA might be recoverable in the laboratory?
    A. from stromatolites 1 billion years old
    B. from brachiopods 250 million years old
    C. from dinosaurs 64 million years old
    D. from Neanderthals 40,000 years old

18. Trypsin and Subtilisin both have a "charge network" with Ser, His and Asp at the active site, but very different overall folds. The similarity is caused by
    A. Intelligent design       D. telepathy
    B. convergent evolution     E. homology only at that site
    C. bifurcated adaptation
19. What are the dimensions of $k_1$, rate constant for $[E] + [S] \rightarrow [ES]$?
   A. sec$^{-1}$  
   B. mol/ liter sec  
   C. liter/ mol sec  
   D. sec liter mol  
   E. furlongs / microsecond  
   F. calories / degree mol

20. Because of the initial rate assumption leading to the Michaelis Menten Equation we can assume that
   A. $k_2$ is zero  
   B. rate of product formation is zero  
   C. $[P]$ approx = zero  
   D. none of the above

21. If an enzyme is turned on by removal of a peptide segment, this would be
   A. allosteric inhibition  
   B. covalent modification  
   C. zymogen cleavage  
   D. none of the above

22. Carbonic Anhydrase has a turnover number of 600,000 sec$^{-1}$, and a high $K_m$ equal to 8 mM. Can we assume that this means that binding of substrate is weak?
   A. Yes, high $K_m$ means weak binding  
   B. Yes, especially when $k_2$ is high, binding is weak  
   C. No, because $K_m$ contains $k_2$ and high $K_m$ means nothing here  
   D. No, $k_2$ is irrelevant, high $K_m$ means tight binding

23. Enzymes do all of the following except which?
   A. have active site cleft  
   B. stabilize the transition state  
   C. provide energy to make reaction go  
   D. act as catalysts  
   E. speed up reactions with $\Delta G$

24. After this test I will
   A. laugh  
   B. cry  
   C. shovel snow  
   D. drink  
   E. cannot tell from available data

25. (reserved for NCBI search result)
PART II  Answer these questions here on the question pages.

1.  a.  The peptide Trp-Arg-Ile-Thr-His-Glu would have what sequence when expressed in one-letter amino acid code?
   (2)
   
   b.  Draw the dipeptide Phe-Val (FV) as it would appear at pH 7 in water.
   (3)

   c.  Lysine’s pKa values are 1.8 (alpha carboxyl), 9.0 (alpha amino), and 11.5 (R group).  Calculate the isoelectric point for Arginine (the pl) – show work and circle answer.
   (2)

   d.  To 1 mole of Lysine at its isoelectric point is added 0.2 moles of HCl.  What is the pH after the addition?  State equation, show work, circle answer.
   (3)
2. a. Draw the structures of Ninhydrin and Edman's Reagent

(2)

b. What are the differences between Rate Sedimentation and Equilibrium Sedimentation? What do you learn from each process? Which is quicker and easier?

(4)

c. Describe Amino Acid Analysis. Does it tell you the sequence of a peptide?

(4)
3. 
   a. Draw an AT base pair, and show where sugars attach.  
   (4)

   b. Briefly state what Reverse Transcriptase does – what sort of organisms 
      depend on Reverse Transcriptase?  
   (2)

   c. Describe the start and stop signals for prokaryotic transcription. Be 
      reasonably complete, this is a 4 point question. Include whatever details you can 
      recall.  
   (4)
4. a. On the BLOSUM 62 diagram there are only 3 amino acid residues which have NO positive scoring replacements. They are P, G, and C. In each case the highest scores include A and S at zero or minus one. Draw P, G, and C and for each briefly explain why they would be unique and irreplaceable in proteins.

(6)

b. Berg says that even though Actin and Hsp-70 share only 15% sequence identity, visual inspection of the 3-D structures proves that the two proteins are paralogs. Suppose that there is another protein "X" which has a 15% identity with Hsp-70, and only a 2% identity with Actin, but is judged to be homologous with Hsp-70 by visual inspection. Must protein "X" be homologous with Actin as well? Explain your answer, and tell what percentage of identity normally is taken to "prove" homology between two proteins.

(4)
5.  

a. An enzyme is found to have a $V_{\text{max}}$, at a certain concentration, of 60 mM per second. The enzyme has a $K_m$ with its substrate of 4 mM. Calculate the initial rate when substrate is present at 6 mM concentration. Show work and circle answer.

(4)

b. On axes provided, sketch the curves or lines which would be observed for an enzyme in the presence and absence of a noncompetitive inhibitor. The axes are for a double reciprocal ("Lineweaver Burk") plot.

(3)

c. Given that $R = 1.987 \text{ cal/}^{o}\text{ mol}$ and $T = 300^{o}\text{K}$, calculate the equilibrium constant for a reaction with $\Delta G^{\circ} = -3 \text{ kcal/mol}$.

(3)