name: _____

number : _____

KEEP THIS <u>CLOSED ON YOUR DESK</u> UNTIL THE START OF THE EXAM

CLOSED BOOK EXAM.

Faculty approved calculators are permitted

<u>BCH 2333A & BCH 2333B</u>

MIDTERM EXAM

February 28, 2009

Professors: Bennett, Kleine, Mezl[A]

Length : 3 hours

<u>Material needed:</u> This exam, 1 computer answer sheet

<u>INSTRUCTIONS</u>

<u>Part I</u> Chose the best answer for each of the 40 MCQ questions.
(60 % of grade)

<u>Part II</u> Answer THREE of the 4 essay questions directly on the exam.
Extra questions will not be corrected.
(40 % of grade)

<u>AT THE END</u>: - Check that your <u>Family name</u> and <u>student number</u> are **on the exam and on the computer answer sheet.**

1. In transforming the Michaelis-Menten equation into a straight line equation, y = mx + b, the Lineweaver-Burk double reciprocal plot, which of the following is NOT a true representation?

A) slope = K_m/V_{max} B) y-intercept is $1/V_{max}$ C) x-intercept is $1/K_m$
D) $y = 1/v_o$ E) x = 1/[S]

2. An enzyme has a Vmax of 50 μ mol substrate transformed per minute per milligram of enzyme and a Km of 0.001 M. Calculate the substrate concentration that will yield a reaction rate of one half maximal velocity.

A) 0.001 μ M; B) 25 μ M; C) 50 μ M; D) 1 mM; E) 0.05 M

3. The following results were obtained in the study of an enzyme known to follow Michaelis-Menten kinetics (you can use the graph paper which is provided):

Product formed (μmol/min)	**Substrate added (mmol/L)**
217	0.8
325	2
433	4
488	6
647	1000

The Km for this enzyme is approximately:
A) 1mM B) 2mM C) 4mM D) 6mM E) 1000mM

4. The International Unit of an enzyme is based on the:

A) ratio of enzyme to other proteins.
B) micromoles of product formed per minute. C) moles of substrate used.
D) micromoles of product produced at Vmax/2. E) micromoles min^{-1} mg^{-1}.

5. When every enzyme molecule in the reaction mixture has its substrate binding site occupied by substrate, it is considered _____, the kinetics are _____-order, and the velocity is ____.

A) complementary; zero; Vmax B) inhibited; first; ½ Vmax
C) saturated;first; ½ Vmax D) saturated; zero; Vmax
E) active; zero; Vmax

6. The ΔG for a biochemical process:

A) is never zero
B) does not depend on temperature
C) is negative when the reaction is spontaneous
D) does not depend on the concentration of products
E) none of these answers are correct

7. The presence of an appropriate enzyme increases the rate of a reaction because:

A) the enzyme lowers the ΔG of the reaction
B) the equilibrium is displaced such that it favours the products
C) the enzyme supplies the required energy
D) the reverse reaction is blocked
E) none of these answers are correct

8. Hydrolases are enzymes that:

A) have substrates that can be hydrogenated
B) catalyse the addition of water to a double bond
C) accelerate the formation of water from proteins
D) rupture single bonds by using a water molecule
E) none of these answers are correct

9. A holoenzyme:

A) is an enzyme which is in its active form
B) an enzyme which has lost its native structure
C) an enzyme which breaks its substrate into multiple fragments
D) an enzyme which must form a complex with other enzymes
E) none of these answers are correct

10. Which of the following can function as a coenzyme?

A) DPF B) FAD C) PITC
D) Zn^{2+} E) at least two of these answers are correct

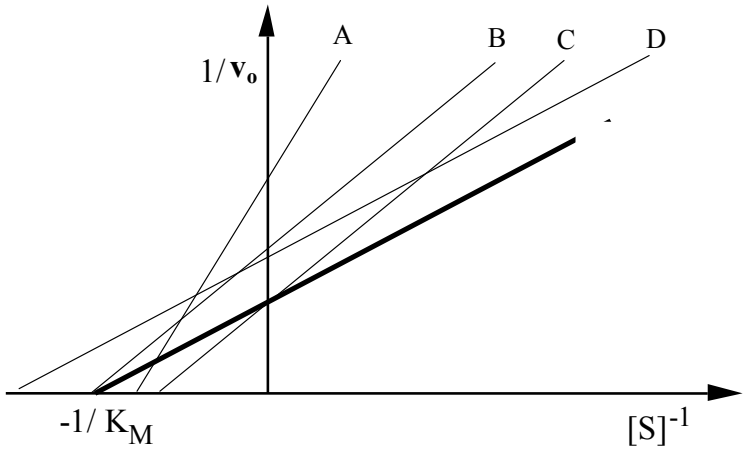
11. Chymotrypsin:

A) does not require a coenzyme
B) hydrolyses certain esters and nitrophenylacetate
C) forms a Shiff base
D) contains an ionisable serine residue
E) at least two of these answers are correct

12. The Michaelis constant

A) varies with the concentration of the enzyme
B) generaly has a value between 1 and 10^6 s^{-1}
C) varies with the concentration of substrate
D) is equal to ½ of the maximal velocity
E) none of these answers are correct

13. The thick line on the following curve was obtained in the absence of inhibitor. Which of the other lines corresponds to that obtained in the presence of a uncompetitive inhibitor?



A) A B) B C) C D) D E) none of these answers

14. Dietary essential fatty acids for humans include:

A) α-linolenic and oleic acids.
B) oleic and linoleic acids.
C) palmitic and oleic acids.
D) linoleic and α-linolenic acids.
E) all are true.

15. Glycosphingolipids consist of a _____ with one or more _____ residues in a _____ linkage at the 1-hydroxyl moiety.

A) sugar; fatty acids; ester
B) ceramide; sugar; β-glycosidic
C) ceramide; fatty acid; amide
D) glycerol; fatty acids; ester
E) none are true

16. The common name of 9-octadecenoic acid is:

A) lauric acid
B) palmitic acid
C) stearic acid
D) myristic acid
E) oleic acid

17. The structure of a cerebroside is shown in drawing A, B, C, D or E.

18. The structure of sphingomyelin is shown in drawing A, B, C, D or E.

19. The structure of phosphatidylethanolamine is shown in drawing A, B, C, D or E.

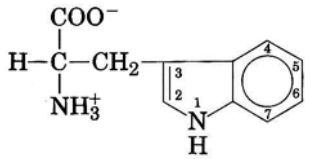
20. Choose the correct answer :

A) if **1,2, and 3** are correct
B) if **1 and 3** are correct
C) if **2 and 4** is correct
D) if **4** is correct
E) if **1,2,3, and 4** are correct

Which of the following domains are found in amyloid-β?

1) A transmembrane domain
2) A protease inhibitor domain
3) A heparin binding domain
4) A DNA binding domain

21. This amino acid is:



A) Trp
B) Phe
C) Met
D) His
E) None of the above

22. Choose the correct answer :

A) if **1,2, and 3** are correct
B) if **1 and 3** are correct
C) if **2 and 4** is correct
D) if **4** is correct
E) if **1,2,3, and 4** are correct

Which of the following primarily determine tertiary structure?

1) Ionic interactions
2) Disulfide bonds
3) Hydrogen bonding
4) Non-polar hydrophobic interactions

23. When calcium binds calmodulin, a conformational change is initiated that enables calmodulin to form quaternary structure. Which event is initiated by calcium binding that allows calmodulin to interact with another protein polypeptide?

A) Formation of helix-loop-helix supersecondary structure
B) Ionic interactions between calcium and glutamate and aspartate R-groups
C) Exposure of previously "buried" hydrophobic residues
D) Dipole-dipole interactions
E) The denaturation and refolding of calmodulin

24. Choose the correct answer :

A) if **1,2, and 3** are correct
B) if **1 and 3** are correct
C) if **2 and 4** is correct
D) if **4** is correct
E) if **1,2,3, and 4** are correct

Which is the correct sequence of events in the processing of pro-insulin to insulin?

1) Polypeptide folds as a result of hydrophobic interactions
2) Polypeptide backbone is stabilized by hydrogen bonding
3) Disulfide bonds form
4) 33 amino acids are removed by proteolytic excision

25. Which amino acid is a cyclic amino acid?

(A) M
(B) Asparagine
(C) P
(D) Gly
(E) N

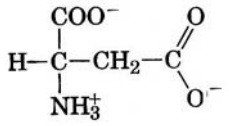
26. Which amino acid contains sulfur?

(A) M
(B) Asparagine
(C) P
(D) Gly
(E) N

27. Which amino acid is not chiral?

(A) M
(B) Asparagine
(C) P
(D) Gly
(E) N

28. This amino acid is:

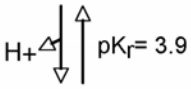


A) Arg
B) Q
C) D
D) Asn
E) Glutamic acid

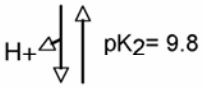
29-33. Using the information below, identify the amino acid structure at each stage of ionization (question 29-32) and calculate the pI (question 33)

Structure 1

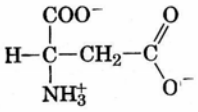
Structure 2

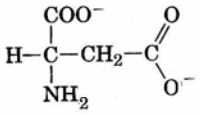


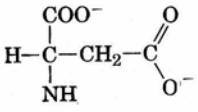
Structure 3

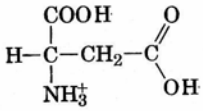


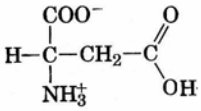
Structure 4

(A) 

(B) 

(C) 

(D) 

(E) 

29. Structure 1 is:
(A)
(B)
(C)
(D)
(E)

30. Structure 2 is:
(A)
(B)
(C)
(D)
(E)

31. Structure 3 is:
(A)
(B)
(C)
(D)
(E)

32. Structure 4 is:
(A)
(B)
(C)
(D)
(E)

33. All the information you require to calculate the pI is provided on in the figure above (labelled Question 29-33). The pI of this amino acid is:

A) 5.9
B) 6.8
C) 3.0
D) 6.2
E) 7.0

34. Which amino acid with a polar but uncharged R group can be hydrolyzed and thereby converted into another amino acid having a negatively charged R group at pH near 7 ?

A) asparagine
B) serine
C) isoleucine
D) glutamic acid
E) arginine

35.The approximate size of a mitochondrion:

A) 0.02 μ B) 0.08 μ C) 0.4 μ D) 2 μ E) 10μ

36. The concentration of pure benzene is about:

A) 10 M B) 20 M C) 30 M D) 40 M E) 50 M

37. You read the line "A 1 osmolar solution gives an osmotic pressure of 22.4 Atm". Which of the following is true about the line that you have read:

A) There is an 100 x error: the pressure should be 0.22 Atm.
B) The polymer will get diluted with water before this pressure is achieved.
C) The pressure should be about 3000 mm of mercury.
D) The pressure should be about 6 Atm.
E) The pressure should be about 200 m of water.

38. The O_2 pressure on top of Mt Everest is about :

A) 8 mm Hg B) 20 mm Hg C) 50 mm Hg D) 120 mm Hg E) 250 mm Hg

39. A weak acid has a pK of 4. A 10^{-9} M solution of this acid will have a pH of about:

A) 4 B) 5 C) 6 D) 7
E) This pH can not be calculated

40. The dielectric constant is

A) related to the square of the distance between two charges
B) inversely related to the square of the distance between two charges
C) related to the osmotic pressure
D) inversely related to the dipole moment
E) related to the dipole moment

ANSWER **THREE** OF THE FOUR FOLLOWING ESSAY QUESTIONS

1. This question has three parts. You must show your calculations and explain what you are doing.

A) To 0.1 L of a 50 mM acetate buffer ($K_a = 1.6\ 10^{-5}$, $pK_a = 4.8$) that is at pH 4.8, you add 2µL of 1N NaOH. Calculate the new pH.

B) A weak acid has a K_d of $1\ 10^{-6}$. What is the pH of a 1 mM solution? What percentage of the acid is ionized?

C) A 5 member flat ring is joined through two carbons to a 6 member flat ring (like Trp!). Determine the straight line distance across the two rings (in nm) and compare it to the longest dimension across the six member ring.

2. Acid-base catalysis is one mechanism of catalysis that is used by enzymes. Name the other five mechanisms of catalysis. Briefly explain three of these mechanisms.

3. a) To which of the six major classes of enzymes does chymotrypsin belong?
b) What reaction is catalysed by chymotrypsin?
c) How does chymotrypsin recognise its substrate? What characteristic feature is recognised?
d) Describe the active site of the enzyme; mention the role of each structural element involved in the catalytic mechanism. (Do not provide the mechanism).

4. Describe the structural processing of the amyloid precursor protein that leads to the formation of mature amyloid fibrils and aggregation into plaques.