

NAME: _____

STUDENT#: _____

YORK UNIVERSITY
FACULTY OF SCIENCE AND ENGINEERING

SC/BIOL 2020A 3.0 – CELL BIOLOGY AND BIOCHEMISTRY I

MIDTERM I – May 23rd, 2012 – **VERSION A**

INSTRUCTIONS:

- 1) Please sign the sign-in sheet that will be circulated during the exam.
- 2) Multiple choice – 30 questions, one mark each. Choose the best single most-correct answer and fill in all answers on the scantron sheet provided. Questions where more than one answer is selected will receive a mark of zero. Please be sure to write your name and shade in your student number on the scantron sheet. **Please indicate on the scantron sheet the version of your test on question #31.**
- 3) Total time – 75 minutes, from 8:35 to 9:50 am.
- 4) Non-programmable calculators are permitted. Programmable calculators will be confiscated until the end of the exam.
- 5) **You MUST hand in both your exam (with your name and student number filled in) and your scantron form to receive a grade**

Good Luck!

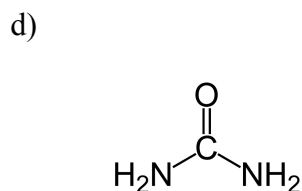
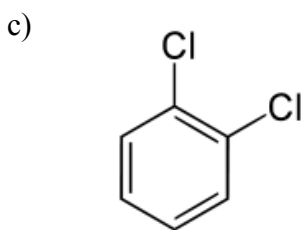
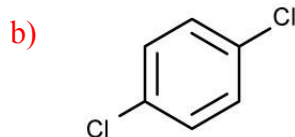
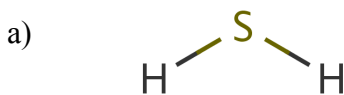
1. Which type of interaction occurs between aromatic rings that are stacked on top of one another?

- a) dipole-dipole
- b) Dispersion/van der Waals
- c) hydrogen bonds
- d) charge-charge
- e) dipole – induced dipole

2. Which type of non-covalent interaction has a fixed bond length?

- a) dipole – dipole
- b) Dispersion/van der Waals
- c) Hydrogen bonds
- d) Charge-charge
- e) Dipole-induced dipole

3. Which of the following molecules would you expect to **not** have a dipole moment?



4. The most significant reason that interactions between polar and non-polar molecules are minimized/not favoured is because these interactions cause a:

- a) decrease in entropy
- b) increase in entropy
- c) decrease in enthalpy
- d) increase in enthalpy
- e) decrease in empathy - the polar substance feels bad for the non-polar substance :-)

5. Amphiphilic compounds are:

- a) polar
- b) non-polar
- c) both polar and non-polar
- d) capable of forming micelles in solution
- e) Two of a-d

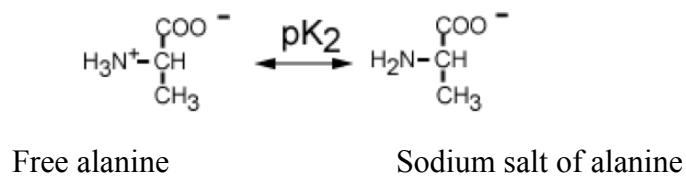
6. What is the hydrogen ion concentration of grapefruit juice, pH = 3.2?

- a) 630 μM
- b) 6.3 μM
- c) 505 mM
- d) 24 M
- e) 41 mM

7. What is the ratio between lactate and lactic acid (lactate/lactic acid) at pH 5.0? The K_a for lactic acid is 138 μM .

- a) 3.13
- b) 0.072
- c) 7.24×10^8
- d) 1.38
- e) 13.8

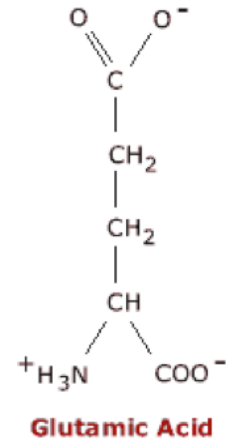
8. You make a buffer out of alanine in which you mix 0.05 mol of the sodium salt with 0.1 mol of free alanine in 2L of water. The pK_2 for alanine is 9.9. What is the final pH?



- a) 9.6
- b) 9.9
- c) 10.5
- d) 9.3
- e) 10.2

9. Glutamic acid contains two carboxylic acid groups (pK_a values of 2.2 and 4.2) and an amine group (pK_a 9.7). What is the pI for glutamic acid? Glutamic acid at pH=7 is shown.

- a) 3.2
- b) 6.0
- c) 6.5
- d) 7.0
- e) none of the above



10) Citric acid is a triprotic acid with three carboxylic acid groups having pK_a values of 3.1, 4.8, and 6.4. If a solution of citric acid has a pH of 5.5, what can be said about the predominant (most abundant) protonation state of the citric acid?

- a) 1 carboxylic acid group is deprotonated, 2 are protonated
- b) 2 carboxylic acid groups are deprotonated, 1 is protonated
- c) all 3 carboxylic acid groups are deprotonated
- d) all 3 carboxylic acid groups are protonated
- e) the protonation state cannot be determined

11. Calculate the isoelectric point of the peptide LEKAT. Some pK_a 's are provided for you below:

$pK_1 = 3.1$
 $pK_2 = 8.0$
 pK_R Histidine = 6.0
 pK_R Glutamic Acid = 4.4
 pK_R Aspartic Acid = 3.9
 pK_R Lysine = 10.0
 pK_R Arginine = 12.5
 pK_R Tyrosine = 10.1

- a) 5.55
- b) 5.95
- c) 9.05
- d) 6.2
- e) 9

12. What is the one letter code for the amino acid tryptophan?

- a) T
- b) R
- c) Y
- d) O
- e) **W**

13. Which of the following pairs of amino acids contains both an aliphatic and an aromatic amino acid?

- a) Thr and Tyr
- b) Val and Gln
- c) **Phe and Ile**
- d) Ser and Cys
- e) none of the above

14. Which of the following pairs of amino acids could form a hydrogen bond through their R-groups?

- a) S and F
- b) D and M
- c) **H and Y**
- d) A and N
- e) L and C

15. Given the following peptide, how many peptides would be produced upon cleavage with trypsin?

IMGFAHYARAVEWLK

- a) 1
- b) **2**
- c) 3
- d) 4

16. If a *cis* peptide bond is found in a protein, the most likely amino acid to contribute the amine to the amide bond is _____.

- a) phenylalanine
- b) leucine
- c) proline
- d) glycine
- e) arginine

17. In an α -helix, a hydrogen bond is formed between the carbonyl oxygen of the i^{th} residue and the amide hydrogen _____ residues away

- a) one
- b) two
- c) three
- d) four
- e) five

18. Which of the following correctly defines the angles ϕ and ψ ?

- a) ϕ : N-alpha carbon; ψ : alpha carbon- C_{carbonyl}
- b) ϕ : alpha carbon- C_{carbonyl} ; ψ : N-alpha carbon
- c) ϕ : C_{carbonyl} -N; ψ : N-alpha carbon
- d) ϕ : N-alpha carbon; ψ : C_{carbonyl} -N
- e) ϕ : alpha carbon-R group; ψ : N-alpha carbon

19. To which domain class would the following protein belong?



- a) mainly α
- b) mainly β
- c) random coil
- d) little 2° structure
- e) β barrel

20. In a β -sheet, the R-groups of the amino acids project:
- a) within the plane of the sheet
 - b) all above or all below the plane of the sheet
 - c) alternatively above and below the plane of the sheet
 - d) randomly project above or below the plane of the sheet
21. On an SDS-PAGE gel, the mobility of a protein on the gel is directly correlated to
- a) the native charge of the protein
 - b) the molecular weight of the protein
 - c) the isoelectric point
 - d) the \log_{10} of the charge of the protein
 - e) the \log_{10} of the molecular weight of the protein
22. A column containing beads coated with nickel ions would most likely be used for:
- a) gel filtration chromatography
 - b) affinity chromatography
 - c) ion exchange chromatography
 - d) size exclusion chromatography
 - e) isoelectric focusing
23. Which statement correctly describes the coordination of iron in active hemoglobin?
- a) Fe(III) with four bonds to the porphyrin ring, one to the distal histidine
 - b) Fe(III) with four bonds to the porphyrin ring, one to the proximal histidine
 - c) Fe(II) with four bonds to the porphyrin ring, one to the distal histidine
 - d) Fe(II) with four bonds to the porphyrin ring, one to the proximal histidine
 - e) Fe(III) with four bonds to the porphyrin ring, one to the distal histidine and one to the proximal histidine
24. Which of the following statements about hemoglobin and myoglobin is/are false?
- a) 2,3-bisphosphoglycerate is a negatively charged molecule that inhibits the transition of hemoglobin to the R state by binding in a positively charged central cavity.
 - b) Hemoglobin has lower affinity for oxygen at low pH due to the formation of a salt-bridge that stabilizes the T state.
 - c) Myoglobin has a higher affinity for oxygen than hemoglobin at low O_2 partial pressure.
 - d) Hemoglobin is a heterotetramer, while myoglobin does not have quaternary structure.
 - e) Two of a-d are false.
 - f) None of a-d are false.

25. The dissociation of ES into E + S is a _____ order reaction with units of _____.

- a) first; sec^{-1}
- b) second; sec^{-1}
- c) first; M^{-1}
- d) second; $\text{M}^{-1} \text{sec}^{-1}$
- e) first; $\text{sec}^{-1} \text{M}^{-1}$

26. To describe the overall catalytic efficiency of an enzyme, we use the _____ that has units of _____.

- a) turnover number; sec^{-1}
- b) k_{cat} ; M
- c) specificity constant; $\text{M}^{-1} \text{sec}^{-1}$
- d) K_{m} ; M
- e) turnover number; $\text{M}^{-1} \text{sec}^{-1}$

27. An enzymatic reaction has a V_{max} of 100 $\mu\text{M}/\text{min}$. At a substrate concentration of 5 μM , the velocity is 25 $\mu\text{M}/\text{min}$. What is the K_{M} for the reaction?

- a) 0.84 μM
- b) 4 μM
- c) 10 μM
- d) 15 μM
- e) none of the above

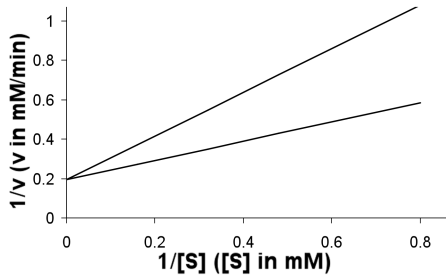
28. What must be true if K_{M} is a measure of the affinity of enzyme and substrate?

- a) k_{cat} must be larger than K_{M}
- b) k_{cat} must be smaller than K_{M}
- c) k_{cat} must be about equal to k_{-1}
- d) k_{cat} must be much smaller than k_{-1}
- e) k_{cat} must be much larger than k_{-1}

29. What are the expected changes in kinetics in the presence of a competitive inhibitor?

- a) V_{max} decreases, K_{M} appears to decrease
- b) V_{max} does not change, K_{M} appears to decrease
- c) V_{max} decreases, K_{M} appears to increase
- d) V_{max} does not change, K_{M} appears to increase
- e) V_{max} decreases, K_{M} does not change

30. You add an enzyme inhibitor to your enzyme of interest and generate the following Lineweaver-Burke plot:



The K_I or K'_I (use the plot to determine which – this is the only purpose of the plot for this question) for the inhibitor is $0.4 \mu\text{M}$ and the $[I]$ is $1.0 \mu\text{M}$. The enzyme's V_{max} is $200 \mu\text{M}/\text{min}$ and its K_M is $10 \mu\text{M}$. At $25 \mu\text{M}$ substrate, what is the apparent initial velocity?

- a) $142 \mu\text{M}/\text{min}$
- b) $83 \mu\text{M}/\text{min}$**
- c) $51 \mu\text{M}/\text{min}$
- d) $100 \mu\text{M}/\text{min}$
- e) $69 \mu\text{M}/\text{min}$