Exam #1 BMB 514 – Medical Biochemistry 9/16/11

STEP 1 - NAME (*Print clearly*) _____ _____
(first) *(last)*

Circle your college and campus:

301 --- CHM-EL
302 --- CHM-GR
303 --- COM-EL
304 --- COM-DMC
305 --- COM-MUC

STEP 2 – Fill in your answer sheet with a #2 scoring pencil, as follows:

- ☑ Print your first and last name on the line provided
- ☑ Code in your Student Number (PID)
- ☑ Code in your section as corresponds to the above list
- ☑ Code in the correct FORM ..... This is Form **A**
- ☑ Sign your name in the signature box. By signing the answer sheet for this exam, the student certifies that he/she has adhered to the policies of academic honesty in the performance of this exam.

STEP 3 - Read these instructions:

- ☑ Page 2 of this exam contains information that may be useful to you: (a) abbreviations for the amino acids; (b) pKa values of functional groups; and (c) table of logarithms.
- ☑ A simple calculator is supplied for your use during this exam. No other electronic or computational devices are to be used. Turn off cell phones; keep them out of sight.
- ☑ The proctors have the authority/responsibility to assign any student a different seat at any time, without implication and without explanation, before or during the examination, as they deem necessary. Accomplish any relocation quietly and without discussion.
- ☑ Make sure your exam has 32 questions.
- ☑ We will not answer questions of clarification. However, if you think there is an error on your exam, summon an exam proctor.
- ☑ Read each question very carefully. Choose the single, best answer and mark this answer on your answer sheet. No points will be added for correct answers which appear on the exam page but not on the answer sheet.
- ☑ When you finish, carefully follow the instructions at the end of the exam. When you leave the exam room, please turn in your answer sheet AND your exam to the proctors standing by the doors INSIDE the auditorium. Once you exit the auditorium, please leave the building. Hallway conversations disturb those still taking the exam.
- ☑ There will be answer keys to this exam posted on the course website by 5:00 p.m. the day of the exam. You may wish to copy your responses from your answer sheet onto the answer grid on the LAST page of this exam so that you can check your results. You can tear off the last page and take it with you.
- ☑ You have 70 minutes to complete this exam. No additional time will be allowed for transfer of answers from the exam to the answer sheet. We will close the exam promptly at 9:10 a.m. Once we withdraw the boxes for the answer sheets from the doors, no additional answer sheets will be accepted.

STEP 4 – Wait until instructed to proceed with the exam!

INFORMATION THAT MAY BE USEFUL FOR THE EXAM

Abbreviations for Amino Acids			
Amino Acid	3-Letter Abbreviation	Amino Acid	3-Letter Abbreviation
Alanine	Ala	Leucine	Leu
Arginine	Arg	Lysine	Lys
Asparagine	Asn	Methionine	Met
Aspartic Acid	Asp	Phenylalanine	Phe
Cysteine	Cys	Proline	Pro
Glutamine	Gln	Serine	Ser
Glutamic Acid	Glu	Threonine	Thr
Glycine	Gly	Tryptophan	Trp
Histidine	His	Tyrosine	Tyr
Isoleucine	Ile	Valine	Val

Ionizable Group	pKa
α-COOH of any aa	2
β-COOH of Asp	4
γ-COOH of Glu	4
imidazole of His	6
SH of Cys	8
α-NH_2 of any aa	9
phenolic OH of Tyr	10
ϵ-NH_2 of Lys	10
guanidino of Arg	12

Tables of Logarithmic Relationships

	Decimal									
Number	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1.	.00	.04	.08	.11	.15	.18	.20	.23	.26	.28
2.	.30	.32	.34	.36	.38	.40	.41	.43	.45	.46
3.	.48	.49	.51	.52	.53	.54	.56	.57	.58	.59
4.	.60	.61	.62	.63	.64	.65	.66	.67	.68	.69
5.	.70	.71	.72	.72	.73	.74	.75	.76	.76	.77
6.	.78	.79	.79	.80	.81	.81	.82	.83	.83	.84
7.	.85	.85	.86	.86	.87	.88	.88	.89	.89	.90
8.	.90	.91	.91	.92	.92	.93	.93	.94	.94	.95
9.	.95	.96	.96	.97	.97	.98	.98	.99	.99	1.00
10.	1.00					logs				

E.g. log 3.5 = 0.54

Reminder: How to form logs of multiples .....

log 35 = log (3.5×10^1) = (log 3.5 + log 10^1) = (0.54 + 1) = 1.54

log 350 = log (3.5×10^2) = (log 3.5 + log 10^2) = (0.54 + 2) = 2.54

log 0.35 = log (3.5×10^{-1}) = (log 3.5 + log 10^{-1})= (0.54 - 1) = - 0.46

Body Mass Index = (weight in lbs) x 704/ (height in inches)^2

CDC Weight Classes

Underweight: <18.5
Normal: 18.5-24.9
Overweight: 25-29.9
Obese: >30

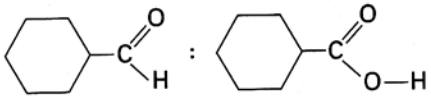
1) The three-dimensional structure of an enzyme in complex with its substrate was determined by X-ray crystallography. The structure revealed that a methionine residue in the active site of the enzyme is in close proximity to an isoleucine residue on a substrate. Which of the following would be the **predominant** interaction between these two amino acids?

A) covalent bond
B) disulfide bond
C) hydrogen bond
D) ionic interaction
E) hydrophobic interaction

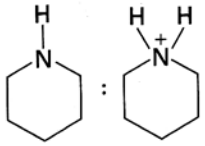
2) Determine which of the following pairs of compounds represent an acid-conjugate base pair. (The structures may not necessarily be written in the order of undissociated acid: conjugate base.)

a. $HCN : CN^-$

b.

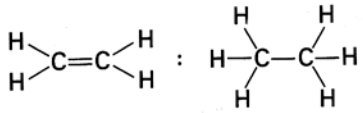


c.



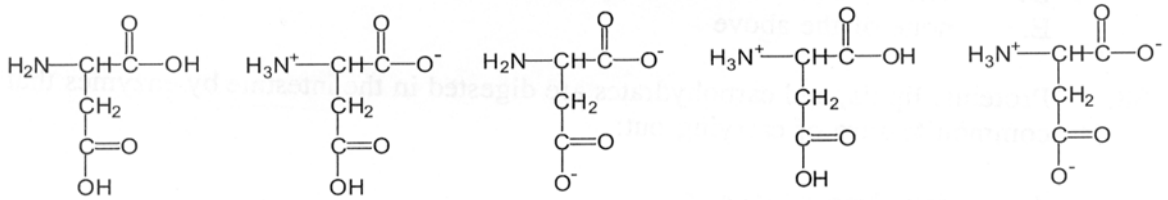
d. $H_3BO_3 : H_2BO_3^-$

e.



A) a, b and c
B) a, b and d
C) a, c and d
D) a, c and e
E) a, b and e

3) Which of the following represents the predominant ionic species of aspartate at pH 11?

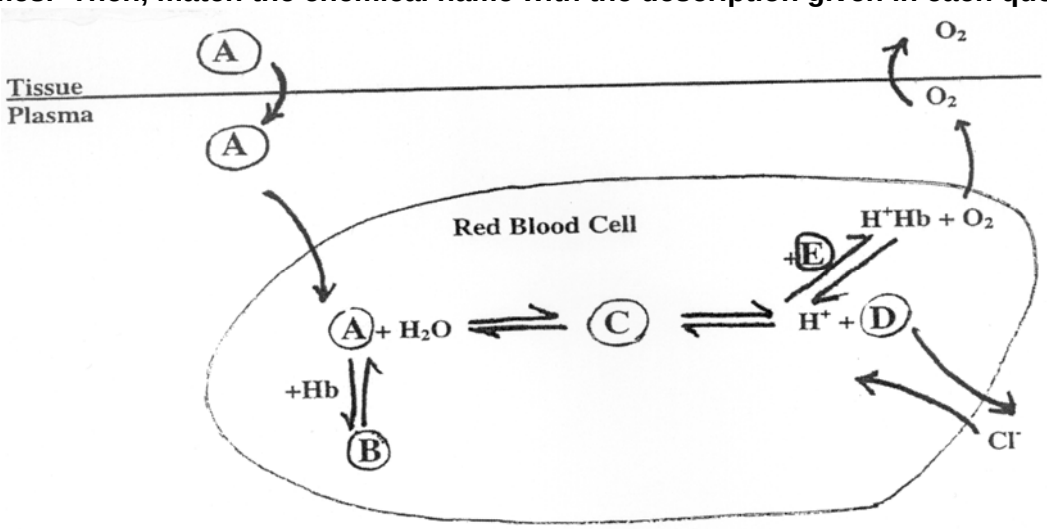


A B C D E

4) A new drug to treat ulcers of the stomach has a critical amino group and a carboxyl group with pKa values of ~9 and ~4. In order to be active, both groups need to be in their acid (HA) form. Would this drug likely be effective if given orally? (The typical pH of the stomach is ~2.)

A) Yes, both groups will be in acid form.
B) No, only the amino group will be in acid form.
C) No, only the carboxyl group will be in acid form.
D) No, both groups will be in the conjugate base form.
E) Yes, both groups will be in the conjugate base form.

Questions 5 - 7 refer to the diagram shown below. Identify the letters A-E in the diagram with chemical names. Then, match the chemical name with the description given in each question.



5) The product derived from the hydration of CO_2 catalyzed by carbonic anhydrase

6) Carbamino hemoglobin

7) Oxygenated hemoglobin

8) The differences between maternal hemoglobin and fetal hemoglobin include:

A) maternal hemoglobin is a tetramer whereas fetal hemoglobin is a monomer.
B) maternal hemoglobin exhibits a sigmoidal O_2 saturation curve while fetal hemoglobin exhibits a hyperbolic curve.
C) maternal hemoglobin utilizes an Fe-containing prosthetic group while fetal hemoglobin utilizes a Zn-containing prosthetic group.
D) maternal hemoglobin exhibits a lower degree of O_2 saturation at all partial pressures of O_2 below saturation.
E) all of the above

9) The main reason for treating severe carbon monoxide poisoning by placing the affected individual in an oxygen tent is:

A) The individual has difficulty breathing.
B) Carbon monoxide poisons oxygen transport across the alveoli of the lung.
C) Carbon monoxide is a competitive inhibitor of oxygen binding to hemoglobin.
D) Carbon monoxide combines with oxygen to form carbon dioxide ($CO + O_2 \rightarrow CO_2$) and this production of non-toxic carbon dioxide reduces the concentration of the poison.
E) In the presence of CO, the heme prosthetic group can form a "sandwich," resulting in the oxidation of iron ($Fe^{+2} \rightarrow Fe^{+3}$).

10) An18-month-old female is taken to ER because of persistent vomiting (20 times in the last 24 hours). While on family vacation in Mexico, she was given vanilla ice cream that was sold by a street vendor (dairy and meat products may harbor staphylococcal enterotoxins that produce food poisoining). You would predict:

	[bicarbonate] in blood	**primary problem**
A)	above normal	metabolic acidosis
B)	above normal	metabolic alkalosis
C)	below normal	metabolic acidosis
D)	below normal	metabolic alkalosis
E)	normal	none

11) In this question, "increased" means higher than normal and "decreased" means lower than normal values of pH = 7.4, $[HCO_3^-]$ = 24 mM, and pCO_2 = 40 mm Hg.

Which of the following best represents **partially compensated** metabolic alkalosis?

	pH	**$[HCO_3^-]$**	**pCO_2**
A)	increased	increased	increased
B)	decreased	increased	increased
C)	increased	increased	decreased
D)	decreased	increased	decreased
E)	decreased	decreased	decreased

12) A 3-year-old child was brought to the hospital with a cough, respiratory distress, and cyanosis (bluish skin due to deoxygenated hemoglobin). Physical examination suggested a lower respiratory tract infection. Other laboratory data available:

	Patient	**Normal**
pO_2 (mm Hg)	29	80-100
pCO_2 (mm Hg)	75	35-45
pH	7.1	7.35-7.45

Other useful values: (a) pK_a = 6.1 for CO_2 - HCO_3^- buffer;
(b) solubility coefficient for CO_2 at 37 ^oC, 0.03 mM/mm Hg.

What is the plasma bicarbonate concentration?

A) 8.7 mM
B) 22.5 mM
C) 24 mM
D) 29 mM
E) 75 mM

13) A 14-year-old boy who had never been immunized against poliomyelitis contracted the disease. He was hospitalized and put on a respirator during the acute phase of his illness. When he appeared to be recovering, he was taken off the respirator, with no apparent ill effects. Several days later, analysis of his blood revealed:

	Patient	**Normal**
Na^+ (mM)	136	136-145
K^+ (mM)	4.5	3.5-4.6
Cl^- (mM)	92	100-106
Total CO_2 (mM)	36	26-27
pCO_2 (mm Hg)	70	35-45
pH	7.32	7.35-7.45

Other useful values: (a) pK_a = 6.1 for CO_2 - HCO_3^- buffer;
(b) solubility coefficient for CO_2 at 37 ^oC, 0.03 mM/mm Hg.

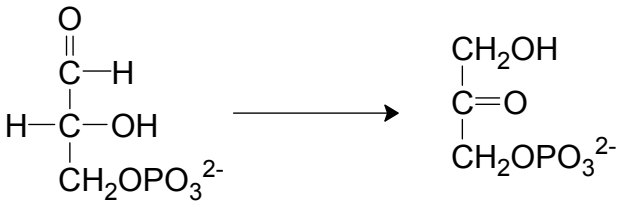
The normal value of the anion gap ranges 14-15 mM (mEq/L). Is the patient's anion gap:

A) in the normal range?
B) extremely elevated, relative to normal?
C) much below normal?

14) Which series of compounds is listed in order from the most reduced state to the most oxidized state?

A) an acid, a ketone, an alcohol, and an alkane
B) an alkane, an alkene, an acid, and an aldehyde
C) an acid, an alkane, an alcohol, and an aldehyde
D) an alkane, an alcohol, an aldehyde, and an acid
E) an alkene, an acid, an aldehyde, and an alcohol

Questions 15 and 16 refer to the chemical reaction shown below. Data for the key reaction parameters in the absence of any enzyme are also provided.



1 **2**

$\Delta G' = +0.6$ kcal/mol
$E_A = 25$ kcal/mol
$V = 2.1 \times 10^{-7}$ sec^{-1}
$K_{eq} = 0.05$

15) If you were to add an enzyme to speed up the reaction, what type of enzyme would carry out this reaction?

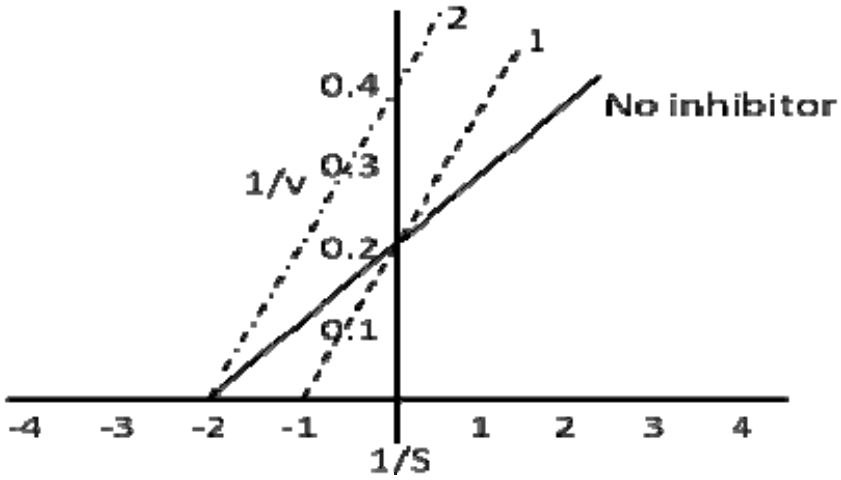
A) Epimerase
B) Isomerase
C) Dehydrogenase
D) Kinase
E) Hydrolase

16) The data associated with the above reaction are the reaction parameters **in the absence of an enzyme.** Which of the following correctly notes the changes that would occur to these parameters in the presence of the appropriate enzyme?

A) $\Delta G'$ is lowered to a negative value in order to make the reaction thermodynamically favorable.
B) E_A is lowered in order to make the transition state more easily reached.
C) V is unchanged by the enzyme.
D) K_{eq} is increased in order to have more of the product at equilibrium

17) Tryptophanyl-tRNA synthetase will charge a tRNA bearing the correct anticodon with L-tryptophan, but not D-tryptophan nor any other amino acid in the process of protein biosynthesis. This is an example of which of the following enzymatic characteristics?

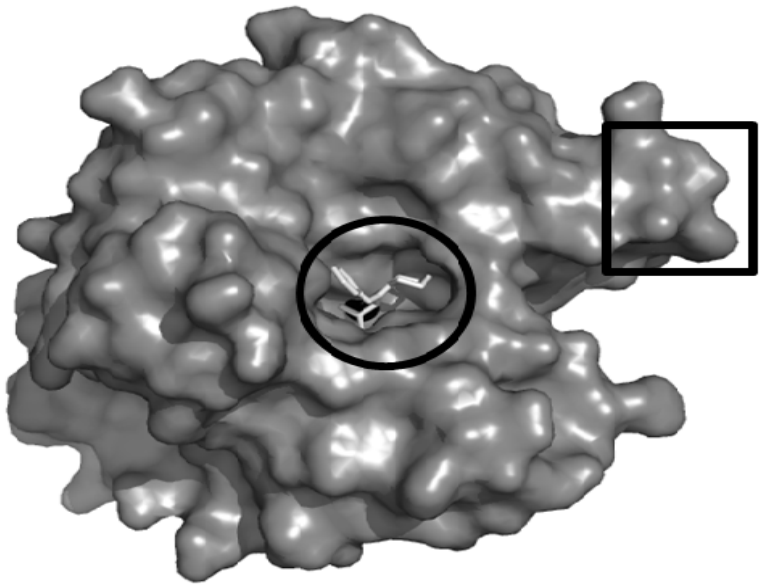
A) Catalytic Power
B) Specificity
C) Transformation of Energy
D) Regulation
E) Competitive Inhibition



Consider the above Lineweaver-Burk plot for the following question. The solid line indicates data observed in the absence of any inhibitor. The dotted lines labeled 1 and 2 indicate data observed in the presence two different inhibitors.

18) Which of the following represents the kinetic values of the enzyme in the presence of a non-competitive inhibitor?

	Km	**Vmax**
A)	0.5	5
B)	-2	0.4
C)	1	2.5
D)	0.5	2.5



19) The amino acid sequence of an enzyme was determined to have a genetic mutation resulting in the amino acid change cysteine → proline that maps to the location on the structure to the right highlighted by a box. The active site is designated by a circle which contains a zinc cofactor shown as a black sphere and an inhibitor shown as white sticks. Of the following options, what is the most likely effect of the mutation?

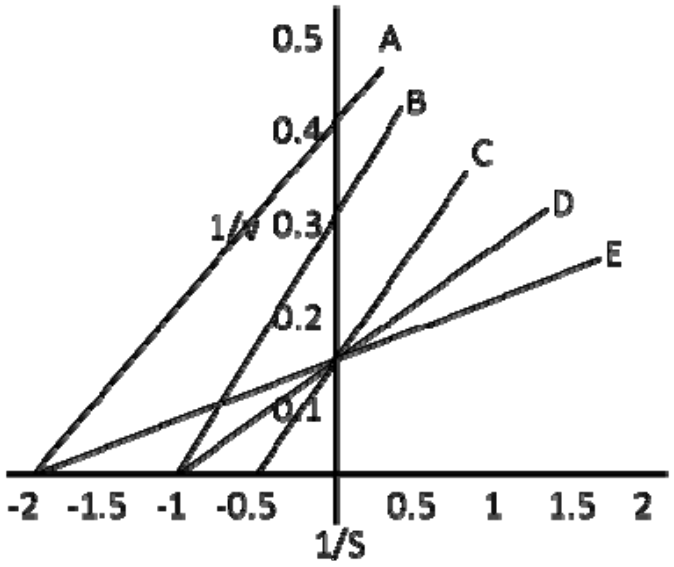
A) The mutant amino acid will directly interfere with catalysis.
B) The mutant amino acid is too far away to have any effect on the active site.
C) The mutant amino acid will alter interactions affecting the overall 3D enzyme structure.
D) The mutant amino acid will change the substrate specificity of the enzyme.
E) The enzyme will no longer bind its cofactor.

20) Given multiple **enzymes** that can catalyze the same reaction, which of the following would be the best choice, given the kinetic parameters below?

	Km	Vmax
A) Enzyme 1	10	10
B) Enzyme 2	0.5	1
C) Enzyme 3	2	1
D) Enzyme 4	0.1	10
E) Enzyme 5	0.5	5

21) Refer to the Lineweaver-Burk plot below, showing the kinetic data representing five similar but distinct **substrates** of a single enzyme. Based on their kinetic parameters, which is the most preferred substrate of the enzyme?

A) Substrate A
B) Substrate B
C) Substrate C
D) Substrate D
E) Substrate E



22) You are seeing a 19 yr old female patient who just tested positive for pregnancy. She says she doesn't need a prenatal vitamin because she eats an "energy bar" every day that has lots of vitamins in it. The nutrition label for her "energy bar" is shown to the right. Of the following options, which of the statements below would be sound advice for your patient?

A) "As long as you have one bar daily, you should be fine."
B) "You will be at risk for developing scurvy."
C) "Your baby will be at risk for neural problems."
D) "You are not getting enough vitamin B5."
E) "You may begin showing signs of Beri Beri."

Nutrition Facts

Serving size: 1 bar (100 grams)
Servings per container: about 12

Amount per Serving

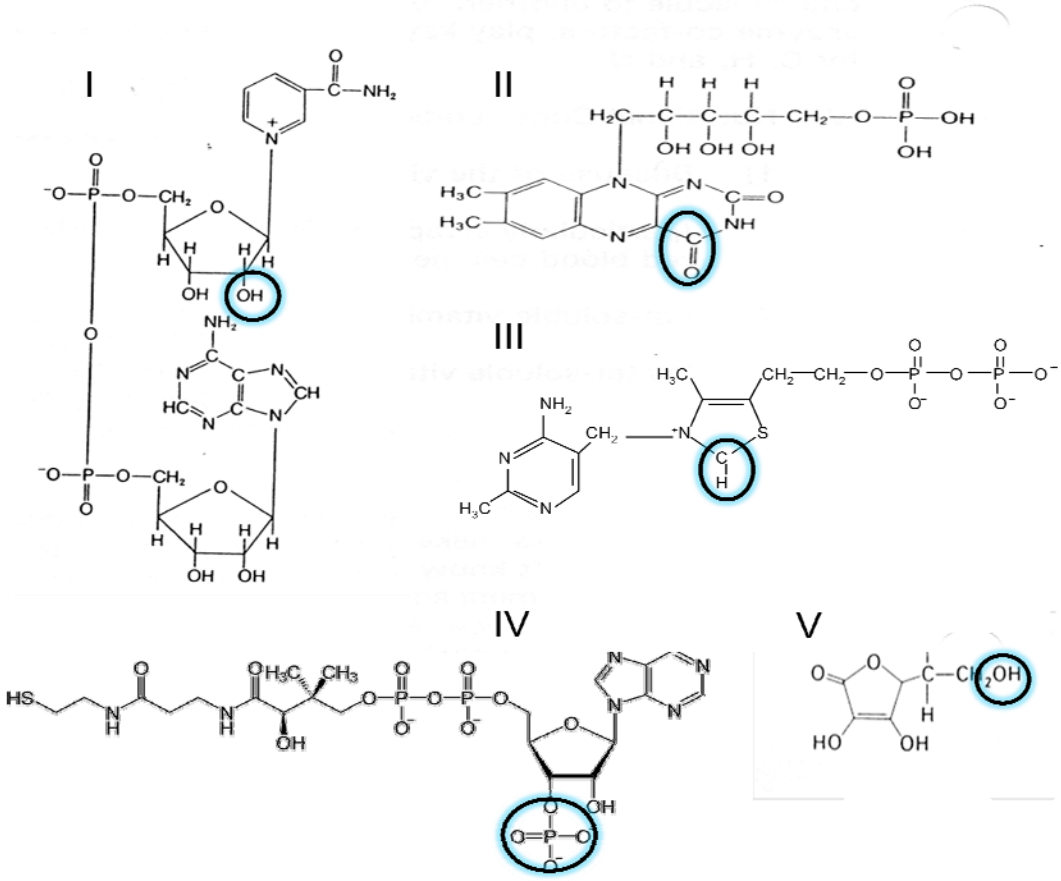
Calories per serving: 140
Calories from fat: 30

Vitamin	Amount	% RDI
Thiamine	1.2 mg	100
Riboflavin	1.3 mg	100
Niacin	2.5 mg	15
Pantothenate	20 mg	400
Pyridoxal	0.4 mg	20
Folate	100 µg	25
Cobalamin	9.5 µg	400
Biotin	30 µg	100
Ascorbate	90 mg	100

23) Your patient comes in for a checkup and you find that he has lost 5 lbs since his last visit. Where did the lost mass (carbon) go?

A) It was burned up and released as heat.
B) It was converted to energy and used up.
C) It was exhaled as carbon dioxide.
D) It was excreted as waste (feces).
E) It's still there; it just weighs less.

Questions 24 & 25 refer to the structures of the coenzyme derivatives labeled I – V below:



24) Which of the coenzyme derivatives above are carriers of carbon chains?

A) II only
B) III and IV
C) I and IV
D) I, II, and V
E) III only

25) Which of the coenzyme derivatives above has its active site appropriately highlighted by an oval?

A) I
B) II
C) III
D) IV
E) V

26) A 17 yr old male varsity wrestler is in your office for a sports physical. He is 5 feet 10 inches tall and weighs 130 pounds. He expresses interest in losing 5 lbs in order to go down a weight class in competition and seeks your approval. Which of the following statements would be the best advice for the patient?

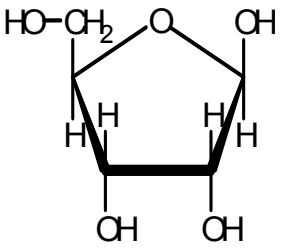
A) "You are borderline underweight now; further weight loss is not recommended."
B) "A little weight loss would be healthy, go ahead."
C) "You are at an unhealthy low weight; you should probably gain a few pounds instead."
D) "You could lose a few pounds. As you get taller, it will all even out."

27) If ΔG^0 for the chemical reaction, A + B ◄——► C + D, is -57 kcal/mol at 25°C, which of the following statements is most accurate?

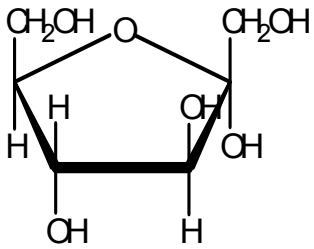
A) under standard conditions, equilibrium will be achieved when all concentrations are equal
B) under standard conditions, the equilibrium mixture will contain a predominance of reactants compared to products
C) entropy is decreased as the reaction procedes to the right
D) under standard conditions, the equilibrium mixture will contain a predominance of products compared to reactants
E) the reaction will always go to the left

28) Consider the reaction A + B ◄——► C + D which has a ΔG°' of +1.2 Cal/mol. Which of the following statements is true regarding this reaction?

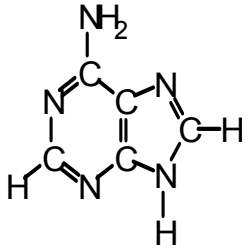
A) The reaction will proceed forward as written under standard conditions.
B) Cellular concentrations of reaction components may make ΔG' a negative value.
C) The reaction will occur slowly.
D) There will be more products than reactants at equilibrium.
E) This reaction could be used to generate ATP.



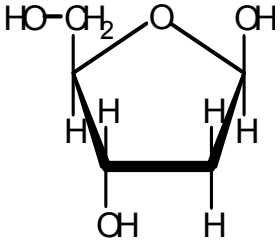
Molecule 2



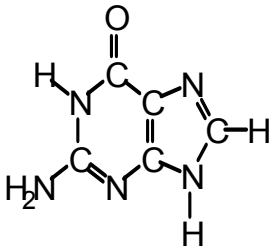
Molecule 4



Molecule 1



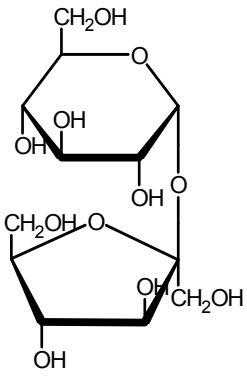
Molecule 3



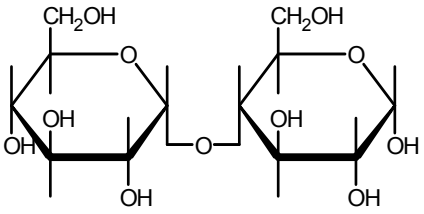
Molecule 5

29) Which of the above molecules are components of RNA?

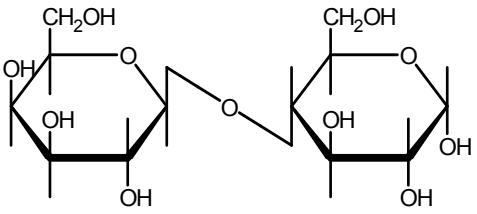
A) Molecules 1, 2, and 3
B) Molecules 1, 4, and 5
C) Molecules 1, 3, and 5
D) Molecules 2, 3, and 5
E) Molecules 1, 2, and 5



Molecule 1



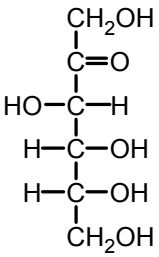
Molecule 2



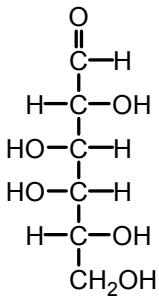
Molecule 3

30) Which of the above molecules has (have) a reducing end?

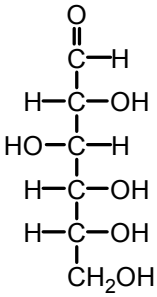
A) Molecule 1
B) Molecule 2
C) Molecule 3
D) Both Molecules 2 and 3
E) Molecules 1, 2, and 3



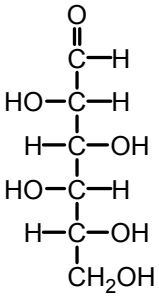
Molecule 1



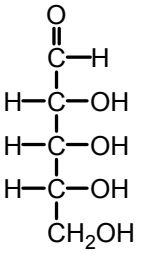
Molecule 2



Molecule 3



Molecule 4



Molecule 5

31) In the above figure, which of the molecules are epimers?

A) Molecules 1 and 5
B) Molecules 2 and 3
C) Molecules 3 and 4
D) Molecules 2 and 4
E) Molecules 1 and 3

32) Food stuff oxidation, transfer of energy to ATP, and utilization of energy and amino acid building blocks to synthesize a new protein are all part of what process?

A) Metabolism
B) Catabolism
C) Anabolism
D) Respiration
E) Digestion

END OF EXAMINATION Tear off this sheet and save to check your answers.

Please remember to:

- Write the letter corresponding to your **FORM** in the appropriate place on the **answer sheet**.
- **SIGN AND RETURN YOUR EXAMINATION** to an instructor **before leaving the exam room**.

FORM: A

1. _____	11. _____	21. _____	31. _____
2. _____	12. _____	22. _____	32. _____
3. _____	13. _____	23. _____	
4. _____	14. _____	24. _____	
5. _____	15. _____	25. _____	
6. _____	16. _____	26. _____	
7. _____	17. _____	27. _____	
8. _____	18. _____	28. _____	
9. _____	19. _____	29. _____	
10. _____	20. _____	30. _____	