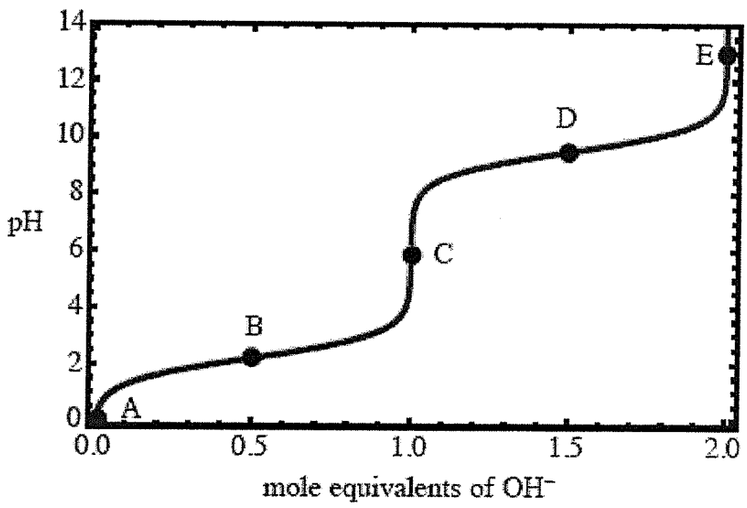
5. In ion exchange chromatography amino acids are eluted from a sulfonic acid resin because_____

A) differences in the charges of the amino acids cause them to travel at different speeds in the electric field.
B) differences in the sizes of the amino acids cause them to elute at different times.
(C) differences in the pI's of the amino acids cause them to elute at different pH's.
D) differences in the chirality of the amino acids cause them to interact differently with the chromatography resin and elute at different times.
E) differences in the hydrogen bonding of the amino acid side chains causes them to elute at different Rf values.

6. The regular, repeating conformation of the polypeptide backbone is called _____.

A) primary structure.
(B) secondary structure.
C) tertiary structure.
D) quaternary structure.
E) double helix.

7. Which statement about the following amino acid titration curve is correct?



A) Point "A" is the good buffering region.
B) The pKa of the compound is about 5.8
C) At point "E" the molecule is likely a zwitterion
D) At point "B" the compound exists mainly in the weak acid form.
(E) The compound being titrated is anionic at point "E"

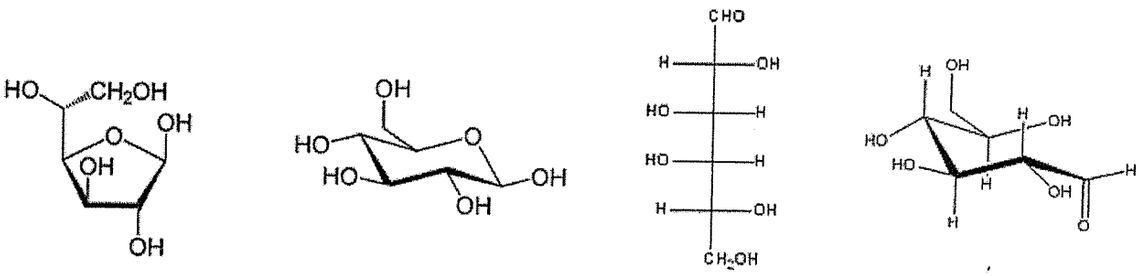
8. Which amino acid is most likely being titrated in the titration curve shown above?

(A) Alanine (neutral AA)
B) Aspartic acid (acidic AA).
C) Glutamic acid (acidic AA)
D) Histidine (basic AA).
E) Lysine (basic AA)

14. Carbohydrate characteristic chemical features include all ***EXCEPT***:

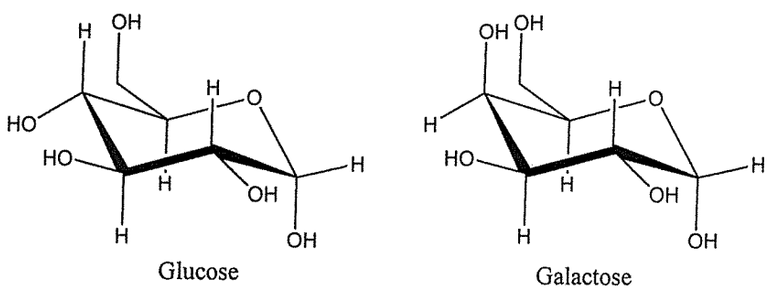
A) the potential to form multiple hydrogen bonds.
B) the existence of one or more asymmetric centers.
C) the capacity to form polymeric structures.
D) the ability to exist in either linear or ring structures.
(E) all are true.

15. The four molecules below are named, from left to right:



A) Ribose, alpha-ribopyranose, L-ribose, hemi-ribose
(B) Beta-D-glucofuranose, beta-D-glucopyranose, D-glucose. D-glucose
C) Alpha-D-glucofuranose, alpha-D-glucopyranose, D-glucose. D-glucose
D) Maltose, alpha-D-glucopyranose, generic hexose, generic aldehyde
E) Ribose, lactose, D-glucose, D-glyceraldehyde

16. Cyclic molecules of glucose and galactose shown below are:



Glucose Galactose

A) Anomers
B) Diastereoisomers
(C) Epimers
D) Cis-trans isomers
E) Dimers

17. The cell walls of bacteria contain a cross-linked network of short peptides and sugars called:

(A) peptidoglycans.
B) cellulose.
C) starch.
D) proteoglycans.
E) glycoproteins.

21. All are true for the DNA double helix ***EXCEPT***:

A) The two strands are held together by interchain hydrogen bonds.
B) The two strands are parallel.
C) The two strands have complementary base pairing.
D) Information is accessed through transcription of the information into RNA.
E) All are true.

22. Identify the DNA sequence that is complementary to the following DNA sequence:

(5') AGTTCCGATCT (3')

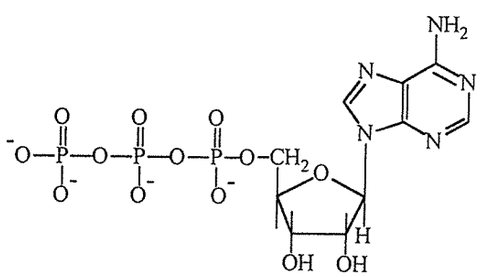
A) (5') AGAUCGGAACU (3').
B) (5') TCAAGGCTAGA (3').
C) (5') AGATCGGAACT (3').
D) (5') AGTTCCGATCT (3').
E) (5') UCAAGGCUAGA (3').

23. Which of the following applies to RNA?

I. It can only exist as double stranded.
II. All organisms store genetic information in the form of RNA.
III. Hydrogen bonding between ribose hydroxyls determines the conformation of RNA.
IV. Base stacking can cause mutations.
V. About 25% of the bases in RNA are uracil.

A) III, IV, & V
B) V
C) I & IV
D) II
E) All are true.

24. Which statement about the following molecule is **CORRECT**?



A) The 5' carbon of ribose is adenylated.
B) The nitrogenous base is hydrophilic.
C) The 1' carbon of ribose phosphorylated.
D) The ribose sugar is flexible.
E) It is part of the DNA sequence ATTAG.

30. Cytochrome c is:

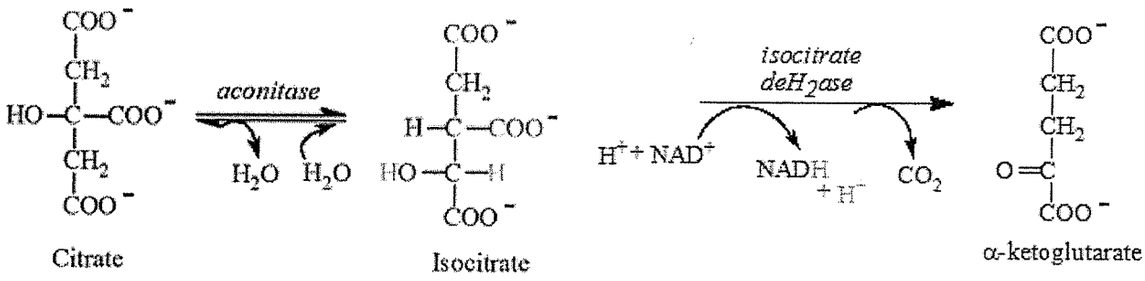
A) An enzyme which pumps protons out of the mitochondrial matrix
B) A coenzyme active in the reduction of ubiquinone
C) An aromatic molecule soluble in mitochondrial membranes
D) An electron carrier which uses Fe and Cr to carry redox reactions
(E) A heme-containing protein which uses Fe in its reduced and oxidized states

31. The following reaction is part of _____.

$$UQH_2 + 2Cyt\text{-}Fe^{3+} \rightleftharpoons UQ + 2Cyt\ c\text{-}Fe^{2+}$$

A) The glycolytic process
B) The Krebs cycle
(C) Complex III of the electron transfer cycle.
D) The start of the electron transfer cycle
E) ADP synthesis

32. In the Krebs cycle, the enzyme aconitase transforms citrate into isocitrate, which is then turned into alpha-ketoglutarate by isocitrate dehydrogenase:



Citrate Isocitrate α-ketoglutarate

Why is the first transformation by aconitase necessary?

A) The loss and gain of water are necessary to lower the ΔG of the second reaction
B) The pKa of citrate is lower than that of isocitrate
C) The reactions are reversible
D) The production of NADH drives the reaction
(E) The position of the –OH group is favorable to form the final product

33. Identify the correct statement:

(A) Pyruvate dehydrogenase is a large complex of 3 enzymes acting with 5 coenzymes
B) The action of the pyruvate dehydrogenase complex is to remove H_2 from pyruvate
C) E1, E2 are two main enzymes of the complex and lipoic acid is attached to E1
D) The role of E3 is to regenerate pyruvate to allow the process to start again
E) Pyruvate dehydrogenase is a large complex of 5 enzymes with 3 coenzymes

LECTURE SECTION (Q 36 to 40: answer on exam sheet in spaces given. Pts: 3.78/question)

36. The two half reactions shown below play an important role in the electron transfer cycle. Their standard reduction potentials are given. Write the global reaction for this system in the correct direction and calculate the ΔG and K_{eq} values at 298 K. ($R = 8.314$ J/mole.K) Write your answer in the space below.

$$\text{cyt-C-Fe}^{3+} + e^- \rightleftharpoons \text{cyt-C-Fe}^{2+} \quad +0.22\ \text{V}$$

$$O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O \quad +1.229\ \text{V}$$

$F = 96.5$ kJ/mol k

$O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O$ $+1.229$ V red.

$4\,\text{Cyc-C-Fe}^{2+} \rightleftharpoons 4\,\text{Cyc-C-Fe}^{3+} + 4e^-$ ox.

$\Delta E = 1.229 - 0.22$ (no multiplication by 4)

$= 1.009$

$\Delta G = -nF\Delta E = -4\,(96.5)(1.009) = 389.5$ kJ

$\Delta G = -RT \ln K_{eq} = -0.0083 \times 298 \times \ln K_{eq}$

$\ln K_{eq} = \frac{\Delta G}{RT} = \frac{389.5}{0.0083 \times 298} = 157.5$

$K_{eq} = e^{157.5} = 2.52 \times 10^{68}$

39. An enzyme has a *Km* for its substrate of 3×10^{-5} M. In one experiment, the initial velocity of the reaction catalyzed by the enzyme was measured at a substrate concentration of 2×10^{-3} M and was found to be 5×10^{-3} moles per litre per second. What would the rate of reaction have been if the substrate concentration had been 3×10^{-5} M?

$K_m = 3 \times 10^{-5}$ M

$V_0 = 5 \times 10^{-3}$ M/s

$[S] = 2 \times 10^{-3}$ M

$$V_0 = \frac{V_{max}[S]}{K_m + [S]} \Rightarrow V_{max} = \frac{V_0 [K_m + [S]]}{[S]}$$

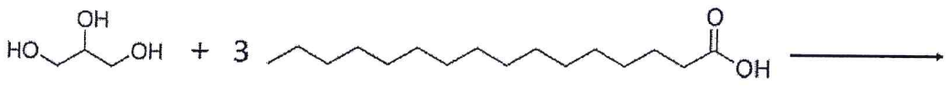
$$= \frac{(5 \times 10^{-3})[(3 \times 10^{-5}) + (2 \times 10^{-3})]}{(2 \times 10^{-3})}$$

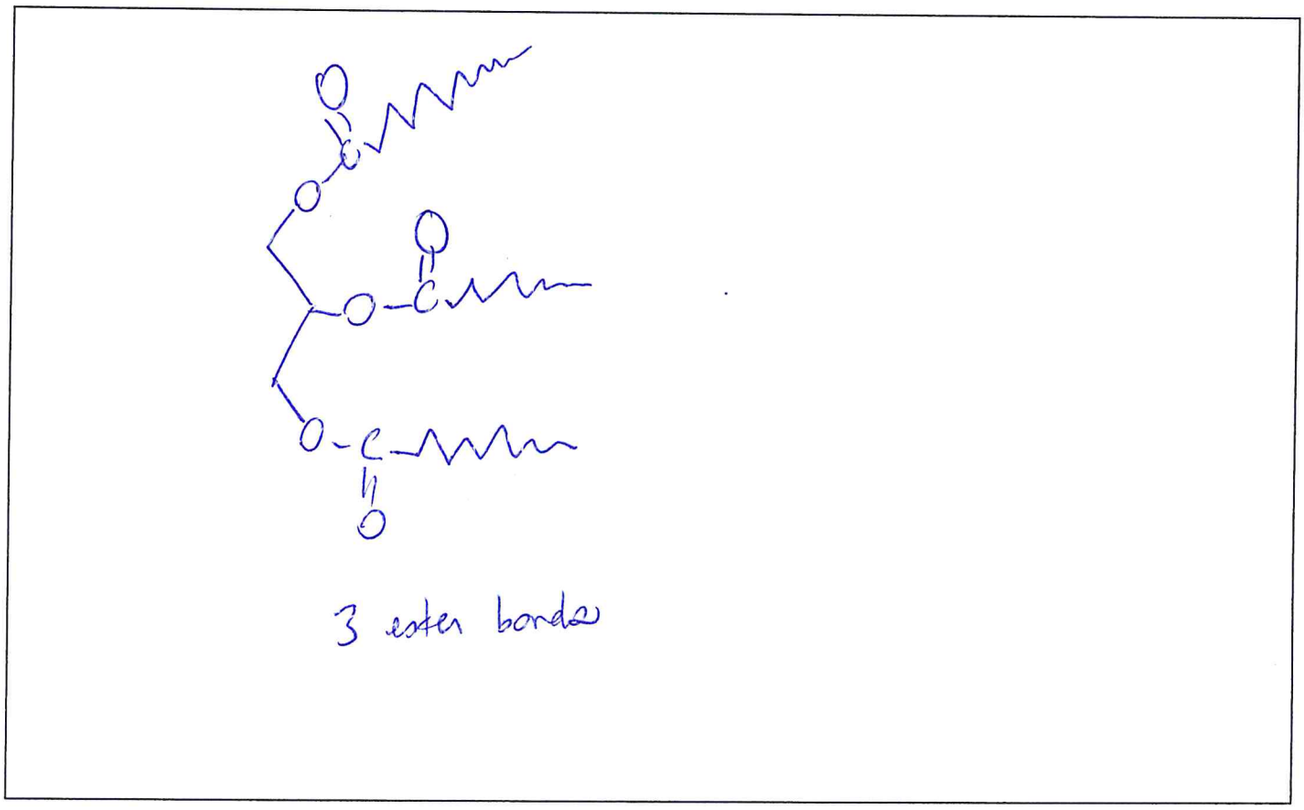
$= 5.1 \times 10^{-3}$ M/s

If $[S] = 3 \times 10^{-5}$ M

$$V_0 = \frac{(5.1 \times 10^{-3})(3 \times 10^{-5})}{(3 \times 10^{-5}) + (3 \times 10^{-5})} = 2.55 \times 10^{-3} \text{ M/s}$$

40. The condensation of glycerol with three fatty acids produces a triglyceride. Complete the following condensation reaction between glycerol and 3 molecules of palmitic acid:





LABORATORY SECTION (Q 41-50: answer on the bubble sheet. Each question: 1.5 pts)

41. You mixed 0.100 mL of a BSA stock solution with 2.90 mL of buffer and measured the absorbance at 280 nm against a buffer blank. If the absorbance of this diluted BSA solution was 0.244, what would the original absorbance of the stock solution have been if you had not diluted it?

Dilution factor = $\frac{3\text{mL}}{0.1\text{mL}} = 30$

$A = 0.244 \times 30 = 7.32$

A) 7.076
B) 2.440
C) 0.244
D) Bradford reagent is always required to determine the concentration of a protein.
(E) 7.320

42. You prepared Michaelis-Menten curves for the hydrolysis of substrate ONPG by β-galactosidase. Which of the following combination of y and x-axis labels would be used for those curves?

A) y-axis: absorbance, x-axis: [ONPG]
B) y-axis: 1/initial rate, x-axis: 1/[ONPG]
C) y-axis: absorbance, x-axis: time
(D) y-axis: initial rate, x-axis: [ONPG]