

題號： 414

國立臺灣大學 111 學年度碩士班招生考試試題

科目： 生物化學(A)

題號： 414

節次： 8

共 11 頁之第 1 頁

單選題 共 50 題 (A) (B) (C) (D) (E) 5 選 1 答錯不倒扣
第 1 至 25 題 每題 1.5 分 第 26 至 50 題 每題 2.5 分

1. Protein secondary structures are defined by which of the following interactions?
(A) Van der Waals interactions (B) Columbic interactions
(C) Hydrophobic interactions (D) Hydrogen bonding (E) None of the above
2. What kind of post-translational modification(s) can take place in a serine residue of a protein?
(A) Glycosylation (B) Nitrosylation (C) Lipidation
(D) Ubiquitination (E) All the above
3. HELQ enzyme requires Mg^{2+} for catalysis. When the enzyme lacks Mg^{2+} , it would be referred to as the:
(A) apoenzyme. (B) substrate. (C) coenzyme.
(D) holoenzyme. (E) prosthetic group.
4. The double helix of DNA in the B-form is stabilized by:
(A) covalent bonds between the 3' end of one strand and the 5' end of the other.
(B) hydrogen bonding between the phosphate groups of two side-by-side strands.
(C) hydrogen bonds between the riboses of each strand.
(D) nonspecific base-stacking interaction between two adjacent bases in the same strand.
(E) ribose interactions with the planar base pairs.
5. Most transduction systems for hormones and sensory stimuli that involve trimeric G proteins have in common all of the following **except**:
(A) cyclic nucleotides. (B) nuclear receptors.
(C) receptors that interact with a G protein.
(D) receptors with multiple transmembrane segments. (E) self-inactivation.
6. Which of the following is an advantage of using multiple steps in electron transport?
(A) By using several steps, the net ΔG is higher (more energy is released).
(B) More energy can be captured to synthesize ATP by using small steps.
(C) More heat can be generated by using small steps.
(D) Small steps allow for both more heat generation and more ATP synthesis.
(E) All of these statements are advantages of using multiple steps.

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7. Which of the following statements about phospholipase is **correct**?
1. Phospholipases are designated A, B, etc, based on the different sites in the molecule where they cleave the phospholipids.
 2. Phospholipases break down fats by reducing the double bonds to single bonds.
 3. Many snake venoms contain phospholipases, whose enzymatic activities act to prevent blood clotting.
- (A) 1 and 2 are correct. (B) 1 and 3 are correct. (C) 2 and 3 are correct.
(D) None of above is correct. (E) All of above are correct.
8. Which of the following statements about free energy or standard state is **correct**?
1. Free energy is the energy available to perform work.
 2. Free energy changes can be measured at constant temperature and pressure.
 3. For biochemical reactions, standard state for $[H^+]$ is $10^{-7} M$
- (A) 1 and 2 (B) 2 only (C) 2 and 3
(D) None of above is correct. (E) All of above are correct.
9. Which statement is **correct** regarding prostaglandins?
- (A) Prostaglandins are formed from linolenic acid by oxidation and cyclization.
(B) Prostaglandins are impotent mediators of inflammation.
(C) NSAIDs inhibit the formation of prostaglandins by targeting prostaglandin-endoperoxide H synthase.
(D) Prostaglandins are docosanoids.
(E) None of the above.
10. Which statement is **correct**?
- (A) The PCSK9 protein is a chaperone that binds to HDL receptors on the cell surface.
(B) The PCSK9 protein directs the PCSK9-LDL complex to the ribosome to degrade.
(C) The PCSK9 protein's inhibition results in more HDL receptors on the cell surface.
(D) The current clinically used PCSK9 inhibitors are monoclonal antibodies.
(E) The PCSK9 protein is a vital regulator of circulating HDL receptor levels.
11. The most sensitive indicator of the energetic status of the cell is the concentration of:
- (A) AMP. (B) ADP. (C) ATP. (D) cAMP. (E) glucose.
12. In a biotin-dependent carboxylation, _____ provides the energy for activation of _____.
- (A) acetyl CoA; carbon dioxide (B) ATP; lysine amine group
(C) NADH; bicarbonate (D) ATP; bicarbonate (E) acetyl CoA; carboxyl group

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13. Which of the following compounds has the largest negative value for the standard free-energy change (ΔG°) upon hydrolysis?
- (A) Acetic anhydride (B) Glucose 6-phosphate (C) Glutamine
(D) Glycerol 3-phosphate (E) Lactose
14. Under anaerobic conditions, skeletal muscle generates lactate from pyruvate to:
- (A) lower the pH. (B) promote release of oxygen from hemoglobin.
(C) generate additional ATP. (D) be warning of muscle fatigue.
(E) regenerate NAD^+ for further glycolysis.
15. A cell that is unable to synthesize or obtain tetrahydrofolic acid (H_4 folate) would probably be deficient in the biosynthesis of:
- (A) dCMP. (B) GMP. (C) orotate. (D) dTMP. (E) UMP.
16. In triacylglycerols, the glycerol and the fatty acid moieties is joined covalently in a:
- (A) phosphodiester bond. (B) ester bond. (C) ether bond.
(D) amide bond. (E) *N*- β -glycosyl bond.
17. 2,4-Dinitrophenol and oligomycin inhibit mitochondrial oxidative phosphorylation. 2,4-Dinitrophenol is an uncoupling agent; oligomycin blocks the ATP synthesis reaction itself. Therefore, 2,4-dinitrophenol will:
- (A) allow electron transfer in the presence of oligomycin.
(B) allow oxidative phosphorylation in the presence of oligomycin.
(C) block electron transfer in the presence of oligomycin.
(D) diminish O_2 consumption in the presence of oligomycin.
(E) None of the above
18. A molecule such as 2,4-dinitrophenol (2,4-DNP) works to uncouple the proton gradient. Which of the following is **true** about 2,4-DNP?
- (A) 2,4-DNP is protonated in the matrix and deprotonated in the intermembrane space.
(B) The presence of an uncoupler results in an increase in the activity of the TCA cycle and electron transport.
(C) 2,4-DNP is a very ineffective uncoupler because its hydrophobic structure prevents it from effectively crossing lipid bilayer membranes.
(D) 2,4-DNP has been used as a very effective diet aid for the past 70 years.
(E) None of the above is correct.
19. During β oxidation of fatty acids, _____ is produced in peroxisomes but not in mitochondria.
- (A) acetyl-CoA (B) FADH_2 (C) H_2O (D) H_2O_2 (E) NADH

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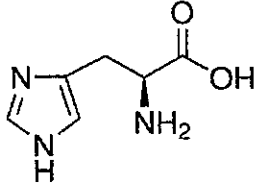
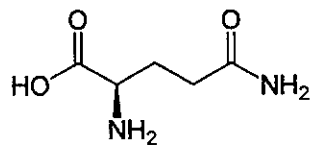
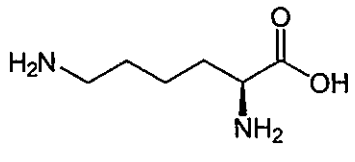
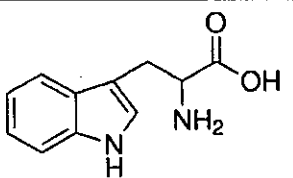
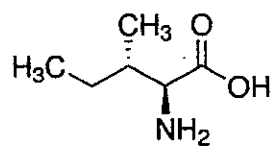
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20. In humans, gluconeogenesis:
- (A) can result in the conversion of protein into blood glucose.
 - (B) helps to reduce blood glucose after a carbohydrate-rich meal.
 - (C) is activated by the hormone insulin
 - (D) is essential in the conversion of fatty acids to glucose.
 - (E) requires the enzyme hexokinase.
21. All are physiological changes initiated by glucagon **except**:
- (A) activation of glycogenolysis in liver.
 - (B) stimulation of liver gluconeogenesis.
 - (C) maintenance of steady-state levels of glucose in the blood stream.
 - (D) activation of glycogenolysis in muscles.
 - (E) All are true.
22. Which of the following is **not** required in the synthesis of fatty acids?
- (A) Acetyl-CoA (B) Biotin (C) HCO_3^- (CO_2)
 - (D) Malonyl-CoA (E) NADH
23. When a cell with the pentose phosphate pathway has need for more pentose phosphates, but **not** for additional NADPH:
- (A) glucose-6-phosphate dehydrogenase is activated.
 - (B) the oxidative and non-oxidative enzymes of the pentose phosphate pathway are active.
 - (C) the non-oxidative enzymes produce pentose phosphates from fructose-6-phosphate and glyceraldehyde-3-phosphate.
 - (D) all enzymes of glycolysis and pentose phosphate pathway are active.
 - (E) None of the above are true.
24. Which of the following descriptions is **correct**, regarding to the use of the enzyme glucose oxidase to determine the concentrations of glucose in blood?
- (A) Glucose is reduced to give glucono- δ -lactone.
 - (B) The reaction produces oxygen in company with glucono- δ -lactone.
 - (C) The reaction requires hydrogen peroxide as the oxidant.
 - (D) Glucose is oxidized to give glucono- δ -lactone.
 - (E) Glucose is oxidized to give glucuronic acid
25. Certain nucleotide bases in DNA molecules are enzymatically methylated. In all known DNA methylation reactions the methyl group donor is:
- (A) S-adenosylmethionine. (B) N^5, N^{10} -methylenetetrahydrofolate.
 - (C) N^5 -methyltetrahydrofolate. (D) HCO_3^- . (E) acetyl-CoA.

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第 26 至 50 題 每題 2.5 分

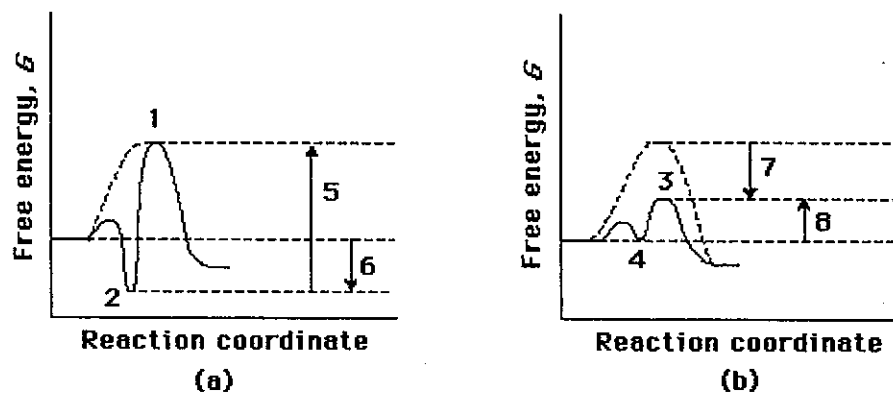
Use the table shown below to answer the questions 26 and 27.

I.	II.	III.
		
IV.	V.	
		

26. Which amino acid in the above table has a pKa that is very sensitive to the microenvironment and is often involved in enzyme catalysis?
 (A) I (B) II (C) III (D) IV (E) V
27. Which amino acid in the above table is able to form a salt bridge with a glutamate?
 (A) I (B) II (C) III (D) IV (E) V
28. Which of the following statements is **correct**?
 (A) Nonpolar compounds force surrounding H₂O molecules to become disordered.
 (B) Nonpolar compounds interfere with the hydrogen bonding among H₂O molecules.
 (C) Nonpolar compounds increase entropy (ΔS) when dissolved in water.
 (D) Nonpolar compounds decrease enthalpy (ΔH) when dissolved in water.
 (E) None of the above

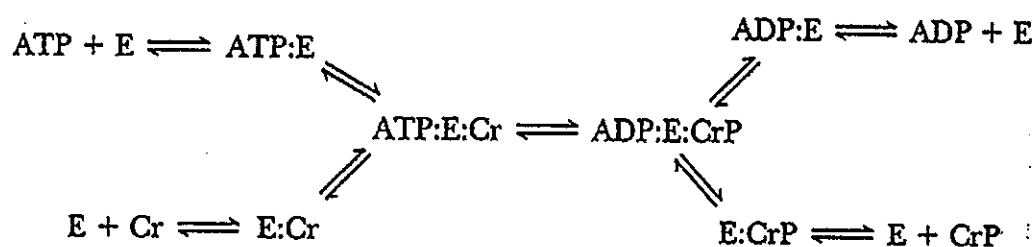
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29. Compare the two reaction coordinate diagrams below and select the answer that **correctly** describes their relationship. In each case, the single intermediate is the ES complex.



- (A) (a) describes a strict “lock and key” model, whereas (b) describes a transition-state complementarity model.
- (B) The activation energy for the catalyzed reaction is #5 in (a) and is #7 in (b).
- (C) The activation energy for the **uncatalyzed** reaction is given by #5 + #6 in (a) and by #7 + #4 in (b).
- (D) The contribution of binding energy is given by #5 in (a) and by #7 in (b).
- (E) The ES complex is given by #2 in (a) and #3 in (b).
30. Which of the following statements regarding enzyme regulation is **true**?
- (A) Addition of an inhibitor to a V system results in kinetics similar to addition of a competitive inhibitor to a typical hyperbolic system.
- (B) Addition of an allosteric activator to a K system changes the plot of V vs. [S] from a sigmoidal curve to a more hyperbolic curve.
- (C) Allosteric effectors are always more powerful than covalent modification.
- (D) The T state of an enzyme generally has more activity than the R state.
- (E) None of the above is true.

31. In the enzyme catalyzed reaction sequence below, can the $E\text{-PO}_4^-$ intermediate be predicted and why?



- (A) Yes, the mechanism is a double-displacement reaction.
- (B) Yes, the reaction fits the ping-pong model.
- (C) No, the reaction is random single-displacement.
- (D) No, the reaction is double-displacement.
- (E) No, the reaction is order single-displacement.

32. An enzyme-catalyzed reaction rate will be increased if the energy level of ES can be increased. Which of the following will **not** increase the energy level of ES?
- (A) Destabilization of ES by strain caused by non-covalent interactions between E and S.
 - (B) Loss of entropy due to binding of E and S.
 - (C) Destabilization of ES by distortion.
 - (D) Destabilization of ES by electrostatic effects.
 - (E) Destabilization of ES by solvation.
33. The enzymes of the citric acid cycle are listed in the following.
- 1. Pyruvate dehydrogenase 2. Succinate dehydrogenase 3. Aconitase
 - 4. Citrate synthase 5. α -ketoglutarate dehydrogenase 6. Isocitrate dehydrogenase
 - 7. Succinyl-CoA synthase 8. Fumarase 9. Malate dehydrogenase
- Which of the following descriptions is **correct**?
- (A) Enzyme 7 catalyzes the reaction that produces FADH_2 .
 - (B) Enzymes 1, 5, and 9 catalyze the reactions that release CO_2 .
 - (C) Enzymes 4 and 8 catalyze reactions consume H_2O .
 - (D) Enzymes 2 and 4 catalyze the reactions that consume double-bond-containing molecules.
 - (E) Enzymes 3 and 6 catalyze the reactions that are bypassed in the glyoxylate cycle.
34. Which of the following statements about oxidation of fatty acids (FAs) is **correct**?
- 1. The energy yield per gram of FA oxidized is lesser than that per gram of carbohydrate oxidized.
 - 2. Carnitine is used to shuttle acyl groups across the inner mitochondrial membranes.
 - 3. Oxidation of acyl-CoA to unsaturated acyl-CoA is catalyzed by NAD-dependent acyl-CoA dehydrogenase.
 - 4. Cleavage of the β -ketoacyl-CoA is catalyzed by thiolase.
- (A) 1 and 3 are correct. (B) 2 and 4 are correct. (C) 1 and 4 are correct.
 - (D) 2 and 3 are correct. (E) All of above are correct.
35. Which of the following statements about amino acid biosynthesis is **incorrect**?
- 1. The conversion of α -ketoglutarate to glutamate is an amidation reaction.
 - 2. Pyridoxal phosphate is a coenzyme frequently encountered in transamination reactions.
 - 3. In animals, conversion of cysteine from serine use 3'-Phospho-5'adenylsulfate as a sulfur donor.
 - 4. Pyruvate generated from glycolysis can be used to synthesize alanine.
- (A) 1 and 3 are incorrect. (B) 2 and 4 are incorrect. (C) 1 and 4 are incorrect.
 - (D) 2 and 3 are incorrect. (E) All of above are incorrect.

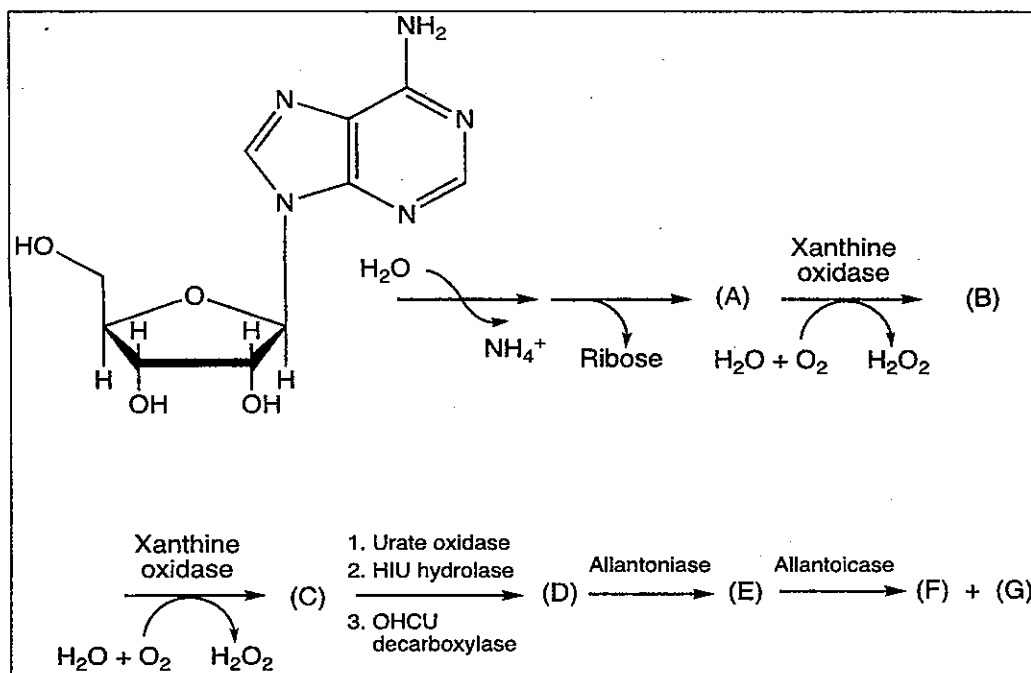
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36. Which of the following statements about urea cycle is **correct**?

1. The urea cycle is linked to the citric acid cycle by arginine.
2. Aspartic acid is the main amino acid precursor for the carbon chain in arginine.
3. Citrulline is synthesized in the cytosol and transported to the mitochondrial matrix for subsequent reaction.
4. Ornithine is synthesized in the mitochondrial matrix and transported to the cytosol for subsequent reaction.

- (A) All of above are **incorrect**. (B) 1 and 3 are correct. (C) 2 and 4 are correct.
 (D) 1 and 2 are correct. (E) 3 and 4 are correct.

37. Shown is the purine catabolism.



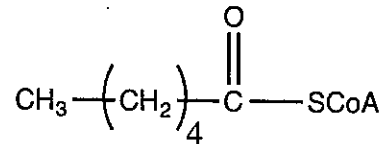
① 	② 	③ 	④ 	⑤
⑥ 	⑦ 	⑧ 	⑨ 	⑩

What is the chemical structure of the compound (A)?

- (A) ① (B) ② (C) ③ (D) ④ (E) ⑤

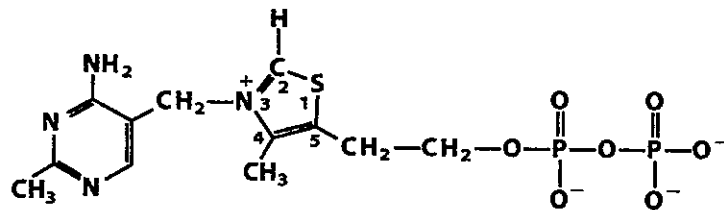
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38. How many ATPs are produced by the complete metabolism of the saturated fatty acid shown below?



- (A) 32 (B) 36 (C) 38 (D) 50 (E) 52

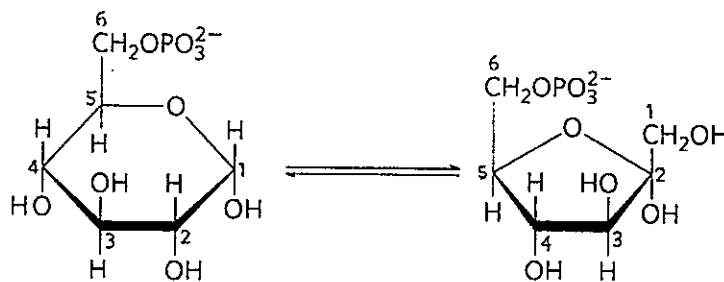
39. Thiamine pyrophosphate (TPP), derived from vitamin B₁, is a coenzyme of pyruvate decarboxylase. Regarding to the functional role of TPP, which atom will be converted into a nucleophile?



Thiamine pyrophosphate (TPP)

- (A) No. 1. (B) No. 2. (C) No. 3. (D) No. 4. (E) No. 5.

40. Which of the following enzymes catalyzes the conversion shown below in the glycolysis pathway?



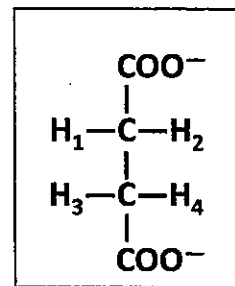
- (A) Hexokinase (B) Phosphofruktokinase-1 (PFK-1) (C) Phosphohexose isomerase (D) Phosphoglucose mutase (E) Phosphohexose epimerase

41. The reaction, 1,3-bisphosphoglycerate → 2,3-bisphosphoglycerate, is catalyzed by:
 (A) bisphosphoglycerate phosphatase (B) bisphosphoglycerate mutase
 (C) 2,3-bisphosphoglycerate synthetases (D) 3-phosphoglycerate isomerase
 (E) 1,3-bisphosphoglycerate hydrolase

42. All are uses of glucose-6-phosphate in liver **except**:
 (A) catabolized to acetyl-CoA for fatty acid biosynthesis.
 (B) generate NADPH and pentoses. (C) released as glucose to blood stream.
 (D) converted to glycogen. (E) All are true.

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43. In the citric acid cycle, succinate is dehydrogenated by succinate dehydrogenase, which yields fumarate. The dehydrogenation of two of the four hydrogens in succinate (labeled as H₁~H₄ in the figure shown below) is stereospecific, with the pro-*S* hydrogen removed from one carbon atom and the pro-*R* hydrogen removed from the other.



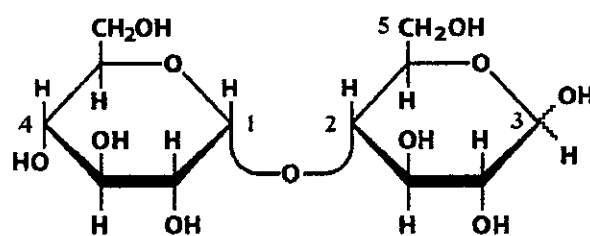
Which of the following two hydrogens could be abstracted in the four hydrogens of the succinate molecule in the reaction catalyzed by succinate dehydrogenase?

- a. H₁ and H₂ b. H₁ and H₃ c. H₁ and H₄ d. H₂ and H₃
e. H₂ and H₄ f. H₃ and H₄
- (A) b and e (B) c and d (C) a and f
(D) Only c could occur. (E) Only d could occur.
44. Which of the following substrates **cannot** contribute to net gluconeogenesis in mammalian liver?
(A) Alanine (B) Glutamate (C) Palmitate (D) Pyruvate (E) α-ketoglutarate
45. Glucose, labeled with ¹⁴C in different carbon atoms, is added to a crude extract of a tissue rich in the enzymes of the pentose phosphate pathway. The most rapid production of ¹⁴CO₂ will occur when the glucose is labeled in:
(A) C-1. (B) C-3. (C) C-4. (D) C-5. (E) C-6.
46. Which of these statements is **true**?
(A) Integral membrane proteins usually contain one or more regions with a high hydrophathy index.
(B) In integral membrane proteins, the domains that protrude on the cytoplasmic face of the plasma membrane nearly always have covalently attached oligosaccharides.
(C) A hydrophathy plot is used to extrapolate for the true molecular weight of a membrane protein.
(D) A hydrophathy plot is used to deduce the quaternary structure of a membrane protein.
(E) A hydrophathy plot is used to determine the water-solubility of a protein.
47. The following fatty acid, in which the indicated carbon is labeled with ¹⁴C, is fed to an animal:
 $^{14}\text{CH}_3(\text{CH}_2)_9\text{COOH}$
- After a period of time for fatty acid β oxidation, the label would most likely be recovered in:
(A) acetyl-CoA. (B) beta-hydroxy butyryl-CoA.
(C) both acetyl-CoA and propionyl-CoA. (D) palmitoyl-CoA.
(E) propionyl-CoA.

48. Which types of columns are affected by the ionic charge, shape, substrate-binding strength of a protein, respectively?

- (A) Gel filtration, Affinity chromatography, Cation or anion exchange.
- (B) Affinity chromatography, Gel filtration, Cation or anion exchange.
- (C) Cation or anion exchange, Gel filtration, Affinity chromatography.
- (D) Gel filtration, Cation or anion exchange, Affinity chromatography.
- (E) Cation or anion exchange, Affinity chromatography, Gel filtration.

49. The following molecular structure is the disaccharide maltose. Which position could be oxidized by the use of Fehling's reagent?



- (A) No. 1.
- (B) No. 2.
- (C) No. 3.
- (D) No. 4.
- (E) No. 5.

50. Oxaloacetate uniformly labeled with ^{14}C (i.e., with equal amounts of ^{14}C in each of its carbon atoms) is condensed with unlabeled acetyl-CoA. After a single pass through the citric acid cycle back to oxaloacetate, what fraction of the original radioactivity will be found in the oxaloacetate?

- (A) All
- (B) 1/2
- (C) 1/3
- (D) 1/4
- (E) 3/4

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