

國立清華大學 103 學年度碩士班考試入學試題

系所班組別：生命科學院甲組、乙組、醫學生物科技學程

考試科目（代碼）：生物化學(0401、0501、0701)

共 10 頁，第 1 頁 \*請在【答案卡】作答

Part 1 單選題（每題一分，共四十分，答錯不倒扣。請在【答案卡】作答）

1. Edman degradation can be used to: (A) decide the C-terminal amino acid (B) cleavage the protein into smaller peptides, (C) determine the N-terminal residue (D) connect overlapping sets of peptide fragments (E) make two different and overlapping peptide fragments.
2. The reaction of cyanogen bromide with a peptide results in cleavage at \_\_\_\_\_ residue and produces peptides with C-terminal homoserine lactone residues where residues once were. (A) Arg (B) His (C) Asp (D) Met (E) Pro.
3. Which one is a helix-breaking amino acid? (A) Asp (B) His (C) Arg (D) Met (E) Pro.
4. Which residue could have the post-translational modification of “phosphorylation”: (A) Asp (B) His (C) Arg (D) Phe (E) Tyr.
5. What is nonprotein part of metalloprotein (A) Heme (B) DNA (C) Carbohydrate group (D) Zn<sup>+</sup> (E) Lipids.
6. The amino acid with a side-chain pK<sub>a</sub> near neutrality and which therefore plays an important role as proton donor and acceptor in many enzyme catalyzed reactions is: (A) Met (B) Cys (C) Pro (D) Ser (E) His.
7. What is the overall net charge on the peptide D-F-A-R-I-G at pH 7.0? (A) +2 (B) +1 (C) 0 (D) -1 (E) -2.
8. If a restriction site of 6 bases starts with 5'-TGC, what are the last three bases in the sequence? (A) 5'-CGT-3' (B) 5'-GCA-3' (C) 5'-ACG-3' (D) 5'-CGG-3' (E) none of the above.
9. Ribosomes are about \_\_\_\_\_ RNA and \_\_\_\_\_ protein. (A) 2/3; 1/3 (B) 1/3; 2/3 (C) 3/4; 1/4 (D) 1/4; 3/4

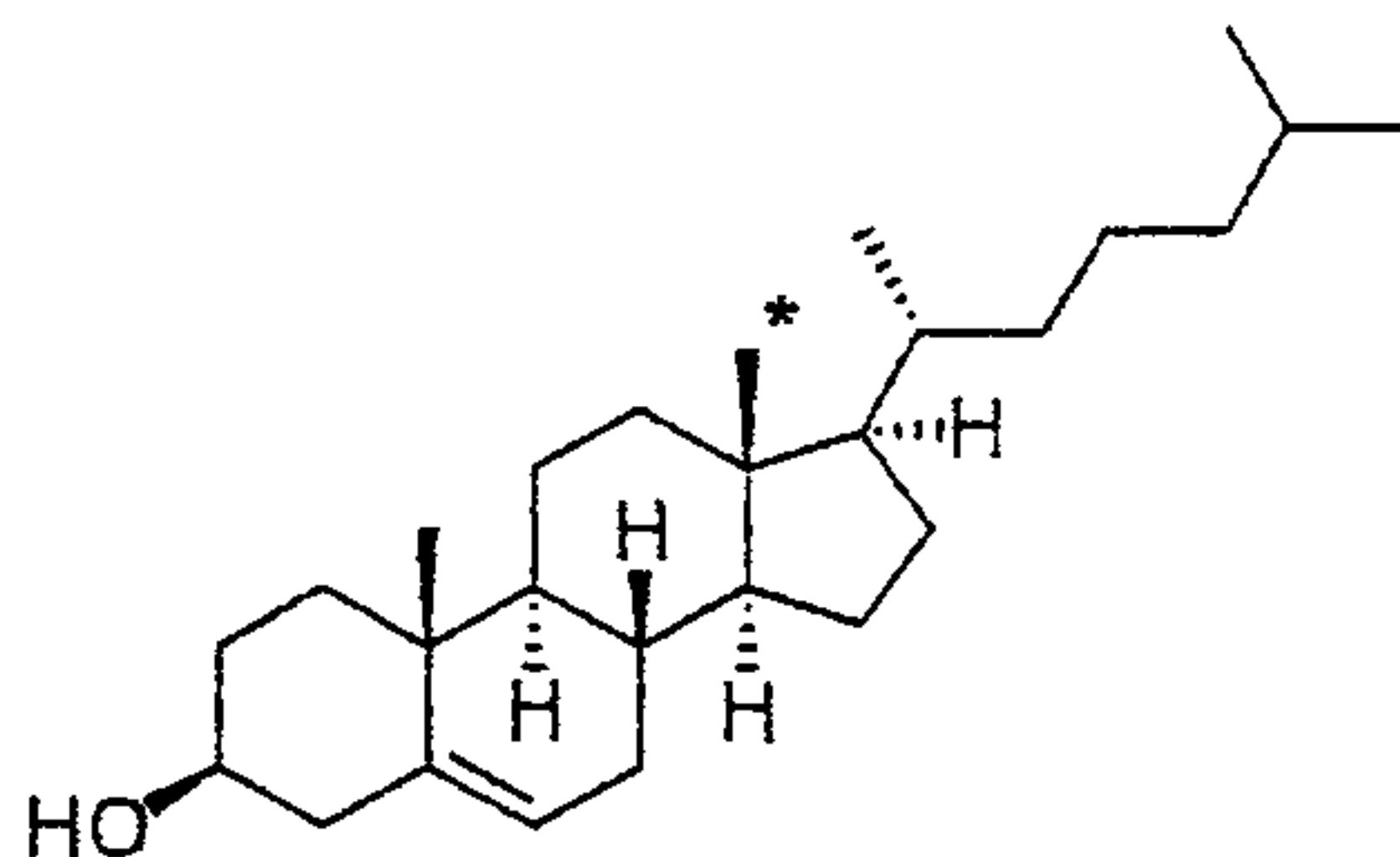
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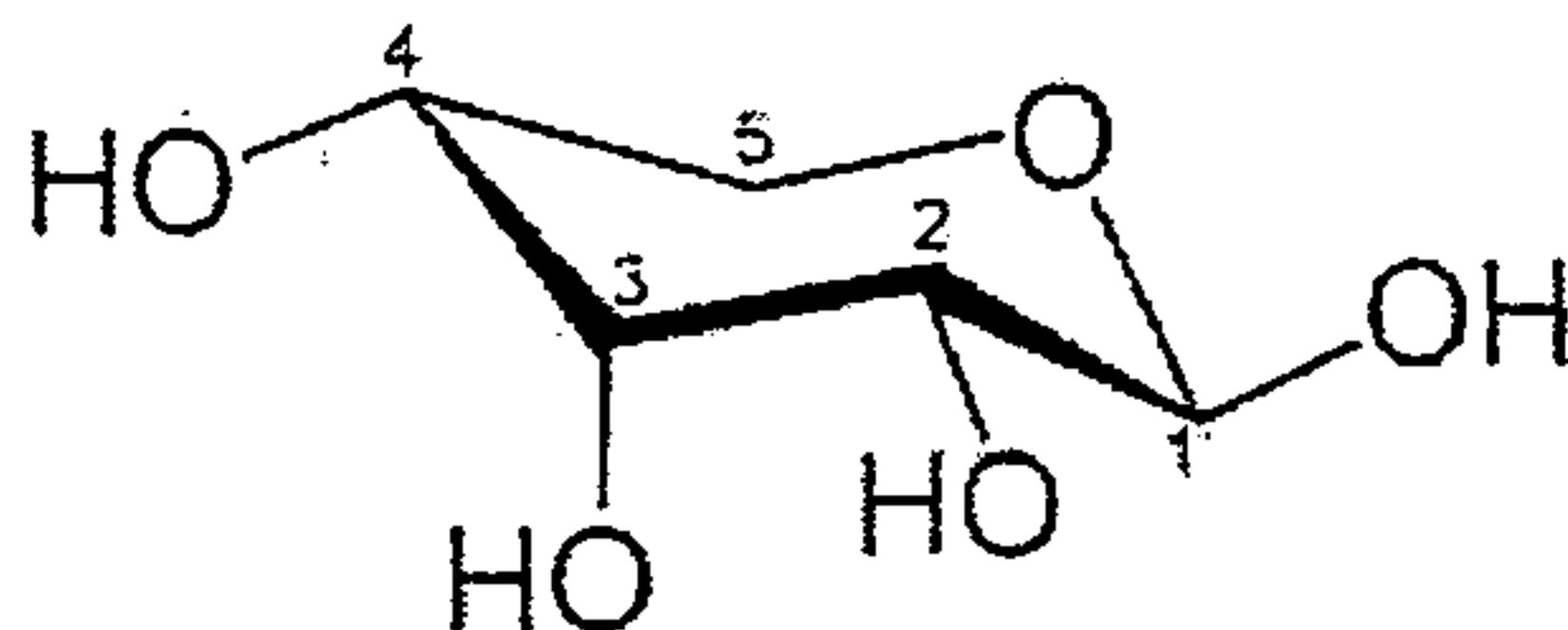
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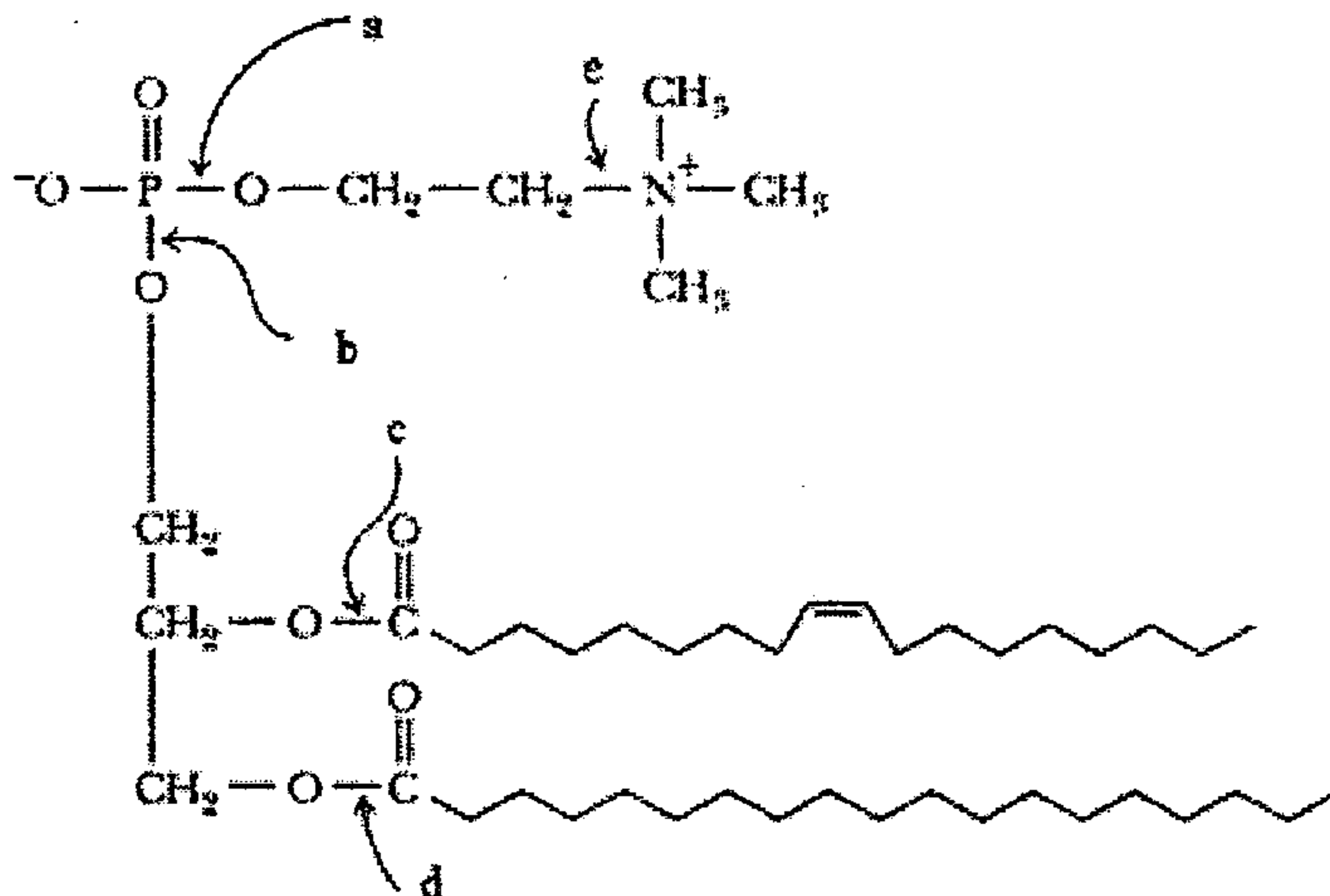
10. Cholesterol is the most common steroid in animals and precursor for all other steroids in animals. The number of the carbon labeled “\*” in the cholesterol showed below is (A) 15 (B) 18 (C) 20 (D) 19 (E) 21.



11. Which one is a nonreducing sugar? (A) Lactose (B) Maltose (C) Cellobiose (D) Sucrose (E) Isomaltose.
12. What is the name of this molecule? (A)  $\alpha$ -D-ribofuranose (B)  $\alpha$ -L-ribofuranose (C)  $\beta$ -D-ribofuranose (D)  $\beta$ -L-ribofuranose (E) none of above.



13. Which one is the cleavage site of Phospholipases D?



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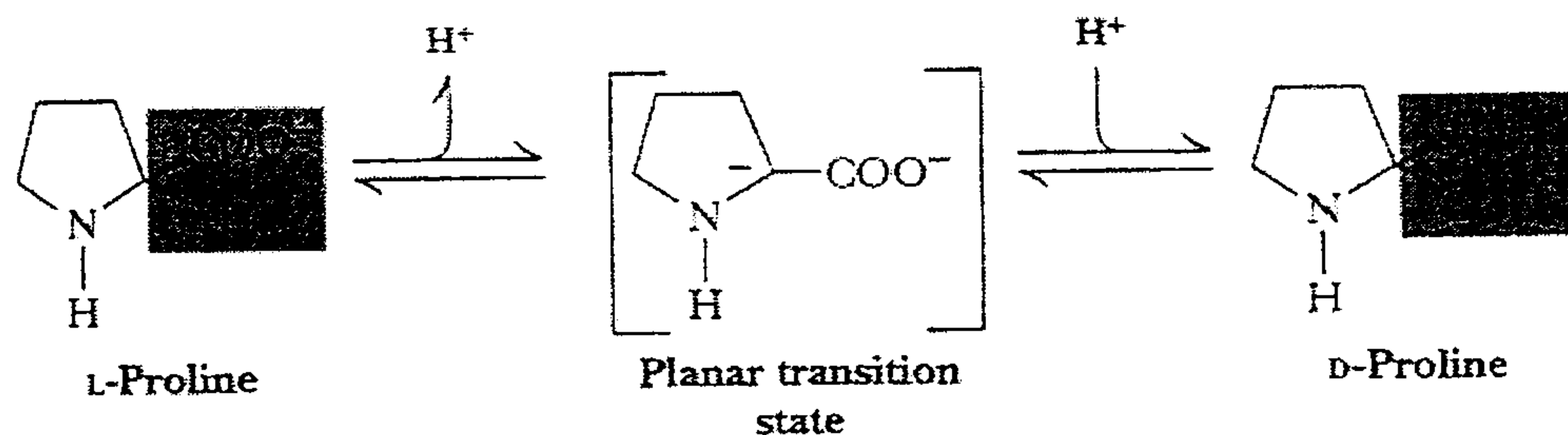
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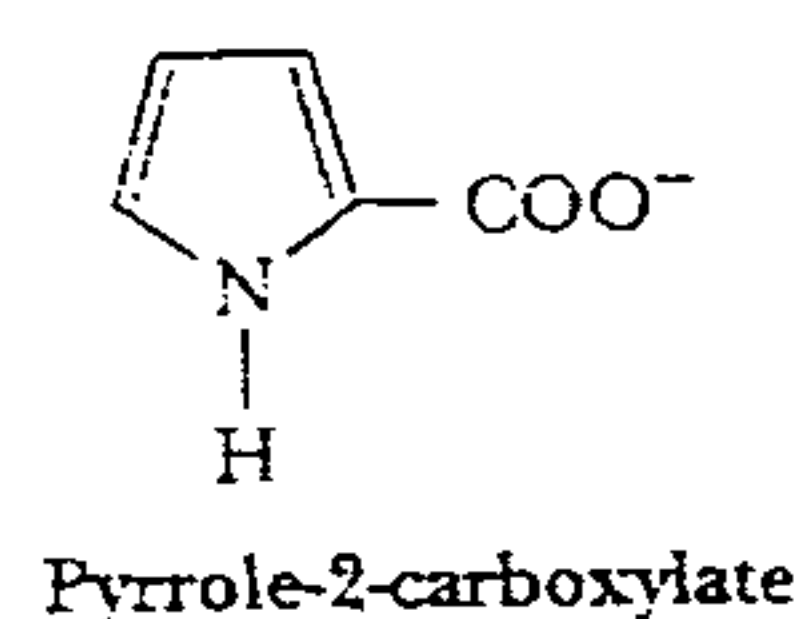
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14. In a sample of double-stranded DNA containing 32% cytosine, the percentage of adenine would be (A) 32% (B) 18% (C) 68% (D) 36% (E) Insufficient information to answer question.

15. Which of the following supposedly has the greatest affinity to the proline racemase? (that catalyzes the following reaction)



A transition state analog:



(A) L-Proline (B) D-Proline (C) The planar transition state (D) Pyrrole-2-carboxylate (E) Proton.

16. A plot of  $1/v$  vs.  $1/[S]$  for an enzyme catalyzed reaction gave a line with an equation of  $1/v = 0.4/[S] + 0.2$ . The same enzyme with an inhibitor present gave a line with an equation of  $1/v = 0.4/[S] + 0.8$ . Which of the following statements is true? (A) the type of inhibition is competitive (B) the type of inhibition is noncompetitive (C) the type of inhibition is uncompetitive (D) the  $K_m$  with the inhibitor present has decreased (E) None of the above.

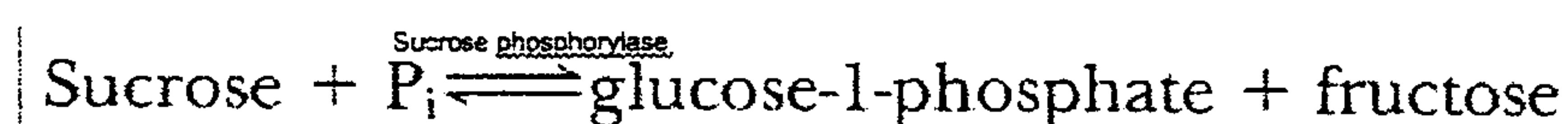
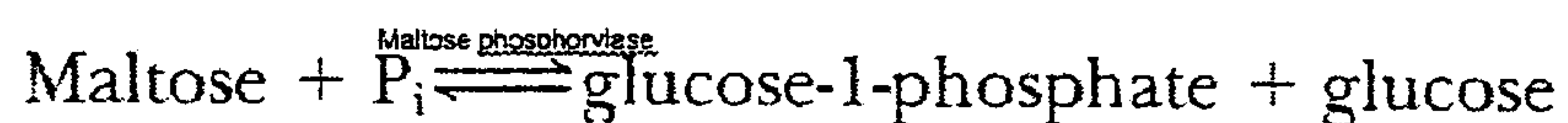
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17. We have two enzymes maltose phosphorylase and sucrose phosphorylase catalyzing the following reactions:



With the presence of unlabeled G-1-P and sucrose phosphorylase in an isotope-labeled  $^{32}\text{P}_i$  solution, we found the “P” on G-1-P can also be isotope-labeled after some time. However, maltose phosphorylase cannot do the same. Which of following is true: (A) Sucrose phosphorylase catalyzes a reaction following double-displacement mechanism (B) Sucrose phosphorylase catalyzes a reaction requiring the formation of tertiary complexes (C) Maltose phosphorylase catalyzes a reaction following what is called “Ping-Pong mechanism” (D) Maltose phosphorylase catalyzes a reaction where enzyme is covalently modified during the catalysis though the modification occurs only transiently (E) NAD<sup>+</sup>-dependent dehydrogenases use a random single-displacement catalytic mechanism

18. About Near Attack Conformation (NAC), which of the following is NOT true?

- (A) Computer simulations find that the chance of NAC to form in the enzyme active site can be 300,000 times larger than that of NAC in the absence of the enzyme
- (B) the energy difference of  $\text{E} \cdot \text{NAC} \rightarrow \text{E} \cdot \text{X}^\ddagger$  is smaller than that of  $\text{NAC} \rightarrow \text{X}^\ddagger$  where  $\text{X}^\ddagger$  means the transition state
- (C) The enzymatic catalysis benefits from lowering the energy barrier of  $\text{S} \rightarrow \text{NAC}$
- (D) The transition state analog has a configuration closer to the transition state than the NAC
- (E) Both the catalyzed and uncatalyzed reactions require the formation of NAC

19. Which of the following will NOT change the Phosphorylases' activity? The energy level in our bodies. (A) Glucose-6-P (B) Caffeine (C) AMP (D) ADP (E) ATP

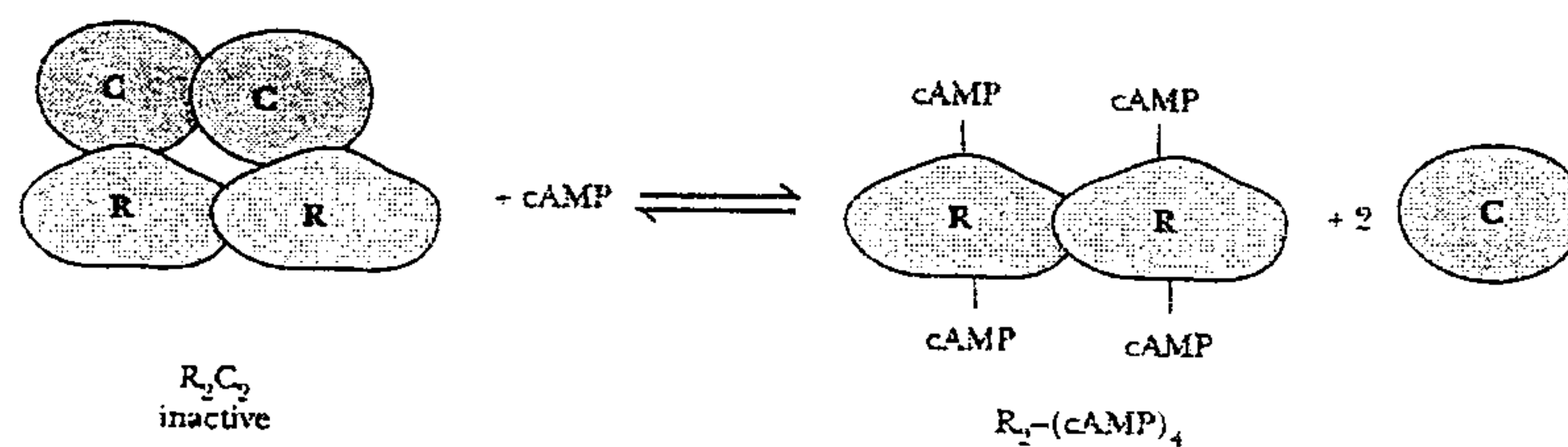
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20. About hemoglobin, which of the following is NOT true? (A) It forms different intra/intermolecular hydrogen-bonding patterns in the 'T' and 'R' forms (B) It demonstrates a mixed KNF and MWC model (C) It binds oxygen weaker than myoglobin below the  $P_{50}$ . (D) It is regulated by pH values (E) It transfers  $\text{CO}_2$  to the lung via the oxygen binding pocket.
21. The following figure shows how Cyclic AMP-dependent protein kinase (PKA) is regulated. The catalytic subunits are controlled by: (A) allosteric control (B) zymogen control (C) covalent modification (D) intrasteric control (E) product inhibition.



22. Insulin in the bloodstream is a response to increased blood glucose, and: (A) stimulates gluconeogenesis, (B) inhibits glycolysis, (C) stimulates glycogen synthesis in muscle and liver, (D) stimulates glycogen breakdown in liver, (E) inhibits phosphoprotein phosphatase-1.
23. Which of the following can be used as a substrate for gluconeogenesis in the liver? (A) alanine, (B) glutamic acid, (C) glycerol, (D) succinate, (E) all of the above.
24. The primary storage form of lipid is \_\_\_\_\_ and it is normally stored in the \_\_\_\_\_. (A) phospholipid; liver, (B) cholesterol; muscles, (C) monoacylglycerol; adipocytes, (D) triacylglycerols; adipocytes, (E) triacylglycerols; liver.

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25. Bile salts are important in the initial digestion of triacylglycerols in the intestine because they: (A) are coenzymes for pancreatic lipase, (B) convert the inactive lipase into the active form, (C) emulsify the triacylglycerol globules to produce greater surface area which will increase the activity of the lipase, (D) activate the cleavage at the C-2 position, (E) permit greater permeability of the triacylglycerols through the intestinal membrane.
26. For the complete oxidation of a saturated fatty acid with 18 carbons, how many times must the  $\beta$ -oxidation cycle be repeated? (A) 4, (B) 7, (C) 8, (D) 6, (E) 16.
27. Hormones such as glucagon \_\_\_\_ glycolysis by activating cAMP-dependent protein kinase that will \_\_\_\_ pyruvate kinase to \_\_\_\_ the enzyme. (A) activate; carboxylate; activate, (B) activate; phosphorylate; activate, (C) activate; phosphorylate; inhibit, (D) inhibit; phosphorylate; inhibit, (E) inhibit; phosphorylate; activate.
28. All are important reasons to phosphorylate glucose in the first step of glycolysis EXCEPT: (A) the large positive free energy is required in getting the pathway started, (B) glucose-6-phosphate has a negative charge preventing transport out of the cell, (C) the concentration of free glucose in the cell is lowered favoring influx of glucose, (D) phosphorylation keeps the glucose in the cell.
29. A compound with a negative redox potential means it has (A) lower affinity for electron, (B) higher affinity for electron, (C) lower affinity for proton, (D) higher affinity for proton, (E) none of the above.
30. The first intermediate in TCA cycle is (A) isocitrate, (B) fumarate, (C) succinate, (D) citrate, (E) oxaloacetate.
31. Which one of the following is a common product of cyclic and noncyclic electron transport of higher plants' photosynthesis? (A) NADH, (B) NADPH, (C)  $O_2$ , (D) ATP, (E)  $CO_2$ .

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32. In a eukaryotic cell, the enzymes of glycolysis are located in the (A) cytosol, (B) mitochondrial matrix, (C) intermembrane space, (D) plasma membrane, (E) endoplasmic reticulum.
33. At which wavelength does chlorophyll molecules absorb the least? (A) 440 nm, (B) 460 nm, (C) 520 nm, (D) 650 nm, (E) 680 nm.
34. The number of which subunit of mitochondrial ATP synthase varies from species to species? (A)  $\alpha$ , (B)  $\gamma$ , (C) a, (D) b, (E) c.
35. During strenuous exercise, lactic acid is produced in our muscles due to lack of (A)  $\text{NAD}^+$ , (B)  $\text{O}_2$ , (C) ATP, (D) glucose, (E) ADP and Pi.
36. Pyridoxal phosphate is a cofactor for which of the following enzymatic reactions?: (A)  $\text{CO}_2$  fixation, (B) redox-regulation, (C) aminotransferase, (D) carboxylation, (E) decarboxylation.
37. Each of the following serves as a cofactor for enzymes EXCEPT: (A) biotin, (B) copper, (C) ascorbic acid, (D) zinc, (E) pantothenic acid.
38. Which of the following hormones would have the longest duration of action? (A) insulin, (B) glucagon, (C) epinephrine, (D) epidermal growth factor, (E) thyroxine.
39. The cost in high-energy phosphate bonds for the formation of glucose from 1 mole of pyruvate is: (A) 4 moles of ATP, (B) 3 moles of ATP, (C) 2 moles of ATP, (D) 1 moles of ATP, (E) none of the above.
40. Which of the following compounds is a building block of both phosphatidylcholine and sphingomyelin? (A) CDP-cholin, (B) acetylcholine, (C) UDP-glucose, (D) epinephrine, (E) none of the above.

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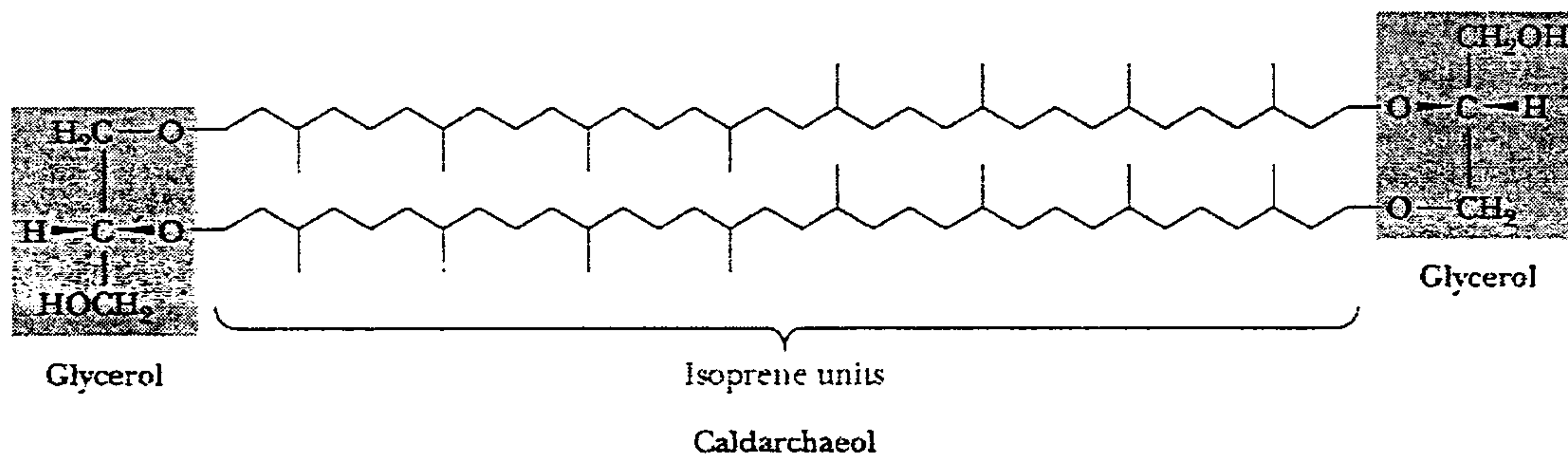
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Part 2 問答題 (每題十分，共六十分。請在【答案卷】務必依序作答)

1. "ATP" is an intermediate energy-shuttle molecule.
  - a) What is the full name of ATP?
  - b) Draw the molecular formula and structure of ATP
  - c) Write down the ATP hydrolysis reaction
  - d) Explain the reason of why ATP hydrolysis can generate a large negative free energy change (10%)
2. This is the structure of caldarchaeol, an isoprene-based lipid found in archaea. Archaea are found primarily in harsh environments. (a) What is the contribution of caldarchaeol to Archaea to adapt to these stressful conditions? (b) Please indicate the glycerol is in the *R* or *S* configuration? (10%)



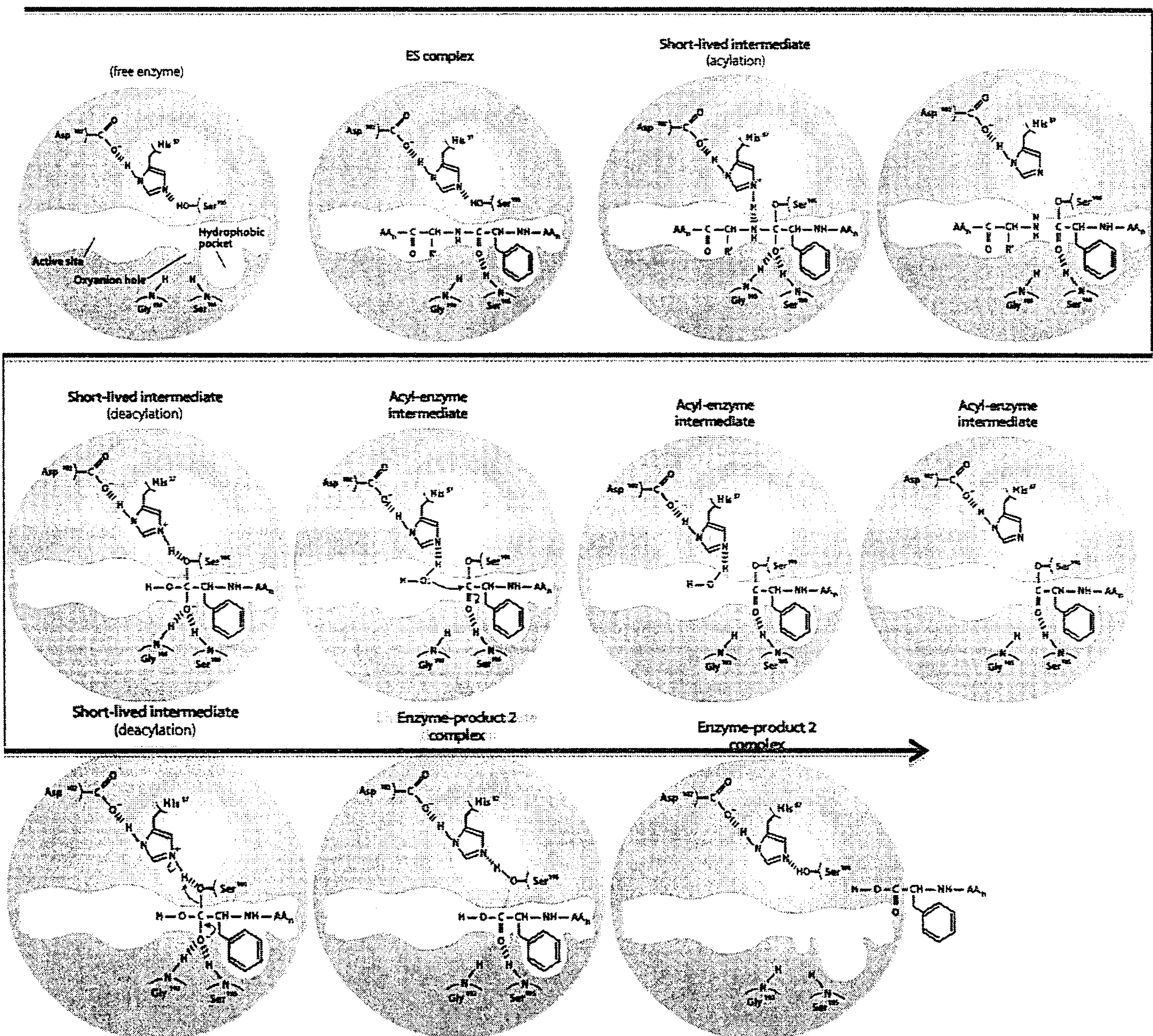
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3. This is an enzymatic reaction of chymotrypsin. Why does it take phenylalanine as the cleavage point but not other basic residues like what trypsin does? (2 %); What does the residue Gly193 do there? (3 %) Where exactly do you think the LBHB is being formed? (2 %); How does it regulate its own activity? (3 %)



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4. Arachidonic acid is an important polyunsaturated lipid in our body: (A) Please plot the structure of arachidonic acid (C<sub>20</sub>:4) and (B) please explain how arachidonic acid is synthesized from the essential fatty acid Linoleic acid (C<sub>18</sub>:2) in eukaryotes and define the structure of each intermediate.(10%)
5. Why does oxygen act as the final electron acceptor of the mitochondrial electron transport chain? (10%)
6. What is the start building block of cholesterol? What is the control enzyme for cholesterol biosynthesis? How the cells manipulate the oversupply of cholesterol? (10%)